Travers

bushfire & ecology

bushfire protection assessment

Planning Proposal
Lot 1 DP 218016, Lot B DP 370979
& Lot 22 DP 564065
166 - 176 St Andrews Road, Varroville

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

October 2015
(REF: A15141B)

Bushfire Protection Assessment

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166 - 176 St Andrews Road, Varroville

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Date:	12 October 2015
File:	A15141B

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. The advice does advise 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 in September 2013 in support of a planning proposal to amend the local planning controls under Campbelltown Local Environmental Plan – District 8 (Central Hills Lands) 2008. The proposal was to allow a cemetery as an additional permissible land use at 166 - 176 St Andrews Road, Varroville.

That planning proposal was lodged with Campbelltown Council in September 2013, with a gateway determination approved by the Sydney West Joint Planning Panel on 19 June 2015.

This updated bushfire protection assessment has been prepared for the amended planning proposal and updated conceptual Masterplan. 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 (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 building construction and the introduction of controls which avoid placing inappropriate developments in hazardous areas and placement of combustible material in APZs.

Our assessment found that bushfire can potentially affect future buildings on site from the forest and woodland vegetation proposed to be retained and rehabilitated on site, resulting in possible ember attack, radiant heat and potentially flame attack.

The bushfire risk to the planning proposal can however be mitigated if appropriate bushfire protection measures (including asset protection zones) are put in place and managed during each stage of the development and in perpetuity.

The assessment has concluded that future development on site will provide compliance with the planning principles of *PBP* and *Community Resilience Practice Note 2/12 – Planning Instruments and Policies*.

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*
LHCCREMS	*Lower Hunter Central Coast Regional Environmental Management Strategy*
OPA	Outer protection area
PBP	*Planning for bush fire protection 2006*
RFS	NSW Rural Fire Service
SFPP	Special fire protection purpose

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Introduction 1

Travers bushfire & ecology has been requested by *Catholic Metropolitan Cemeteries Trust c/- Urbis* to undertake a bushfire protection assessment for the planning proposal located at 166 - 176 St Andrews Road, Varroville.

The proposal is located on land mapped by Campbelltown 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 (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:

- 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; and
- 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 site is currently zoned under the Campbelltown Local Environmental Plan (LEP) – District 8 (Central Hills Lands) 2008 as 7(d1) Environmental Protection (Scenic) and part 6(c) Open Space (regional).

The planning proposal seeks to amend local planning controls under the LEP to allow a cemetery as an additional permissible land use on the site.

A concept masterplan has been developed (refer Figure 1.2) which has been designed subject to the site constraints, including the identified ecological, riparian and bushfire issues. The masterplan provides for the following built facilities:

- Gatehouse to meet the incoming funeral services, process paperwork and lead service to an onsite facility or grave location;
- Multi-purpose chapel to accommodate up to 500 people. Alternatively it will be divided into three individual chapels for 150 people with separate entries ;
- Function room to allow families to hold funeral wake services;

- Café and flower shop;
- Administration office;
- Mortuary facilities which take coffins prior to service and for storage; and
- Ground staff facilities (change rooms, bathroom and workshop facilities.

The concept master plan has been used to highlight the bushfire constraints and minimum APZs required for the proposed future built assets on site (refer Schedule 1 attached). Recommendations have also been made for future road design, building construction, water supply and utilities.

In addition to these built assets, the vision for the cemetery is to provide for the following:

- A distinctive landscaped cemetery providing concealed, private and low lying burial spaces to minimise visual impact; and
- The conservation and restoration of the three (3) heritage buildings in the southern portion of the site. These building will form part of an educational walk. These buildings will not be occupied.

Figure 1.1 – Concept masterplan

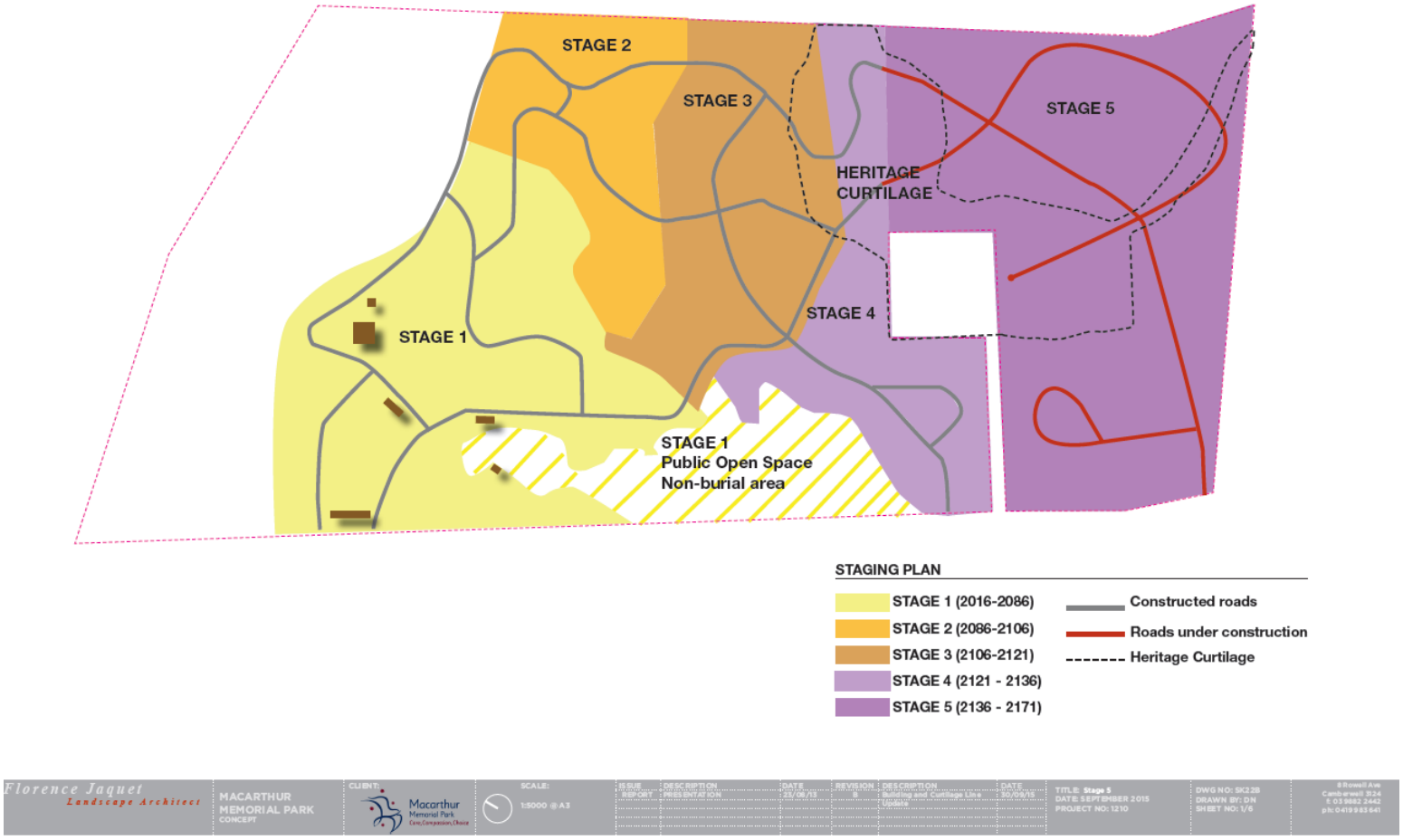


Figure 1.2 – Concept staging plan

1.3 Information collation

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

- Campbelltown Local Environmental Plan – District 8 (Central Hills Lands);
- Draft Campbelltown Local Environmental Plan 2014;
- Ecological Constraints Assessment, 2015 prepared by *Travers bushfire & ecology*
- *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); and*
- *Community Resilience Practice Notes 2/12 Planning Instruments and Policies.*

An inspection of the proposed development site and surrounds was undertaken 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 site is approximately 113ha in size (includes Lot 1 DP 218016, Lot B DP 370979 and Lot 22 DP 564065). The property is located between Camden Valley Way and the Hume Highway, south of St James Road on St Andrews Road, Varroville.

Table 1.1 provides a summary of the planning, cadastral, topographical, and disturbance details of the study area.

Table 1.1 – Site features

Location	St. Andrews Road, Varroville
Local government area	City of Campbelltown
Grid reference	299000E 6235700N
Elevation	50-100m AMSL
Topography	Situated on a steady SE sloping landscape parallel to St Andrews Road with a steeper incline towards the vegetated northern boundary.
Geology and soils	Geology; Shale carbonaceous claystone, laminate, coal in parts. Unnamed sandstone member – fine to medium grained quartz-lithic sandstone.
Catchment and drainage	Catchment – Bunbury Curran Creek Small creeks and tributaries across the site drain SE joining until they reach Bunbury Curran Creek.
Vegetation	Where present, native vegetation has a riparian structure due to small creeks and tributaries running through the site. In most areas trees are around 15-25m tall, there is a limited mid-storey and is mostly made up of weeds such as African Olive, and a ground layer of grasses and herbs. The vegetation is highly modified throughout the study area due to previous historical clearing.
Existing land use	Rural, grazing and unmanaged
Clearing	The majority of the study area has been previously cleared for indicated land uses.

Figure 1.2 – Aerial appraisal
(source: Department of Lands)

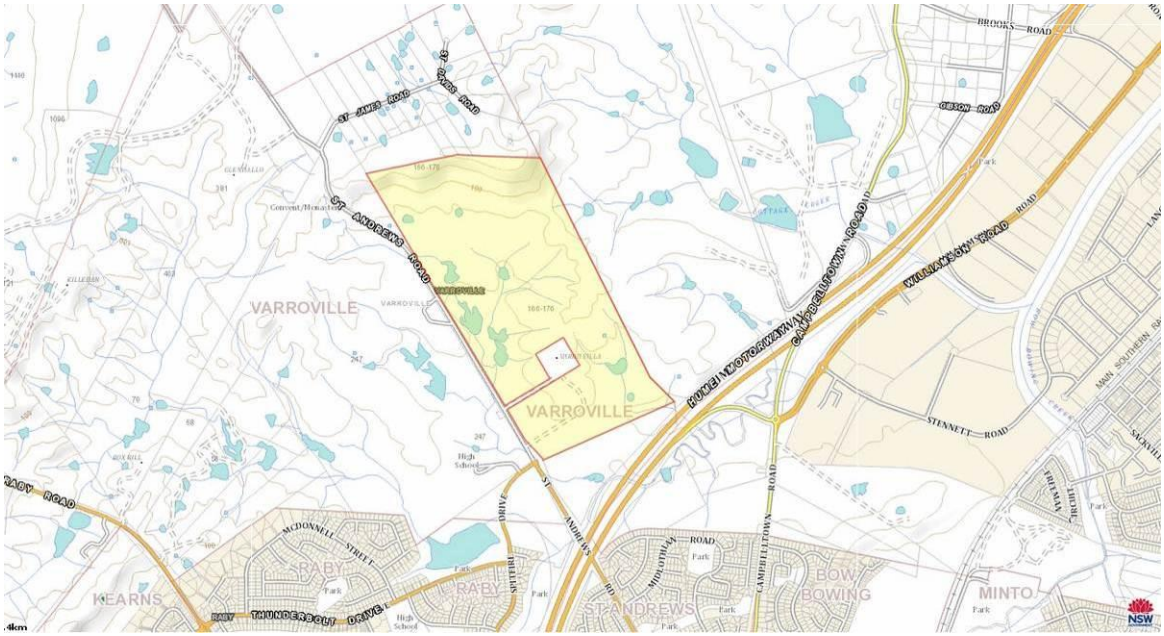


Figure 1.3 – Topographical map
(source: Department of Lands)

1.5 Legislation and planning instruments

1.5.1 Environmental Planning and Assessment Act (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. The planning proposal is located on land that is mapped by Campbelltown Council as being bushfire prone (refer Figure 1.4) containing both Category 1 and Category 2 vegetation types.

Figure 1.4 – Bushfire prone land map
*(*Source: Campbelltown Council*)*

PBP (pg 4) stipulates that if a proposed amendment to land use zoning or land use affects a designated bushfire prone area then 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 made by the Commissioner and to have regard to the planning principles of *PBP* (detailed within Section 1.5.3).

1.5.2 Local Environmental Plan (LEP)

A LEP 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 proposal is to proceed as an amendment to the current Campbelltown LEP as outlined below.

Campbelltown Local Environmental Plan (LEP) – District 8 (Central Hills Lands)

The site is currently zoned under the LEP as 7(d1) Environmental Protection (Scenic) and part 6(c) Open Space (regional).

Draft Campbelltown LEP (2014)

The proposed zoning for the site is E3 Environmental Protection Zone and RE1 Public Recreation Zone.

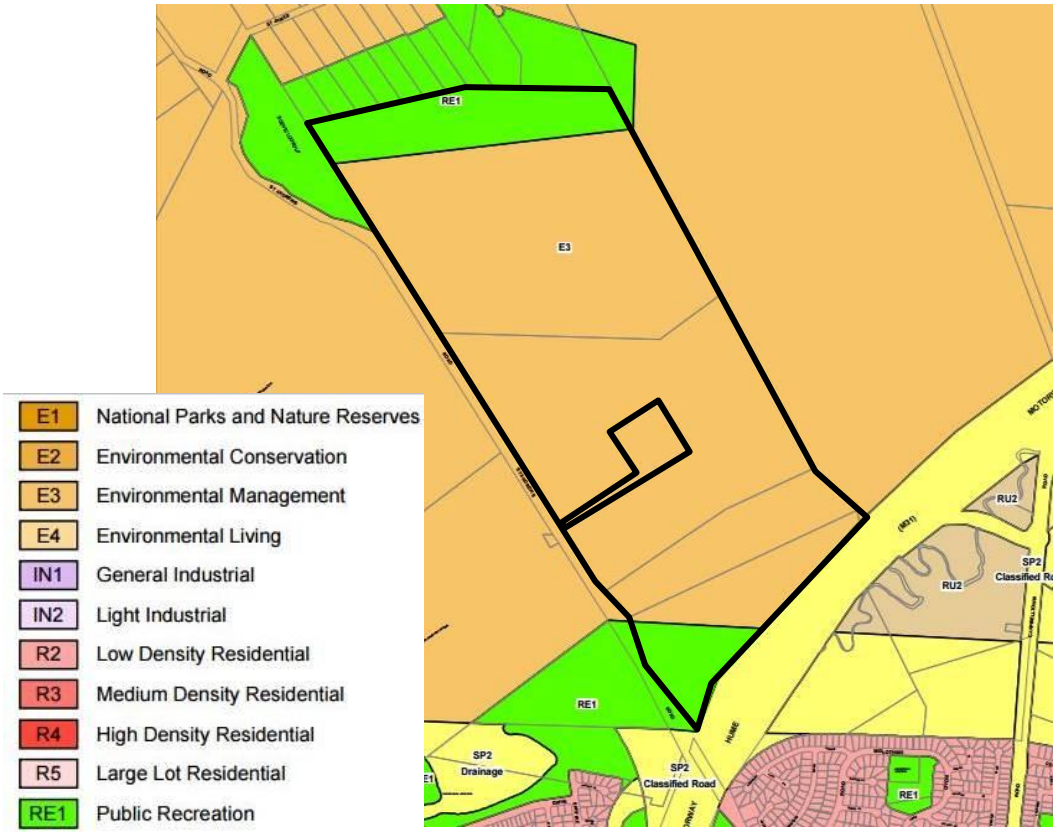


Figure 1.5 – Zoning map
*(*Source: Draft Campbelltown LEP 2014*)*

The proposal seeks to amend the LEP current and draft LEP to allow for a cemetery as an additional permissible land use under this 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 rezoning as well as guidance on effective bushfire protection measures, such as;

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

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

The proposed future use of the site as cemetery involves the construction of two (2) Class 9 buildings (i.e. multipurpose chapel and function room) in accordance with the *BCA*.

PBP states that Class 9 buildings should be considered on their merits under Section 79BA and or 79C of the *EP&A Act.* Future buildings (used for chapel & function room) are considered assembly buildings. They are not habitable buildings and for that reasons are not regarded as being *Special Fire Protection Purpose Developments* (SFPP). Those type/s of facilities are regarded as requiring additional bushfire protection measures given the nature of their use e.g. aged care housing. However in the case of the proposed assembly for this development they are not classified in that manner.

Notwithstanding due to the extent of persons whom may frequent these facilities there is a potential for them to be at risk and in this regard the RFS (via PBP) requires that they be assessed as it they were SFPP. Therefore the specific objectives listed in Section 4.2.3 *Specific Objectives* should be considered*.* The proposal's compliance with these aims and objectives are provided within the conclusion of this report.

These objectives include the need to:

6. Provide for the special characteristics and needs of occupants. Unlike residential subdivisions, which can be built to a construction standard to withstand the fire event, enabling occupants and fire fighters to provide property protection after the passage of fire, occupants of SFPP developments may not be able to assist in property protection. They are more likely to be adversely affected by smoke or heat while being evacuated; and
7. Provide for safe emergency evacuation procedures. SFPP developments are highly dependent on suitable emergency evacuation arrangements, which require greater separation from bushfire threats. During emergencies, the risk to fire fighters and other emergency services personnel can be high through prolonged exposure, where door-to-door warnings are being given and exposure to the bushfire is imminent.

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

1.5.4 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.

In NSW, construction in bushfire prone areas applies to Class 2, 3, 4 and 9b buildings or a Class 10a associated with Class 2, 3, 4 & 9b buildings.

The construction manual for the deemed-to-satisfy requirements is *AS3959*.

1.6 Environmental and cultural constraints

1.6.1 Environmental constraints

The development, including the application of APZs, seeks to avoid impact on the identified ecological constraints. The APZs provided are confined to existing cleared areas, however they do include a portion of moderate quality Cumberland Plain Woodland. It is expected that no trees are required to be removed as part of the APZ.

Travers bushfire & ecology was engaged to undertake flora and fauna survey and review the ecological constraints within Nos. 166-176 St. Andrews Road, Varroville.

This report has identified the following ecological constraints:

- Five (5) threatened fauna species including Cumberland Plain Land Snail (*Meridolum corneovirens*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Eastern Bentwing-bat (*Miniopterus orianae oceansis*), East-coast Freetail Bat (*Micronomus norfolkensis*) and Large-footed Myotis (*Myotis macropus*) were recorded;
- Two (2) Endangered ecological communities were recorded i.e. Cumberland Plain Woodland and Moist Shale Woodland; and
- Riparian corridors.

The report provides the following migration measures:

- Provide suitable revegetation offsets within the riparian corridors as appropriate and implement progressively throughout the life of the cemetery; and
- Progressively revegetate riparian corridors to provide connective habitat.

1.6.2 Heritage constraints

The implementation of any APZ, or other work, must not adversely impact any future identified Aboriginal sites of significance.

A basic search was conducted on the Aboriginal Heritage Information System (AHIMS). The results show that there are no identified Aboriginal sites of significance within Lot 1 DP 218016, Lot B DP 370979 or Lot 22 DP 564065 or within 50m of those lots.

According to the study undertaken by *Kayandel Archeological Services Opportunities and Constraints, Aboriginal Heritage, South-West Business Park, Varroville,* October 2008, there is a likelihood that Aboriginal artefacts could be found on the site. Although there are no known sites on the property, a number of sites are present north of Bunbury Curran Hill. The

most likely occurrence of artefacts and signs of Aboriginal activity is thought to be on the ridges and around larger watercourses.

According to the *Scenic Hills Association's* website, the Scenic Hill area was known as Yandel'ora (Land of Peace between People), a meeting place for South-East Australia, where disputes, laws and marriages were discussed.

The three (3) buildings within the southern portion of the site have European heritage significance. A conservation / restoration plan is being prepared for these buildings which will be utilised as part of an educational walk.

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 built assets.

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

- Woodland / forest vegetation approximately 60-100m north and north-west of the chapel. Given the presence of a shrub layer, this is considered to have a forest formation in accordance with David Keith;
- Cumberland Plain Woodland located between the proposed chapel buildings and the ground maintenance facilities and west of the administration building;
- Remnant forest external to the site and adjacent to the ground staff facility building;
- Riparian corridors, assuming potential for revegetation; and
- Unmanaged grassland vegetation within the remainder of the site.

2.2 Effective slope

The effective slope is assessed for a distance 100m. 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 generally between 0 – 5 degrees as identified in Table 2.1 & 2.2 below.

2.3 Bushfire attack assessment

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.

Tables 2.1 & 2.2 provide a summary of the bushfire attack assessment and the minimum required APZs in compliance with *PBP*. The APZs provided for the chapel and function room (Table 2.1) have been designed to reduce radiant heat exposure to <10kW/m2. The APZ for other buildings have been design to avoid flame contact to buildings (Table 2.2).

Table 2.1 – Bushfire attack assessment (SFPP – chapel and function room)

Building	Aspect	Vegetation formation within 140m of development	Effective slope of land	Minimum APZ required equivalent to 10kw/m^2 (metres)
Chapel	North-west and north-east	Grassland	Level to up slope	60
	South-west	Grassland and forest	0-5 ^{0D}	70
	South-east	Grassland	0-5 ^{0D}	36 (refer Note 1)
Function room	North-east & north-west	Grassland	Level to up slope	32 (refer Note 1)
	South-east	Remnant woodland	0-5 ^{0D}	40
	South-west	Dam	Level	N/A (refer Note 2)

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

Note 1: A performance based assessment using Appendix B of *AS3959* was undertaken to determine the required APZ (equivalent to radiant heat flux <10kW/m2) based on grassland vegetation on slopes of between 0-5 ^{0D} (determined to be the worst case scenario). The results of the assessment, provided within Appendix 2, were prepared using the bushfire attack assessor (BFAA) developed by *Newcastle Bushfire Consulting.*

Note 2: The function room has been placed outside of the 10m buffer to the dam. It is expected that the area adjacent to the dam will consist of landscaped vegetation and will not pose a significant bushfire risk to the function centre. Planting in the area should use low flammable species and consist of grasses and shrubs.

Table 2.2 – Bushfire attack assessment (office, administration, staff & cafe buildings)

Building	Aspect	Vegetation formation within 140m of development	Effective slope of land	Minimum APZ required equivalent to 29kw/m^2 (metres)
Mortuary Facilities	North-west and north-east	Grassland & forest	Level to up slope	20 (30 – 60m provided by chapel APZ)
	South-east	Grassland	0-5 ^{0D}	10 (20m provided by chapel APZ)
	South-west	N/A	N/A	>100m provided by chapel APZ
Admin. building	North-east, north-west & south-east	Grassland	0-5 ^{0D} and upslope	10

	West	Cumberland Plain Woodland / Forest	0-2 ^{0D}	23 (refer Note 1)
Ground staff facilities	South-west	Forest	0-5 ^{0D}	26 (refer Note 1)
	North-west	Grassland	Up slope 0-5 ^{0D}	10
	North-east & south-west	Cumberland Plain Woodland / Forest	Level to up slope	20
Gate house	North-west	Cumberland Plain Woodland / Forest	5 ^{0U}	10
	North-east, south-east and south-west	Grassland	0-5 ^{0D} and upslope	10
	The gatehouse building will be used by < 2 staff members to direct visitors around the site. Based on this use the report has recommended a minimum defendable space as it is accepted that staff have the capability of safely evacuating during a bushfire event.			
Cafe	North, south-east & west	Grassland & dam	0-5 ^{0D} and upslope	10 (refer Note 2)
Historical buildings	North, south, east & west	Grassland & exotic vegetation	0-5 ^{0D} and upslope	50

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

Note 1: A performance based assessment using Appendix B of *AS3959* was undertaken to determine the required APZ (equivalent to radiant heat flux <29kW/m2) based on forest vegetation and remnant forest (PBP fuel loads) on slopes of between 2 ^{0D}, 5^{0D} & 5^{0U} (determined to be the worst case scenario). The results of the assessment, provided within Appendix 2, were prepared using the bushfire attack assessor (BFAA) developed by *Newcastle Bushfire Consulting.*

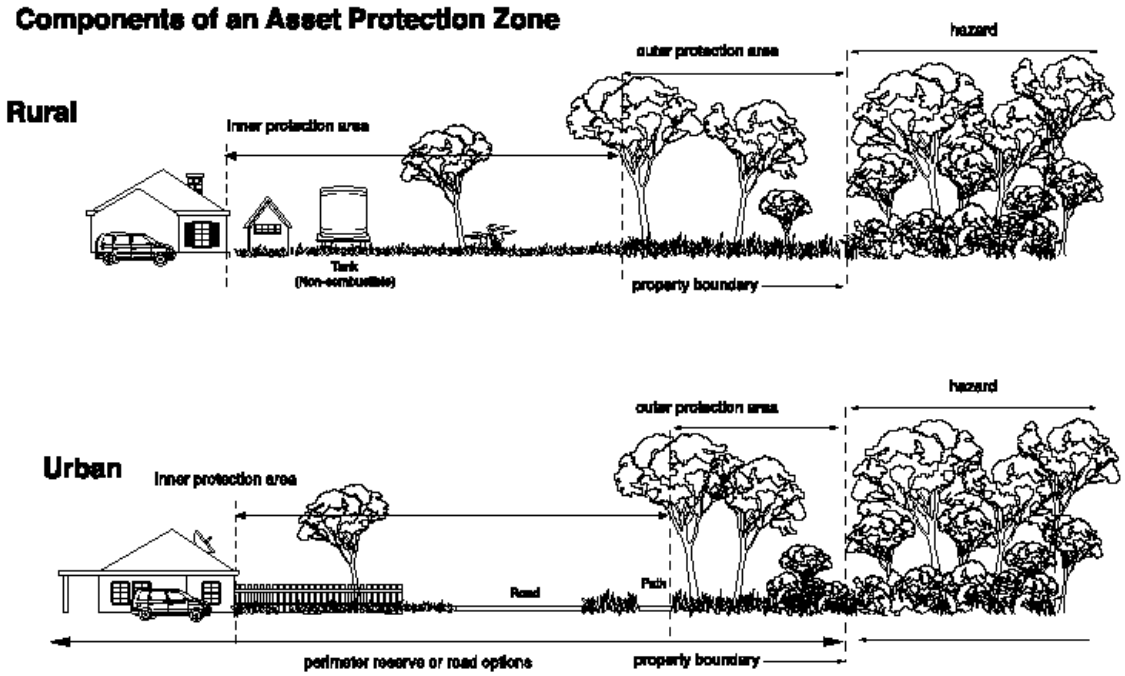
Note 2: The cafe has been placed outside of the 10m buffer to the dam. It is expected that the area adjacent to the dam will consist of landscaped vegetation and will not pose a significant bushfire risk to the function centre. Planting in the area should use low flammable species and consist of grasses and shrubs.

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 building. 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:



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 states that although Class 9 assembly buildings are not a SFPP development, they should be considered as if they were. While the bushfire protection measures 'in combination', as outlined by *PBP* continue as a principle, there is more reliance on space around buildings and less reliance on building construction standards. As a result, the APZs applied to the chapel / condolence rooms are based on minimising radiant heat exposure to 10kW/m^2 to increase the safety of occupants during an evacuation event.

The APZs applied to the administration and office buildings are based on ensuring that a radiant heat flux of 29kW/m^2 is not exceeded to maximise the chance of building survival.

Table 3.1 outlines the proposals compliance with the performance criteria for APZs.

Table 3.1 – Performance criteria for asset protection zones (*PBP* guidelines pg. 19)

Performance criteria	Acceptable solutions	Complies
Radiant heat levels of greater than 10kW/m^2 will not be experience by occupants or emergency services workers entering or exiting a building (applies to the chapel and condolence rooms)	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 - refer Table 2.1.
Radiant heat levels at any point on a proposed building will not exceed 29kW/m^2 (applies to the office and administration buildings)	APZs are provided in accordance with Appendix 2. APZs are wholly within the boundary of the development site.	Complies - refer Table 2.2.
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 – The APZ will consist of landscaped areas, roads and grassed areas which require minimal maintenance. The APZ is not located on slopes exceeding 18^o.
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.

3.2 Building protection

Although not required in terms of planning proposals, the following advice in relation to building construction levels can be used for future planning / costing purposes.

The construction classification system is based on five (5) bushfire attack levels (BAL). These are BAL – Flame Zone (FZ), BAL 40, BAL 29, BAL 19 and BAL 12.5 AS3959 – *Construction of buildings in bushfire-prone areas*. The lowest level, BAL 12.5, has the longest APZ distance while BAL – FZ has the shortest APZ distance. These allow for varying levels of building design and use of appropriate materials.

Generally any building within 100m of bushland vegetation or 50m of grassland vegetation will need to comply with *AS3959 (2009) Construction of buildings in bushfire-prone areas*. The following building construction standards apply to the current master plan design:

- BAL 12.5 for the multi-purpose chapel and function room
- BAL 12.5 for the office building

- BAL 29 for the administration, café, mortuary facility and ground staff facility

3.3 Hazard management

Should the development be approved, the owner of the property (*Catholic Metropolitan Cemeteries Trust*) will be required to manage the APZ in accordance with the RFS guidelines *Standards for Asset Protection Zones (RFS, 2005),* with landscaping to comply with Appendix 5 of *PBP.*

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).

3.4 Access for fire fighting operations

It is proposed to initially bring the main access to the site at the northwest end, from St Andrews Road via a roundabout.

It is proposed to establish a service entry north the main entry point as it is important to separate vehicular access for maintenance purposes (i.e. soil deliveries etc.) to ensure minimal disruption and risks to visitors.

Generally, parking will be provided on the side of the road to allow for parking on both sides of the roads whilst leaving one lane for traffic. All permanent buildings will have suitable parking provision.

The site is large and will eventually require further entry and exit points as it slowly expands. These will be developed one at a time, as required. Cemeteries expand on an as needed basis, usually planning in 10 year increments. Once space is anticipated to run out in coming years, the next stage of development (roads, services, lawns, gardens etc.) will be implemented, each in manageable sizes.

Table 3.2 outlines the performance criteria and acceptable solutions for future public roads and parking facilities within the cemetery.

Table 3.2 – Performance criteria for internal roads (*PBP* guidelines pg. 35)

Performance criteria	Acceptable solutions	Complies
Internal road widths and design enable safe access for emergency services and allow crews to work with equipment about the vehicle.	Internal roads are two-wheel drive, sealed, all weather roads.	Complies – can be a condition of consent.
	Internal perimeter roads are provided with at least two traffic lane widths (carriageway 8m minimum kerb to kerb) and shoulders on each side, allowing traffic to pass in opposite directions.	Complies – can be a condition of consent. Roads depicted on the concept plan have a width of 8m. Appropriate parking bays should be provided to ensure a clearway width of 8m (2 way traffic) and 4.5m (single land traffic).
	Roads are through roads. Dead end roads are not more than 100m in length from a through road, incorporate a minimum 12m outer radius turning circle, and are clearly sign posted as a dead end.	Complies – can be a condition of consent. Consideration of staging is required as the cemetery expands to minimise dead end roads or to provide temporary turning circles (12m outer radius).
	Traffic management devices are constructed to facilitate access by emergency services vehicles.	Complies – can be a condition of consent.
	A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.	Complies – can be a condition of consent.
	Curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress.	Complies – can be a condition of consent.
	The minimum distance between inner and outer curves is 6m.	Complies – can be a condition of consent.

Performance criteria	Acceptable solutions	Complies
	Maximum grades do not exceed 15^{o} and average grades are not more than 10^{o}.	Complies – can be a condition of consent.
	Cross fall of the pavement is not more than 10^{o}.	Complies – can be a condition of consent.
	Roads do not traverse through a wetland or other land potentially subject to periodic inundation (other than storm surge).	Complies
	Roads are clearly sign-posted and bridges clearly indicate load ratings.	Complies – can be a condition of consent.
	The internal road surfaces and bridges have a capacity to carry fully-loaded fire fighting vehicles (15 tonnes).	Complies – can be a condition of consent.

3.5 Water supplies

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

Table 3.3 outlines the performance criteria and acceptable solutions for reticulated water supply.

Table 3.3 – 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 3.4 outlines the required performance criteria for the gas supply.

Table 3.4 – 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 3.5 outlines the required performance criteria for electricity supply.

Table 3.5 – 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).

3.8 Emergency and evacuation planning

Table 3.6 outlines the required performance criteria for the proposal's emergency procedures

Table 3.6 – Performance criteria for emergency and evacuation planning (*PBP* guidelines pg.39)

Performance criteria	Acceptable solutions	Complies
An emergency and evacuation management plan is approved by the relevant fire authority for the area.	An emergency / evacuation plan is prepared consistent with the *RFS* Guidelines for the Preparation of an Emergency / Evacuation Plan. *Note: The applicant should provide a copy of the above document to the local Bush Fire Management Committee for their information prior to the occupation of any accommodation of a SFPP*.	Complies - can be made a condition of consent.
Suitable management arrangements are established for consultation and implementation of the emergency and evacuation plan.	An emergency planning committee is established to consult with staff in developing and implementing and emergency procedures manual. Detailed plans of all emergency assembly areas including onsite and offsite arrangements as stated within AS3745 are clearly displayed, and an annual trial emergency evacuation is conducted.	Complies - can be made a condition of consent.

Conclusion & Recommendations

4

4.1 Conclusion

This bushfire protection assessment has been undertaken in support of a planning proposal that seeks to amend local planning controls under Campbelltown Local Environmental Plan – District 8 (Central Hills Lands) 2008. The proposal is to allow a cemetery as an additional permissible land use on 166 - 176 St Andrews Road, Varroville.

Our assessment found that bushfire can potentially affect future buildings on site from the forest and woodland vegetation proposed to be retained and rehabilitated on site, resulting in possible ember attack, radiant heat and potentially flame attack.

The assessment has concluded that future development on site will provide compliance with the planning principles of *PBP* and *Community Resilience Practice Note 2/12 – Planning Instruments and Policies*.

Future development on site is to comply with the following planning principles:

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.	Public roads within the property are to comply with Table 3.2
Provision, at the urban interface, for the establishment of adequate APZs for future housing.	APZs have been recommended in compliance with PBP for both the chapel / function room (SFPP) and the office buildings
Minimising the perimeter of the area of land interfacing the hazard, which may be developed.	Compliant. The built structures on site have been positioned with adequate separation from bushfire threats.
Introduction of controls which avoid placing inappropriate developments in hazardous areas.	Future development consists of chapels / function rooms and administration buildings which are 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.
Provide for the special characteristics and needs of occupants. Unlike residential subdivisions, which can be built to a construction standard to withstand the fire event, enabling occupants and fire fighters to provide property protection after the passage of fire, occupants of SFPP developments may not	The chapel and function rooms have been provided with adequate APZs to enable safe evacuation.

Table 4.1 – Planning principles

Planning principles	Recommendations
be able to assist in property protection. They are more likely to be adversely affected by smoke or heat while being evacuated.	
Provide for safe emergency evacuation procedures. SFPP developments are highly dependent on suitable emergency evacuation arrangements, which require greater separation from bushfire threats. During emergencies, the risk to fire fighters and other emergency services personnel can be high through prolonged exposure, where door-to-door warnings are being given and exposure to the bushfire is imminent.	An emergency / evacuation plan will be prepared consistent with the *RFS Guidelines for the Preparation of Emergency / Evacuation Plan* prior to building occupation.

The following recommendations are provided to ensure that future development is in accordance with, or greater than, the requirements of *PBP.*

4.2 Recommendations

Recommendation 1 - APZs are to be provided to the future built structures on site. APZs are to be measured from the exposed wall of the building toward the hazardous vegetation. The minimum APZ must be achievable for all buildings fronting the bushfire hazard as nominated in Table 2.1 & 2.2 and also as generally depicted in Schedule 1.

Recommendation 2 - Fuel management within the APZs is to be maintained by regular maintenance of the landscaped areas, mowing of lawns in accordance with the guidelines provided in Appendix 1, and as advised by the RFS in their publications.

Recommendation 3 - Building construction standards are to be applied for future buildings in accordance with *Australian Standard AS3959 Construction of buildings in bushfire-prone areas (2009)* with additional construction requirements as listed within Section A3.7 of Addendum Appendix 3 of *PBP.*

Recommendation 4 – Public access roads are to comply with the acceptable solutions provided within Section 4.2.7 of *PBP* (refer Section 3.4 of this report).

Recommendation 5 – Water, electricity and gas supply is to comply with the acceptable solutions as provided within Section 4.2.7 of *PBP* (refer Sections 3.5, 3.6 and 3.7 of this report).

Recommendation 6 – An emergency / evacuation plan will need to be prepared consistent with the *RFS Guidelines for the Preparation of Emergency / Evacuation Plan* prior to building occupation.

References

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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.*

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.

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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

Ground staff facility

Mortuary Facilities

Multipurpose Chapel

Administration

Gatehouse

Function room

Cafe & Flower Shop

Legend

- Site boundary
- Buildings
- Road

Riparian Zone

- 10m buffer from Top of Bank
- 20m buffer from Top of Bank
- 30m buffer from Top of Bank

Vegetation Communities

EEC - Vegetation

- Cumberland Plain Woodland

Non-EEC Vegetation

- African Olive
- Dam with occasional fringing sedges
- Exotic Vegetation
- Heritage Gardens

- Asset Protection Zone

Aerial source:

Travers bushfire & ecology
www.traversecology.com.au

PROJECT & MXD REFERENCE
Varroville
A15141_BF001

DATE & ISSUE NUMBER
9/10/2015
Issue 1

SCALE & COORDINATE SYSTEM
1:4,000 @ A3
GDA 1994 MGA Zone 56

0 100 200 m

TITLE

Schedule 1 - Bushfire Protection Measures

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.

Document Path: n:\GIS STORAGE\N Drive\A15141_SouthWestBusinessPark_Varroville\MXDs\A15141_BF001.mxd

Management of Asset Protection Zones

A1

The RFS advises that when living in a bushfire prone environment APZs are required to be provided between hazardous fuels and a building.

The RFS provides basic advice in respect of managing APZs in several documents namely *Planning for Bush Fire Protection 2006 (PBP)* and *Standards for Asset Protection Zones* (undated but circa 2006).

APZs provide a level of defendable space between the hazard and a building. These zones are usually shown on plans adjacent to either cultural or natural assets. They act to significantly lessen the impact of intense fire. The major mitigating factor that limits the effects of wildfire is the amount of fuel available to burn. By reducing the amount of fuel there will be a reduction in the intensity of the fire.

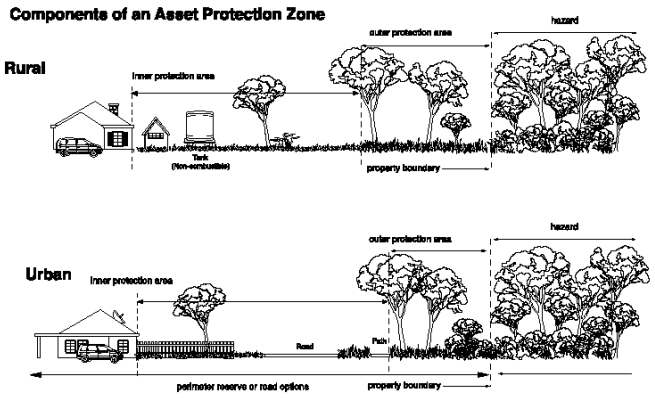
When considering bushfire fuel it is important to understand that it occurs in our native bushland in three vertical layers – see Table 1.

Table 1 – Fuel layers

Fuel layer name	Location of layer in vertical column	Type of fuel
Ground fuels	Below ground level	Peatmoss (always below the surface)
Surface fuels	0-200mm	Litter layer (leaves & twigs)
Aerial fuels	200-3,000mm	Shrubs and grasses
Canopy fuels	>3,000mm	Tree canopy

The APZ can be further classified into two sub-zones with each having a specific role. These sub-zone areas are called the inner protection area (IPA) and the outer protection area (OPA) – see figure below.

The IPA is managed as a fuel free zone while the OPA is managed as a fuel reduced zone. This means that the fuel free zone has little fuel available to be consumed in the event of a fire whilst the fuel reduced zones has less than normal fuel levels that could be consumed in the event of a fire.



Inner protection area (IPA)

This area is almost free of all fuels and usually takes the form of grassy areas, car parks, roads, concrete areas, tracks or trails. It does not imply or require the wholesale removal of every tree and or shrub.

This zone is intended to stop the transmission of flame and reduce the transmission of radiant heat by the elimination of available fuel. This area also allows airborne embers to fall safely without igniting further outbreaks.

This zone also provides a safe fire fighting position and is operationally important for implementation of clear fire control lines.

Grasses may occur within an IPA if they are generally no higher than 50-75mm. Above this height, fuel weights tend to increase exponentially and consequentially cause greater flame heights and therefore fire intensity

Shrubs may occur within an IPA in the form of clumping amidst open grassy areas. The design of the clumping will be dependent on species selection and spatial density. For example, the larger the shrubs the less clumping may occur in a given area.

As a general rule, trees are allowed within an IPA but only where those trees are at least 5m away from a building.

A recommended performance standard for the fuel load of an IPA is between 0-4t/ha. Shrubs may occur within an IPA commensurate with a spatial distribution of 15-20%. For example an area of 100m^2 (10mx10m) can have up to 20% of this area composed of shrubs.

If a shrub layer is present the following table shows the additional fuel weights that should be added to the calculated surface fuels.

Shrub cover	Fuel weight
10-30%	2.5 tonnes / ha
35-50%	5.0 tonnes / ha
55-75%	7.5 tonnes / ha

Presence of trees within an inner protection area

A tree may occur within an IPA if the canopy does not form a link with shrubs. The reason is to lessen any chance for vegetation linking and the capability for fire to extend into the canopy.

It is a basic premise in fire behaviour understanding that fire cannot occur in the canopy unless surface fuels such as grasses or shrubs are burning. This merging creates opportunity for fire to link with the canopy and therefore increase fire intensity by some significant amount.

Trees that have a canopy beginning near the ground (such as Forest Oaks *Allocasuarina*) form a continuous link with the tree canopy and shrubs. A forest canopy cannot therefore burn without fuel to feed that fire. In a tall open forest, where the trees are generally above 20m in height the canopy is separated from the land surface by some distance. In an open woodland the low canopy height (usually <5m) merges with the shrubland layer.

Knowing the relationship between the shrub layer and the tree canopy allows fire managers to design safer areas in the APZs. It is for this reason that vegetation such as Forest Oaks are usually excluded from an IPA.

Similarly, in open forests the height of the forest is sufficiently removed from the shrub layer. As a general rule, trees are allowed within an IPA where the density of those trees is commensurate with Table 2 below and located on slopes up to 20% with a westerly aspect.

In respect of trees that can be located in an IPA Table 2 provides guidelines.

Table 2 – Tree density in inner protection area

Distance from building wall	Trees permitted on the exposed side of a building	Trees permitted on the non exposed side of a building
Within 5m	No trees	No trees
Between 5-10m	One tree per 100m^2	2 trees per 100m^2
Between 10-20m	<10 tree per 400m^2	<10 trees per 400m^2

Outer protection area (OPA)

This zone is designed to stop the development of intense fires and the transmission of severe radiated heat.

The OPA assumes all trees will remain but with either a modified shrub / grass layer or regular removal of the litter layer. In some sparse vegetation communities the shrub layer may not require modification.

The fire fighting advantage will manifest in reduced fire intensity. It achieves this by denying fire a significant proportion of the fuel to feed upon. Fuels containing small (or fine) leaves such as Forest Oaks (or similar) are targeted for removal due to the capacity to burn quickly and therefore feed fire up into adjacent trees.

In most cases, the removal of 85% of the litter layer will achieve a satisfactory OPA. A recommended performance standard for the fuel load of an OPA is between 4-6t/ha.

Managing the APZ

Fuel management within the APZs should be maintained by regular maintenance such as:

- Mowing grasses regularly - grass needs to be kept short and, where possible, green.

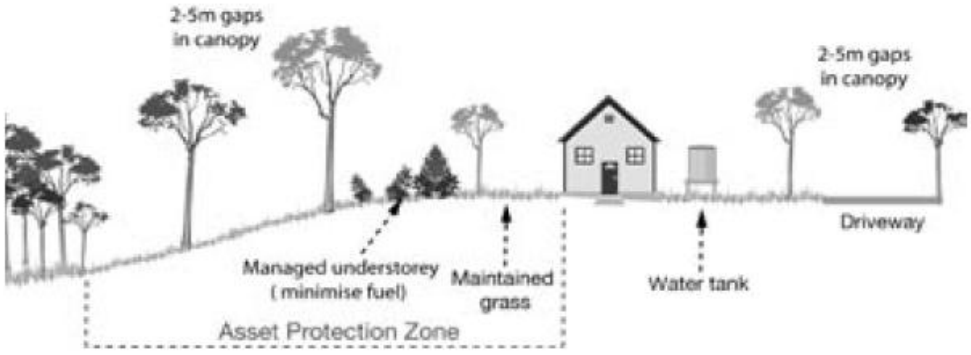
- Raking or manual removal of fine fuels - ground fuels such as fallen leaves, twigs (less than 6mm diameter) and bark should be removed on a regular basis. This is fuel that burns quickly and increases the intensity of a fire. Fine fuels can be removed by hand or with tools such as rakes, hoes and shovels.

- Removal or pruning of trees, shrubs and understorey - the control of existing vegetation involves both selective fuel reduction (removal, thinning and pruning) and the retention of vegetation. Prune or remove trees so that you do not have a continuous tree canopy leading from the hazard to the asset. Separate tree crowns by 2-5m. A canopy should not overhang within 2-5m of a building. Native trees and shrubs should be retained as clumps or islands and should maintain a covering of no more than 20% of the area.

- Trees or tall shrubs may require pruning upon building completion in line with *PBP.* Notwithstanding this, the presence of shrubs and trees close to a building in a bushfire prone landscape requires specific attention to day to day management and owners and or occupier should be made aware that whilst landscaping can contribute to a way of life and environmental amenity the accumulated.

In addition, the following general APZ planning advice should be followed:

- Ensure that vegetation does not provide a continuous path to the house.
- Plant or clear vegetation into clumps rather than continuous rows.
- Prune low branches 2m from the ground to prevent a ground fire from spreading into trees.
- Locate vegetation far enough away from the asset so that plants will not ignite the asset by direct flame contact or radiant heat emission.
- Ensure that shrubs and other plants do not directly abut the building. Where this does occur, gardens should contain low flammability plants and non flammable ground cover such as pebbles and crushed tile; and
- The following RFS illustrative diagram depicts one version of an ideal situation. Specific advice is to be sought from qualified experts to ensure that the implemented APZs meet the performance criteria of APZs.



Figures courtesy of NSW RFS 2006.

Performance based assessment

A2

NBC Bushfire Attack Assessment Report V2.1

AS3959 (2009) Appendix B - Detailed Method 2

Printed: 1/10/2015 **Assessment Date:** 24/09/2015

Site Street Address:	St Andrews Road, Varroville		
Assessor:	Mr Admin; admin		
Local Government Area:	Campbelltown	**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 Chapel - South-east

Vegetation Information

Vegetation Type:	Grassland	**Vegetation Group:**	Grassland
Vegetation Slope:	5 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	4.5	**Overall Fuel Load(t/ha):**	4.5

Site Information

Site Slope	5 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m)	Default	**APZ/Separation(m):**	36

Fire Inputs

Veg./Flame Width(m):	100	**Flame Temp(K)**	1200

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):**	1.28
Level of Construction:	BAL 12.5	**Fire Intensity(kW/m):**	55481
Radiant Heat(kW/m2):	9.93	**Flame Angle (degrees):**	86
Flame Length(m):	8.88	**Maximum View Factor:**	0.111
Rate Of Spread (km/h):	23.86	**Inner Protection Area(m):**	36
Transmissivity:	0.802	**Outer Protection Area(m):**	0

Run Description:	B Function room north-west & north-east		
Vegetation Information			
Vegetation Type:	Grassland	Vegetation Group:	Grassland
Vegetation Slope:	0 Degrees	Vegetation Slope Type:	Level
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):	32
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1200
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):	3.7
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	39293
Radiant Heat(kW/m2):	9.82	Flame Angle (degrees):	82
Flame Length(m):	7.47	Maximum View Factor:	0.108
Rate Of Spread (km/h):	16.9	Inner Protection Area(m):	32
Transmissivity:	0.811	Outer Protection Area(m):	0

Run Description:	C Adminstration - West		
Vegetation Information			
Vegetation Type:	Forest	Vegetation Group:	Forest and Woodland
Vegetation Slope:	2 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	20	Overall Fuel Load(t/ha):	25
Site Information			
Site Slope	2 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	23
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):	8.51
Level of Construction:	BAL 29	Fire Intensity(kW/m):	35587
Radiant Heat(kW/m2):	27.93	Flame Angle (degrees):	63
Flame Length(m):	20.91	Maximum View Factor:	0.439
Rate Of Spread (km/h):	2.76	Inner Protection Area(m):	23
Transmissivity:	0.836	Outer Protection Area(m):	0

Run Description:	D Ground staff facilities - south-west		
Vegetation Information			
Vegetation Type:	Forest	**Vegetation Group:**	Forest and Woodland
Vegetation Slope:	5 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	20	**Overall Fuel Load(t/ha):**	25
Site Information			
Site Slope	5 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m)	Default	**APZ/Separation(m):**	26
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):**	8.97
Level of Construction:	BAL 29	**Fire Intensity(kW/m):**	43772
Radiant Heat(kW/m2):	28.52	**Flame Angle (degrees):**	64
Flame Length(m):	25.03	**Maximum View Factor:**	0.452
Rate Of Spread (km/h):	3.39	**Inner Protection Area(m):**	26
Transmissivity:	0.83	**Outer Protection Area(m):**	0