BUSHFIRE ASSESSMENT REPORT

PROPOSED SCHOOL
ALTERNATE SOLUTION

LOT 412 and 413 DP 1063902
507 Medowie Road, Medowie

Date: **4/3/2018**

Prepared for: **Catherine McAuley Catholic College**

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Document Status

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1	27/11/2017	Draft	M. Hamilton	P.Couch
2	30/11/2017	Draft Rev A – corrected supporting plans and photographs.	M. Hamilton	P.Couch
3	12/3/2018	Final	M. Hamilton	P.Couch
4	15/3/2018	Rev A – altered reference to underground electrical transmission lines where onsite.	M. Hamilton	P.Couch
5	26/3/2018	Rev B – rewording to underground electrical transmission lines servicing the buildings within the school.	M. Hamilton	P.Couch
6	4/4/2018	Rev C – preparation of alternate solution examining outer protection area for forested wetland to reduce ecological impact.	M. Hamilton	P.Couch
7	4/3/2019	Rev D – preparation of alternate solution for modelling of revegetated 20 metre wide riparian corridor.	M. Hamilton	P.Couch

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This report has assessed the proposed school against the requirements of s100B of the *Rural Fires Act 1997,* AS3959 (2009) Building in Bushfire Prone Areas and Planning for Bushfire Protection, 2006.

This report establishes that the school does not comply with the acceptable solutions of Planning for Bush Fire Protection 2006 and offers an alternate solution to more accurately measure the bushfire attack level.

TABLE 1 – PROPERTY DETAILS AND TYPE OF PROPOSAL

Applicant Name	Catherine McAuley Catholic College		
Site Address	507 Medowie Road, Medowie	**Lot/Sec/DP**	Lot 412 and 413 DP 1063902
Local Government Area	Port Stephens	**FDI**	100
Bushfire Prone Land	Yes – within the 100 metre buffer of a Category 1 Vegetation		
Type of development	School	**Type of Area**	Urban/Rural Residential
Special Fire Protection Purpose	Yes	**Flame Temperature**	1200K
Application Complies with DTS Provisions	No. Alternate solution proposes outer protection area for forested wetland to reduce ecological impact and riparian corridor modelling	**Referral to RFS required**	Yes. Bushfire Safety Authority Required

TABLE 2 – BUSHFIRE THREAT ASSESSMENT

	North	**East**	**Southwest**	**West**
AS3959 (2009) Vegetation Structure	Forest	Remnant Vegetation < 50 metre fire run towards buildings	Forested Wetland	Remnant Vegetation < 50 metre fire run towards buildings
Asset Protection Zone	130 metres	87 metres	50 metres	50 metres
Accurate Slope Measure	1 degree downslope	Level	Level	1 degree downslope
Slope Range	1 to 5 degrees downslope	Level/Uplsope	Level/Uplsope	1 to 5 degrees downslope
PBP (2006) Table A2.6 Minimum Setbacks	60 metres	30 metres	50 metres	40 metres
AS3959 (2009) Bushfire Attack Level (BAL)	BAL-LOW	BAL-12.5	BAL-12.5	BAL-12.5

* A riparian corridor will be revegetated within an unmapped waterway on the southern portion of the site. An alternate solution has been prepared supporting a 16 metre asset protection zone from the thin arm of eastern riverine forest. Refer to Section 8.0 Alternate Solution.

TABLE 3 – PLANNING FOR BUSHFIRE PROTECTION (2006) 4.2.7 COMPLIANCE

Performance Criteria	Proposed Development Determinations	Method of Assessment
Asset Protection Zone	Minimum setbacks have been determined in accordance with Planning for Bushfire Protection (2006) Table A2.6 and are able to be achieved within the subject site and neighbouring road reserve considered equivalent to an Asset Protection Zone. An easement will be obtained over the western lands guaranteeing perpetual management of the asset protection zone. Construction Asset Protection Zones for vegetation excepting the revegetated riparian corridor has been determined in accordance with AS 3959-2009 Method 1 Simplified Procedure.	**Alternate Solution for Revegetated Riparian Corridor and Outer Protection Area**
Access – Internal Roads	The internal access roads are to comply with Planning for Bushfire Protection (2006) Section 4.2.7.	Acceptable Solution
Water Supply	Hydrant network to be installed in accordance with Planning for Bushfire Protection (2006) Section 4.2.7.	Acceptable Solution
Electrical Supply	The electrical transmission lines to the local area are located overhead with landscaping onsite to be managed so that no part of a tree is closer to a power line than the distance set out in accordance with the specifications in 'Vegetation Safety Clearances' issued by Energy Australia (NS179, April 2002). The electrical supply to the proposed buildings will be located underground.	Acceptable Solution
Gas Supply	Gas supply if installed shall comply with deemed to satisfy requirements.	Acceptable Solution
Emergency and Evacuation Planning	The facility shall have an emergency management plan developed in accordance with AS 3745 'Emergency control organisation and procedures for buildings, structures and workplaces'. Specific consideration shall be given to the eco-tourism development for the evacuation of large volumes of people and consider their expected age.	Acceptable Solution

2.0 INTRODUCTION

2.1 PURPOSE OF REPORT

The purpose of this report is to establish suitable bushfire mitigation measures for the proposed school to be constructed at Lot 412 and 413 DP 1063902, 507 Medowie Road, Medowie. The assessment acknowledges the requirements of s100B of the Rural Fires Act 1997 and Planning for Bushfire Protection 2006 to protect persons, property and the environment from danger that may arise from a bushfire.

Under the provisions of section 100B of the Rural Fires Act 1997 as amended, a Bushfire Safety Authority (BFSA) is required from the Commissioner of the NSW Rural Fire Service.

This report complies with Rural Fires Regulation 2008 Clause 44 Application for Bushfire Safety Authority. The assessment encompasses the subject site and neighbouring areas.

The recommendations within this report address the aims and objectives of Planning for Bushfire Protection 2006 to reduce the risk of ignition of the school in a bushfire event.

2.2 PROPOSED DEVELOPMENT

The land is zoned R2 low density residential and RU2 Rural Landscape. The land is comprised of two allotments totalling approximately 26.77 hectares in size. The proposed development includes the construction of a school.

2.3 SIGNIFICANT ENVIRONMENTAL FEATURES

There are no known significant environmental features affecting the site.

2.4 ENVIRONMENTAL ASSETS

The only known environmental asset on the subject site is the SEPP 14 Wetland located south and southwest of the school. The asset protection zone extends a small distance into the wetland with environmental studies having reviewed the impact.

2.5 ABORIGINAL HERITAGE

Searches of National Parks and Wildlife database identify 4 Aboriginal sites are recorded in or near the subject site as defined by National Parks and Wildlife Act 1974.

PHOTOGRAPH 1 – SITE PHOTO

View of the subject site looking north. Significant clearing has already been completed onsite. Mown grass surrounds the existing dwelling and shed.

PHOTOGRAPH 2 – SOUTHERN VEGETATIVE THREAT

View of forested wetland located south of the site. The vegetation shows signs of periodic innundation of water. The vegetation further to the south changes to be shrubland and scrub.

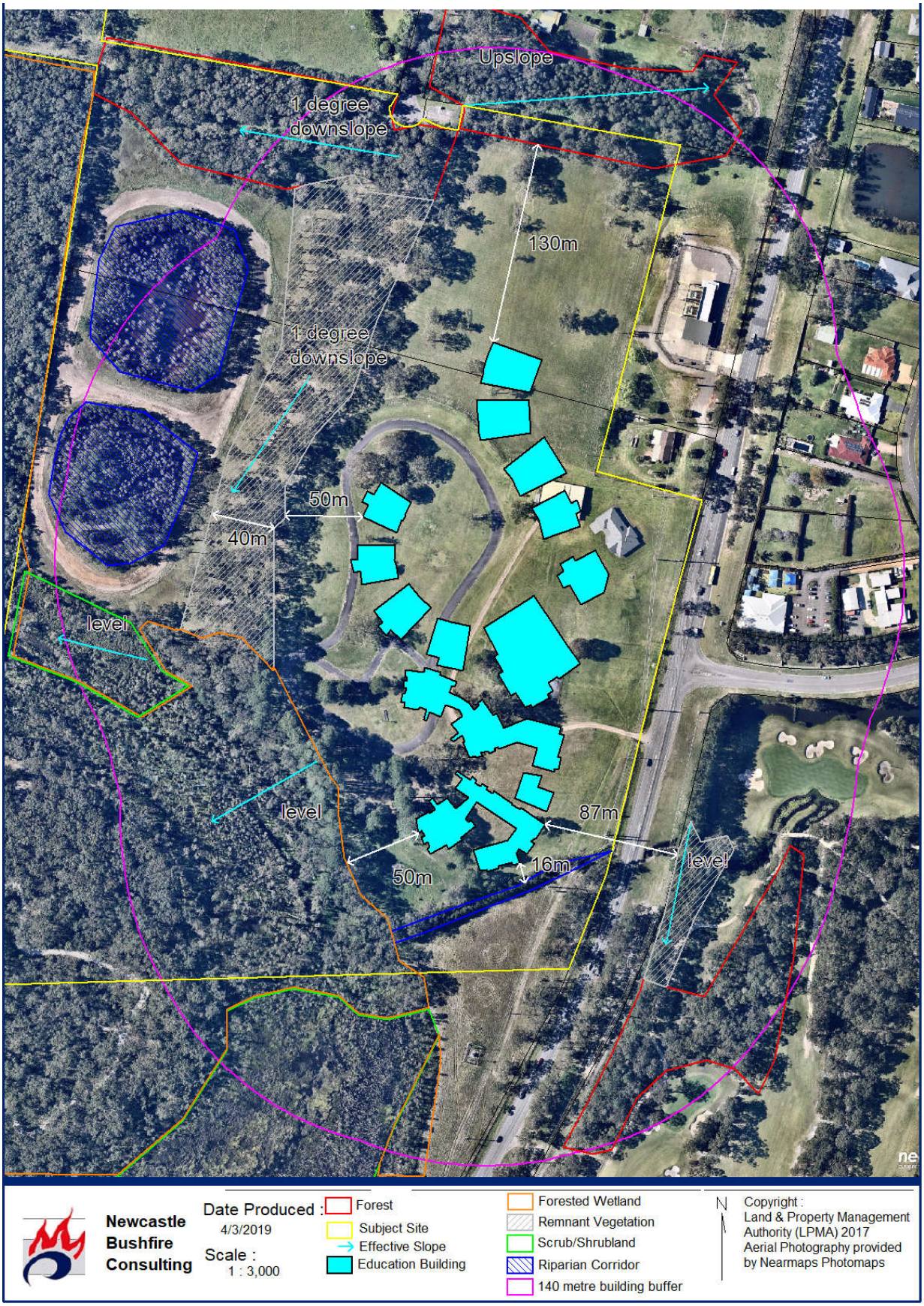

FIGURE 1 – SITE CONSTRAINTS MAP

3.0 BUSHFIRE ATTACK ASSESSMENT

3.1 VEGETATION CLASSIFICATION

Potential bushfire hazards were identified from Port Stephens Council bushfire prone mapping as occurring within the investigation area. Aerial mapping and inspection of the site reveals that the bushfire prone land map is reasonably accurate in respect to the current bushfire hazard.

The major vegetative threats have been determined using Keith (2004) to derive vegetation structures listed in Planning for Bushfire Protection (2006). General vegetation structures have been translated to AS3959 (2009) groupings.

Primary Vegetation Structures have been identified in Figure 1 – Site Constraints Map and separation distances shown in Table 2 – Bushfire Attack Assessment.

3.2 EFFECTIVE SLOPE

Effective slope was measured using 0.5 metre contour data obtained from Department of Lands and verified by a laser hypsometer on site. The laser hypsometer verified slope within the vegetation calculating effective fire run slope from 5 separate measurements in each dominant direction.

Effective Slopes have been identified in Figure 1 – Site Constraints Map and slope ranges are shown in Table 2 – Bushfire Threat Assessment.

3.3 MINIMUM SETBACKS AND ASSET PROTECTION ZONES

Minimum setbacks have been determined in accordance with Table A2.6 (Planning for Bushfire Protection) for vegetation excepting the revegetated riparian corridor. The minimum Asset Protection Zone has been demonstrated in Section 1 Executive Summary and Compliance Tables.

The required asset protection zone is available entirely within the subject site. Refer to alternate solution for the examination of an outer protection area and the riparian corridor.

3.4 BUSHFIRE ATTACK LEVELS

Bushfire attack levels and relevant construction levels in accordance with AS3959 (2009) have been demonstrated in Section 1 Executive Summary and Compliance Tables, Table 2 Bushfire Threat Assessment.

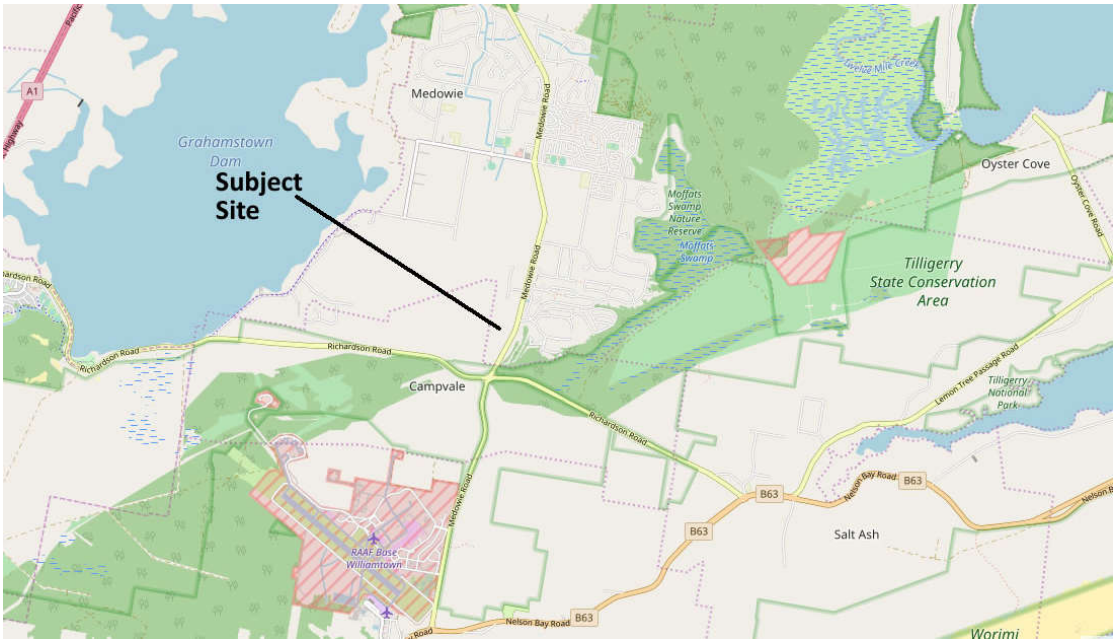

FIGURE 2 – LOCALITY MAP
Courtesy of OpenStreetMap

PHOTOGRAPH 3 – WESTERN REMNANT WOODLAND

View of woodland remnant located west of the proposed school. Eucalypts dominate the upper stratum. The understorey ranges from mown to unmown grass.

FIGURE 3 – SITE PLAN

4.0 UTILITY SERVICES AND INFRASTRUCTURE

4.1 WATER SERVICES

A reticulated water supply and street hydrant access is available in the local street network. A hydrant system shall be designed for the school in accordance with AS 2419.1 – 2005.

4.2 ELECTRICITY SERVICES

The existing electrical supply to the local area is via overhead electrical transmission lines. Landscaping onsite should be managed so that no part of a tree is closer to a power line than the distance set out in accordance with the specifications in 'Vegetation Safety Clearances' issued by Energy Australia (NS179, April 2002).

The subject site is proposed to accommodate up to two electrical kiosk substations where the power supply will connect to the school. The proposed electrical transmission lines servicing the school buildings will be located underground.

4.3 GAS SERVICES

- Reticulated or bottled gas installed and maintained in accordance with AS 1596 -2002 and the requirements of the relevant authorities. Metal piping is to be used.
- Fixed gas cylinders to be kept clear of flammable material by a distance of 10m and shielded on the hazard side of the installation.
- Gas cylinders close to the building are to have the release valves directed away from the building and at least 2m from flammable material with connections to and from the gas cylinder being of metal.
- Polymer sheathed flexible gas supply lines to gas meters adjacent to the buildings are not to be used.

5.0 PROPERTY ACCESS

Public Road Access
The subject site is located on Medowie Road being a dual carriageway road interconnecting into the local road network. Emergency Services are expected to have good access to the area at most times.

The existing Public Road network is deemed adequate to handle increased volumes of traffic in the event of a bush fire emergency. No new public roads are proposed for this development.

Fire Trails

Fire trails do not intersect the vegetation in the local area. A fire trail has been proposed running around the western perimeter of the school to improve access for firefighters to fight fire. The 4 metre wide fire trail will connect to the internal road network of the school, allowing multiple fire trucks to enter and leave the property without turning the vehicle around. It is noted the vegetation adjacent the school to the west north is remnant woodland with a presently mown understorey and a perimeter road is deemed excessive to fight fire in this location. Any firefighting is expected to be more than 100 metres west of the school with access trails presently in place.

Fire trails shall comply with section 4.1.3 of Planning for Bush Fire Protection 2006 as detailed below:

- A minimum carriageway width of four metres with an additional one metre wide strip on each side of the trail (clear of bushes and long grass) is provided.
- The trail is a maximum grade of 15 degrees if sealed and not more than 10 degrees if unsealed.
- A minimum vertical clearance of four metres to any overhanging obstructions, including tree branches is provided.
- The crossfall of the trail is not more than 10 degrees.
- The trail has the capacity for passing by:
    - a passing bay every 200 metres, 20 metres long by three metres wide, making a minimum trafficable width of seven metres at the passing bay.
- The fire trail is accessible to firefighters and maintained in a serviceable condition by the owner of the land.

Property Access

Property access is provided by way of Medowie Road providing access from the public road system directly to the private land giving fire fighters access to the building.

Property access roads shall comply with sections 4.1.3 and 4.2.7 of Planning for Bush Fire Protection 2006 as detailed below:

- 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.
- 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).

6.0 LANDSCAPING MAINTENANCE

It is recommended that landscaping is undertaken in accordance with Appendix 5 of Planning for Bushfire Protection 2006 and maintained for the life of the development.

Trees should be located greater than 2 metres from any part of the roofline of a building. Garden beds of flammable shrubs are not to be located under trees and should be no closer than 10 metres from an exposed window or door. Trees should have lower limbs removed up to a height of 2 metres above the ground.

The landscaped area should be maintained free of leaf litter and debris. The gutter and roof should be maintained free of leaf litter and debris.

Landscaping should be managed so that flammable vegetation is not located directly under windows.

Ground fuels such as fallen leaves, twigs (less than 6mm in diameter) and branches should be removed on a regular basis, and grass needs to be kept closely mown and where possible green.

7.0 EMERGENCY AND MAINTENANCE PLANS

7.1 BUSHFIRE MAINTENANCE PLANS

A fire management plan is to be prepared that addresses the following requirements:

a) Contact person / department and details; and
b) Schedule and description of works for the construction of asset protection zones and their continued maintenance.
c) Landscaping shall be managed as outlined within section 4.1.3 and Appendix 5 of Planning for Bush Fire Protection 2006 and the NSW Rural Fire Service's document Standards for asset protection zones.

7.2 FIRE EMERGENCY PROCEDURES

Arrangements for emergency and evacuation are to comply with section 4.2.7 of Planning for Bush Fire Protection 2006.

An Emergency /Evacuation Plan is to be prepared consistent with AS 3745 'Emergency control organisation and procedures for buildings, structures and workplaces' and consider bushfire.

8.0 ALTERNATE SOLUTION

At the request of the client I have been asked to provide an unbiased safety model for the proposed development. The proposed alternate solution offers compliance with the National Construction Code 2016 performance measure of reducing the chance of ignition to the building from the firefront and the objectives of Planning for Bushfire Protection (2006).

Proposed Alternate Solution
The proposed alternate solution examines the potential of an outer protection area for forested wetland and more accurate measurement of the revegetated Eastern Riverine riparian corridor.

The outer protection area proposed in a forest for special fire protection purpose developments will be applied in a similar manner for forested wetland. This is proposed due to the asset protection zone entering a SEPP14 wetland area and the intention to reduce the ecological impact created by the asset protection zone.

The Bushfire Attack Level (BAL) for the revegetated riparian corridor has been examined using an AS3959 (2009) Method 2 Detailed Fire Model and short fire run calculations based on NSW Rural Fire Service Community Resilience Fact Sheet Short Fire Run – Methodology for Assessing Bushfire Risk for Low Risk Vegetation using Martin Alexander's (1985) elliptical fire growth model. The unmapped waterway located south of the proposed classrooms will be revegetated to be approximately 10 metres on either side of the waterway with a reduction in size directly adjacent the building. Surveyors have indicated the unmapped waterway is 5 to 8 metres in width which is identified as a very conservative width. Revegetation averaging will be used where the vegetation is closest to the school building. Design fires have been prepared with a constricted flame width that could establish from an evolving spot fire and project Vesta flame lengths or a transitioning line fire with full flame lengths.

The riparian corridor will be revegetated to Eastern Riverine Corridor levels. Penny Watson (2012) assessment of fuel load dynamics in NSW vegetation for Eastern Riverine Corridor has been deemed a more accurate fuel load assessment than Rainforest fuel loads for the subject vegetation.

The proposed alternate solution will establish the asset protection zone required to ensure that a firefighter evacuating a student or building user from any building will be exposed to less than 10kW/m2 radiant heat.

The basis for the assessment of compliance for this site is Planning for Bushfire Protection 2006 Section 4.2.7 Standards for Bush Fire Protection Measures for Special Fire Protection Purpose Developments.

The specific performance criteria measure is compliance with Planning for Bushfire Protection 2006 Asset Protection Zones. The acceptable solutions are identified as:

1) an APZ is provided in accordance with the relevant tables and figures in Appendix 2 of this document.
2) exits are located away from the hazard side of the building.
3) the APZ is wholly within the boundaries of the development site.

The primary focus of this alternate solution is the compliance with acceptable solution 1 as items 2 and 3 are complied with.

Planning for Bushfire Protection 2006 Appendix 3 (amended May 2010) Section A3.3 Compliance Approaches and A3.4 Alternative Solution Approach to Site Assessment: Radiant Heat Flux and Required Separation Distances, outline the performance criteria for alternate solutions.

Asset Protection Zone Performance Criteria

> "radiant heat levels of greater than 10kW/m2 will not be experienced by occupants or emergency services workers entering or exiting a building.''

An asset protection zone shall be provided in accordance with Planning for Bushfire Protection Table A2.6 for all pieces of vegetation excepting the southern riparian corridor with the consideration of Table A2.7 examined to provide an Outer Protection Area.

Table A2.7 provides outer protection areas for forest vegetation with the outer protection area based on a parallel assessment of woodland fuel loadings within the outer protection area as a fuel reduced zone and the inner protection area defined as 10 kw/m2 radiant heat exposure from woodland vegetation.

A 20 metre outer protection area is detailed for forest vegetation applied to special fire protection purpose developments. This translates to a 10 metre outer protection area for forested wetland environment where the overall asset protection zone is 10 metres less than forest.

Evaluation of Alternate Solution - Outer Protection Area
Planning for Bushfire Protection (2006) details the deemed to satisfy conditions for special fire protection purpose with the provision of the outer protection area being an extrapolation of existing accepted legislation. The reduced ecological impact of establishing a 10 metre outer protection area in place of inner protection area should be considered due to the SEPP14 wetland.

Assessment of Revegetated Eastern Riverine Corridor
AS3959 (2009) Building in Bushfire-Prone Areas details the calculations required for detailed fire modelling with the Newcastle Bushfire Consulting designed bushfire modelling tool complying with these calculations. The detailed fire models have been provided in Appendix 2.0 of this report.

Penny Watson (2012) conducted a thorough assessment of vegetation structures throughout New South Wales and is deemed current best practice in assessing peak fuel loads. Watson (2012) identifies that Eastern Riverine Corridor has a maximum surface and elevated fuel loading of 8.2 tonnes per hectare using a peak accumulation curve. The NSW Rural Fire Service Community Resilience Fact Sheet Short Fire Run – Methodology for Assessing Bushfire Risk for Low Risk Vegetation summarises Penny Watson fuel loads and adds an overall fuel load.

Fuel Load inputs as per NSW Rural Fire Service Community Resilience Fact Sheet Short Fire Run – Methodology for Assessing Bushfire Risk for Low Risk Vegetation (2017)
Surface Fuel Load: 8.2 tonnes per hectare
Overall Fuel Load: 15.1 tonnes per hectare
Shrub Height: 0.9 metres

Short Fire Run Calculation
The development departs from the acceptable solutions of AS 3959-2009 due to the modelling of fire growth calculations where the direct perpendicular fire runs are less than 150 metres in length. Adjacent burn patterns are also examined as a 100 metre wide headfire could not establish in the southern riparian corridor. The proposed alternate solution will establish the asset protection zone required and a safe bushfire attack level.

Planning for Bush Fire Protection 2006 Appendix 3 (amended May 2010) Section A3.3 Compliance Approaches and A3.4 Alternative Solution Approach to Site Assessment: Radiant Heat Flux and Required Separation Distances, outline the performance criteria for alternate solutions.

Given the shape and size of the hazard based on the specific location of the subject property, the alternate solution will need to demonstrate that future buildings comply with the performance criteria.

Design Fire Revegetated Eastern Riverine Corridor burning South to North

A fire could not evolve within this bushland to have a 100-metre wide headfire. The real head width would be smaller and produce less radiant heat exposure than that described Planning for Bush Fire Protection (2006) or AS3959 (2009) design fires.

The fire will still be an accelerating or evolving fire and will not be in equilibrium state of energy release.

The most conservative measure of fire run is 20 metres in a direct path with a short fire run calculation having been made based on Martin Alexander's research of fire shape. This is considered reasonably conservative using NSW Rural Fire Service Community Resilience Fact Sheet Short Fire Run – Methodology for Assessing Bushfire Risk for Low Risk Vegetation.

Utilising Alexander's (1985) ellipse model the flame width for a fire burning directly south to north will be 10.25 metres.

Alexander's ellipse model does not differentiate the width of the ellipse with differing fuel loads or fuel structures. The flame width input has however been utilised to model the detailed fire models for the differing vegetation structures.

Short Fire Run Calculations are shown below:

Inputs

Fire Run Distance	28	
FDI	100	metres
Veg Slope	0	
Surface Fuel Load	8.2	deg
Overall Fuel Load	15.1	tph
Wind Speed	30	tph
Elevated Fuel Height	0.9	kph
		metres
Outputs		
ROS	984.00	
Length/Breadth Ratio	2.82	metres per hour
Headfire/Backfire spread	29.85	
Full Elipse Length	32.96	metres per hour
Full Spread	1016.96	This should be less than the fire run distance
Head Width	360.18	
ROS	16.40	
Duration to travel Fire Run	1.71	metres per minute
ROS	0.98	minutes

Length/Breadth using ROS	2.82	kph
Headfire/Backfire spread ratio	29.85	kph
	16.95	
Total Ellipse Length	28.94	metres per minute
Head Width	10.25	metres

McArthur Modified Flame Height	8.208	metres
Vesta Flame Height	5.01	metres

Flame Length: 5 m
Radiant Heat Flux: 5.85 kw/m2 (BAL 12.5)

Design Fire Revegetated Eastern Riverine Corridor burning West to East
The dominant fire run for the southern revegetated riparian corridor will traverse from west to east. A fire could evolve within this bushland to have a narrow head fire. The real head width would be smaller than the AS3959 default of 100 metres and produce less radiant heat exposure than that described Planning for Bush Fire Protection (2006) or AS3959 (2009) design fires.

The most conservative measure of headfire width can be calculated using a 40 second residence time. Wotton et al. (2012) identified 37 seconds as an estimated residence time for the headfire, with this having been rounded up to 40 seconds. The rate of spread is 1.05 km/h with a 40 second residence time yielding a 11.66 metre wide head fire.

A detailed fire model has been calculated with an 11.66 metre wide head fire width and modified McArthur flame length due to the potential for some crowning. The flame angle has been set at 90 degrees as the fire will be burning adjacent the school buildings rather than directly towards them.

Flame Length: 8.21 m
Radiant Heat Flux: 9.96 kw/m2 (BAL 12.5)

Summary of Design Fires
Both design fires for the southern revegetated riparian corridor will be an accelerating or evolving fire and will not be in equilibrium state of energy release.

The intensity, rate of spread and flame width calculations of Planning for Bush Fire Protection (2006) and AS3959 (2009) are deemed overly conservative for the subject site. The proposed fire model uses the below variations from presently accepted Bush

Fire Protection (2006) and AS3959 (2009) fire modelling and provides a step by step procedure to determine the potential width of a fire using equilibrium fire spread models:

1. Flame will be a convective column utilising the view factor model of flame tilt.
2. Radiant heat shall be measured as a cylinder or elliptical shape rather than a flat panel. Alexander (1985) proposes the length to breadth ratio of 1.0 + 0.0012 $W^{2.154}$ where W equals a theoretical wind speed of 30 km/h.
3. AS3959 (2009) Rate of spread (metres per minute) = (0.0012 * FDI * Surface fuel load* $^{(0.069*SLOPE)}$*1000)/60.
4. The fire will take minutes to travel the entire length of the vegetation if it moves at peak rate of spread and this is based upon full equilibrium fuel consumption and energy release. This is not possible and represents a significant redundancy.
5. Alexander (1985) proposes a headfire spread ratio of = ((Lb+$\sqrt{}$(Lb^2)-1) / Lb-$\sqrt{}$(Lb^2) -1)).
6. Alexander (1985) proposes ellipse length by dividing the forward rate of spread (AS3959 (2009) calculation) with the Headfire Spread. Ellipse length (El) = ROS/Hfs+ROS.
7. Total ellipse length (Tel) is calculated by multiplying Ellipse length by the time taken to travel the short fire run distance.
   Tel = El * (distance/ROS)
8. The ellipse breadth (Eb) is calculated by multiplying the actual fire run (as it is shorter than the ellipse length) by the length:breadth ratio.

Fire Model Redundancies

1. Fuel loadings in the vegetation are significantly overestimated with the entirety of the fuel not able to be fully consumed in an evolving fire.
2. Flame emissivity is conservative, with 95% emitting power (as detailed in AS3959 2009). The flames produced by this fire will be thermally thin and are unlikely to have 95% emitting power of the intensity described by the design fire.
3. Rate of spread assumes that the fire is moving at equilibrium rate of spread from the instant it starts. This is not possible with Cheney and Barry's (1969) forest growth model of $R=R_{ss}\ e^{-a/t}$ being more appropriate, where R = rate of spread at time t, Rss = equilibrium rate of spread, t = time since ignition. A heuristic provided by Cheney and Barry (1969) estimates there will be a 30 to 45 minute evolution before 90 percent energy release is achieved in a medium growing forest fire. A threshold headwidth of 120 metres is required to achieve equilibrium rate of spread for a large forest fire with the vegetation expected to travel far slower than AS3959 (2009) design fire rate of spread.

Evaluation of Alternate Solutions

AS3959 (2009) Building in Bushfire-Prone Areas and Planning for Bush Fire Protection (2006) detail the calculations required for detailed fire modelling, and Newcastle Bushfire Consulting's proprietary modelling tool uses these. The detailed fire models have been provided in Appendix 2.0 of this report.

Redundancies are included in the design fire for rate of spread and flame length and a conservative measure of bushfire attack is provided to the building.

All of the proposed buildings are built in a location where a person could be evacuated to less than 10 kw/m2 radiant heat exposure.

It is deemed very unlikely that a firefighter would evacuate a building user directly towards the bushland and if a fire was impacting on the buildings the 10 kw/m2 radiant heat exposure would be likely to last for 30 seconds or less.

Time constraints have prevented the ability to have a specific pre-DA meeting with NSW RFS to discuss the short fire run model and the west to east headfire measurement technique for this project. It is noted a pre-DA meeting was held for a Lake Macquarie Aged Care facility on 23/8/2018 with New South Wales Rural Fire Service. Agreement has been achieved in principle for the same concept.

Compliance with National Construction Code 2016

The combination of building recommendations, fire resistant design, maintenance of landscaping/asset protection zones and acknowledgment of risk achieves the performance requirements of the National Construction Code 2016.

Bushfire Certification

In accordance with NSW RFS Alternate Solutions Practice Note 1/07 (Release 3), this report has been prepared by Phillip Couch, a Fire Protection Association, Bushfire Planning and Design - Alternate Solutions certified practitioner (FPAA BPAD-Level 3) and a Graduate Fire Engineer with the Institution of Fire Engineers. Phillip Couch certifies that the described Bushfire Behaviour is the expected fire behaviour for the adjacent vegetation and the design complies with the Performance Criteria of Planning for Bushfire Protection.

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Grad Dip Design for Bushfire Prone Areas
FPAA BPAD – Level 3 Certificate Number BPD-PA-16132

9.0 RECOMMENDATIONS

Based upon an assessment of the plans and information received for the proposal, it is recommended that development consent be granted subject to the following conditions:

1. The proposed building works shall comply with BAL-12.5 in accordance with AS 3959-2009 Building in Bushfire Prone Areas and the construction requirements of Planning for Bushfire Protection 2006 Appendix 3 (amended May 2010).
2. At the commencement of building works and in perpetuity a minimum 50 metre asset protection zone shall be managed as outlined within section 4.1.3 and Appendix 5 of Planning for Bush Fire Protection 2006 and the NSW Rural Fire Service's document Standards for asset protection zones. The asset protection zone shall be divided into the below components:

    Asset Protection Zone Northwest, West and Southwest

    a. Inner Protection Area – 40 metres
    b. Outer Protection Area – 10 metres

    Asset Protection Zone South

    a. Inner Protection Area – 16 metres
3. Water, electricity and gas are to comply with section 4.2.7 of Planning for Bush Fire Protection 2006.
4. The property access is to comply with section 4.2.7 of Planning for Bush Fire Protection 2006.
5. The fire trail shall be staged in accordance with the plan titled 'Site Fire Trail Staging', prepared by Webber Architects (Ref: 2544_TD_02_0035_B) dated 19 December 2018. The fire trail construction shall comply with section 4.1.3(3) of 'Planning for Bush Fire Protection 2006';
6. Landscaping is to be undertaken in accordance with Appendix 5 of Planning for Bushfire Protection 2006 and managed and maintained in perpetuity.
7. An Emergency /Evacuation Plan is to be prepared consistent with AS 3745 'Emergency control organisation and procedures for buildings, structures and workplaces' and consider bushfire.

10.0 CONCLUSION

The final recommendation is that there is buildable area onsite for the development with appropriate services and asset protection zones available. The proposed development can comply with the requirements of Planning for Bushfire Protection 2006 guidelines as required under section 100b of the Rural Fires Act 1997. This report should be referred to NSW Rural Fire Service for the issue of a Bushfire Safety Authority.

11.0 APPENDIX 1.0 – ASSET PROTECTION ZONES SUMMARY

Below is a summary of Asset Protection Zones outlined in Appendix 5 of Planning for Bushfire Protection (2006) and the NSW Rural Fire Services "Standards for Asset Protection Zones". The property owner should obtain these two documents and familiarise themselves with their content.

Generally
Asset Protection Zones (APZ) refers to the area between the bushfire threat and the asset (i.e. building). The APZ may contain two areas; the Inner Protection Area (IPA) and the Outer Protection Area (OPA). Some areas should be managed entirely as an Inner Protection Area (IPA). Refer to the plans for locations of APZ and distances from Assets.

Inner Protection Area (IPA)
The inner protection area is located adjacent to the asset and is identified as a fuel free zone.

A. Shrubs (consisting of plants that are not considered to be trees)

1. Shrubs must be located away from a buildings glazing and vent openings.
2. Avoid planting around entry ways if the vegetation is flammable.
3. A maximum 30% of the Inner Protection Area may contain shrubs.
4. A minimum 1.5 metre separation of shrubby vegetation from the building shall be maintained.
5. Shrubs must not have a connection with the tree canopy layer; remove/trim shrubs or underprune trees.
6. Ensure turf is suitably mown and/or grasslands are continually slashed to restrict to max 100mm high.

B. Trees: Maintain a minimum 2-5 metre canopy separation.

1. Trees are allowed in the inner protection area however they should not touch or overhang buildings. No tree should be within 2 metres of the roofline.
2. Underprune branches between the shrub layer and the canopy layer.
3. Ensure branches do not overhang buildings.
4. Ensure all trees in the IPA within 3 metres of buildings do not provide a serious fire threat.
5. Trees should have lower limbs removed up to a height of 2 metres above the ground.

Outer Protection Area (OPA)
The Outer Protection Area (OPA) is located adjoining vegetation threat. The OPA should be maintained as a fuel reduced area. This assumes trees may remain but with a significantly reduced shrub, grass, and leaf litter layer. In many situations leaf litter and the shrub layer may not require maintenance at all.

A. Shrubs:

1. Reduce or trim large stands of shrubs

B. Trees:

1. Existing trees can be retained.
2. Ensure a separation is available between shrubs and tree canopy.
3. Reduce tree canopy so there is no interlocking canopy.

12.0 APPENDIX 2.0 – AS3959 2009 METHOD 2 DETAILED FIRE MODEL

NBC Bushfire Attack Assessment Report V3.0

AS3959 (2009) Appendix B - Detailed Method 2

Print Date: 6/03/2019 **Assessment Date:** 4/03/2019

Site Street Address: 507 Medowie Road, Medowie

Assessor: Phillip Couch; Newcastle Bushfire Consulting

Local Government Area: Port Stephens **Alpine Area:** No

Equations Used

Transmissivity: Fuss and Hammins, 2002
Flame Length: RFS PBP, 2001/Vesta/Catchpole
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: Southern Riparian Corridor Burning South to North

Vegetation Information

Vegetation Type:	Forest	**Vegetation Group:**	Forest and Woodland
Vegetation Slope:	0 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	8.2	**Overall Fuel Load(t/ha):**	15.1
Vegetation Height(m):	0.9	Only Applicable to Shrub/Scrub and Vesta	

Site Information

Site Slope:	0 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m):	2	**APZ/Separation(m):**	16

Fire Inputs

Veg./Flame Width(m):	10.25	**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):**	2.39
Level of Construction:	BAL 12.5	**Fire Intensity(kW/m):**	7677
Radiant Heat(kW/m2):	5.85	**Flame Angle (degrees):**	73
Flame Length(m):	5.01	**Maximum View Factor:**	0.061
Rate Of Spread (km/h):	0.98	**Inner Protection Area(m):**	16
Transmissivity:	0.853	**Outer Protection Area(m):**	0

Run Description:	Southern Riparian Corridor Burning West to East		
Vegetation Information			
Vegetation Type:	Forest	**Vegetation Group:**	Forest and Woodland
Vegetation Slope:	0 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	8.2	**Overall Fuel Load(t/ha):**	15.1
Vegetation Height(m):	0.9	Only Applicable to Shrub/Scrub and Vesta	
Site Information			
Site Slope:	0 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m):	2	**APZ/Separation(m):**	16
Fire Inputs			
Veg./Flame Width(m):	12	**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):**	4.1
Level of Construction:	BAL 12.5	**Fire Intensity(kW/m):**	7677
Radiant Heat(kW/m2):	9.96	**Flame Angle (degrees):**	90
Flame Length(m):	8.21	**Maximum View Factor:**	0.105
Rate Of Spread (km/h):	0.98	**Inner Protection Area(m):**	16
Transmissivity:	0.851	**Outer Protection Area(m):**	0

13.0 REFERENCES AND DISCLAIMER

References

Standards Australia (2009) AS3959 Construction of Buildings in Bushfire-Prone Areas

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

Environmental Planning and Assessment Act (1979)

New South Wales Rural Fire Service (2006) Planning for Bush Fire Protection

New South Wales Rural Fire Service (2010) Planning for Bush Fire Protection Appendix 3 Amendment

New South Wales Rural Fire Service (2017) Community Resilience Fact Sheet Short Fire Run – Methodology for Assessing Bushfire Risk for Low Risk Vegetation

Watson, P. (2012) Fuel Load Dynamics in NSW Vegetation

Wotton, B. M., Gould, J. S., McCaw, W. L., Cheney, N. P., & Taylor, S. W. (2012). Flame temperature and residence time of fires in dry eucalypt forest. International Journal of Wildland Fire, 21(3), 270-281.

Disclaimer

Despite the recommendations in this report, it is impossible to remove the risk of fire damage to the building entirely. This report assesses and provides recommendations to reduce that risk to a manageable level. It is of paramount importance that the recommendations are adhered to for the life of the structure and that all maintenance is performed, to ensure a level of protection is provided to the building, occupants and fire fighters.

Planning for Bushfire Protection (2006) states that notwithstanding the precautions adopted, it should always be remembered that bushfires burn under a wide range of conditions and an element of risk, no matter how small always remains.

AS3959 (2009) Building in Bushfire Prone Areas states that the standard is designed to lessen the risk of damage to buildings occurring in the event of the onslaught of bushfire. There can be no guarantee, because of the variable nature of bushfires, that any one building will withstand bushfire attack on every occasion.