



bushfire & ecology

Bushfire protection review for an aged care facility 10 Terminal buildings Middle Head, Mosman

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EXECUTIVE SUMMARY

Sydney Harbour Federation Trust (the Trust) has commissioned *Travers bushfire & ecology* to provide specialist advice to assist in the assessment of a proposal to develop an aged care facility within the 10 Terminal group of buildings and determine any bushfire planning measures applicable – see Figure A1.



Figure A1 - 10 Terminal buildings

The Trust has a wide ranging responsibility to itself, the commonwealth government and to the broader community in the carriage of its land management decisions. In that regard the Trust requires the assessment to be undertaken in accord with industry best practice.

Given the commonwealth ownership of the land the Trust are not required to apply NSW legislation to their decisions. However, the Trust is required to apply commonwealth law and industry best practice. To that end, the Trust would reflect best practice bushfire planning policy and this report applies those same standards.

In 2013/14, the Sydney Harbour Federation Trust (the Trust) engaged *Travers bushfire & ecology* to prepare a bushfire management plan for Headland Park that included the Middle Head peninsula. This recent study provided a thorough understanding of the Trust responsibilities whilst recognising the other major land owners e.g. HMAS Penguin in the north-west and the National Parks and Wildlife Service through the location of Sydney

Harbour National Park that extends from the north-east at Cobblers Beach through to the south-west at Obelisk Bay.

To assess if an aged care facility can be located in this area a detailed site analysis has been undertaken and the application of a combination of bushfire protection measures have been explored.

The acceptability of bushfire risk relates directly to future occupants, the broader community that frequent the area and emergency services personnel whom may be required to assist during an incident. The level of risk can be mitigated in an effective manner through the provision of key bushfire protection measures. Ultimately, radiant heat can be mitigated through a combination of well managed asset protection zones (APZs) and radiant heat barriers which will require construction.

Another major issue that required due consideration was the main road and how the fringing vegetation along Middle Head Road, south west of the former golf clubhouse, can be managed to assure effective egress and access at the time of an emergency. There is an existing hazard 'pinch point' immediately south-west of the former golf clubhouse. This is not an issue particular to the proposed aged care facility as this same recommendation has been made within the Headland Park bushfire management plan prepared for the Trust in 2013/14. It is to be assumed the Trust will deal with roadside management as recommended as part of this application.

Ultimately the development will comply with the NSW Rural Fire Service (RFS) *Planning for Bush Fire Protection 2006 (PBP)* in the manner that bushfire protection measures can be effectively addressed. Notwithstanding that, the ongoing management of the facility by the Trust (albeit via a lessee) must ensure they implement an effective operational planning initiative to ensure any future lessee and their staff is fully conversant with their obligations and how the bushfire management protection functions must be addressed on a day to day basis. In this regard, annual audits of the facility should occur prior to the bushfire season to establish that operational readiness is fully functional.

The assessment has concluded that the proposal has the potential (pending appropriate conditions of consent) to comply with the specific performance criteria and importantly the aims and objectives of *PBP* and compliance with the Trust's own draft bushfire management plan.

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John Travers is a BPAD consultant certified by the Fire Protection Association. FPA Australia administers the Bushfire Planning and Design (BPAD) Accreditation Scheme. The Scheme accredits consultants who offer bushfire assessment, planning, design and advice services. It accredits practitioners who meet criteria based on specific accreditation and competency requirements, including a detailed knowledge of the relevant planning, development and building legislation for each State and Territory. Through the Accreditation Scheme, BPAD Accredited Practitioners are recognised by industry, regulators, fire agencies, end-users and the community as providers of professional bushfire assessment, planning, design and advice services. The Scheme provides an enhanced level of confidence for government and the community that practitioners are accredited by a suitably robust scheme that is administered by the peak national body for fire safety. Note: L3 is the highest level and L1 is the lowest level.

GLOSSARY OF TERMS

APZ	asset protection zone
AS1596	Australian Standard – The storage and handling of LP Gas
AS2419	Australian Standard – Fire hydrant installations
AS3745	Australian Standard – Planning for emergencies in facilities
AS3959	Australian Standard – Construction of buildings in bushfire-prone areas 2009
BCA	Building Code of Australia
BSA	bushfire safety authority
EEC	endangered ecological community
EP&A Act	Environmental Planning & Assessment Act 1979
FDI	fire danger index
IPA	inner protection area
OPA	outer protection area
PBP	Planning for Bush Fire Protection 2006
RF Act	Rural Fires Act 1997
RFS	NSW Rural Fire Service
SFAZ	strategic fire advantage zone
SFPP	special fire protection purpose
SHFT Act	Sydney Harbour Federation Trust Act
TSC Act	Threatened Species Conservation Act 1995

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REFERENCES



The Trust has commissioned *Travers bushfire & ecology* to provide specialist advice to assist in the assessment of a proposal to develop an aged care facility within the 10 Terminal group of buildings and determine any bushfire planning measures applicable.

The Trust has a wide ranging responsibility to itself, the commonwealth government and to the broader community in the carriage of its land management decisions. In that regard, the Trust requires the assessment to be undertaken in accord with industry best practice.

This report will therefore;

- Review the capability of 10 Terminal locations to be a safe place for an aged care facility given the site is mapped as a bushfire prone area
- Review the access and egress of the site in view of an imminent emergency
- Determine whether the aged care facility can be made compliant with industry best practice
- Determine whether or not any lessee should be responsible for managing defensible space around the perimeter of the aged care facility
- Review the Trust's fire management planning policies and initiatives to determine whether the Trust is capable of being an effective land manager to protect an aged care facility from poor management by any lessee.

1.1 Information collation

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

- Site plans and elevations prepared by *Boffa Robertson Group* dated March 2014
- Draft Bushfire Management Plan for Headland Park, Mosman, dated January 2014, prepared by *Travers bushfire & ecology* for the Sydney Harbour Federation Trust.
- Fire Management Plan Sydney Harbour & Botany Bay (La Perouse Precinct) National Parks, December 2005, prepared by *NSW National Parks and Wildlife Service.*

An inspection of the proposed development site and surrounds was undertaken by John Travers on several occasions in 2013 and 2014 to assess the topography, slopes, aspect, drainage, vegetation and adjoining land use/s in the preparation of a fire management plan for the Trust. Subsequent visits in late 2013 and again on four occasions in 2014 were targeted to assist the Trust in the identification of bushfire measures required for an aged care facility proposed for the 10 Terminal buildings.

1.2 Commonwealth Legislation - Sydney Harbour Federation Trust Act

The Sydney Harbour Federation Trust Act (SHFT Act) sets out the Trust's vision for the harbour sites under its control. The SHFT Act excludes any land owned by the Trust from the operations of NSW planning law.

This includes the need to apply the provisions within Section 100B of the *Rural Fires Act (RF Act)* which requires the application of NSW bushfire planning doctrine i.e. *Planning for bushfire protection (2006) (PBP)* published by the RFS and its application to any development planning proposed by the Trust.

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

The *Building Code of Australia* (*BCA*) is given effect through the *Environmental Planning & Assessment Act* (*EP&A Act*) and forms part of the regulatory environment of construction standards and building controls. The *BCA* is a national approach across all states and territories.

It outlines objectives, functional statements, performance requirements and deemed to satisfy provisions.

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

The construction manual for the deemed to satisfy requirements is the Australian Standard AS3959 Construction of buildings in bushfire-prone areas (2009) (AS3959).

1.3 NSW legislation and polices

There are various legislative and regulatory requirements and provisions that relate to bushfire planning and management within NSW.

The following legislation has been reviewed to guide the Trust on best practice bushfire protection for the proposed development of the aged care facility.

1.3.1 NSW bushfire prone land mapping

In NSW, bushfire prone land maps provide a trigger for the development assessment provisions. The proposed aged care facility is located on land that is mapped by Mosman Council as being bushfire prone (refer Figure 1.1). Whilst bushfire prone mapping relates to NSW law it is the case that the Trust should be responsive to such a plan in order to enable conformity to peripheral land uses which are controlled by NSW laws e.g. national park.

The orange colour on Figure 1.1 represents Vegetation Category 1 – Forest, whilst the red colour represents a 100m buffer. Any development of bushfire prone land (i.e. within the orange or red) requires compliance with the objectives outlined in the document entitled *PBP*.



Figure 1.1 – Bushfire prone land map (Source: Mosman Council Bushfire Prone Land Map accessed 160713)

1.3.2 The NSW Rural Fires Act (RF Act)

This legislation governs the prevention and control of bushfire, hazard reduction and its administration. Although the following state legislation does not apply specifically to the Trust land, the Trust acknowledges that development within their land should adhere to best practice bushfire planning so it is consistent with relevant State and local plans.

Section 100B of the *RF Act* states that the Commissioner may issue a bushfire safety authority (BSA) for a special fire protection purpose (SFPP) development (such as an aged care facility) which is located on bushfire prone land.

There is no requirement under commonwealth law for the Trust to seek a BSA from the RFS.

1.3.3 NSW State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004.

Chapter 3 Part 2 Clause 27, advised that any development on bushfire prone land must take into consideration the general location of the proposed development, the means of access to and egress from the general location and other relevant matters, including the following:

- 1. The size of the existing population within the locality
- 2. Age groups within that population and the number of persons within those age groups
- 3. The number of hospitals and other facilities providing care to the residents of the facilities within the locality, and the number of beds within those hospitals and facilities
- 4. The number of schools within the locality and the number of students at those schools

- Existing development within the locality that has been carried out under this Policy or Stage Environmental Planning Policy No 5 – Housing for Older People or People with a Disability
- 6. The road network within the locality and the capacity of the road network to cater for traffic to and from existing development if there were a need to evacuate persons from the locality in the event of a bushfire
- 7. The adequacy of access to and from the site of the proposed development for emergency response vehicles
- 8. The nature, extend and adequacy of bush fire emergency procedures that are able to be applied to the proposed development and its site
- 9. The requirements of NSW Fire Brigades.

1.3.4 NSW Planning for Bush Fire Protection 2006 (PBP)

Bushfire protection planning requires the consideration of the RFS planning policy entitled *Planning for bushfire protection (PBP)* published by the RFS in 2006.

Bushfire planning requires due consideration to the type of development planned and the way in which that development can be self-reliant in the case of a bushfire emergency. *PBP* provides planning controls for building in bushfire prone areas as well as guidance on effective bushfire protection measures that can be used to mitigate the impacts from ember, radiant heat and flame attack.

The policy aims to provide for the protection of human life (including fire fighters) and to minimise impacts on property and the environment from the threat of bushfire, while having due regard to development potential, site amenity and protection of the environment. More specifically, the aims and objectives for all development located on bushfire prone land should:

- 1. Afford occupants of any building adequate protection from exposure to a bushfire
- 2. Provide for a defendable space to be located around buildings
- 3. Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition
- 4. Ensure that safe operational access and egress for emergency service personnel and residents is available
- 5. Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the APZ
- 6. Ensure that utility services are adequate to meet the needs of fire fighters (and others who may assist in bushfire fighting).

As the development is a type of development regarded by the RFS as a special fire protection purpose (SFPP) development, *PBP* requires <u>additional</u> objectives to be considered. These include the need to:

7. Provide for the special characteristics and needs of occupants. Unlike residential subdivisions, which can be built to a construction standard to withstand the fire event, enabling occupants and fire fighters to provide property protection after the passage of fire, occupants of SFPP developments may not be able to assist in property protection. They are more likely to be adversely affected by smoke or heat while being evacuated.

8. Provide for safe emergency evacuation procedures. SFPP developments are highly dependent on suitable emergency evacuation arrangements, which require greater separation from bushfire threats. During emergencies, the risk to fire fighters and other emergency services personnel can be high through prolonged exposure, where door to door warnings are being given and exposure to the bushfire is imminent.

The nature of SFPPs means that occupants may be more vulnerable to bushfire attack for one or more of the following reasons:

- They may be less educated in relation to bushfire impacts
- They may have reduced capacity to evaluate risk and to respond adequately to the bushfire threat
- They may present organisational difficulties for evacuation and / or management
- They may be more vulnerable through stress, anxiety and smoke impacts arising from bushfire threat
- There may be significant communication barriers
- Supervision during a bushfire may be difficult
- Logistical arrangements for the numbers of residents may be complicated in terms of alternate accommodation, transport, healthcare and food supplies

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

The proposal has been assessed in compliance with the following measures:

- 1. APZs that satisfy areas of defensible space
- 2. Building construction that complies with AS3959
- 3. Access arrangements that lead to safe access and egress
- 4. Water supply and utilities such that enable water and power resources to be available
- 5. Landscaping design that is suitable for a bushfire prone area
- 6. Emergency management arrangements that satisfy effective evacuation and incident planning.

PBP defines *performance criteria* and *acceptable solutions* for the six (6) bushfire protection measures outlined above.

1.4 Performance based assessments and developing alternate solutions

The performance criteria can be satisfied in one of two different ways:

- Use of the acceptable solutions; or
- Demonstrating another solution satisfying the specific objectives and performance criteria.

1.4.1 Acceptable solutions

PBP has identified acceptable solutions or 'deemed to satisfy' measures which will meet the specific objectives of the performance criteria.

These are not exhaustive and other deemed to satisfy options may apply. Notwithstanding this, any variation from the suggested solutions in *PBP* require justification to demonstrate how they can be met through other methods.

1.4.2 Alternative solutions

An alternative solution is a variation to the deemed to satisfy (acceptable solutions).

The applicant must provide substantiated evidence that the alternative solution can achieve the performance criteria and the objectives of *PBP*. The performance criterion allows the applicant to be flexible and innovative in responding to development opportunities and constraints. It recognises that no two sites or proposals are the same and allows the applicant to consider a broad range of issues and information, including the application of new technologies.

The following assessment, in Section 2 outlines the proposal's compliance with the performance criteria either via the adoption of the acceptable solutions as outlined within *PBP* as well as providing alternative solutions in respect to

- Access and emergency evacuation
- Setbacks provided and limiting radiant heat exposure to <10 kW/m².

1.5 Environmental and cultural constraints

The impact of bushfire protection measures (i.e. APZs) on environmental and cultural assets must be taken into account.

1.5.1 Environmental constraints

The proposed APZs that surround 10 Terminal buildings are mostly confined within the existing cleared and managed land and therefore will have a minimum environmental impact.

1.5.2 Aboriginal sites of significance

There are no known aboriginal heritage sites of significance within the existing cleared areas of the site and therefore there will be no impact on aboriginal sites of significance.

1.5.3 European heritage

The application of bushfire protection measures, including the upgrading of buildings in accordance with *AS3959* must take into account the conservation of significant heritage fabric and its setting.

The application of *PBP* is to be considered in the context of the conservation principles, processes and practices of the *Illustrated Burra Charter* (Australia *ICOmOS*, 2013).

The 10 Terminal buildings were constructed between 1939-1945. The Middle Head precinct is listed as part of the 'Defence Site-Georges Heights and Middle Head' on the *Commonwealth Heritage List* as Historic Place No. 105541.

It is listed on the Register of the National Estate as Historic Place No. 102619 and 'Middle Head and Georges Heights' Historic Place No. 101087. In particular the 'Ten Terminal Regiment Headquarters and AusAid Training Centre' is listed as Historic Place No. 105587 on the *Commonwealth Heritage List* and Historic Place No. 103342 on the Register of the National Estate.

Schedule 5 of Mosman LEP 2012 – Environmental Heritage contains numerous listings for the Middle Head precinct including the Terminal Regiment HQ', AusAid Training Centre.

1.6 Surrounding land use

Headland Park encompasses an area of approximately 44.36 hectares. However it is the complexity of land use that characterises the landscape and the human settlement.

Sydney Harbour National Park occurs to the north-east, east and south as well as managed / bushland vegetation within HMAS Penguin land to the north-west. The Precincts of Georges Heights, Training Command and Lower Georges Heights are adjoined by Middle Head Road to the north-west and the residential urban area of Mosman. HMAS Penguin (adjoining Middle Head Precinct) was established in the early 1940s and is an operational Naval base comprising of a range of facilities such as barracks, administration buildings, a hospital, training facilities and a jetty. The southern portion of the base contains remnant bushland.

The landscape within Headland Park is characterised by a relatively flat-topped ridge which extends from Middle Head to Mosman, rising from 40m measured from the Australian Height Datum (AHD) to 80m AHD respectively. The crest of that ridge has been developed for both residential (Mosman) and military management (HMAS) purposes. Steep, rocky slopes extend downslope from the relatively flat-topped ridge to waters of Sydney Harbour and contain irregular cliff lines and numerous ledges. The landscape includes narrow crests and ridges, narrow incised valleys, steep side slopes with rocky benches, broken scarps and boulders.

1.7 Middle Head Peninsula Land Use and Utilisation

The various land uses on the Middle Head Peninsula (Middle Head and Chowder Bay) include the following;

HMAS Penguin	Defence training, medical and accommodation 7 days / 24 hours	
Middle Head Oval	Sports use	Weekends and
	Emergency helicopter landing	evenings
Parkland	Passive recreation	7 days / daytime
Former Golf Club House	Restaurant and retail	7 days / daytime

Chowder Bay	Restaurant	7 days / day & evening
	Cafe x 2	7 days / daytime
	Function centre and administration	7 days/ day & evening
	Marine science education (with limited	7 days / 24 hours
	accommodation and conferencing facilities)	
	School group accommodation	7 days / 24 hours
	Offices	Weekdays / daytime
	Diving centre	7 days / daytime
Middle Head	Office	Weekdays / daytime
	Depot	5 days / daytime
ASOPA	Office suites	5 days / daytime
	Cafe	7 days / daytime
	Retail	5 days / daytime
Timber barracks	Potential for demolition	N/A
10 Terminal buildings	Residential aged care under consideration	7 days / 24 hours
Outdoor special events	Sydney Harbour spectator events (e.g. Sydney-	7 days / 24 hours
and recreational activities	Hobart), naval events, fishermen, beachgoers,	
	walkers, cyclists, etc.	

Source; Sydney Harbour Trust

The overall extent of persons on the Middle Head peninsula fluctuates greatly, with an estimate of up to 2,000 visitors in peak times (source: Trust staff in consultation).

The Trust has two (2) rangers on duty from 8am - 6pm, 7 days a week, plus security patrols outside these hours.

1.8 Fire history, frequency and causes of ignition

Fire is a natural component of Australian native plant communities and is an important consideration in future management of Headland Park. Fire frequency, intensity and season of occurrence are major factors influencing the distribution and composition of flora and fauna communities.

A variety of fire regimes are required in order to conserve floristic diversity in perpetuity and to provide diversity of habitat. Inappropriate and frequent fire regimes can cause loss of particular flora and fauna species and/or communities. Similarly, species which require fire for regeneration will decline if fire does not occur for long periods

There have been a number of small wildfires over the years within the adjoining National Park. They vary in size between 0.02–15.19ha. Fires over 1ha in size include the following:

- 15.19 ha wildfire adjacent to the southern boundaries of Mosman Drill Hall precinct, 1981-82
- 5 ha wildfire to the north of Middle Head precinct, 1994-95
- 1.6 ha hazard reduction burn, adjacent to the eastern boundary of Mosman Drill Hall precinct, 2003-04
- 1.4 ha wildfire, approximately 200m to the south-east of the Mosman Drill Hall, 1997-98

The future fire management within *Headland Park* must not only consider the safety and protection of staff, visitors, human settlement and cultural heritage assets, but must also provide a high priority for maintaining ecological diversity within the site. In that regard three (3) hazard reduction burns are proposed to be undertaken by NPWS in 2014, in consultation with the Trust when the right conditions are available.



2.1 Background of proposal

The aged care facility is proposed to occupy the existing 10 Terminal buildings (Buildings 1, 2, 3, 6 & 7) as identified within the SHFT Management Plan – Mosman No. 7 Middle Head (June 2007) - refer Figure 2.1 below.

The aged care facility proposes eighty nine (89) beds and a staff complement which we assume are to be in accord with government regulations for a 24/7 roster – see Figures 2.2 to 2.4 below.



Figure 2.1 – Middle Head (Source: SHFT Management Plan – Mosman No. 7 Middle Head, 2007)



Figure 2.2 – Building elevations



Figure 2.3 – First Floor Plan



Figure 2.4 – Ground floor plan

2.1.1 Site description

The Middle Head Precinct is approximately 11ha in area and is located near the end of the Middle Head ridge, one of the three headlands that define the entrance to Sydney Harbour – see Figure 2.5.

The 10 Terminal buildings are currently vacant and are located within a cleared open portion of the Trust land. The collage of buildings contain a mixture of exotic plantings (trees and shrubs), interspersed with large paved areas, including tennis courts, driveways and parking areas.

The proposed aged care facility is immediately adjoined to the west by ASOPA buildings used for a variety of commercial purposes. A recently constructed car parking facility is located to the east whilst Middle Head Oval and vacant buildings (B1–B3) are located to the north.

The northern edge of the precinct (located over 70m from the proposed aged care facility) is bound by a vegetated rocky escarpment which lead down to the foreshore of Hunters Bay and Cobblers Beach.

The bushland of Sydney Harbour National Park encloses the southern, eastern and northeastern boundaries of the site (located 30-50m to the south and over 80m to the north-east). Sydney Harbour Scenic Walk and the associated bushfire strategic fire advantage zone (SFAZ) adjoin the southern boundary of the Middle Head precinct. The national park is managed by the National Parks and Wildlife Service (NPWS). The NPWS uses the area just north-east of the Trust's land as a parking and materials storage area.

HMAS Penguin (an operational Naval base) borders the western edge of the precinct.



Figure 2.5 – Aerial appraisal

2.2 Aged care facility affectation

An aged care facility entails the provision of a wide range of service for the aged and in some cases, the infirm. Significant human and infrastructure resources are required to ensure the ongoing welfare of residents. A wide array of staff resources are also provided on a 24hr day but limited during night shifts.

Bushfires may cause stress for residents and staff simply by knowing a bushfire is in close proximity. Smoke may cause anxiety and or breathing issues. The sight of flame and an airborne ember attack may also contribute to anxiety levels and a potential feeling of vulnerability.

Whilst these are common impacts from the occurrence of bushfire there has not been a fatal injury in an aged care facility from a bushfire attack in NSW. There have been cases where internal building fires (not related to bushfire) have led to resident deaths.

Therefore, the planning for an aged care facility requires careful consideration to ensure passive protection is applied at design stage and that no reliance is required for active fire management systems such as uprated building construction standards and or water spray protection systems.

It is not acceptable to make a building a fire bunker through the applications of building design and construction. For this type of special purpose development a major focus must be on the provision of sufficient defensible space around the 10 Terminal buildings in the form of managed APZs. This provides the necessary passive design that enables radiant heat flux to be reduced before it impacts the periphery of the buildings.

This can be achieved by providing the necessary managed space (as per RFS specifications) and / or in combination with radiant heat barriers that combine to deny radiant heat flux >10 k/W^2 from impacting the external walls of buildings.

It is also the case that the adjoining NPWS bushland to the south and south east can and will burn but the bushfire may not manifest in the need to evacuate residents. This is the case for the 10 Terminal buildings as the extent of the vegetation within the adjoining national park is a narrow band of tall heath and rainforest thicket.

Vegetation in the forest / rainforest assemblage to the north is located on a sandstone escarpment. The small area of this vegetation patch and the moist conditions in the scrub layer does not lead to a rapid fire movement such that evacuation would be ordered.

Other vegetation patches to the west may burn adjacent to the former golf clubhouse on the entry road and may lead to a temporary blockade to normal road use for several hours. This issue of roadside vegetation management has been recommended to the Trust for ongoing management in a draft bushfire management plan prepared by this firm in late 2013/2014 such that this impediment would be removed and or managed.

2.3 Asset protection zones (APZs)

APZs are areas of managed land which reduce the forward movement of fire and reduce the creation of new fires from embers sparking dry grass. It is not possible to stop all fires even within a well-managed APZ but is possible to deny flame movement through tree and shrub canopies through their omission.

Development types that are permissible within the APZ area includes access roads, swimming pools, non-habitable buildings, parking areas, administration buildings,

landscaped areas or similar types of managed grass / paved areas e.g. passive recreation space such as seats and tables or pavilions.

Table 2.1 below outlines the performance criteria and the acceptable solutions as provided within *PBP* for APZs.

Column 3 outlines the proposal's compliance with the acceptable performance criteria.

 Table 2.1 – Performance criteria for asset protection zones (PBP guidelines pg. 19)

Performance criteria	Acceptable solutions	Alternate solution potential
Radiant heat levels of greater than 10kW/m ² will not be experienced by occupants or emergency services workers	An APZ should be provided in accordance with the relevant tables and figures in Appendix 2 of <i>PBP</i> .	Should a development plan not be compliant then an alternate solution should be proposed in a bushfire engineering assessment or more directly via a designed solution which will ensure that radiant heat levels greater than 10 kW/m ² will not impact a building used as a habitable room. This may occur through a radiant heat barrier or the location of another building which provides a similar affect.
a building.	Exits should be located away from the hazard side of the building.	Any worthy proposal should define entry and exit locations to enable access and or evacuation egress. It is more of a concern where access doors are minimal as oppose to buildings that have many exits points.
	The APZ should be wholly within the boundaries of the development.	The APZ extends into existing managed area within the National Park to the south and south-east (refer to Section 2.3 below). From a permissibility perspective new APZs should not be
		located on neighbours land without their consent. Clearing of vegetation on neighbours land for the purpose of an APZ may be a criminal action.
		However where land is cleared and managed such as car parks and or gardens or mown grass then there is a realistic expectation of a continuance and the <i>RFS</i> accept that as reasonable exception to the provision.
Applicant demonstrates that issues relating to slope are	Mechanisms should be in place to provide for the	The APZ must be managed on a day to day basis to ensure effective fuel management on grasses, shrubs and trees near buildings.
addressed: maintenance is practical, soil stability is not compromised and the potential for	maintenance of the APZ over the life of the development.	A properly prepared fuel management plan would be the basis of this obligation.

Performance criteria	Acceptable solutions	Alternate solution potential
crown fire is negated.	The APZ should not be located on land with a slope exceeding	Steep land makes it very difficult to manage fuels by conventional means such as mowing or slashing. Rocky terrain makes it more difficult again.
	18°.	Given there is ongoing lawn management on the APZ lands it is reasonable to assume this will continue.
		However, the area of non-compliance by the APZ into the vegetated portions of the national park on the southern and eastern boundary (see Table 2.3) are located on a short 2m high 'filled' edge and this area is not possible to manage.
		In this case, a radiant heat barrier will be required to offset the loss of APZ distance. Given the tall heath nature of the vegetation and the lack of eucalypts there is capacity for this alternative solution to work well in limiting radiant heat flux.
APZs are managed and maintained to prevent the spread	In accordance with the requirements of	A fuel management plan must be prepared that deals with all the needs of the landscape to ensure it is managed in its current condition on a day to day basis.
the building.	Asset Protection Zones (RFS 2005).	A fuel management plan would detail the areas to be managed, how that management will occur and whom will do the work and at what regularity.
Vegetation is managed to prevent flame contact and reduce radiant heat to buildings, minimise the potential for wind driven embers to cause ignition and reduce the effect of smoke on residents and fire- fighters	Compliance with Appendix 5 of <i>PBP</i>	Insitu vegetation whether as grasses, small shrubs, tall shrubs and or trees are to be managed in accord with the fuel management plan which should accord with the objectives and principles provided by the RFS in Appendix 5 of <i>PBP</i> .

2.4 APZ within National Parks Land

The APZ is not wholly within the boundaries of the Trust's land. In the case of the national park there are several situations where day to day management currently occurs – refer to Figure 2.6 and note the legend where it refers to 'edge of managed vegetation'.

The APZ extends within the National Park land by approximately 5-15m. For example, there is a small triangular area (approx $10m^2$ - see photo 1) to the east of building no 6 that is national park but has been an apparent managed garden for the life of 10 Terminal buildings.

There is a managed edge on Figure 2.6 which can reasonably be relied upon as managed land given the topographic situation of the filled landscape and the natural edge of the small stepped escarpment. Given these buildings predated the dedication of the national park it is thought this land boundary anomaly is not a significant issue.

The following photos depict the existing managed APZ lands surrounding the proposed aged care facility site. Roads within the development precinct of 10 Terminal buildings are in place and considered not practical or necessary to widen – see photos below.



Photo collage of the edge of the south-eastern APZ zone



Figure 2.6 – NPWS strategic fire advantage zone and edge of managed zone

Figure 2.6 depicts the NPWS *Strategic Fire Advantage Zone*. This is explained within the *Sydney Harbour and Botany Bay (La Perouse Precinct) Fire Management Plan* as *Management Area MH3 – Obelisk Beach*.

The area of national park to the south of the proposed aged care facility has been identified within that plan as Management Area MH3 – Obelisk Beach. This area includes a portion of a walking track that runs along the boundary of the site.

This management area has been identified in blue on Figures 2.6 & 2.7 and includes an;

- APZ maintained at <5T/ha by slashing and walking tracks <2t/ha by manual clearing. (this area is the existing 5–15m wide cleared portion of land adjoining the site)
- Strategic Fire Advantage Zone. The strategies include assessing fuel loads prior to the fire season each year by visual assessment method, maintain zone at 15T/ha by manual clearing or prescribed burning, maintain walking tracks <2t/ha by manual clearing and extinguish all wildfire.

Notwithstanding these statements of intent this zone has no real benefit as a regular boundary managed zone but it does reflect the expectation that the existing managed incursions will not be an issue with the NPWS.

2.5 Draft Bushfire Management Plan for Headland Park

A Draft Bushfire Management Plan has been prepared for Headland Park (inclusive of Middle Head) by *Travers bushfire & ecology* – see bushfire protection strategies outlined on Figure 2.7.

This plan outlines a five (5) year plan (2013/14–2018) which aims to identify the bushfire protection strategies to be undertaken by the Trust to protect life and property from wildfire.

The plan identifies bushfire management zones and provides management area profiles for each of these zones. Maps accompany these zones to identify the assets and extent of works required within each of these zones. A works program has been developed to ensure the implementation of these works in perpetuity. Figure 2.7 depicts the bushfire management zones for Middle Head.

The land surrounding the proposed aged care facility is identified as MH APZ. The strategy for maintenance is to continue mowing / slashing the land on a regular basis to ensure the height of grass does not exceed 10cm, as well as the annual removal of fallen / dead fuels such as branches, bark and leaves.

The plan also identifies the implementation of a 7m wide APZ (MH APZ 3) measured east from the edge of Middle Head Road south west of the former clubhouse. Although no removal of trees is required the plan recommends the following:

- Maintain shrubs in well-spaced clumps that do not exceed 30% of the area. Areas of flammable shrubs are not to be located under trees (prevent the spread of canopy fire).
- Annually remove fallen / dead fuels such as branches, bark and leaves
- Maintain grass to height of 10cm



Figure 2.7 - Sydney Harbour Trust Draft Fire Management Plan strategies

2.6 HMAS Penguin

A Property Bushfire Management Plan has been prepared by HMAS Penguin for land located to the west of Middle Head Road. As identified in Figure 2.8 below the land is managed as SFAZ 1, SFAZ, 2 and SFAZ 3.

SFAZ 1 & 3 – undergo fuel monitoring to maintain low to moderate fuel hazard to enhance effectiveness of APZs and to aid fire suppression.

SFAZ 2 – undergoes hazard reduction burning works. The procedure involves preparing a hazard reduction burn plan 12 months before the scheduled month / season. As well as engaging resources for burning two (2) months before a scheduled burn period.



Figure 2.8 – HMAS Penguin property management strategies plan

2.7 APZ Determination

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

PBP guidelines require the identification of the predominant vegetation formation to determine APZ distances for SFPP developments. The hazardous vegetation is calculated for a distance of at least 140m from a proposed building envelope.

The vegetation within 140m of 10 Terminal buildings has been identified as tall heath interspersed with emergent trees / rainforest. Variations in the overall vegetation community occur in the form of the vegetation communities listed in Table 2.2 below.

Table 2.2 – Vegetation communities

Aspect	Vegetation community	Vegetation formation
	Coastal Sandstone Foreshores Forest	Dry Sclerophyll Forest
East	Coastal Headland Littoral Thicket	Rainforest
	Coastal Enriched Sandstone Moist Forest	Wet Sclerophyll Forest
South	Coastal Tea-tree-Banksia Scrub	Tall Heath
	Coastal Sandstone Foreshores Forest	Dry Sclerophyll Forest
North	Coastal Enriched Sandstone Moist Forest	Wet Sclerophyll Forest
	Coastal Sandstone Foreshores Forest	Dry Sclerophyll Forest

Notwithstanding these categories vegetation is determined on the basis of crown cover for assessing bushfire behaviour. If vegetation has a crown cover greater than 75% it is to be regarded as rainforest and if it is between 75-30% it is to be regarded as forest. This assists in determining the best fit for assessing bushfire behaviour i.e. flame length and radiant heat flux.

In regard to slope assessment the effective slope is assessed for a distance 100m within the hazard (not the APZ). Effective slope refers to that slope which provides the most effect upon likely fire behaviour. A mean average slope may not in all cases provide sufficient information such that an appropriate assessment can be determined. The effective slope within the hazardous areas is identified within Table 2.3 below.

Table 2.3 provides the required APZs for the development based on the acceptable solutions (column 4) as well as the APZ provided (alternate solution), relative to slope and vegetation characteristics for the proposed development.

Aspect	Vegetation within 140m of development	Effective slope of land	APZ required for SFPP Acceptable solutions (metres)	APZ provided (metres)
South-east (45m wide flame front)	Predominantly heath with some emergent trees but calculated as rainforest due to canopy closure	8 ^{0d}	50	33
South-east (100m flame front)	Predominantly heath with some emergent trees but calculated as rainforest due to canopy closure	8 ^{0d}	50	38
South	Predominantly heath with some emergent trees	0-5 ^{0d}	50	50
North	Rainforest	>18 ^{0d}	65	75 (plus the existing B1, B2 & B3 buildings act as an insitu radiant heat shield).

Table 2.3 – Bushfire attack assessment

Notes: Slope is either 'u' meaning upslope or 'd' meaning downslope

Table 2.3 column 4 identifies non-compliance in the south-eastern aspects.

In this case, it will be necessary to consider an alternate solution to ensure compliance. Such a solution would involve either additional vegetation removal and / or the construction of radiant heat barriers near the edge of the hazardous vegetation.

2.8 Possible alternate solution to the lack of sufficient APZ in the S/E

Possible alternate solutions can involve various scenarios such as:

- constructed earth mounds
- erected non-combustible barriers with gates, openings or offsets to enable ready access to each side
- stone walls such as used at North Head, or a
- combination of the above

Generally, the installation of radiant heat barriers is not an effective approach to reducing APZ length as the vegetation is normally much taller than the barrier. For example, forests are generally 25m in height and a typical 2m radiant heat barrier would do little in that context. However, in the case of the eastern and south-eastern vegetation stands off the 10 Terminal buildings this is not the case and the vegetation is predominantly over a ledge (of previous fill material and or sandstone escarpment) and is approximately 2-3m down slope leaving the exposed vegetation at ground level protruding vertically by approximately 2-3m.

Modelling has been undertaken to determine the height of an effective radiant heat barrier. Modelling was based on the type of vegetation located on the southern fringe and its behaviour in a fire event. The vegetation is a mixture of littoral thicket and tall heath.

The RFS permits the selection of the appropriate vegetation formation to estimate fire behaviour and thus radiant heat output.

The modelled output is attached and they determine the correct height of a radiant heat barrier to restrict radiant heat impacts.

The effective height of a barrier consists of the calculated height through modelling less the height of the vertical escarpment (or filled bench) which acts as an insitu barrier. In this case the modelled height must deduct the height of the insitu escarpment and fill bench to derive the effective height of a barrier.

Modelled results are;

- A 2.05m barrier above the upper ground level is required for the east-south-eastern portion see Figure 2.9. This is composed of a calculated overall high radiation barrier of 4.25m less the existing height of fill embankment of 2.2m which equals 2.05m.
- A 3.14m barrier above the upper ground level is required for the south-south-eastern portion see Figure 2.9. This is composed of a calculated overall high radiation barrier of 5.34m less the existing height of fill embankment of 2.2m which equals 3.14m.

In this case, a variable height radiant heat barrier (2.05m to 3.14m) would need to be located close to the hazardous vegetation and extend along the boundary as shown on Figure 2.9. The length of the barrier (as shown) is based on 'modelling arcs' of radiant heat flux attack and could be incorporated into landscape features such as earth mounds. The 2.05m high barrier is located in accord with the yellow line shown on Figure 2.9 whilst the 3.14m high barrier is located as per the aqua green line on Figure 2.9.



Figure 2.9 - Location of 10 Terminal buildings and radiant heat barrier (shown as a yellow and aqua line). Red line is Trust boundary.

2.9 Construction standards

The RFS do not permit higher building construction standards to offset the impact of radiant heat, flame contact and or ember attack for aged care structures. They require a reasoned setback from hazardous vegetation that will contain the impact of radiant heat to be $<10k/Wm^2$.

Several alternative ways with which this can occur is if other buildings act as radiant heat barriers or as previously mentioned if radiant heat barriers are constructed.

The APZs, as illustrated in Figure 2.9 and Tables 2.3 in conjunction with the installation of a radiant heat barrier, would comply with the performance criteria of *PBP*. This APZ distance is based on ensuring building occupants are not exposed to a radiant heat threshold of >10 kW/m^2 for SFPP development.

The refurbishment of the 10 Terminal buildings for aged care use will require upgrading to achieve basic bushfire protection e.g. ember attack. This would typically entail window screen protection, gutter protection screen and protection screen over other entry points (vents).

Should any building additions be required then they would need to be constructed in accord with the minimum standard being BAL 12.5 as defined with the *AS3959*, with additional construction requirements as outlined within Addendum Appendix 3 of *PBP*.

2.10 Access

Bushfire planning requires due consideration to the full extent of road access for evacuation potential and the entry of emergency service personnel during emergency incidents.

Whilst the 10 Terminal buildings exist and have done for many years they are subject to a different land use and for this reason access capability is an issue for the development of any aged care facility. Should the access or egress routes be subject to emergency incidents such as internal fire or bushfire then evacuation may be denied.

It is for this reason that aged care facilities should be designed so as not to require evacuation as the first option. They should be well protected and specifically in accord with the NSW RFS specifications.

The primary access point to the development will be via the existing Middle Head Road which provides the only egress route out of Headland Park. The majority of this road is managed on either side of the road in various land ownerships. Notwithstanding that there is a need to ensure the roadside verges are well managed and to that extent recommendations have been made within the draft Headland Park bushfire management plan.

The access network within Headland Park consists of the following elements,

- The main public roads adjoining and leading into the park Middle Head Road, Chowder Bay Road and Suakin Drive.
- Internal streets and laneways within each precinct Dominion Crescent, Imperial Place and Commonwealth Avenue.
- A major pathway circuit that provides access for people with all levels of mobility and links the significant public places, features and landmarks, the entry roads, car parks and local neighbourhood.

- A minor pathway network providing more variety, intimacy and seclusion, and access for able-bodied walkers to limited areas within the bushland; and
- The car parks and bus set down areas (SHFT, 2008)

Middle Head Road provides the single road link serving the Middle Head, while Chowder Bay Road passes through Sydney Harbour National Park to provide a single access road to Chowder Bay. An historic cobblestone road winds down to Cobblers Beach and this is the original track constructed to connect the fort with the former jetty at the beach. There are other paths through the National Park providing access to the beaches. Chowder Bay also has its own wharf and has the potential for ferry and charter boat access.

The land uses within *Headland Park* and the surrounding land has increased the visitation to the area. As a result, evacuation is a fire management issue that needs to be addressed in any proposed adaptive re-use of buildings within *Headland Park*.

As a result of this necessity the roadside vegetation on the main access is subject to recommendations within the draft Headland Park bushfire management plan prepared for the Trust by this firm. The implementation of a 7m wide APZ, along the eastern edge of Middle Head Road will provide additional protection for existing and future users of this road in times of emergency. The area required for ongoing fuel management is drawn on Figure 2.10.



Figure 2.10 - Extract of MH APZ 3 from the Draft Headland Park Bushfire Management Plan

In accord with the RFS *PBP* provisions the intent of measures required by the RFS for internal roads is "to provide safe operational access for emergency services personnel in suppressing a bush fire, while residents are accessing or egressing an area".

Table 2.4 outlines the requirements for compliance with the performance criteria for public roads.

Table 2.4 – Performance Criteria for Internal Roads

(Source: Planning for bush fire protection guidelines RFS pg. 35)

Performance criteria	Acceptable solutions	Alternate solution proposed
Internal road widths and design enable safe access for emergency services and allow crews to work with equipment about the vehicle	Internal roads are two wheel drive, sealed, all weather roads.	The public road design complies
	Internal perimeter roads are provided with at least two (2) traffic lane widths (carriageway 8m minimum kerb to kerb) and shoulders on each side, allowing traffic to pass in opposite directions.	The ideal of 8m refers to public road width leading to a facility. Within the facility if there are short sections of road then a reduced width of 6.5m is acceptable. This is the case for the access road that passes 10 Terminal buildings
	Roads are through roads. Dead end roads are not more than 100m in length from a through road, incorporate a minimum 12m outer radius turning circle, and are clearly sign posted as a dead end.	The Middle Head peninsula is a large land mass with one single access road
	Traffic management devices are constructed to facilitate access by emergency services vehicles.	The 10 Terminal precinct complies as traffic devices such as fire trail gates are not required in this circumstance as road access is provided on public roads
	A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.	The access road complies
	Curves have a minimum inner radius of 4m and are minimal in number to allow for rapid access and egress.	The public road design complies
	The minimum distance between inner and outer curves is 6m.	The public road design complies
	Maximum grades do not exceed 15° and average grades are not more than 10°.	The public road design complies
	Cross fall of the pavement is not more than 10° .	The public road design complies

Performance criteria	Acceptable solutions	Alternate solution proposed
	Roads do not traverse through a wetland or other land potentially subject to periodic inundation (other than storm surge).	The 10 Terminal precinct is not affected by wetlands
	Roads are clearly sign posted and bridges clearly indicate load ratings.	No bridges exist
	The internal road surfaces and bridges have a capacity to carry fully loaded firefighting vehicles (15 tonnes).	The public road design appears to comply

2.11 Water supply

Future water supply must comply with *PBP* as outlined in the following acceptable solutions for water supply:

Table 2.5 – Performance criteria for reticulated water supplies

(Source: Planning for bush fire protection guidelines RFS pg. 37)

Performance criteria	Acceptable solutions
Water supplies are easily accessible and located at regular intervals	Access points for reticulated water supply to SFPP developments incorporate a ring main system for all internal roads. Fire hydrant spacing, sizing and pressures comply with AS2419.1 - 2005. Where this cannot be met, the RFS will require a test report of the water pressures anticipated by the relevant water supply authority, once development has been completed. In such cases, the location, number and sizing of hydrants shall be determined using fire engineering principles.

2.12 Gas supply

Future gas supply must comply with *PBP* as outlined in the following acceptable solutions for gas supply.

Table 2.6 – Performance criteria for reticulated water supplies

(Source: Planning for bush fire protection guidelines RFS pg. 37)

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

2.13 Electrical supply

In bushfire scenarios, electrical power can be potentially lost for extended periods and this causes impacts upon air conditioning systems, lighting, opening of electrical doors, communication/s systems and fire reporting systems. These all lead to the lowering of personal welfare condition and putting occupants at potential risk.

Whilst the loss of power is a potential issue it can be fully resolved through the provision of alternative power generation systems designed by electrical engineers.

2.14 Air conditioning Systems

Air conditioning systems can be operated with effective 3 stage filtration to ensure against entry of airborne smoke. The use of activated carbon and heap filters including panel filters and deep bed filters are central to the design. Air-con engineers can specify the needs of the system.

The RFS are experienced in approving air conditioning systems that accord with appropriate air circulation. A specification for this should be sought prior to construction approval.

2.15 Emergency and evacuation planning

A detailed emergency bushfire evacuation plan is to be prepared for an aged care facility. Table 2.7 outlines the required acceptable solutions for emergency procedures:

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

Table 2.7 – Performance criteria for emergency and evacuation planning	
(Source: Planning for bush fire protection guidelines RFS pg. 37)	



3.1 Conclusion

The Trust has commissioned *Travers bushfire & ecology* to provide specialist advice to assist in the assessment of a proposal to develop an aged care facility within the 10 Terminal group of buildings and determine any bushfire planning measures applicable.

The Trust has a wide ranging responsibility to itself, the commonwealth government and to the broader community in the carriage of its land management decisions. In that regard, the Trust requires the assessment to be undertaken in accord with industry best practice.

In 2013 *Travers bushfire & ecology* prepared a draft Headland Park bushfire management plan for the Trust lands located on the Middle Head peninsula. This recent study provided a thorough understanding of the Trust responsibilities in their area of responsibility whilst recognising the other major land owners e.g. HMAS Penguin in the north-west and the National Parks and Wildlife Service through the location of Sydney Harbour National Park that extends from the north-east at Cobblers Beach through to the south-west at Obelisk Bay.

Given the commonwealth ownership of the land the Trust are not required to apply NSW legislation to their decisions. However, the Trust is required to apply commonwealth law and industry best practice. To that end, the Trust would reflect best practice bushfire planning policy.

A detailed site analysis has been undertaken and the application of a combination of bushfire protection measures have been explored to assess if the construction of an aged care facility can be located in an area that may be subject to a level of bushfire risk. The acceptability of that risk relates directly to future occupants, the broader community that frequent the area and emergency services personnel whom may be required to assist during an incident.

The level of risk can be mitigated in an effective manner through the provision of key bushfire protection measures, for example.

- 1. APZs that provide the necessary defensible space
- 2. Building construction that complies with AS3959
- 3. Access road design that provides safe access and egress
- 4. The availability of appropriate water supply and electrical power
- 5. Landscaping design that is suitable for a bushfire prone area

6. Emergency management arrangements that satisfy effective evacuation and incident planning.

Ultimately, radiant heat can be mitigated through a combination of well managed APZs and radiant heat barriers which will require construction.

Ultimately, the development will comply with the RFS *PBP* in the manner that bushfire protection measures can be effectively addressed. Notwithstanding that, the ongoing management of the facility by the Trust (albeit via a lessee) must ensure they implement an effective operational planning initiative to ensure any future lessee and their staff are fully conversant with their obligations and how the bushfire management protection functions must be addressed on a day to day basis. In this regard, annual audits of the facility should occur prior to the bushfire season to establish that operational readiness is fully functional.

The assessment has concluded that the proposal has the potential (pending appropriate conditions of consent) to comply with the specific performance criteria and importantly the aims and objectives of *PBP* and compliance with the Trust's own draft bushfire management plan.

The assessment has concluded that the proposal has the potential to comply with the specific performance criteria and more broadly, the aim and objectives of the RFS as expressed in *PBP*.

PBP Aim 1 - Afford occupants of any building adequate protection from exposure to a bushfire

<u>Response</u>: APZs in conjunction with the installation of radiant heat barriers will provide compliant protection for aged care in line with *PBP*.

PBP Aim 2 - Provide for a defendable space to be located around buildings

<u>Response</u>: The existing APZs provide a sufficient defendable space surrounding the proposed aged care facility. The provision of a radiant heat barrier will provide additional protection for fire fighters and occupants from radiant heat exposure above 10k/Wm².

PBP Aim 3 - Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition

<u>Response:</u> The combination of APZs, radiant heat barrier and BAL 12.5 construction will prevent direct flame contact and material ignition.

PBP Aim 4 - Ensure that safe operational access and egress for emergency service personnel and residents is available

<u>Response:</u> The implementation of a 7m wide APZ (outer protection area) along the eastern edge of Middle Head Road will provide additional protection for people utilising this road in times of emergency, as already recommended in the draft Headland Park bushfire management plan.

PBP Aim 5 - Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the APZ

<u>Response:</u> The Sydney Harbour Federation Trust and the lessee will be required to manage the APZ to the specifications of approval.

PBP Aim 6 - Ensure that utility services are adequate to meet the needs of fire fighters (and others who may assist in bushfire fighting).

<u>Response:</u> Water supply, gas services and electricity are to comply with Section 4.1.3 of *PBP*.

PBP Aim 7 - Provide for the special characteristics and needs of occupants. Unlike residential subdivisions, which can be built to a construction standard to withstand the fire event, enabling occupants and fire fighters to provide property protection after the passage of fire, occupants of SFPP developments may not be able to assist in property protection. They are more likely to be adversely affected by smoke or heat while being evacuated.

<u>Response</u>: APZs in conjunction with the installation of radiant heat barriers will provide adequate protection for aged care occupation. The 10 Terminal buildings will also be upgraded to ensure compliance with BAL 12.5 of AS3959 – 2009 to prevent material ignition.

PBP Aim 8 - Provide for safe emergency evacuation procedures. SFPP developments are highly dependent on suitable emergency evacuation arrangements, which require greater separation from bushfire threats. During emergencies, the risk to fire fighters and other emergency services personnel can be high through prolonged exposure, where door to door warnings are being given and exposure to the bushfire is imminent

<u>Response:</u> A bushfire evacuation plan should be prepared, specifically for the aged care facility and lodged with the local emergency management committee and the bushfire protection committee

Notwithstanding the aims of the RFS there is the specific role of the Trust and the way their aims are adhered to. The following provides a response to the Trust aims and objectives.

Trust Aim 1 - Review the capability of 10 Terminal locations to be a safe place for an aged care facility given the site is mapped as a bushfire prone area.

Response This can be made compliant

Aim 2 - Review the access and egress of the site in view of an imminent emergency.

Response: Can be made compliant

Aim 3 - Determine whether the aged care facility can be made compliant with industry best practice.

Response: Yes

Aim 4 - Determine whether or not any lessee should be responsible for managing defensible space around the perimeter of the aged care facility.

Response: No. the Trust should manage the APZ lands

Aim 5 - Review the Trust fire management planning policies and initiatives to determine whether the Trust are capable of being an effective land manager to protect an aged care facility from poor management by any lessee.

Response: Yes. They can, and do so, on regular basis.

3.2 Recommendations

Recommendation 1 - APZs are to be provided to the proposed development. APZs are to be measured from the exposed wall of the aged care facility toward the hazardous vegetation as nominated within this report and also as generally depicted in Figure 2.9.

Recommendation 2 – The Trust should instigate MH APZ 3 as advised in the Draft Bush Fire Management Plan and as drawn on Figure 2.10.

Recommendation 3 – A fuel management plan should be prepared which details all the fuel management required and its ongoing compliance regimes.

Recommendation 4 - Landscaping within the APZ is to be undertaken in accordance with a fuel management plan prepared as a result of Recommendation 4 above; and Appendix 5 of *PBP*, also available from <u>www.rfs.nsw.gov.au</u> by following the links 'Publications' and 'Building in a Bush Fire Prone Area'.

Recommendation 5 – Installation of a radiant heat barrier as depicted within this report should be constructed as per the location drawing on Figure 2.9.

Recommendation 6 - The proposed building refurbishments are to comply with BAL 12.5 *Australian Standard AS3959 Construction of buildings in bushfire-prone areas (2009)* with additional construction requirements as listed within Section A3.7 of Addendum Appendix 3 *(PBP).*

Recommendation 7 – Access, water, electricity and gas supply is to comply with Section 4.2.7 of *PBP*.

Recommendation 8 – Air conditioning system design should ensure that filtration is in accord with ember elimination standards and smoke retardation. A specification for this should be provided prior to construction by an air-conditioner engineer.

Recommendation 9 – An emergency / evacuation plan is to be prepared consistent with the RFS *Guidelines for the Preparation of Emergency / Evacuation Plan.*

REFERENCES

- Australian Building Codes Board (2010) *Building Code of Australia*, Class 1 and Class 10 Buildings Housing Provisions Volume 2
- Chan, K.W. (2001) The suitability of the use of various treated timbers for building constructions in bushfire prone areas. Warrington Fire Research
- Councils of Standards Australia AS3959 (2009) Australian Standard Construction of buildings in 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
- Rural Fire Service (2006) *Planning for bushfire protection a guide for councils, planners, fire authorities and developers.* NSW Rural Fire Service

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

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



Performance based assessment

A1

Modelled Area A - south-eastern sector

Base Calculation

NBC Bushfire Attack Assessment Report V2.1 AS3959 (2009) Appendix B - Detailed Method 2			
Printed: 3/04/20	14 Assessment Date:	2/04/2014	FPA
Site Street Address:	Syd Harbour Trust Termir	nal 10, Mosman	Contilled Basinees Bashee Plansing 8 Oct Ch
Assessor:	John Travers; Travers Bu	shfire and Ecology	
Local Government Area:	Mosman	Alpine Area:	No
Equations Used			
Transmissivity: Fuss and H Flame Length: RFS PBP, 2 Rate of Fire Spread: Noble Radiant Heat: Drysdale, 19 Peak Elevation of Receive Peak Flame Angle: Tan et	łammins, 2002 2001 9 et al., 1980 985; Sullivan et al., 2003; Tai r: Tan et al., 2005 al., 2005	n et al., 2005	
Run Description: E	Eastern aspect off Blg 6		
Vegetation Information	<u>1</u>		
Vegetation Type:	Rainforest	Vegetation Group:	Forest and Woodland
Vegetation Slope:	8 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	10	Overall Fuel Load(t/ha):	12
Site Information			
Site Slope	3 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	33
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1200
Calculation Parameters	s		
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	g 18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack: N	ODERATE	Peak Elevation of Received	/er(m): 5.6
Level of Construction: B	AL 19	Fire Intensity(kW/m):	12921
Radiant Heat(kW/m2): 1	8.88	Flame Angle (degrees):	78
Flame Length(m): 14	4.99	Maximum View Factor:	0.208
Rate Of Spread (km/h): 2	.08	Inner Protection Area(m): 33
Transmissivity: 0.	.811	Outer Protection Area(m	i): 0

Pre-shield calculation

Run Description:	Run Description: eastern aspect pre shielding calc		
Vegetation Informatio	<u>n</u>		
Vegetation Type:	Rainforest	Vegetation Group:	Forest and Woodland
Vegetation Slope:	8 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	2.8	Overall Fuel Load(t/ha):	3.8
Site Information			
Site Slope	3 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	33
Fire Inputs			
Veg./Flame Width(m):	45	Flame Temp(K)	1200
Calculation Parameter	8		
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/k	g 18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	_OW	Peak Elevation of Receiv	ver(m): 0.39
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	1146
Radiant Heat(kW/m2): 3	3.93	Flame Angle (degrees):	87
Flame Length(m): 4	1.25	Maximum View Factor:	0.044
Rate Of Spread (km/h): 0).58	Inner Protection Area(m)): 33
Transmissivity: 0	.808	Outer Protection Area(m): 0

Shield Result calculation

Run Description:	eastern aspect Shield resul	t	
Vegetation Informatio	<u>n</u>		
Vegetation Type:	Rainforest	Vegetation Group:	Forest and Woodland
Vegetation Slope:	8 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	10	Overall Fuel Load(t/ha):	12
Site Information			
Site Slope	3 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	33
Fire Inputs			
Veg./Flame Width(m):	45	Flame Temp(K)	1090
Calculation Parameter	'S		
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/k	g 18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	.OW	Peak Elevation of Receiv	/er(m): 5.44
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	12921
Radiant Heat(kW/m2): 1	0.07	Flame Angle (degrees):	73
Flame Length(m): 1	4.99	Maximum View Factor:	0.165
Rate Of Spread (km/h): 2	2.08	Inner Protection Area(m): 33
Transmissivity: 0	.803	Outer Protection Area(m): 0

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Modelled Area B south-eastern sector

Base Calculation

NBC Bushfire Attack Assessment Report V2.1				
Printed: 3/04/201	4 Assessment Date:	2/04/2014	FPA	
Site Street Address: Syd Harbour Trust Terminal 10, Mosman			Bathle Pasinees Bathle Pasinees & desch	
Assessor:	John Travers; Travers Bu	shfire and Ecology		
Local Government Area:	Mosman	Alpine Area:	No	
Equations Used				
Transmissivity: Fuss and Ha Flame Length: RFS PBP, 20 Rate of Fire Spread: Noble Radiant Heat: Drysdale, 19 Peak Elevation of Receiver: Peak Flame Angle: Tan et a	ammins, 2002 001 et al., 1980 .85; Sullivan et al., 2003; Tai .Tan et al., 2005 al., 2005	n et al., 2005		
Run Description: S	Southeasern aspect 100fl	ame front base calc		
Vegetation Information	<u>1</u>			
Vegetation Type:	Rainforest	Vegetation Group:	Forest and Woodland	
Vegetation Slope:	8 Degrees	Vegetation Slope Type:	Downslope	
Surface Fuel Load(t/ha):	10	Overall Fuel Load(t/ha):	12	
Site Information				
Site Slope	3 Degrees	Site Slope Type:	Downslope	
Elevation of Receiver(m)	Default	APZ/Separation(m):	38	
Fire Inputs				
Veg./Flame Width(m):	100	Flame Temp(K)	1200	
Calculation Parameters	8			
Flame Emissivity:	95	Relative Humidity(%):	25	
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308	
Moisture Factor:	5	FDI:	100	
Program Outputs				
Category of Attack: MODERATE Peak Elevation of Receiver(m): 5.36				
Level of Construction: B	AL 19	Fire Intensity(kW/m):	12921	
Radiant Heat(kW/m2): 1	5.71	Flame Angle (degrees):	79	
Flame Length(m): 14	4.99	Maximum View Factor:	0.176	
Rate Of Spread (km/h): 2.	08	Inner Protection Area(m): 38	
Transmissivity: 0.	8	Outer Protection Area(m	i): 0	

Pre-shield calculation

Run Description:	southeastern pre shield cal	c		
Vegetation Informatio	<u>n</u>			
Vegetation Type:	Rainforest	Vegetation Group:	Forest	and Woodland
Vegetation Slope:	8 Degrees	Vegetation Slope Type:	Downs	lope
Surface Fuel Load(t/ha):	3.5	Overall Fuel Load(t/ha):	5	
Site Information				
Site Slope	3 Degrees	Site Slope Type:	Downs	lope
Elevation of Receiver(m)	Default	APZ/Separation(m):	38	
Fire Inputs				
Veg./Flame Width(m):	100	Flame Temp(K)	1200	
Calculation Parameter	8			
Flame Emissivity:	95	Relative Humidity(%):	25	
Heat of Combustion(kJ/k	g 18600	Ambient Temp(K):	308	
Moisture Factor:	5	FDI:	100	
Program Outputs				
Category of Attack: L	.OW	Peak Elevation of Receiv	/er(m):	0.68
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):		1884
Radiant Heat(kW/m2): 5	5.58	Flame Angle (degrees):		88
Flame Length(m): 5	5.34	Maximum View Factor:		0.063
Rate Of Spread (km/h): 0).73	Inner Protection Area(m):	38
Transmissivity: 0	.798	Outer Protection Area(m):	0

Shield Result calculation

Run Description:	Southeastern aspect shield	result		
Vegetation Information	<u>n</u>			
Vegetation Type:	Rainforest	Vegetation Group:	Forest	and Woodland
Vegetation Slope:	8 Degrees	Vegetation Slope Type:	Downs	lope
Surface Fuel Load(t/ha):	10	Overall Fuel Load(t/ha):	12	
Site Information				
Site Slope	3 Degrees	Site Slope Type:	Downs	lope
Elevation of Receiver(m)	Default	APZ/Separation(m):	38	
Fire Inputs				
Veg./Flame Width(m):	100	Flame Temp(K)	1200	
Calculation Parameter	s			
Flame Emissivity:	95	Relative Humidity(%):	25	
Heat of Combustion(kJ/k	g 18600	Ambient Temp(K):	308	
Moisture Factor:	5	FDI:	100	
Program Outputs				
Category of Attack: L	.OW	Peak Elevation of Receiv	ver(m):	5.36
Level of Construction: E	BAL 12.5	Fire Intensity(kW/m):		12921
Radiant Heat(kW/m2): 1	0.1	Flame Angle (degrees):		79
Flame Length(m): 1	4.99	Maximum View Factor:		0.113
Rate Of Spread (km/h): 2	2.08	Inner Protection Area(m):	38
Transmissivity: 0	.8	Outer Protection Area(m	ı):	0



Management of Asset Protection Zones



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

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

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

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

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

Table 1 – Fuel layers

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

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

Components of an Asset Protection Zone



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

hazard

Inner protection area (IPA)

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

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

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

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

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

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

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

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

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

Presence of trees within an inner protection area

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

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

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

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

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

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

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

Table 2 – Tree density in inner protection area

Outer protection area (OPA)

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

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

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

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

Managing the APZ

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

- Mowing grasses regularly grass needs to be kept short and, where possible, green.
- Raking or manual removal of fine fuels ground fuels such as fallen leaves, twigs (less than 6mm diameter) and bark should be removed on a regular basis. This is fuel that burns quickly and increases the intensity of a fire. Fine fuels can be removed by hand or with tools such as rakes, hoes and shovels.
- Removal or pruning of trees, shrubs and understorey the control of existing vegetation involves both selective fuel reduction (removal, thinning and pruning) and the retention of vegetation. Prune or remove trees so that you do not have a continuous tree canopy leading from the hazard to the asset. Separate tree crowns by 2-5m. A canopy should not overhang within 2-5m of a dwelling. Native trees and shrubs should be retained as clumps or islands and should maintain a covering of no more than 20% of the area.
- Tree or tall shrubs may require pruning upon dwelling completion in line with *PBP*. Notwithstanding this, the presence of shrubs and trees close to a dwelling in a bushfire prone landscape requires specific attention to day to day management and owners and or occupier should be made aware that whilst landscaping can contribute to a way of life and environmental amenity the accumulated.

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

- Ensure that vegetation does not provide a continuous path to the house
- Plant or clear vegetation into clumps rather than continuous rows
- Prune low branches 2m from the ground to prevent a ground fire from spreading into trees
- Locate vegetation far enough away from the asset so that plants will not ignite the asset by direct flame contact or radiant heat emission
- Ensure that shrubs and other plants do not directly abut the dwelling. Where this does occur, gardens should contain low flammability plants and non flammable ground cover such as pebbles and crush tile; and