BLACKASH
BUSHFIRE CONSULTING

Bushfire Hazard Assessment

Middle Head Oval Amenities

1110 Middle Head Road, Mosman

Prepared for

Mosman Municipal Council

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

Version 1.1

6 June 2024

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Project Name:	Middle Head Oval Amenities Building
Site Details	1110 Middle Head Road, Mosman
Client Details:	Mosman Municipal Council c/o Archer Office Via email: andy@archeroffice.com
BlackAsh Contact Details	
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Version	Primary Author(s)	Description	Date Completed
0.1	Corey Shackleton	Draft	8 May 2024
1.0	Corey Shackleton	Final	13 May 2024
1.1	Corey Shackleton	Final	6 June 2024

Corey Shackleton | Principal Bushfire & Resilience
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Fire Protection Association of Australia BPAD Level 3 – 34603

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

Contents

1. Abbreviations

APZ	Asset protection zone
AS2419	*Australian Standard – Fire hydrant installations*
AS3745	*Australian Standard – Planning for emergencies in facilities*
AS3959	*Australian Standard – Construction of buildings in bushfire-prone areas 2018*
BAL	Bushfire Attack Level
NCC	*National Construction Code*
BFSA	Bush Fire safety authority
EP&A Act	*Environmental Planning & Assessment Act 1979*
EPA Reg	*Environmental Planning and Assessment Regulation 2000*
GTA	General terms of approval
PBP	*Planning for Bush Fire Protection 2019*
RF Act	*Rural Fires Act 1997*
RFS	NSW Rural Fire Service
RFR	*Rural Fires Regulation* 2013

2. Glossary

AS3959	Australian Standard AS 3959 Construction of buildings in bushfire-prone areas, Standards Australia, 2018, that outlines construction standards applicable to residential developments in bush fire prone areas
Bushfire Prone Area	An area of land that can support a bush fire or is likely to be subject to bush fire attack.
Bush fire safety authority	An approval of the Commissioner of the RFS required for a subdivision for residential or rural residential purpose or for a special fire protection purpose listed under section 100B of the *Rural Fires Act 1997*.
Infill Development	Refers to the development of land by the erection of or addition to a residential building (or buildings) which does not require the spatial extension of services including public roads, electricity or water and is within an existing allotment.

3. Property, Proposal & Summary

Address:	1110 Middle Head Road, Mosman
Lot/ DP:	203//DP1022020
Suburb, town or locality:	Middle Head
Local Government Area:	Mosman
Type of development:	Infill development – Other (Sports Facilities)
Existing use	Open Space
Intended use	Amenities Building

4. Compliance with *Planning for Bush Fire Protection 2019*

Type of Development	Infill - Other
Aim of PBP	Yes
Objectives of PBP	Yes
Specific Objectives for Infill	Yes
BAL	BAL-12.5

BPAD Certification

Name Corey Shackleton	I hereby certify, in accordance with Section 4.14 of *the Environmental Planning and Assessment Act 1979* that: • I am a person recognised by the NSW Rural Fire Service as a qualified consultant in bushfire risk assessment; and • the development conforms to the relevant specifications and requirements of *Planning for Bushfire Protection 2019*.	
Company Details & ABN Blackash Bushfire Consulting		
BPAD Accreditation Number BPD-PA-34603	**Signature**	**Date** 6 June 2024

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

5. Introduction

Blackash Bushfire Consulting has been engaged by Mosman Municipal Council to provide a Bushfire Hazard Assessment report to support the proposed new building containing public amenities, kiosk and sports club facilities, and a new shelter over existing tiered seating for the Middle Head Oval Amenities, 1110 Middle Head Road, Mosman.

Section 4.14 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) requires compliance with the RFS document *Planning for Bush Fire Protection 2019* (PBP 2019). The NSW Rural Fire Service (RFS) document PBP 2019 applies to all new development on bushfire prone land.

PBP 2019 recognises that infill development proposals will be constrained by existing situations – pre-existing subdivision patterns and existing built forms surrounding the subject site. Consequently, each proposal must be considered on its merits and in accordance with the intent and performance criteria for infill development. Industrial development such as the proposed development is designated as "other" development in PBP 2019. As "other" development, the proposed development has considerable flexibility and the nature of the development often results in the structures providing a higher degree of bushfire resistance that required by the NSW Rural Fire Service (NSW RFS). As "other" development, a key issue for the proposal will be meeting the aim and objectives of *Planning for Bushfire Protection* and the performance requirements for commercial development.

The site is located within Middle Head in the Mosman Local Government Area. There is a very low-risk bushfire hazard to the north and south of the site. The proposed development has been designed to provide compliance with the relevant specifications and requirements of *Planning for Bush Fire Protection 2019*.

Under s4.14 (1)(b) of the *Environmental Planning and Assessment Act* 1979, as the consent authority, Mosman Municipal Council or the Sydney Harbour Trust can issue development consent if it has been provided with a certificate by a person who is recognised by the NSW RFS as a qualified consultant in bush fire risk assessment stating that the development conforms to the relevant specifications and requirements.

Having been provided with a certificate by a person who is recognised by the NSW RFS as a qualified consultant, council or the Sydney Harbour Trust is legally satisfied that the development complies with PBP 2019 and therefore Council cannot refer to the NSW RFS under Under s4.14 (1A) of the *Environmental Planning and Assessment Act* 1979.

This assessment has been prepared by Corey Shackleton, Principal Bushfire and Resilience, Blackash Bushfire Consulting. Corey is a person who is recognised by the NSW RFS as a qualified consultant in bush fire risk assessment (FPAA BPAD-Level 3 Certified Practitioner No. BPD-PA-34603).

Figure 1: Site Location

6. Site Description & Proposal

The site is located within the Mosman LGA and sits the Middle Head peninsula. The site encompasses the existing Middle Head Oval and surrounding infrastructure. Middle Head Road provides public access to the site.

The proposal is for the redevelopment of the amenities building at Middle Head Oval, including:

- The demolition of the existing amenities building which was constructed in the 1980's.
- The construction of a new single storey amenities building, comprising of:
    - Kiosk
    - Admin & first aid room
    - Storage areas
    - Umpire's change room
    - Public amenities
    - Two change rooms with shower and toilet facilities
- The construction of a second pavilion structure to provide shade to spectators utilising the existing tiered concrete bleachers.
- A landscape proposal that activates the space created by the demolition of the existing building.

7. Bushfire Prone Land

Bushfire prone land maps provide a trigger for the development assessment provisions and consideration of sites that are bushfire prone.

Bushfire prone land (BFPL) is land that has been identified by council, which can support a bushfire or is subject to bushfire attack. Bushfire prone land maps are prepared by local council and certified by the Commissioner of the NSW RFS.

Figure 3 shows the Bushfire Prone Land Map for the site. The extract from the Mosman Bushfire Prone Map shows that the site contains a band of Category 1 vegetation which runs along the steep foreshore areas to the north and south of the site.

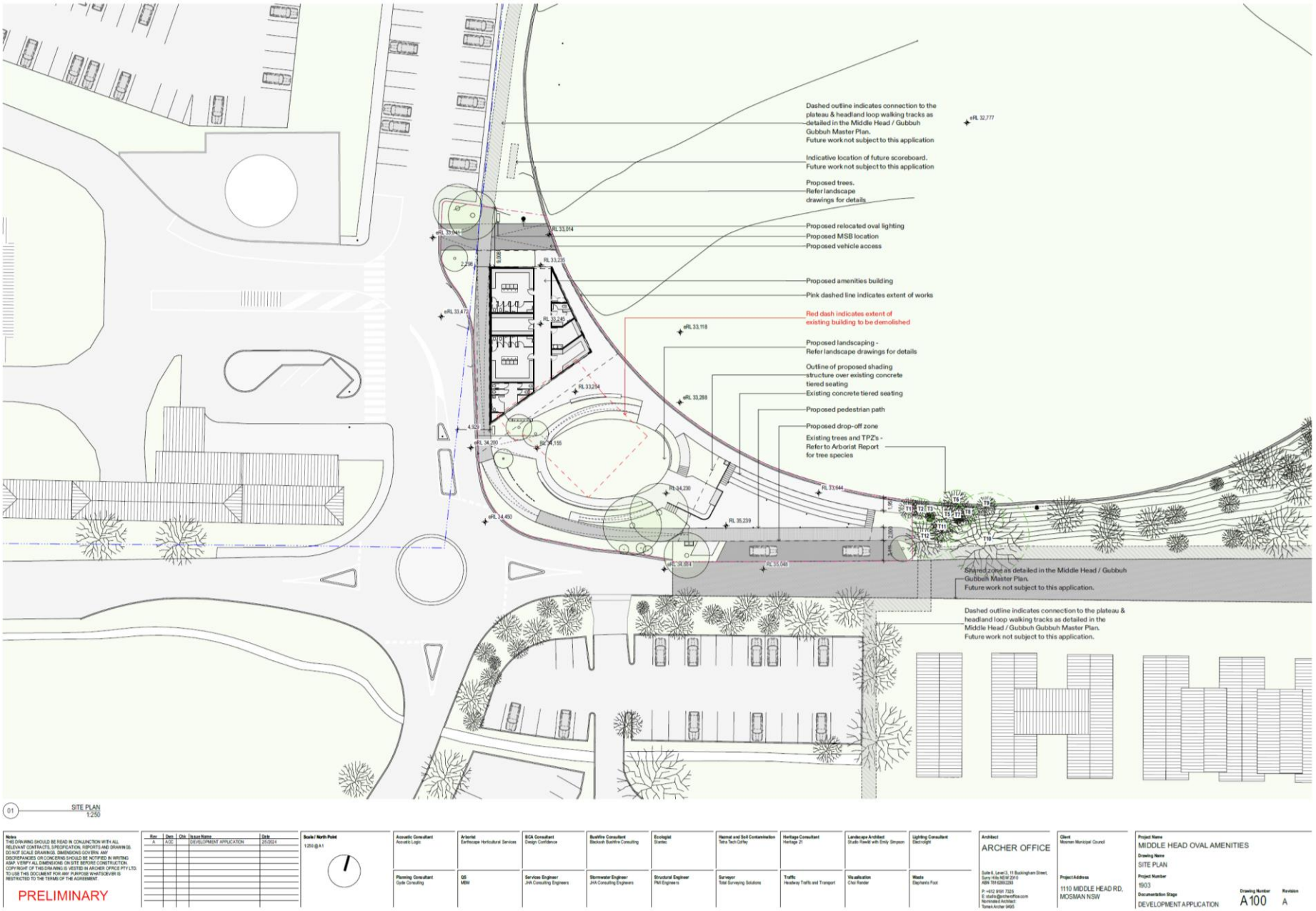


Figure 2: Proposed Development

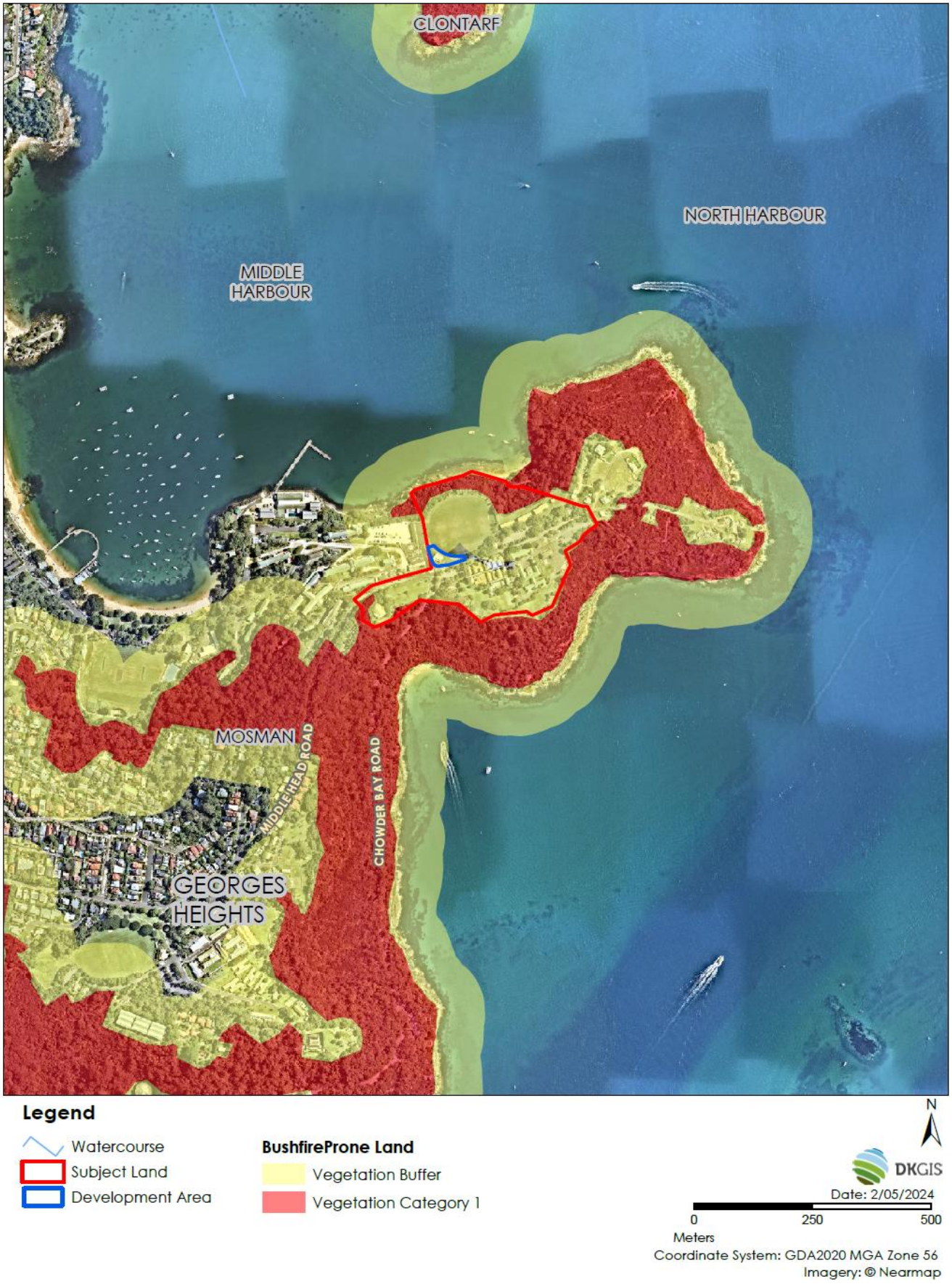


Figure 3: Bushfire Prone Land

8. Legislative Framework

PBP 2019 acknowledges that infill development proposals will be constrained by existing situations – pre-existing subdivision patterns and existing built forms surrounding the subject site. Consequently, each proposal must be considered on its merits and in accordance with the intent and performance criteria for infill development.

The proposed community development is designated as "other" development by *Planning for Bushfire Protection 2019* (PBP 2019).

A defendable space is provided through onsite setbacks. This coupled with the suite of bushfire protection measures ensures the proposed dwelling can comply with PBP 2019.

The site is identified as 'bushfire prone land' (see Figure 3) for the purposes of Section 10.3 of the *Environmental Planning and Assessment Act, 1979* (EPA Act) and the legislative requirements for development on bushfire prone lands are applicable. All development on bushfire prone land must consider and comply with PBP 2019. However, industrial development has considerable flexibility and the nature of the development often results in the structures providing a higher degree of bushfire resistance than required by the NSW RFS.

As "other" development, the proposed industrial development and future development is addressed through demonstrating compliance with the aim and objectives of PBP.

9. Bushfire Assessment Requirements

The subject land is identified as being bushfire prone land on the Mosman Bushfire Prone Land Map. As infill development, the proposed development is to be assessed by Council under the provision of Section 4.14 of the EP&A Act, which includes the consideration of the PBP 2019. The following detailed assessment is based on the methodology and requirements of PBP 2019 and supporting RFS policy.

PBP 2019 recognises the unique attributes of infill development and promotes detailed site analysis and the application of a combination of bushfire protection measures (BPMs) to achieve an acceptable outcome. The BPMs work in combination to provide a suite of measures that meet the aim and objective and Section 4.3 of PBP 2019. The BPMs are shown in Figure 4.

Appropriate combinations depend upon geographic location and site circumstances.

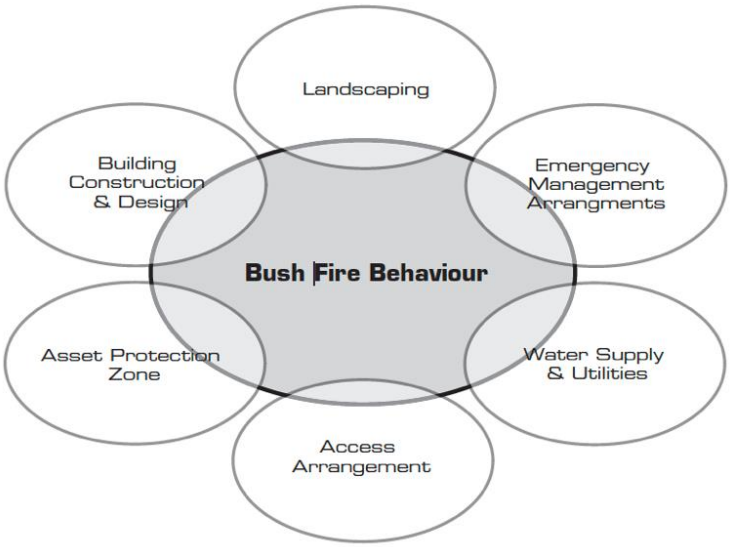


Figure 4: Bushfire Protection Measures in Combination (source PBP 2019 p. 26)

Methodology

PBP 2019 provides a methodology to determine the bushfire threat posed to a site and Australian Standards for the *Construction of Buildings in Bushfire Prone Areas* (AS3959) is used to determine the construction requirement to reduce potential bushfire attack.

The following assessment is prepared in accordance with PBP 2019 and Method 1 from AS3959. This assessment is based on a site inspection and detailed desktop assessment of the site utilising the following resources:

- *Planning for Bushfire Protection* (NSW RFS, 2019);
- Aerial mapping; and
- Detailed GIS analysis.

Bushfire Hazard

An assessment of the bushfire hazard is necessary to determine the application of bushfire protection measures such as Asset Protection Zone (APZ) locations and dimensions and future building construction requirements in accordance with AS3959. The vegetation formations (bushfire fuels) and the topography (effective slope) combine to create the bushfire threat that may affect bushfire behaviour at the site, and which determine the building response of PBP 2019.

Fire weather

The fire weather is dictated by PBP and assumes a credible worst-case scenario and an absence of any other mitigating factors relating to aspect or prevailing winds. The site has a Fire Danger Index (FDI) of 100 as per PBP 2019.

Vegetation

Predominant Vegetation is classified by structure or formation using the system adopted by Keith (2004) and by the general description using PBP 2019. Vegetation types give rise to radiant heat and fire behaviour characteristics.

The predominant vegetation is determined over a distance of at least 140 metres in all directions from the proposed site boundary or building footprint on the development site. Where a mix of vegetation types exist, the type providing the greater hazard is said to predominate.

The land to the north and south of the site is Sydney Coastal Dry Sclerophyll Forests which exists on the steep banks of the foreshore. Land to the east and west is well maintained. (see Figure 4).

Slopes Influencing Bushfire Behaviour

The 'effective slope' influencing fire behaviour approaching the sites has been assessed in accordance with the methodology specified within PBP 2019. This is conducted by measuring the worst-case scenario slope where the vegetation occurs over a 100 metre transect measured outwards from the development boundary or the existing/ proposed buildings.

The slopes within the areas of Sydney Coastal Dry Sclerophyll Forests ranges from 6.8 degrees downslope in the south to 20.9 degrees downslope in the north (Figure 4).

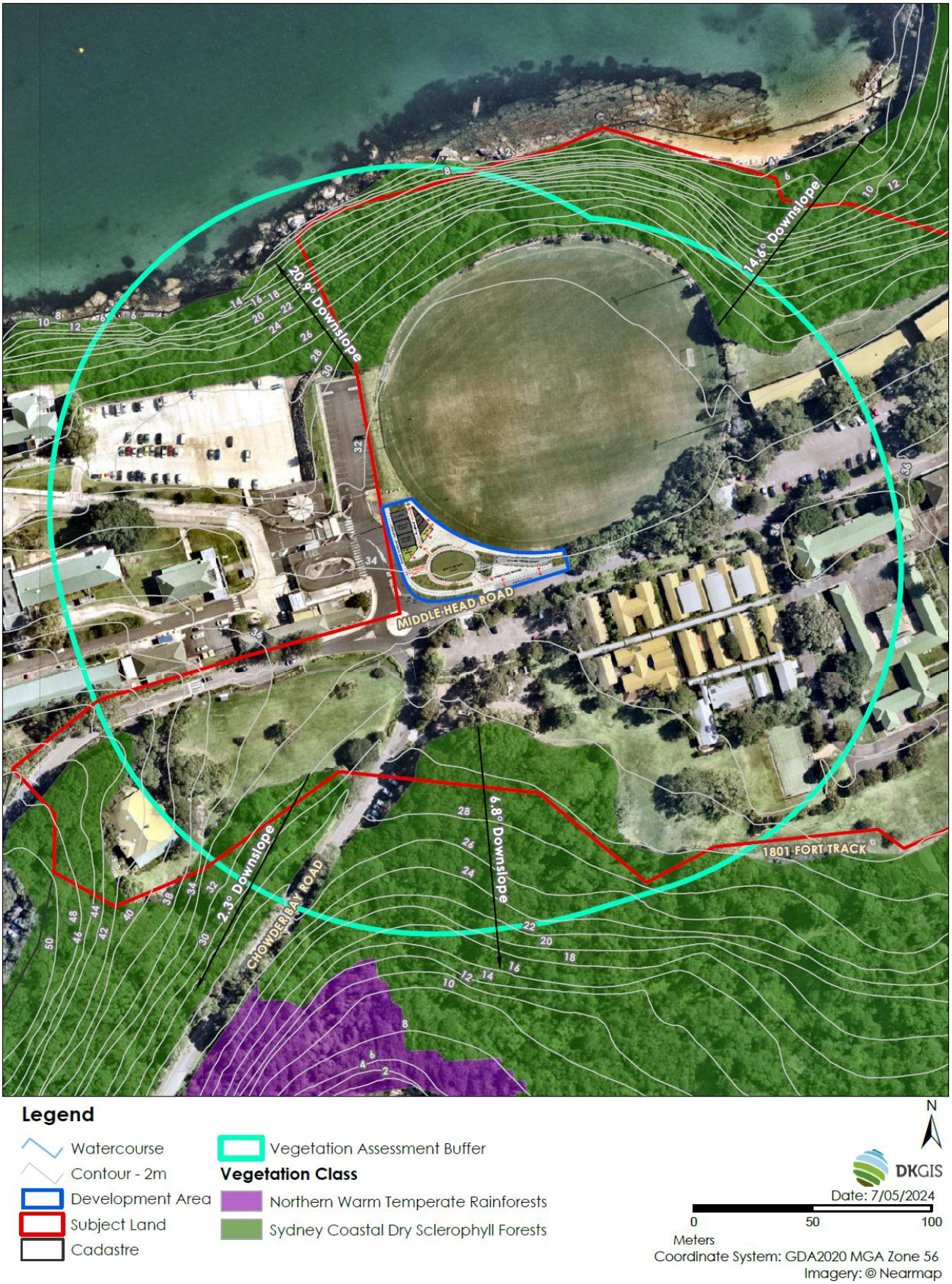


Figure 4: Vegetation and Slope

10. Asset Protection Zones

An Asset Protection Zone (APZ) is a buffer zone between a bushfire hazard and buildings. The APZ is managed progressively to minimise fuel loads and reduce potential radiant heat levels, flame, smoke and ember attack. The appropriate APZ distance is based on vegetation type, slope and the nature of the development.

The APZ can include roads or properties managed to be consistent with APZ standards set out in NSW RFS document *Standards for Asset Protection Zones*. The APZ provides a fuel-reduced, physical separation between buildings and bush fire hazards is a key element in the suite of bush fire measures and dictates the type of construction necessary to mitigate bushfire attack.

PBP 2019 requires APZs for commercial and industrial development to provide a defendable space and minimise material ignition.

The proposed amenities building is surrounded by managed land which forms part of the existing Middle Head Oval. This provides for a significant defendable space.

11. Bushfire Attack Levels

The Bushfire Attack Level (BAL) is a means of measuring the severity of a buildings or sites potential exposure to ember attack, radiant heat and direct flame contact. In the Building Code of Australia, the BAL is used as the basis for establishing the requirements for residential construction to improve protection of building elements.

As "Other" development, the development must comply with objective 3 of PBP 2019 which requires that the development:

> *3. Provide appropriate separation between a hazard and buildings, which, in combination with other measures, prevent the likely fire spread to buildings.*

Asset Protection Zones (see section 7.5) will be provided around the proposed amenities and office buildings that include existing roads, hardstand areas and managed land. The land to the north and south of the site is Sydney Coastal Dry Sclerophyll Forests which exists on the steep banks of the foreshore and presents a low bushfire risk. The nature of the proposed development means only the proposed amenities warrant construction requirements of AS3959-2018 as identified in PBP 2019.

Table 3 provides a summary of the BALs for the proposed amenities and office buildings and Figure 5 depicts the BAL requirements across the site.

Table 3: Bushfire Attack Levels

Direction	Slope	Vegetation	APZ Proposed	Bushfire Attack Level
North	20.9° Downslope	Sydney Coastal Dry Sclerophyll Forests	>50 metres	BAL-12.5*
East	NA	No hazard	Nil	NA
South	6.8° Downslope	Sydney Coastal Dry Sclerophyll Forests	>50 metres	BAL-12.5
West	NA	No hazard	Nil	NA

**Note: Based on detailed Radiant Heat modelling (see section 11.1).*

Given the nature of the proposed amenities building, strict compliance with AS3959 is not practical or appropriate. In this regard, the proposed amenities building shall be constructed to ensure all openings are enclosed or covered with a non-corrosive metal screen mesh with a maximum aperture of 2mm. Where appropriate and applicable, this includes any sub floor areas, openable windows, vents, weepholes and eaves. External doors are to be fitted with draft excluders.

Where the openings relate to open areas or areas of non-combustible materials (i.e. showers/changerooms) they do not require protection.

11.1. Radiant Heat Modelling

Detailed radiant heat modelling has been undertaken for the site due to the unique site-specific inputs. Table 2 below is a summary of the key inputs, while the detailed outputs for each BAL can be found in Appendix 2-4.

The radiant heat modelling has considered the following which present as the likely worst case bushfire scenario from the north. The effective slope has been rounded up to the nearest degree which adds conservatism in the assessment and redundancy in the design.

North Fire Scenario – The reasonable worst-case scenario is a fire run from the north which burns towards the site through the Sydney Coastal Dry Sclerophyll Forests. This will burn on a steep, 20.9 degree slope up towards the site. Due to the foreshore location of the vegetation, there is a limited run towards the site, this has been factored into the modelling with a conservative 100 metre short fire run.

South Fire Scenario – The south fire scenario has been assessed and BALs determined using Appendix A1.12.5 of PBP 2019.

Table 2 (below) is a summary of the key inputs used for the Radiant Heat modelling. Full results for north elevation are provided in Appendix 2.

Table 2: SFR Key inputs.

Direction	Slope	Vegetation	Separation	SFR	Radiant Heat
North	21° Downslope	Sydney Coastal DSF		100 metres	See Appendix 2

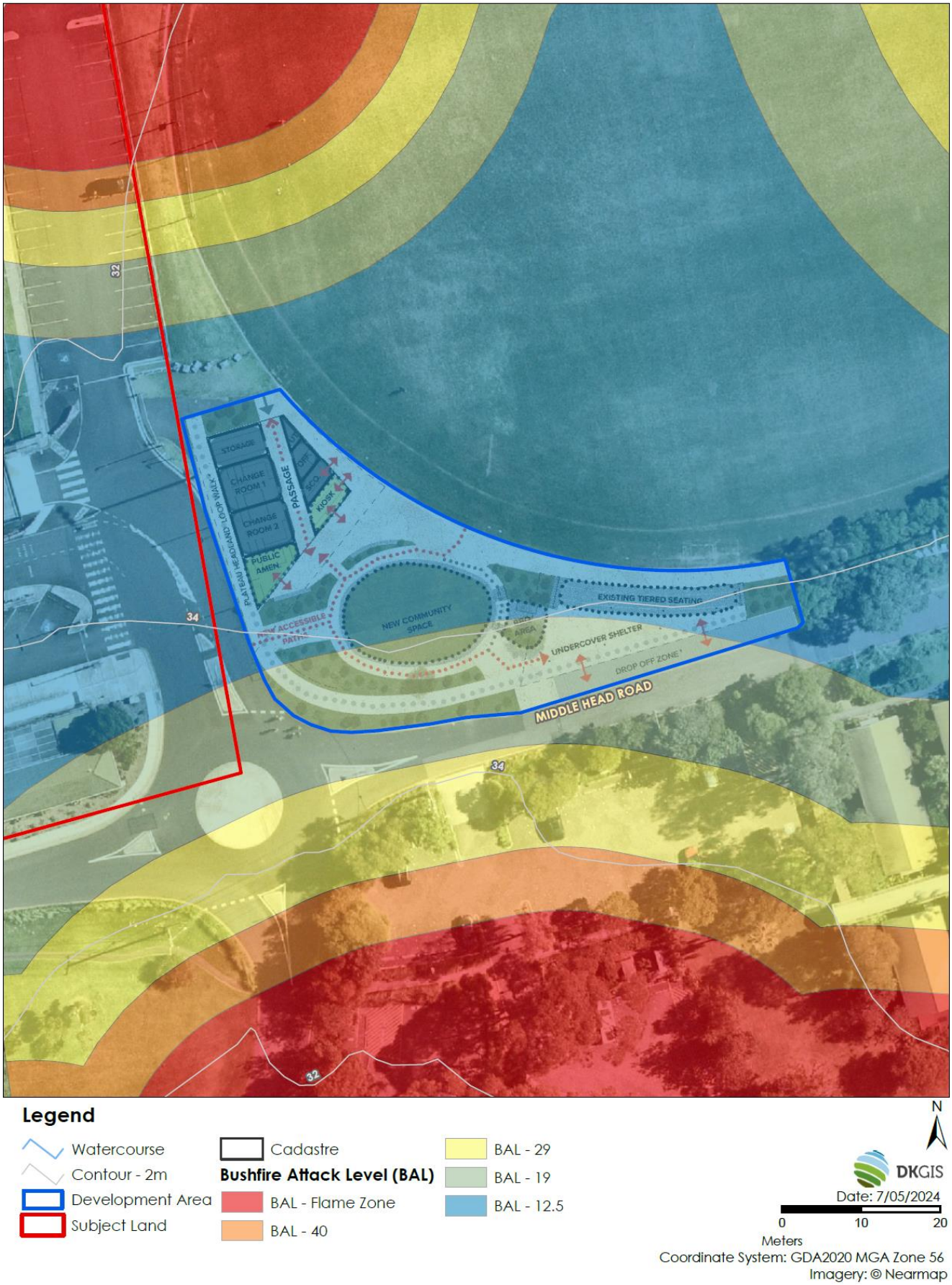


Figure 5: Bushfire Attack Levels

12. Water Supply and Utilities

PBP 2019 (p. 47) requires that adequate services of water for the protection of any amenities building during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to the area.

Suitable water supply arrangements will be provided for firefighting that meet the NSW RFS requirements. A reticulated water supply for potable water supply and fire hydrants are provided to the site and this will not be impacted or altered by the proposed development.

The fire-fighting water supply to the proposed development is therefore considered complaint with PBP 2019.

13. Access

PBP 2019 requires that the design of access roads enables safe access and egress for people attempting to leave the area while emergency service personnel are arriving to undertake firefighting operations.

Vehicular access to the proposed amenities building will be provided via Middle Head Road and the existing access.

Middle Head Road can support heavy rigid and articulated vehicle access to the hardstand extension area. This road network provides suitable access for fire-fighting appliances like NSW RFS Category 1 Tankers.

Given the low bushfire risk, lack of adjoining bushfire prone vegetation and nature of the road design, access complies with the requirements of PBP 2019.

14. Assessment Against the Aim and Objective of PBP

All development in Bushfire Prone Areas needs to comply with the aim and objectives of PBP. Table 2 shows the compliance with PBP.

Table 2: Compliance with Aim & Objectives of PBP.

Aim	Meets Criteria	Comment
The aim of PBP is to use the NSW development assessment system to provide for the protection of human life (including fire fighters) and to minimise impacts on property from the threat of bushfire, while having due regard to development potential, onsite amenity and the protection of the environment.	Yes	Landscaping, defendable space, access and egress, emergency risk management and construction standards are in accordance with the requirements of PBP and the aims of PBP have been achieved.
Objectives	**Meets Criteria**	**Comment**
Afford occupants of any building adequate protection from exposure to a bushfire.	Yes	The development provides opportunity for all occupants to be shielded from any external bushfire. The proposed amenities and office buildings will be constructed to comply with the NCC and AS3959 (2018).
Provide for a defendable space to be located around buildings.	Yes	Defendable space is provided around the proposed amenities and office buildings located on the hardstand extension.
Provide appropriate separation between a hazard and buildings, which, in combination with other measures, prevent the likely fire spread to buildings.	Yes	The proposed amenities building are separated from the vegetated areas and provide APZs and commensurate construction consistent with the NCC and equivalent to AS3959.
Ensure that safe operational access and egress for emergency service personnel and occupants is available.	Yes	The site has direct access to public roads, and access and egress for emergency vehicles and evacuation is adequate.
Provide for ongoing management and maintenance of bushfire protection measures.	Yes	The site will be managed including all APZ and landscaping in accordance with PBP 2019.
Ensure that utility services are adequate to meet the needs of firefighters.	Yes	Utility services are adequate to meet the needs of firefighters (and others assisting in bushfire fighting).

The suite of bushfire protection measures provided for the proposed development satisfies the objectives for buildings of Class 5-8 under the NCC as identified in section 8.3.1 of PBP 2019.

15. Recommendations

The following recommendation has been made within this report to ensure the proposed redevelopment of the amenities building are compliant with Section 4.14 of the EPA Act and *Planning for Bush Fire Protection 2019*:

Recommendation 1: The proposed amenities building is to be constructed to ensure all openings are enclosed or covered with a non-corrosive metal screen mesh with a maximum aperture of 2mm. Where appropriate and applicable, this includes any sub floor areas, openable windows, vents, weepholes and eaves. External doors are to be fitted with draft excluders. Where the openings relate to open areas or areas of non-combustible materials (i.e. showers/changerooms) they do not require protection.

16. Conclusion

This assessment has demonstrated that the proposed redevelopment of the amenities can comply with *Planning for Bush Fire Protection 2019*. The recommendations have been provided to ensure compliance with *Planning for Bush Fire Protection 2019* and ensure considerable redundancy in the design.

As a person recognized by the NSW RFS as a qualified consultant, this report /certificate confirms that the proposed development conforms to the relevant specifications and requirements of *Planning for Bush Fire Protection 2019* and is issued consistent with s4.14 (1)(b) of the *Environmental Planning and Assessment Act 1979*.

Having been provided with a certificate by a person who is recognised by the NSW RFS as a qualified consultant, council / the Sydney Harbour Trust is therefore legally satisfied that the development complies with PBP 2019 and cannot refer to the NSW RFS under Under s4.14 (1A) of the *Environmental Planning and Assessment Act* 1979.

Given this, there is no further assessment or referral required and council / the Sydney Harbour Trust can issue consent in accordance with this report under s4.14 (1) of the *Environmental Planning and Assessment Act 1979*.

Corey Shackleton | Principal Bushfire & Resilience
Blackash Bushfire Consulting
B.Sc., Grad. Dip. (Design for Bushfire Prone Areas)
Fire Protection Association of Australia BPAD Level 3 - 34603

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

Appendix 1: References

Australian Building Codes Board Building Code of Australia Volumes 1&2

Councils of Standards Australia AS3959 (2018) – Australian Standard Construction of buildings in bushfire-prone areas

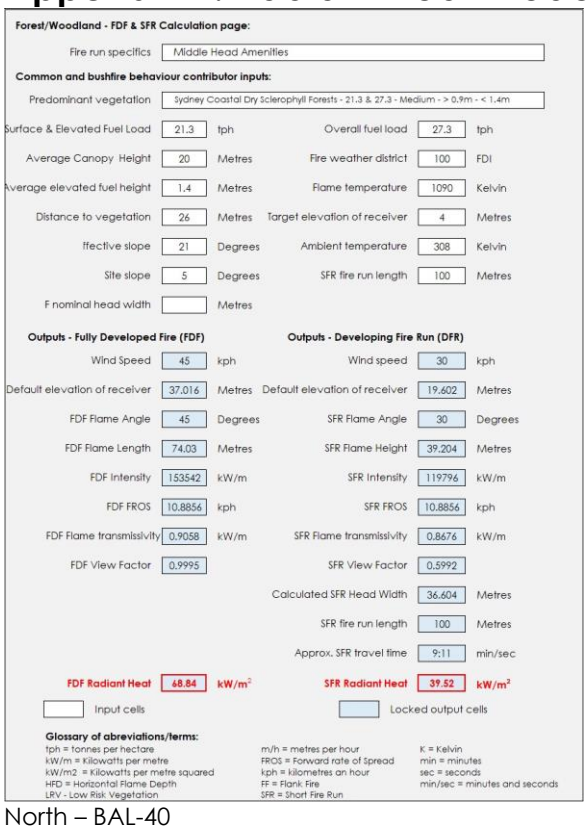
Keith, David (2004) – Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT. The Department of Environment and Climate Change

NSW Rural Fire Service (2015) Guide for Bushfire Prone Land Mapping

NSW Rural Fire Service (NSW RFS). 2019. Planning for Bushfire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners.

NSW Government (1979) Environmental Planning and Assessment Act 1979. NSW Government Printer

Appendix 2: Radiant Heat Modelling Output – North



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Middle Head Amenities

Common and bushfire behaviour contributor inputs:

Predominant vegetation: Sydney Coastal Dry Sclerophyll Forests - 21.3 & 27.3 - Medium - > 0.9m - < 1.4m

Surface & Elevated Fuel Load	21.3	tph	Overall fuel load	27.3	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	26	Metres	Target elevation of receiver	4	Metres
ffective slope	21	Degrees	Ambient temperature	308	Kelvin
Site slope	5	Degrees	SFR fire run length	100	Metres
F nominal head width		Metres			

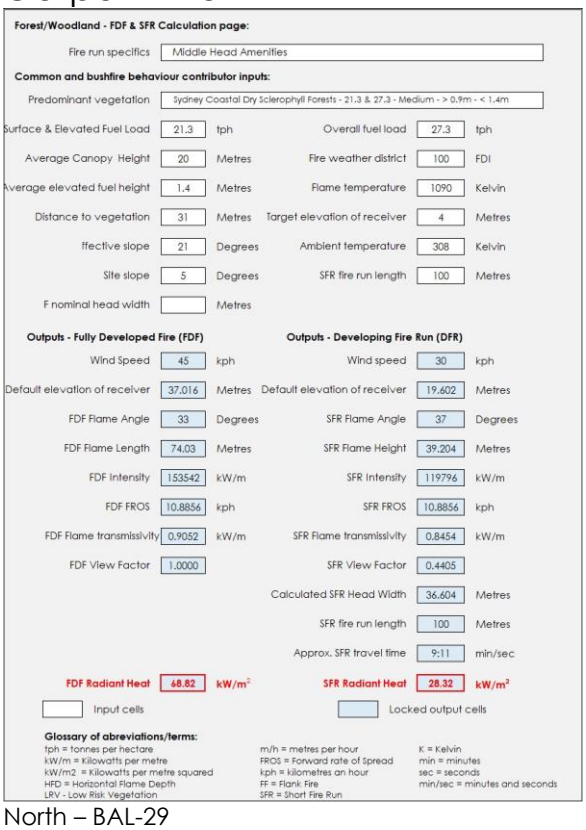
Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	37.016	Metres	Default elevation of receiver	19.602	Metres
FDF Flame Angle	45	Degrees	SFR Flame Angle	30	Degrees
FDF Flame Length	74.03	Metres	SFR Flame Height	39.204	Metres
FDF Intensity	153542	kW/m	SFR Intensity	119796	kW/m
FDF FROS	10.8856	kph	SFR FROS	10.8856	kph
FDF Flame transmissivity	0.9058	kW/m	SFR Flame transmissivity	0.8676	kW/m
FDF View Factor	0.9995		SFR View Factor	0.5992	
			Calculated SFR Head Width	36.604	Metres
			SFR fire run length	100	Metres
			Approx. SFR travel time	9:11	min/sec
FDF Radiant Heat	**68.84**	**kW/m²**	**SFR Radiant Heat**	**39.52**	**kW/m²**

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

North – BAL-40



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Middle Head Amenities

Common and bushfire behaviour contributor inputs:

Predominant vegetation: Sydney Coastal Dry Sclerophyll Forests - 21.3 & 27.3 - Medium - > 0.9m - < 1.4m

Surface & Elevated Fuel Load	21.3	tph	Overall fuel load	27.3	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	31	Metres	Target elevation of receiver	4	Metres
ffective slope	21	Degrees	Ambient temperature	308	Kelvin
Site slope	5	Degrees	SFR fire run length	100	Metres
F nominal head width		Metres			

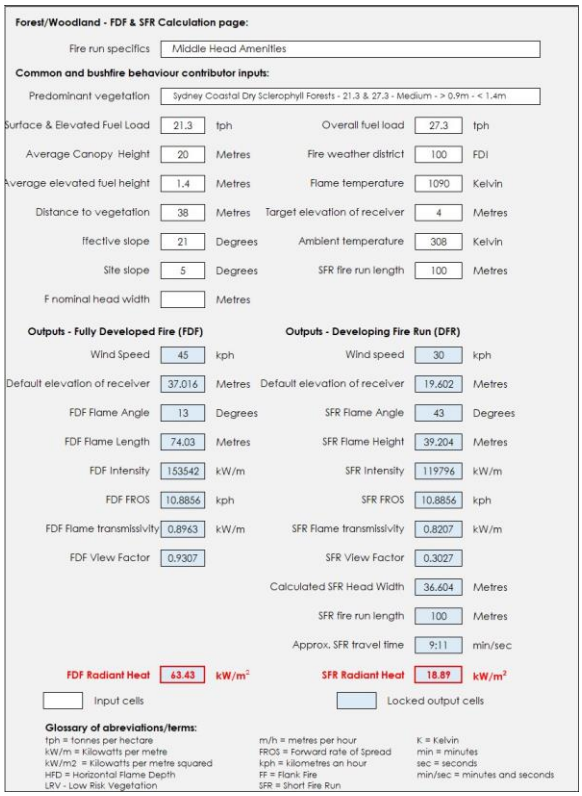
Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	37.016	Metres	Default elevation of receiver	19.602	Metres
FDF Flame Angle	33	Degrees	SFR Flame Angle	37	Degrees
FDF Flame Length	74.03	Metres	SFR Flame Height	39.204	Metres
FDF Intensity	153542	kW/m	SFR Intensity	119796	kW/m
FDF FROS	10.8856	kph	SFR FROS	10.8856	kph
FDF Flame transmissivity	0.9052	kW/m	SFR Flame transmissivity	0.8454	kW/m
FDF View Factor	1.0000		SFR View Factor	0.4405	
			Calculated SFR Head Width	36.604	Metres
			SFR fire run length	100	Metres
			Approx. SFR travel time	9:11	min/sec
FDF Radiant Heat	**68.82**	**kW/m²**	**SFR Radiant Heat**	**28.32**	**kW/m²**

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

North – BAL-29



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Middle Head Amenities

Common and bushfire behaviour contributor inputs:

Predominant vegetation: Sydney Coastal Dry Sclerophyll Forests - 21.3 & 27.3 - Medium - > 0.9m - < 1.4m

Surface & Elevated Fuel Load	21.3	tph	Overall fuel load	27.3	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	38	Metres	Target elevation of receiver	4	Metres
ffective slope	21	Degrees	Ambient temperature	308	Kelvin
Site slope	5	Degrees	SFR fire run length	100	Metres
F nominal head width		Metres			

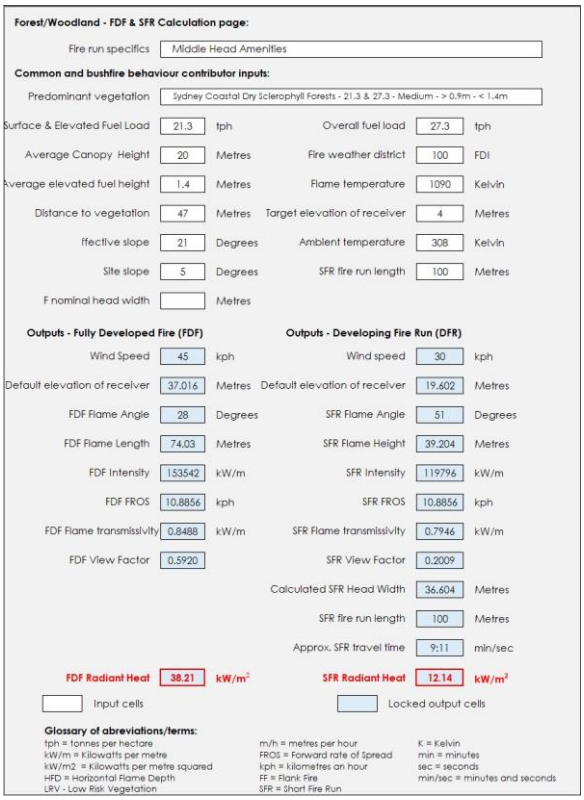
Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	37.016	Metres	Default elevation of receiver	19.602	Metres
FDF Flame Angle	13	Degrees	SFR Flame Angle	43	Degrees
FDF Flame Length	74.03	Metres	SFR Flame Height	39.204	Metres
FDF Intensity	153542	kW/m	SFR Intensity	119796	kW/m
FDF FROS	10.8856	kph	SFR FROS	10.8856	kph
FDF Flame transmissivity	0.8963	kW/m	SFR Flame transmissivity	0.8207	kW/m
FDF View Factor	0.9307		SFR View Factor	0.3027	
			Calculated SFR Head Width	36.604	Metres
			SFR fire run length	100	Metres
			Approx. SFR travel time	9:11	min/sec
FDF Radiant Heat	**63.43**	**kW/m²**	**SFR Radiant Heat**	**18.89**	**kW/m²**

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

North – BAL-19



Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics: Middle Head Amenities

Common and bushfire behaviour contributor inputs:

Predominant vegetation: Sydney Coastal Dry Sclerophyll Forests - 21.3 & 27.3 - Medium - > 0.9m - < 1.4m

Surface & Elevated Fuel Load	21.3	tph	Overall fuel load	27.3	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	47	Metres	Target elevation of receiver	4	Metres
ffective slope	21	Degrees	Ambient temperature	308	Kelvin
Site slope	5	Degrees	SFR fire run length	100	Metres
F nominal head width		Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	37.016	Metres	Default elevation of receiver	19.602	Metres
FDF Flame Angle	28	Degrees	SFR Flame Angle	51	Degrees
FDF Flame Length	74.03	Metres	SFR Flame Height	39.204	Metres
FDF Intensity	153542	kW/m	SFR Intensity	119796	kW/m
FDF FROS	10.8856	kph	SFR FROS	10.8856	kph
FDF Flame transmissivity	0.8488	kW/m	SFR Flame transmissivity	0.7946	kW/m
FDF View Factor	0.5920		SFR View Factor	0.2009	
			Calculated SFR Head Width	36.604	Metres
			SFR fire run length	100	Metres
			Approx. SFR travel time	9:11	min/sec
FDF Radiant Heat	**38.21**	**kW/m²**	**SFR Radiant Heat**	**12.14**	**kW/m²**

Input cells | Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare; kW/m = Kilowatts per metre; kW/m2 = Kilowatts per metre squared; HFD = Horizontal Flame Depth; LRV - Low Risk Vegetation; m/h = metres per hour; FROS = Forward rate of Spread; kph = kilometres an hour; FF = Flank Fire; SFR = Short Fire Run; K = Kelvin; min = minutes; sec = seconds; min/sec = minutes and seconds

North – BAL-12.5

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