

Bushfire Protection Assessment

Proposed classrooms – St Anthony of Padua Catholic School

Prepared for
Sydney Catholic Education Office

July 2018



DOCUMENT TRACKING

Item	Detail
Project Name	Bushfire Protection Assessment: Proposed primary school – St Anthony of Padua Catholic School
Project Number	18SUT_9739
Project Manager	Steven Houghton Suite 2, Level 3, 668 Princes Highway, Sutherland NSW 2232 (02) 8536 8605
Prepared by	Steven Houghton FPAA BPAD L2 Certified Practitioner No. BPAD46241-L2
Reviewed by	Mick George
Approved by	Bruce Horkings FPAA BPAD-A Certified Practitioner No. BPAD29962-L3
Status	Final
Version Number	1
Last saved on	18 July 2018

This report should be cited as 'Eco Logical Australia July 2018. Bushfire Protection Assessment: Proposed primary school – St Anthony of Padua Catholic School. Prepared for Sydney Catholic Education Office.

Disclaimer

This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and Sydney Catholic Education Office. The scope of services was defined in consultation with Sydney Catholic Education Office by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.

Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.

Bushfire template 12/8/13

Contents

1	Property and proposal	1
1.1	Description of proposal	1
1.2	Location and description of subject land	2
1.3	Assessment process	2
1.4	Bush fire prone land status	2
2	Bushfire threat assessment	7
3	Bushfire protection measures.....	9
3.1	Asset Protection Zones (APZ)	9
3.2	APZ maintenance plan	11
3.3	Construction standard	11
3.4	Access	12
3.5	Services – Water, electricity and gas	14
3.5.1	Water supply	14
3.5.2	Electricity services	14
3.5.3	Gas services	14
3.6	Evacuation / emergency response procedures	15
4	Assessment of environmental issues	15
5	Recommendations and conclusion	16
	References	18
	Appendix A – BFAA Report.....	19
	Appendix B - Photographs	20

List of figures

Figure 1: Location.....	3
Figure 2: Development plan	4
Figure 3: Liverpool Council Bush Fire Prone Land Map	5
Figure 4: Austral and North Leppington Indicative Layout Plan	6
Figure 5: Bushfire Hazard Assessment.....	8

List of tables

Table 1: Summary of bushfire protection measures assessed	2
Table 2: Threat assessment, APZ and category of bushfire attack	10
Table 3: Performance criteria for Internal Access Roads (PBP page 35).....	13
Table 4: Performance criteria for reticulated water supplies (PBP page 37)	14
Table 5: Summary of bushfire protection measures assessed	16

1 Property and proposal

Name:	St Anthony of Padua Catholic School		
Street or property name:	125 – 165 Tenth Avenue and 140 – 170 Eleventh Avenue		
Suburb, town or locality:	Austral	Postcode:	2179
Lots and DPs:	Lot 810 DP2475; Lot 811 DP2475; Lot 812 DP2475; Lot 839 DP2475; Lot 840 DP2475, Lot 841 DP2475, Lot 842 DP2475; Lot 1 DP1232692, Lot 2 DP1232692		
Local Government Area:	Liverpool Council		
Type of area:	Rural residential transitioning to urban		
Type of development:	School (Pre-school to Year 12)		

1.1 Description of proposal

The Sydney Catholic Education Office commissioned Eco Logical Australia Pty Ltd (ELA) to prepare a bushfire protection assessment (BPA) for the proposed redevelopment of St Anthony of Padua Catholic School as shown in **Figure 1** (hereafter referred to as the 'subject land') in accordance with the NSW Department of Planning and Environment Secretary's Environmental Assessment Requirements dated 19 December 2017 (SSD 8865). This bushfire assessment report has been prepared to support the Environmental Impact Statement.

The school currently has approximately 120 kindergarten and year 1 students and 20 staff, and is planned to become a Preschool to Year 12 school for approximately 2,500 students and 200 staff members.

A previous BPA was prepared by ELA (Ref: 15SUT_3297) for the initial construction of an administration building and new classrooms, car park and landscaping. It is understood that these approved buildings are currently under construction and are now to become an Early Learning Centre (ELC) and Kindergarten as shown in **Figure 2** and are considered under this assessment.

Works covered by the development application subject to this report are:

- Concept proposal for the staged redevelopment of the school comprising envelopes for educational buildings and associated facilities including a church, trade training centre, multi-purpose hall, library, indoor and outdoor sports facilities for 2,500 students (Pre-school to Year 12) and 200 staff members; and
- Stage 1 works for the construction of educational buildings for years 1-12, specialist buildings with rooms for arts, woodwork, computer labs, new administration building, a multi-purpose hall and a child care centre.

A plan of the development is shown in **Figure 2**. The subject land and surrounds was inspected on 20 March 2018.

1.2 Location and description of subject land

The subject land is located in the south-western Sydney suburb of Austral within the Austral and Leppington North Precinct of the South West Growth Area. It is currently zoned R2 Low Density Residential under the *State Environmental Planning Policy – Sydney Growth Centres 2006*.

Figure 3 shows the current bush fire prone land mapping in relation to the subject land and **Figure 4** shows the Indicative Layout Plan (ILP) for Austral and North Leppington, indicating that all directions apart from the existing area of woodland to the north of the site will be developed in the future and hazards removed as a result of development.

1.3 Assessment process

Being a Special Fire Protection Purpose (SFPP) development, the concept proposal and proposed Stage 1 works were assessed in accord with Section 100B of the *Rural Fires Act 1997* and '*Planning for Bush Fire Protection 2006*' (RFS 2006), herein referred to as PBP.

Assessment included a review of background documentation, design team consultation, GIS analysis and a site inspection on 20 March 2018.

Table 1 identifies the bushfire protection measures assessed and whether these involved acceptable or performance solutions.

Table 1: Summary of bushfire protection measures assessed

Bushfire Protection Measure	Acceptable Solution	Performance Solution	Report Section
Asset Protection Zones	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3.1
Construction standard	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.3
Access	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.4
Water supply	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.5.1
Gas and electrical supplies	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.5.2
Emergency and Evacuation planning	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4

1.4 Bush fire prone land status

The proposed development includes land classified as bush fire prone on Liverpool City Council's bush fire prone land (BFPL) map (**Figure 3**).

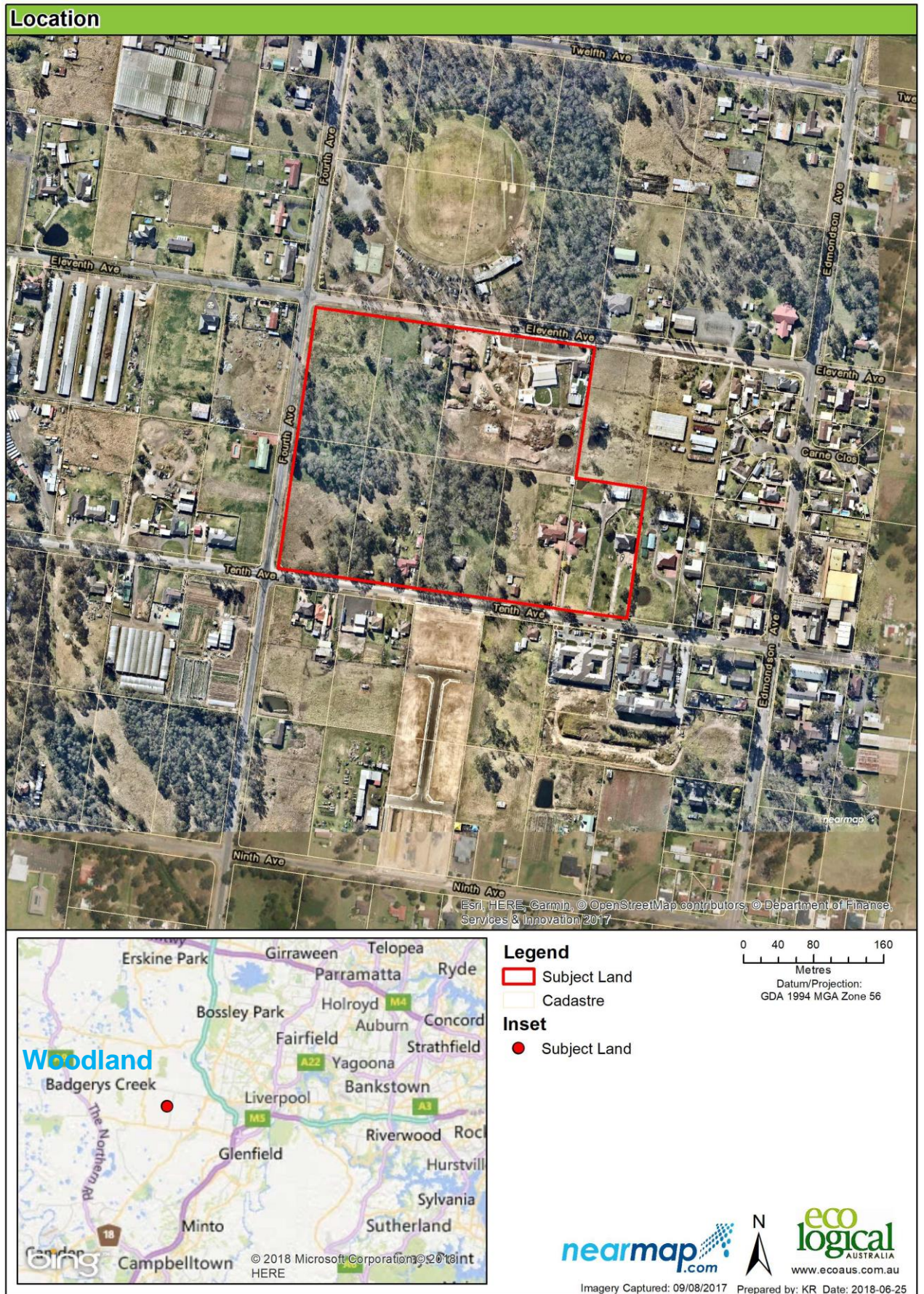


Figure 1: Location

© ECO LOGICAL AUSTRALIA PTY LTD

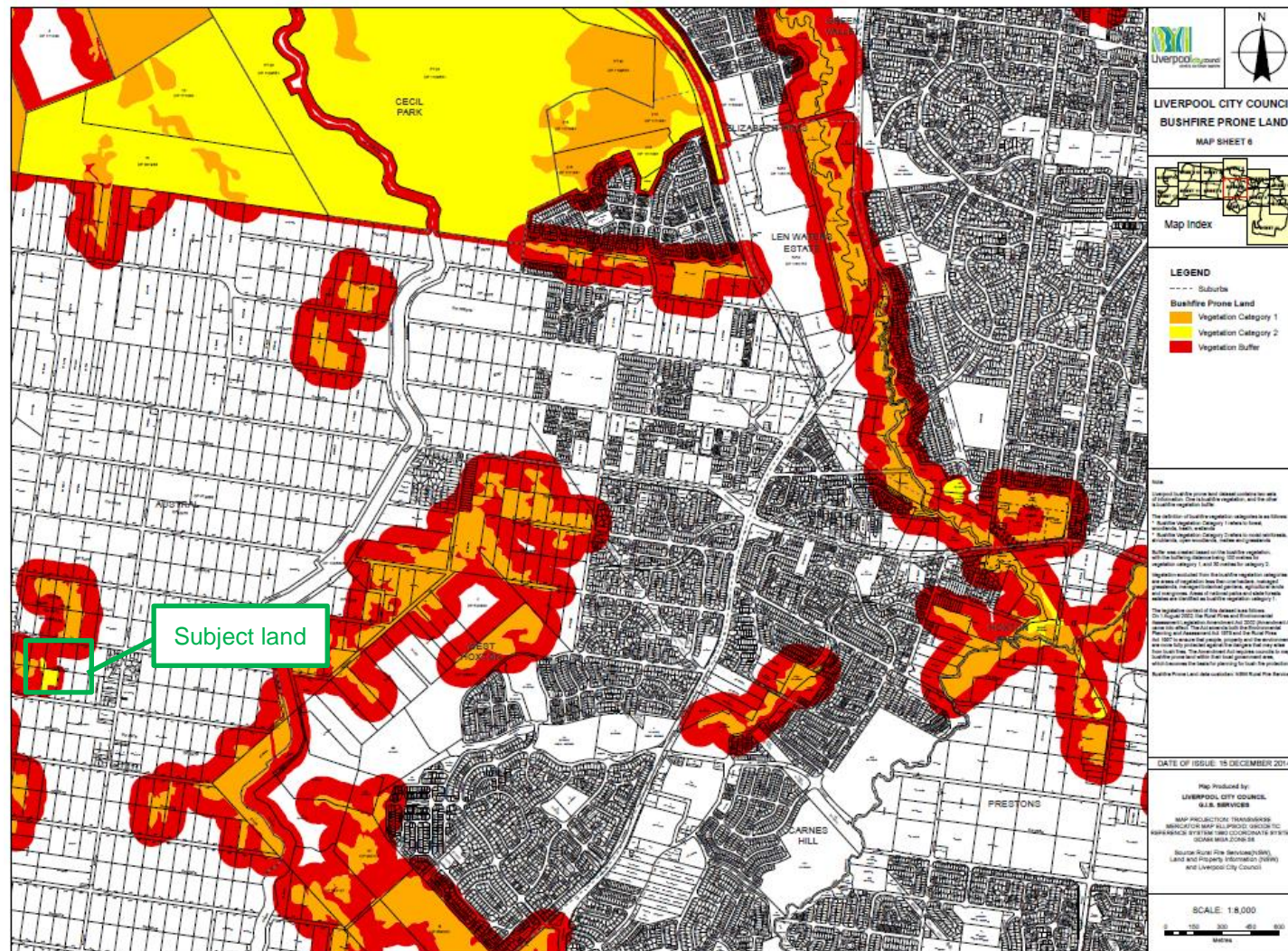


Figure 3: Liverpool Council Bush Fire Prone Land Map

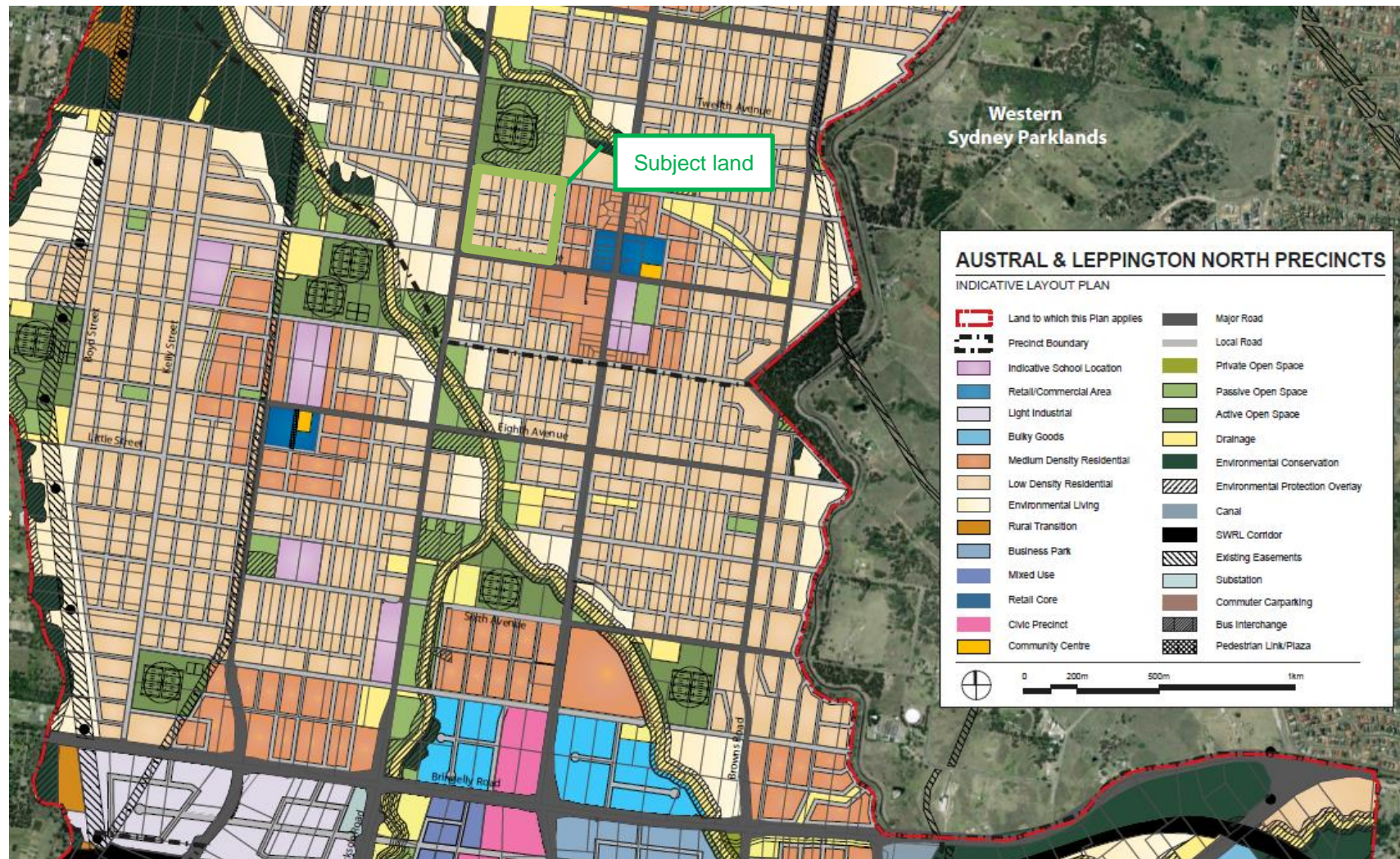


Figure 4: Austral and North Leppington Indicative Layout Plan

2 Bushfire threat assessment

Figure 5 shows the effective slope and predominant vegetation on a transect line representing the highest bushfire threat potentially posed to the proposed development site.

The effective slope has been determined from 2 m contour data and revised where required by site assessment. The land is almost flat with a gentle downward slope from the north at 1.5° downslope.

Immediately adjoining the subject land to the north is Eleventh Avenue with an area of Shale Plains Woodland (SPW) further to the north (see **Photo 1-3**). This area is zoned *RE1-Public Recreation* under the Growth Centres SEPP and adjoins an existing sporting field with associated buildings and gravel carpark that is classified as managed land under PBP (**Photo 4-5**). The Indicative Layout Plan (ILP) for the Austral and Leppington North Precinct identifies this use will continue in the future (**Figure 4**). The ILP shows that the area surrounding the sporting field, including the carpark area to the south, is mapped under the Environmental Protection Overlay. As shown in **Photo 4-5**, this area is highly managed and used as a gravel carpark and assembly hall. Only the area directly to the east of the oval has sufficient CPW to constitute a bushfire hazard under PBP.

SPW is found within the Cumberland Plain Woodland (CPW) community which is listed as an endangered ecological community under the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*. CPW is categorised as a Coastal Valley Grassy Woodland by Keith (2004) and 'woodland' in PBP.

As a result of development across the Austral and Leppington North Precinct, much of the land surrounding the subject land will be residential development as future stages of the Precinct are completed (see **Figure 4**). The bushfire hazard currently existing within the subject site (see **Figure 5**) will be removed during the Stage 1 works associated with the school construction, therefore was not assessed as a hazard to the proposed development.

In all other directions are public roads and well-maintained and managed properties with existing dwellings and ancillary buildings. There is no other vegetation that constitutes a bushfire hazard within 100 m of the site.

Figure 5 and **Table 2** show the vegetation and slope information assessed. Where required additional information is provided within **Table 2** on why and how the chosen slope and vegetation has been calculated.

The site is located within the Local Government Area (LGA) of Liverpool City Council and has a Fire Danger Index (FDI) of 100.

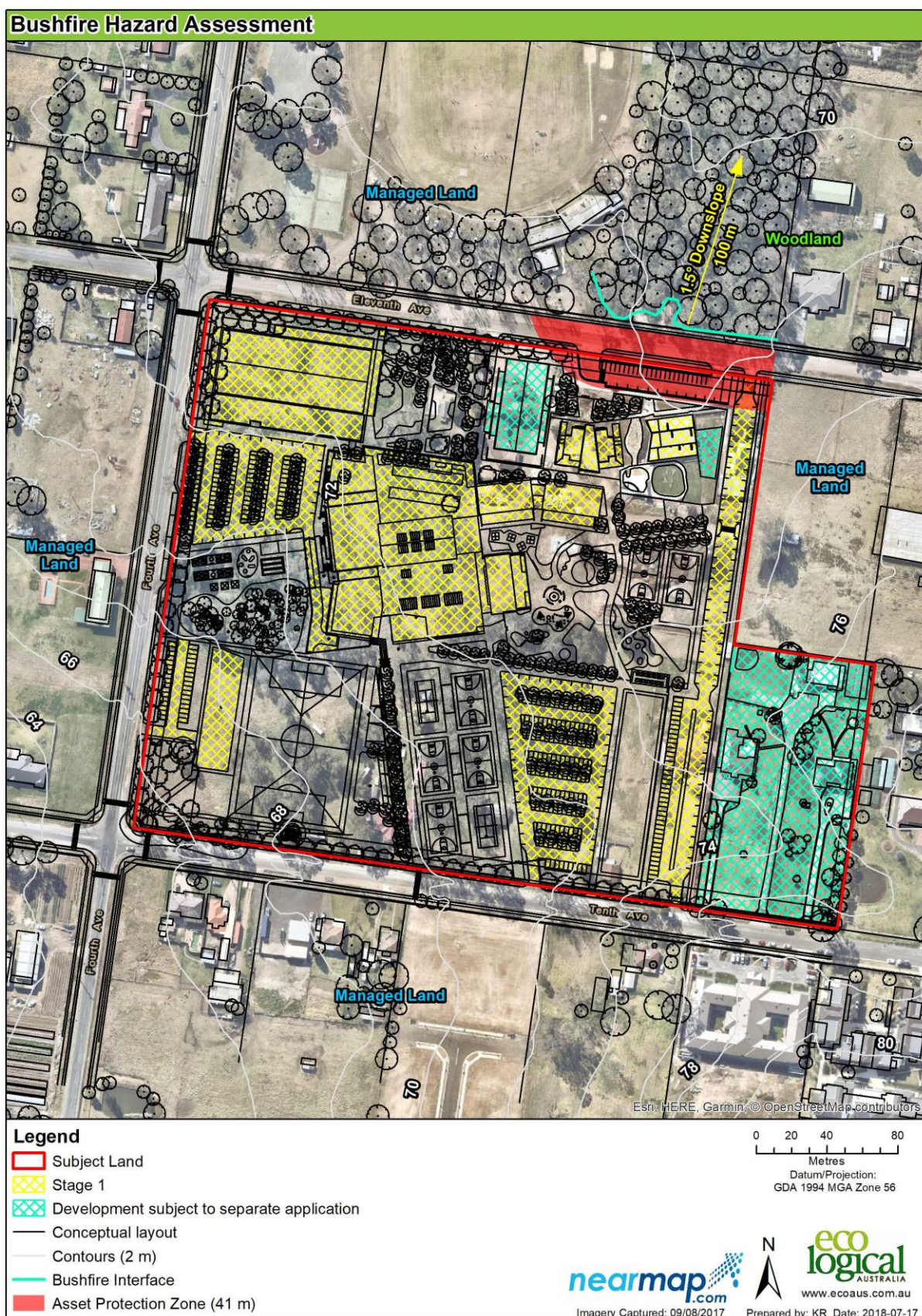


Figure 5: Bushfire Hazard Assessment

3 Bushfire protection measures

3.1 Asset Protection Zones (APZ)

Table 2 shows the dimensions of the APZ required; and where relevant, information on how the APZ is to be provided is included. The footprint of the required APZ is also shown in **Figure 5**.

SFPP developments are required to achieve the APZ performance criteria of '*radiant heat levels not greater than 10kW/m² to be experienced by occupants or emergency services workers entering or exiting the building*'. This has been achieved using a performance solution described further below with the results included in **Table 2**.

As outlined in CB3 of Appendix B of AS 3959-2009 (Standards Australia 2009) the vegetation classification system and associated fuel loads in AS 3959-2009 are based on a national system. Vegetation classification systems specific to the relevant State are accepted as an alternate to the national system. In NSW, a system has been established by Keith (2004) and the fuel loads identified in PBP have been extensively researched. This assessment utilises the fuel loadings for a grassy woodland as described in **Section 2** of this report and in accordance with Table A2.1 of PBP. A refined slope measurement of 1.5 degrees downslope is used within the Method 2 (AS 3959-2009) modelling.

The NBC Bushfire Attack Assessor was used to determine the refined APZ in accordance with Appendix B: Detailed Methodology for Determining the Bushfire Attack Level (BAL) – Method 2 of Australian Standard 3959-2009: '*Construction of buildings in bushfire-prone areas*' (Standards Australia 2009).

This site-specific methodology is used to demonstrate that the development achieves the PBP performance criteria (Section 4.2.7 [p 33]) '*radiant heat levels of greater than 10 kW/m² will not be experienced by occupants or emergency services workers entering or exiting a building*.' The results of this assessment are shown in **Appendix A**.

The APZ assessment is tabulated below in **Table 2**.

Table 2: Threat assessment, APZ and category of bushfire attack

Direction from envelope	Slope ¹	Vegetation ²	PBP required APZ (SFPP) ³	Modelled SFPP APZ (<10 kW/m ²) ⁴	Available APZ	AS 3959-2009 Bushfire Attack Level (BAL) ⁵	Comments
	Church (closest proposed building to bushfire hazard)						
North	1.5° downslope	Woodland	50 m	41 m	45 m	BAL-12.5	Provided by Eleventh Avenue and within property boundaries
	Classrooms (Year 12 classroom closet to bushfire hazard)						
North	1.5° downslope	Woodland	50 m	41 m	95 m	BAL-12.5	Provided by Eleventh Avenue and within property boundaries
	Kindergarten and ELC proposed change of use						
North	1.5° downslope	Woodland	50 m	41 m	50 m	BAL-12.5	Provided by Eleventh Avenue and within property boundaries

¹ Slope most significantly influencing the fire behaviour of the site having regard to vegetation found. Slope classes are according to PBP.

² Predominant vegetation is identified, according to PBP and "Where a mix of vegetation types exist the type providing the greater hazard is said to be predominate".

³ Assessment according to table A2.6 of PBP (2006).

⁴ Assessment according to Method 2 of Australian Standard 3959: Construction of buildings in bushfire-prone areas' 2009

⁵ Assessment according to table 2.4.2 of Australian Standard 3959: Construction of buildings in bushfire-prone areas' 2009

3.2 APZ maintenance plan

The required APZ are provided by Eleventh Avenue to the north, proposed carparks, footpaths and landscaping. Where the APZ is to be established, or any future landscaping is proposed, it is to be managed to Inner Protection Area standards as follows:

- No tree or tree canopy is to occur within 2 m of the future building rooflines;
- The presence of a few shrubs or trees in the APZ is acceptable provided they:
 - Are well spread out and do not form a continuous canopy;
 - Are not species that retain dead material or deposit excessive quantities of ground fuel in a short period or in a danger period; and
 - Are located far enough away from the building so that they will not ignite future buildings by direct flame contact or radiant heat emission.
- Any landscaping or plantings should preferably be local endemic mesic species or other low flammability species;
- A minimal ground fuel is to be maintained to include less than 4 tonnes per hectare of fine fuel (fine fuel means ANY dead or living vegetation of <6 mm in diameter e.g. twigs less than a pencil in thickness. 4 t/ha is equivalent to a 1 cm thick layer of leaf litter); and
- Any structures storing combustible materials such as firewood (e.g. sheds) must be sealed to prevent entry of burning debris.

Further details on APZ implementation and management can be found on the NSW RFS website including:

https://www.rfs.nsw.gov.au/_data/assets/pdf_file/0010/13321/Standards-for-Asset-Protection-Zones.pdf.

3.3 Construction standard

The building construction standard is based on the determination of the Bushfire Attack Level (BAL) in accordance with Method 1 of *Australian Standard AS 3959-2009 'Construction of buildings in bushfire-prone areas'* (Standards Australia 2009). The BAL is based on known vegetation type, effective slope, and managed separation distance between the development and the bushfire hazard.

In response to the predicted bushfire attack, the proposed buildings are exposed to **BAL-12.5** as defined in AS 3959-2009.

It is important that the version of AS3959-2009 applicable at the time of construction is consulted. Additionally, the NSW variation to AS 3959-2009 as outlined in PBP 2010 Appendix 3 Addendum is to be applied.

3.4 Access

The subject land has frontage and road access to Eleventh Avenue to the north, Fourth Avenue to the west, Tenth Avenue to the South with a driveway/drop area and carpark along the eastern boundary. Car parking is provided at multiple points across the site. It is anticipated that a fire impacting the subject land would be attended to by fire appliances situated within the hardstand surface of Eleventh Avenue or from the driveway/drop off area. If required fire appliances will also be able to traverse the grassed playground areas of the school.

The access arrangements will enable emergency vehicles to access the site in the event of an emergency.

Proposed internal access roads are required to comply with standards contained within section 4.2.7 of PBP for the design and construction of roads within SFPP developments, as listed in **Table 3**.

Table 3: Performance criteria for Internal Access Roads (PBP page 35)

Performance Criteria	Acceptable Solutions	Compliance
The intent may be achieved where:		
<ul style="list-style-type: none"> internal road widths and design enable safe access for emergency services and allow crews to work with equipment about the vehicle. 	<ul style="list-style-type: none"> internal roads are two-wheel drive, sealed, all-weather roads; internal perimeter roads are provided with at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb) and shoulders on each side, allowing traffic to pass in opposite directions; roads are through roads. Dead end roads are not more than 100 metres in length from a through road, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end; traffic management devices are constructed to facilitate access by emergency services vehicles. a minimum vertical clearance of four metres to any overhanging obstructions, including tree branches, is provided. curves have a minimum inner radius of six metres and are minimal in number to allow for rapid access and egress. the minimum distance between inner and outer curves is six metres. maximum grades do not exceed 15 degrees and average grades are not more than 10 degrees. crossfall of the pavement is not more than 10 degrees. roads do not traverse through a wetland or other land potentially subject to periodic inundation (other than flood or storm surge). roads are clearly sign-posted and bridges clearly indicate load ratings. the internal road surfaces and bridges have a capacity to carry fully-loaded firefighting vehicles (15 tonnes). 	<p>Can comply</p> <p>No perimeter road required as not directly adjoining the hazard, and Eleventh Ave separates the hazard and the subject site therefore providing access requirements.</p> <p>Can comply</p> <p>Can comply</p> <p>Can comply</p> <p>Can comply</p> <p>Can comply</p> <p>Can comply</p> <p>Can comply</p> <p>Can comply</p>

3.5 Services – Water, electricity and gas

3.5.1 Water supply

The subject land is serviced by reticulated water with hydrants located at regular intervals along Eleventh Avenue. **Table 4** identifies the acceptable solution requirements of Section 4.2.7 of PBP for which the proposal is compliant with, subject to the following specifications:

Table 4: Performance criteria for reticulated water supplies (PBP page 37)

Performance Criteria	Acceptable Solutions	complies
The intent may be achieved where:		
<ul style="list-style-type: none"> water supplies are easily accessible and located at regular intervals 	<ul style="list-style-type: none"> access points for reticulated water supply to SFPP developments incorporate a ring main system for all internal roads. 	Can comply
	<ul style="list-style-type: none"> fire hydrant spacing, sizing and pressures comply with AS 2419.1 – 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. 	Can comply
	<ul style="list-style-type: none"> the provisions of public roads in section 4.1.3 in relation to parking are met. 	Can comply

3.5.2 Electricity services

The existing overhead electrical transmission lines are compliant with Section 4.1.3 of PBP, subject to the following specifications:

- Lines with short pole spacing (30 metres) are required, 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 specifications in *'Guide for the Management of Vegetation in the Vicinity of Electricity Assets'* issued by the Industry Safety Steering Committee 3 (ISSC3 2016).

3.5.3 Gas services

Gas services (reticulated or bottle gas) are compliant with Section 4.2.7 of PBP, subject to the following specifications:

- Any gas services are to be installed and maintained in accordance with Australian Standard AS/NZS 1596 *The storage and handling of LP Gas* (SA 2014). Metal piping is to be used;
- All fixed gas cylinders are kept clear of all flammable materials to a distance of 10 metres and shielded on the hazard side of the installation;
- If gas cylinders need to be kept close to the building, the release valves are directed away from the building and at least 2 metres away from any combustible material, so that they do not act as a catalyst to combustion. Connections to and from gas cylinders are metal; and
- Polymer sheathed flexible gas supply lines to gas meters adjacent to buildings are not used.

3.6 Evacuation / emergency response procedures

A Bushfire Emergency Response and Evacuation Plan prepared following the NSW RFS (2014) Guide to developing a bush fire emergency and evacuation plan (https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0020/29270/Form.pdf) is to be prepared prior to occupation and is recommended as a condition of consent.

4 Assessment of environmental issues

An assessment of significant environmental features, threatened species or Aboriginal relics identified under the *Biodiversity Conservation Act 2016* or the *National Parks Act 1974* that will affect or be affected by the bushfire protection proposals in this report has not been undertaken as it is covered by other parts of the DA process. However, site impacts have been minimised by carefully selected bushfire protection measures. The impact footprint of these measures e.g. APZ is clearly identified within this report and therefore capable of being clearly assessed by suitably qualified persons as required.

The NSW Department of Planning and Environment is the determining authority for this development; they will assess more thoroughly any potential environmental and heritage issues.

5 Recommendations and conclusion

The proposed development complies with the acceptable solutions within 'Planning for Bush Fire Protection 2006', (see **Table 1**).

Modelling using Method 2 of AS 3959-2009 (Standards Australia 2009) demonstrates that the proposal is able to achieve the threshold of <10 kW/m² radiant heat exposure.

Table 5: Summary of bushfire protection measures assessed

Bushfire Protection Measures	Complies	Requirements	Acceptable Solution	Performance Solution	Report Section
Asset Protection Zones	<input checked="" type="checkbox"/>	APZ dimensions are detailed in Table 2 and Figure 5 .	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3.1
APZ Maintenance plan	<input checked="" type="checkbox"/>	Identified APZ to be maintained in perpetuity to the detailed specifications in Section 3.2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.2
Construction standard	<input checked="" type="checkbox"/>	A maximum of BAL-12.5 is achievable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.3
Access	<input checked="" type="checkbox"/>	Internal access to meet PBP acceptable solution specifications for a SFPP development.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.4
Water supply	<input checked="" type="checkbox"/>	Reticulated water supply to meet PBP acceptable solution specifications for a SFPP development.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.5.1
Electricity service	<input checked="" type="checkbox"/>	Electricity supply located underground.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.5.2
Gas service	<input checked="" type="checkbox"/>	Gas services are to be installed and maintained in accordance with AS/NZS 1596:2014.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.5.3
Evacuation / Emergency Response procedures	<input checked="" type="checkbox"/>	A Bushfire Emergency Response and Evacuation Plan is to be prepared prior to occupation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3.6

In the author's professional opinion, the bushfire protection requirements listed in this assessment provide an adequate standard of bushfire protection for the proposed development, a standard that is consistent with *Planning for Bush Fire Protection 2006* and appropriate for the issue of a Bush Fire Safety Authority.

Yours sincerely



Steven Houghton

Bushfire Consultant

FPAA BPAD Certified Practitioner No. BPAD46241-L2



Bruce Horkings

Senior Bushfire Consultant

FPAA BPAD Certified Practitioner No. BPAD29962-L3



References

Ecological Australia (2015) *Bushfire Protection Assessment* – St Anthony of Padua Catholic School.

Industry Safety Steering Committee 3 (2016) '*Guide for the Management of Vegetation in the Vicinity of Electricity Assets*'.

Keith, D. 2004. *Ocean Shores to Desert Dunes*. Department of Environment and Conservation, Sydney.

NSW Rural Fire Service (RFS). 2006. *Planning for Bush Fire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners* including the 2010 Appendix 3 Addendum. Australian Government Publishing Service, Canberra.

NSW Rural Fire Service (RFS). 2014. *Development Planning – A guide to developing a Bush Fire Emergency Management and Evacuation Plan*. State of NSW through the NSW RFS.

Standards Australia. 2009. *Construction of buildings in bushfire-prone areas*, AS 3959-2009. SAI Global, Sydney.

Standards Australia. 2014. *The storage and handling of LP Gas*, AS/NZS 1596:2008, SAI Global, Sydney.

Standards Australia. 2017. *Fire hydrant installations - System design, installation and commissioning*, AS2419.1, SAI Global, Sydney.

Appendix A – BFAA Report

NBC Bushfire Attack Assessment Report V2.1

AS3959 (2009) Appendix B - Detailed Method 2

Printed: 26/06/2018 Assessment Date: 26/06/2018



Site Street Address: 140-170 Eleventh Avenue [St Anthony of Padua Catholic School], Austral
 Assessor: Bruce Horkings; Ecological Australia
 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: T1 - North

Vegetation Information

Vegetation Type:	Woodland	Vegetation Group:	Forest and Woodland
Vegetation Slope:	1.5 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	10	Overall Fuel Load(t/ha):	15

Site Information

Site Slope	0 Degrees	Site Slope Type:	Level
Elevation of Receiver(m)	Default	APZ/Separation(m):	41

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:	100

Program Outputs

Category of Attack:	LOW	Peak Elevation of Receiver(m):	5.16
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	10314
Radiant Heat(kW/m2):	9.93	Flame Angle (degrees):	81
Flame Length(m):	10.45	Maximum View Factor:	0.112
Rate Of Spread (km/h):	1.33	Inner Protection Area(m):	41
Transmissivity:	0.794	Outer Protection Area(m):	0

Appendix B - Photographs

Photo 1: Woodland vegetation to north adjacent to the oval



Photo 2: Woodland vegetation to the north-east



Photo 3: Looking towards Woodland vegetation from newly constructed carpark.

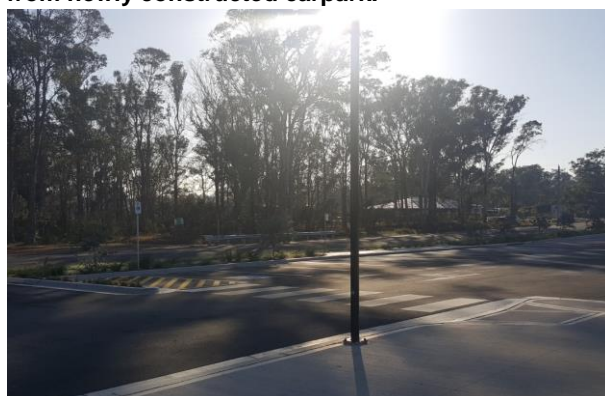


Photo 4: Bushfire interface setback from Eleventh Avenue



Photo 5: Looking north-west from development at managed land for oval carpark.



**HEAD OFFICE**

Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA

Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

COFFS HARBOUR

35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH

Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 02 9542 5622

DARWIN

16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601
F 08 8941 1220

SYDNEY

Suite 1, Level 1
101 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9542 5622

NEWCASTLE

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

ARMIDALE

92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

WOLLONGONG

Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

BRISBANE

Suite 1 Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7191
F 07 3854 0310

HUSKISSON

Unit 1 51 Owen Street
Huskisson NSW 2540
T 02 4201 2264
F 02 4443 6655

NAROOMA

5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

MUDGEES

Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

GOSFORD

Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

1300 646 131
www.ecoaus.com.au