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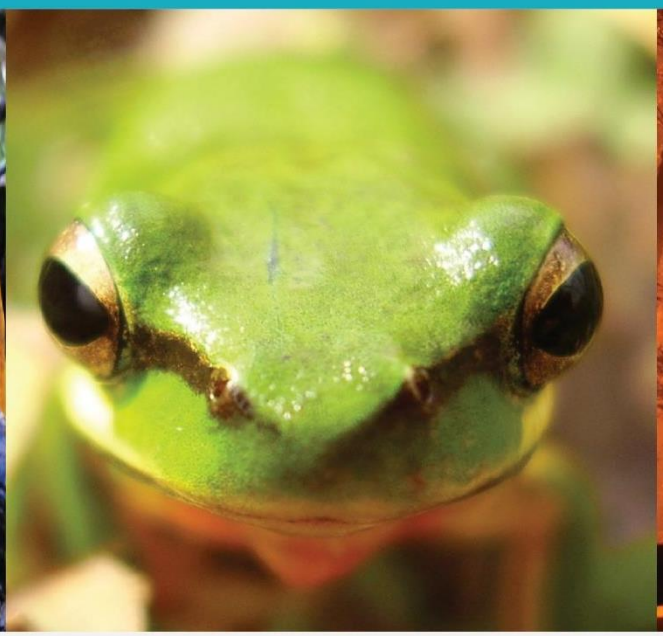

STRATEGIC BUSHFIRE STUDY

Patyegarang Planning Proposal

Morgan Road, Belrose

14 February 2024

(REF: 18CR39)

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Morgan Road, Belrose

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Date:	14/2/24
File:	18CR39

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EXECUTIVE SUMMARY

Travers bushfire & ecology (TBE) has been engaged by the Metropolitan Local Aboriginal Land Council (MLALC) to undertake a strategic bushfire study (SBS) for the Patyegarang Planning Proposal (PP) located at Morgan Road, Belrose.

This SBS specifically addresses the provisions of Chapter 4 – Strategic Planning in *Planning for Bush Fire Protection 2019* (*PBP*) and Ministerial Direction 4.3.

The proposal will involve a rezoning of the site to support future low density residential housing (44.46 ha), open space, Aboriginal cultural assets and conservation lands (27.54 ha).

The planning proposal seeks to retain vegetation in the middle of the site within Snake Creek whilst also retaining a tall heath vegetation assemblage in the eastern sector; and further forested lands in the south and southeast – see Figure X1.

A separate report prepared by *TBE* dated February 2024 addresses the site-specific bushfire protection measures identified in Chapter/s 3, 4 & 5 of *PBP*; and the proposed development plan is shown here as Figure X1.

Figure X1 – Proposed plan of development within PP area
(see A3 version in Appendix 1)

(Lime green represents the asset protection zones whilst the darker green colour represents the proposed conservation area whilst the lighter grey/ green represents the open space).

Location of the Patyegarang Planning Proposal

The suburb of Belrose. Belrose is represented below in Figure X2 by a red dashed line. The Patyegarang Planning Proposal area is located within the yellow circle in Figure X2.

Figure X2 – Location of PP site in relation to the suburb of Belrose

Format of the strategic bushfire study (SBS)

This SBS has analysed the surrounding landscape and land use context including the immediately adjoining land; potential and historic threats to the site; the current and projected access provisions; emergency services provision, and potential implications for infrastructure and utilities serving the community. The assessment was based on the site's current bushfire risk levels and the subsequent post development bushfire risk levels.

The SBS has applied a NERAG risk management protocol to verify the scale and context of potential strategic bushfire risks.

Consultation

Substantial agency and community consultation has occurred since 2018 as part the project's inclusion as part of the Aboriginal Land Planning framework . This has included consultation with RFS, Northern Beaches Council and the community in response to the Development Delivery Plan (DDP) process under the Planning Systems State Environmental Planning Policy 2021 (Aboriginal Land).

Peer reviews

Northern Beaches Council engaged specialist bushfire consultant firm namely Blackash Bushfire Consulting (November 2022) to independently review the Planning Proposal bushfire report prepared by *TBE*. Blackash advised the planning proposal provided a coherent,

evidence-based assessment of the proposal which has responded to the bushfire risk within and external to the site. They provided recommendations such as the assurance that the slip lane could be developed and a number of matters that were required to be considered. Matters such as vegetation at the terminal ends of riparian zones and the ownership of the Forest Way slip lane have been resolved in the amended documentation.

Northern Beaches Council also engaged Meridian Urban a specialist land use planning firm. They mapped fire line intensity of the PP suite as having a medium bushfire risk based on the calculation of fire line intensity (in k/Wm - see Figure 14 of their 2022 report). They later provided recommendations to Council asserting the Blackash list of recommendations (December 2023 report) which have been dealt with.

Community benefit

As required by *PBP* in Section 4 Table 4.2.1 there is a need to review *'the impact upon adjoining landowners and their ability to undertaken bushfire management'*. The predevelopment bushfire risk is principally the manner in which the unmanaged vegetation within the PP site provides a major threat to;

- A mix of urban development in the west and continues on the western side of Forest Way.
- Adjacent aged care and child care development/s on the corner of Forest Way.
- Morgan Road, the over 55's development off Lyndhurst Way and Oates Place in the west.
- Rural residential development to the north and east of Morgan Road.
- Two rural residential allotments to the immediate south of the PP site.
- The residential estate to the southeast of the PP site south of Childs Circuit and Laurie Place.
- OPTUS infrastructure in the south.

The current urban and rural residential landscape that surrounds the PP site can be seen in Figure X3 below.

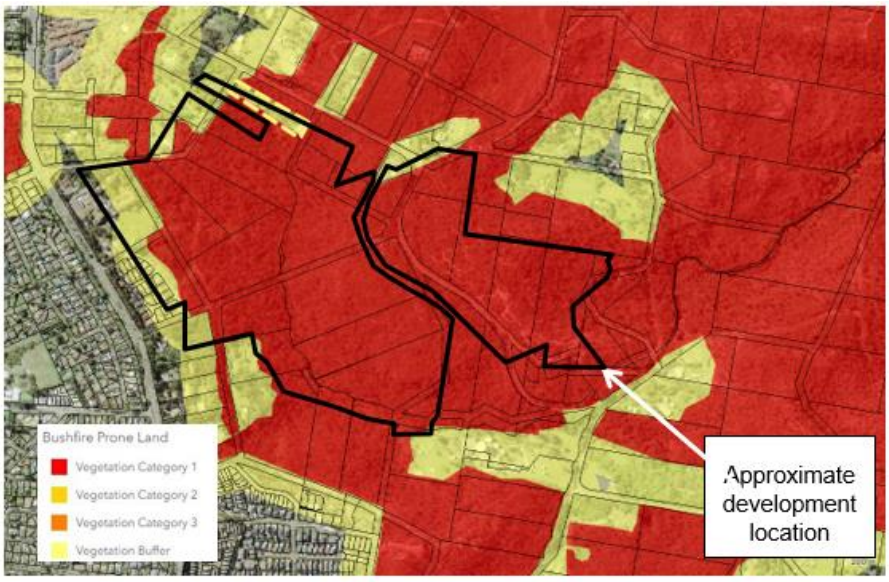

Figure X3 – Bushfire prone mapping as at 2023

The planning proposal either removes or significantly fragments the bushfire hazard – see Figure X5. This demonstrates a significant amount of bushfire prone lands (red colour) over the internal PP landscape which ensures a bushfire attack upon the existing community that resides on the eastern side of Forest Way (see Yellow polygon on Figure X4) and by default a similar exposure to the existing residential community to the south of the PP area (see Red polygon on Figure X4) south of Childs Circuit and Laurie Place; and to a lesser extent the OPTUS facility (See Blue polygon).

The vegetation removal proposed by the planning proposal will dramatically lessen the bushfire threat upon those locations whilst also providing a significant level of protection to the rural residential properties as shown in the Orange polygon. As also required by PBP 2019 in Section 4 Table 4.2.1 there is also a significant benefit for the volunteers who fight the fires for the RFS in that they have roads and asset protection zones where there are currently no such opportunities.

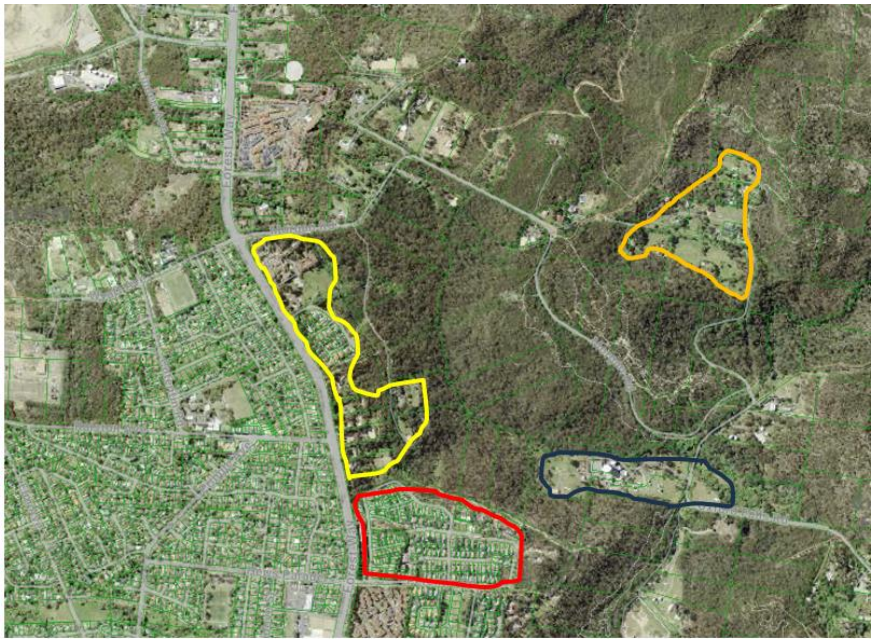

Figure X4 – Residential areas gaining from the revised bushfire prone lands mapping

Figure X5 – Post development bushfire prone mapping

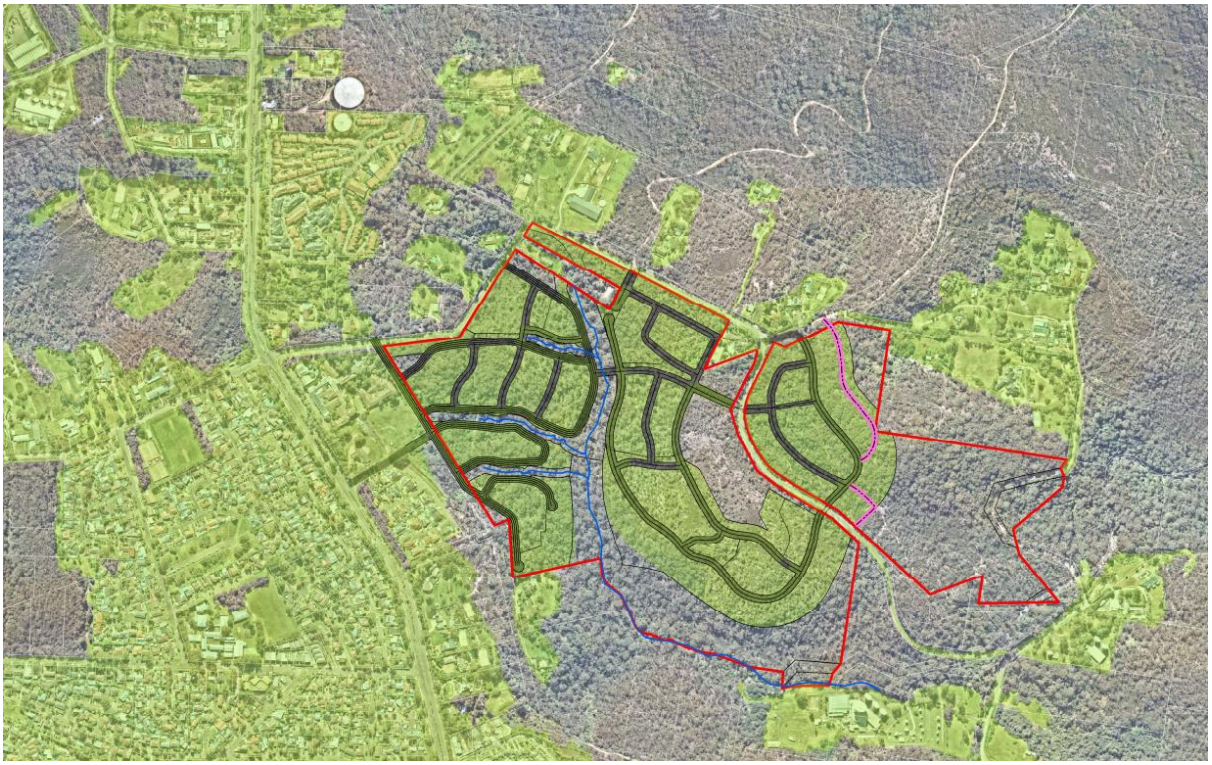

Figure X6 – Post development asset protection zones
(Green colour represents managed areas or proposed asset protection zones)

Outcomes of the study

- The existing bushfire hazards provide significant risk to the existing residential community and the aged care facility; and potentially denies safe evacuation in a bushfire emergency event.
- The planning proposal will remove substantial bushfire hazards that threaten the community.
- The study found the site was not a high-risk bushfire site due to the non-remote nature of the proposal and the limited bushfire hazard exposures affecting the site. Strategically, the site is surrounded by rural residential development in the north and east and low-density residential development in the west leaving only two unmanaged bushland areas in the north east and south both of which produce a moderate exposure to radiant heat (17.4 k/Wm2) which is well below the RFS permitted standard of 29k/Wm2.
- The PP proposes a new slip lane from Morgan Road onto Forest Way and a full reconstruction of Morgan Road to a point 1.8 km from the intersection with Forest Way thus enabling free flowing traffic in the event of an emergency evacuation.
- Traffic modelling advises there will be no traffic queuing at the Forest Way / Morgan Road intersection.
- Safe access and egress for fire fighters and emergency services in the using of the new road.

In conclusion the strategic bushfire study found the Patyegarang Planning Proposal;

- Was a logical extension of existing urban landscape.
- Enabled significant benefits to approximately 50 local families either in the relocation of bushfire prone land or through increased evacuation capability with the reconstruction and widening of Morgan Road coupled with the new slip lane onto Forest Way.

Recommendation

The Patyegarang Planning Proposal has been found to comply with *PBP* section 4 and with Ministerial Direction 4.3 on strategic planning grounds.

John Travers
Travers bushfire & ecology

STRUCTURE OF THIS REPORT

In the delivery of a strategic bushfire study this report has been structured as follows;

- Part 1 provides an explanation of the planning proposal.
- Part 2 provides background to the consultation and peer reviews.
- Part 3 provides a background to the site, its context and contributing background such as fire history, fire behaviour, potential bushfire threats and traffic assessment. This section also deals with land use density as a measure of how *PBP* deals with development control.
- Part 4 begins the risk assessment process by introducing a framework for risk assessment and identifies the theoretical manner in which a bushfire assessment should be considered and undertaken.
- Part 5 addresses the risk assessment of the site in terms of what the risk is pre-development and places a context to that risk in terms of bushfire related issues and traffic related issues.
- Part 6 then addresses how the planning proposal changes the current risk and creates a safer environment for the proposed community and the current community as required by *PBP*.
- Part 7 provides a conclusion and recommendation.

GLOSSARY OF TERMS

AHIMS	Aboriginal Heritage Information System
APZ	asset protection zone
AS1596	*Australian Standard – The storage and handling of LP Gas*
AS2419	*Australian Standard – Fire hydrant installations*
AS3745	*Australian Standard – Planning for emergencies in facilities*
AS3959	*Australian Standard – Construction of buildings in bushfire-prone areas 2018*
BAL	*bushfire attack level*
BCA	*Building Code of Australia*
BSA	bushfire safety authority
DA	development application
DLUP	Development Land Use Plan
EEC	Endangered ecological community
EP&A Act	*Environmental Planning & Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
FFDI	forest fire danger index
IPA	inner protection area
LEP	Local Environmental Plan
LGA	local government area
m	metres
NCC	*National Construction Code*
OPA	outer protection area
PBP 2019	*Planning for Bush Fire Protection 2019*
RF Act	*Rural Fires Act 1997*
RFS	NSW Rural Fire Service
SFR	short fire run
SFPP	special fire protection purpose
TBE	*Travers bushfire & ecology*

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PART 1

INTRODUCTION

1.0 INTRODUCTION

Travers bushfire & ecology (TBE) has been engaged to undertake a strategic bushfire study for the *Patyegarang Planning Proposal* located off Morgan Road, Belrose – see Figure 1.1. The site area is approximately 72 ha with 44.46 ha proposed for low density residential development and 27.54 ha for conservation purposes.

The proposal is subject to the requirements of Section 9.1(2) of the *Environmental Planning and Assessment Act* 1979 (*EP&A Act*) which requires the assessing authority to consult with the Commissioner of the NSW Rural Fire Service and to take into account any comments by the Commissioner.

Figure 1.1 – Patyegarang Planning Proposal site

1.1 Aims of the assessment

The aims of the SBFS are to:

- Review the bushfire threat to the landscape
- Assess current and proposed bushfire protection measures
- Assess the capacity of the site and surrounding area, including services, to accommodate increased development
- Consider the application of a higher risk assessment protocol
- Determine the overall suitability of the planning proposal from a bushfire protection viewpoint.

1.2 Planning Proposal

The objective of the Planning Proposal is to create a residential community which embodies strong conservation principles to support the enhancement of the unique environmental and Aboriginal cultural heritage characteristics of the site.

The intended outcome of the Planning Proposal is to amend the applicable local planning controls to accommodate up to 450 new residential dwellings with a variety of scale and character reflective of the dominant dwelling type in the Belrose locality, as well as a new cultural community centre and protection of Aboriginal heritage sites.

A draft structure plan has been prepared by COX Architecture that is reflective of the site's opportunities and constraints in the areas of flora and fauna biodiversity, bushfire management, transport planning, Aboriginal heritage and stormwater management.

In essence the land uses are as follows;

- Developed area include residential / Aboriginal cultural heritage and associated cultural centre / pocket park, pedestrian and vehicular network
- Asset Protection Zones will be contained within the developable area and managed as asset protection zones in compliance with NSW Rural Fire Service guidelines for APZ management.
- Conservation lands will be maintained in perpetuity by the future community association and Metropolitan Local Aboriginal Land Council.

Recommendations have also been made for future road and fire design, fuels management, traffic management, emergency management, building construction, water supply and peripheral land management.

Of significance is the access / egress capability which has been given significant weight for the overall development design. In this regard the development area is proposed to be accessed via;

- Morgan Road at three (3) locations. Strategically a left turning slip lane detailed design has been completed by the surveyors in liaison with the traffic consultants for the Morgan Road / Forest Way intersection. This will not be controlled by traffic lights.
- Forest Way at two (2) locations – see Figure 1.3 below. The Oates Place access will be in emergencies only.

As required by *PBP* in Section 4 Table 4.2.1 there is a need to review *'the impact upon adjoining landowners and their ability to undertaken bushfire management'*. The predevelopment bushfire risk is principally the manner in which the unmanaged vegetation within the PP site provides a major threat to;

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- OPTUS infrastructure in the south.

Figure 1.2 – Rezoning plan
Legend: *Dark Green – C2 Zone, Light Green – RE2 Zone, Pink – R2 Zone*

Figure 1.3 – Possible development design and retained vegetation zones (Hayes Environmental 2023)

1.3 Information collation

Information sources reviewed for the preparation of this report include the following:

- Bushfire protection - *Travers bushfire & ecology*, July 2023
- Traffic - JMT Consulting, December 2023
- Concept plans - Cox Architecture, 2023
- Biodiversity - Hayes Environmental 2023
- National Emergency Risk Assessment Guidelines 2018 (NERAG)
- *NearMap* aerial photography
- *Deferred Lands Strategic Bushfire Risk Assessment*, Meridian Urban, March 2021
- Topographical maps DLPI of NSW 1:25,000
- *Australian Standard 3959 Construction of buildings in bushfire-prone areas (2018)*
- *Planning for Bush Fire Protection 2019 (PBP)*

An inspection of the proposed development site and surrounds was undertaken by John Travers on over 20 occasions between 2002 and 2023 and by Tony Hawkins on several occasions during autumn 2022. The inspection comprised an assessment of the topography, slopes, aspect, vegetation and adjoining land use. The identification of the wider landscape bushfire risk and existing protection measures was also conducted.

1.4 Legislation and planning instruments

Is the site mapped as bushfire prone?	Yes
Proposed development type	Residential subdivision
Is the development considered integrated for the purposes of Section 100B of the *Rural Fires Act 1997?*	Yes
Is the proposal located in an Urban Release Area as defined under Clause 273 of the EP&A Regulations?	No
Is the land subject to a Development Delivery Plan (DDP) under the Planning Systems State Environmental Planning Policy 2021 (Aboriginal Land).	Yes
Zoning	Deferred Matter
Significant environmental features	Yes – the proposed development (including APZs) will involve the removal of native vegetation.
Details of any Aboriginal heritage	Aboriginal sites and places have been recorded on the site and are well known. An AHIMS report is attached in Appendix 3.

1.4.1 Environmental Planning and Assessment Act

The *EP&A Act* governs environmental and land use planning and assessment within New South Wales with state environmental planning policies assisting that implementation along with environmental planning instruments, development controls and the operation of construction controls through the *National Construction Code (NCC).*

1.4.2 Ministerial Directions under 9.1 of the EPA Act.

The Minister has the power under section 9.1 to require certain 'Ministerial Directions.' One such direction is 4.3 *Planning for Bushfire Protection.* The objectives of the direction are to:

> *(a) protect life, property and the environment from bush fire hazards, by discouraging the establishment of incompatible land uses in bush fire prone areas, and*
> *(b) encourage sound management of bush fire prone areas.*

This direction applies to all local government areas when a relevant planning authority prepares a planning proposal that will affect, or is in proximity to, land mapped as bushfire prone land. This applies where the relevant planning authority is required to prepare a bush fire prone land map under section 10.3 of the EP&A Act, or, until such a map has been certified by the Commissioner of the NSW Rural Fire Service, a map referred to in Schedule 6 of that Act.

Direction 4.3

(1) In the preparation of a planning proposal the relevant planning authority must consult with the Commissioner of the NSW Rural Fire Service following receipt of a gateway determination under section 3.34 of the Act, and prior to undertaking community consultation in satisfaction of clause 4, Schedule 1 to the EP&A Act, and take into account any comments so made.

(2) A planning proposal must: (a) have regard to Planning for Bushfire Protection 2019, (b) introduce controls that avoid placing inappropriate developments in hazardous areas, and (c) ensure that bushfire hazard reduction is not prohibited within the Asset Protection Zone (APZ).

(3) A planning proposal must, where development is proposed, comply with the following provisions, as appropriate:

> *(a) provide an Asset Protection Zone (APZ) incorporating at a minimum: i. an Inner Protection Area bounded by a perimeter road or reserve which circumscribes the hazard side of the land intended for development and has a building line consistent with the incorporation of an APZ, within the property, and ii. An Outer Protection Area managed for hazard reduction and located on the bushland side of the perimeter road,*
>
> *(b) for infill development (that is development within an already subdivided area), where an appropriate APZ cannot be achieved, provide for an appropriate performance standard, in consultation with the NSW Rural Fire Service. If the provisions of the planning proposal permit Special Fire Protection Purposes (as defined under section 100B of the Rural Fires Act 1997), the APZ provisions must be complied with,*
>
> *(c) contain provisions for two-way access roads which links to perimeter roads and/or to fire trail networks,*
>
> *(d) contain provisions for adequate water supply for firefighting purposes,*
>
> *(e) vocalizes the perimeter of the area of land interfacing the hazard which may be developed,*
>
> *(f) introduce controls on the placement of combustible materials in the Inner Protection Area.*

1.4.3 Rural Fires Act 1997 (RF Act)

The proposal is subject to the requirements of Section 9.1(2) of the *Environmental Planning and Assessment Act* 1979 (*EP&A Act*) which requires the assessing authority to consult with the Commissioner of the NSW Rural Fire Service and to take into account any comments by the Commissioner.

1.4.4 Bushfire prone maps

Bushfire prone land maps provide a trigger for strategic planning and development assessment. The proposed rezoning is located on land that is mapped by Northern Beaches Council as being bushfire prone – Category 1 vegetation (depicted red) and its associated buffer (depicted yellow) – see Figure 1.4.

Figure 1.5 depicts a broader vision of the bushfire prone mapping.

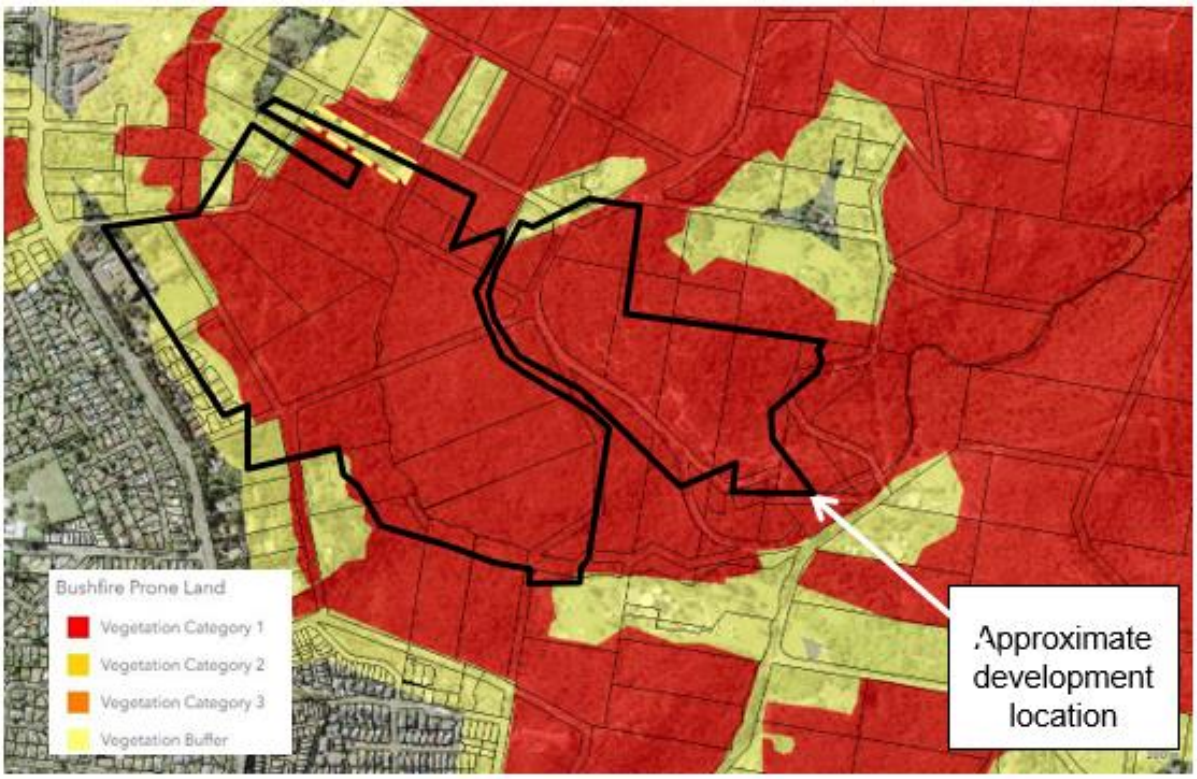


Figure 1.4 – Bushfire prone land map (January 2024, RFS)

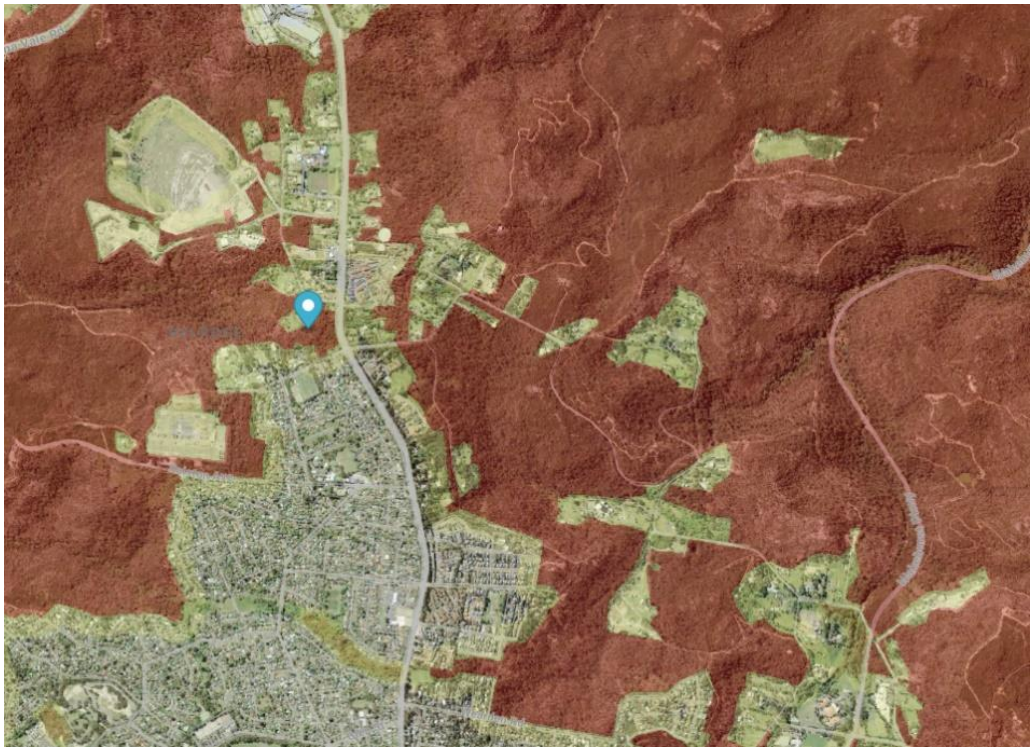


Figure 1.5 – Broader depiction of the local bushfire prone mapping (January 2024, RFS)

1.4.5 Planning for Bush Fire Protection 2019 (PBP)

Bushfire protection planning requires the consideration of the RFS planning policy document entitled *Planning for Bushfire Protection (PBP)* published in 2019*. PBP* provides planning controls for building in bushfire prone areas as well as guidance on strategic planning in bushfire prone areas.

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

- *afford buildings and their occupants protection from exposure to a bush fire.*
- *provide for a defendable space to be located around buildings.*
- *provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings.*
- *ensure that appropriate operational access and egress for emergency service personnel and occupants is available;*
- *provide for ongoing management and maintenance of BPMs; and*
- *ensure that utility services are adequate to meet the needs of firefighters.*

The RFS requires additional objectives to be considered for special protection developments such as

1. minimise levels of radiant heat, localised smoke and *ember attack through increased APZ, building design and siting.*

2. *provide an appropriate operational environment for emergency service personnel during firefighting and emergency management.*

3. *ensure the capacity of existing infrastructure (such as roads and utilities) can accommodate the increase in demand during emergencies as a result of the development.*
4. *ensure emergency evacuation procedures and management which provides for the special characteristics and needs of occupants.*
5. *The nature of SFPP developments means that occupants may be more vulnerable to bushfire attack because;*

    - *they may be less aware in relation to bush fire impacts.*
    - *they may have reduced capacity to evaluate risk and respond adequately to the bush fire threat.*
    - *They may present operational difficulties for evacuation and or management.*
    - *they may be more vulnerable to stress and anxiety arising from bush fire threat and smoke.*
    - *there may be significant communication barriers.*
    - *supervision during a bush fire may be difficult; and they may be unfamiliar with the area.*

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:

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

1.4.6 National Construction Code (NCC) and the Australian Standard AS3959 Construction of buildings in bushfire-prone areas 2018 (AS3959)

The *NCC* (2022) 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 for residential buildings is the *AS3959 Construction of buildings in bushfire-prone areas* 2018.

1.4.7 Planning Systems State Environmental Planning Policy 2021 (Aboriginal Land)

The site is identified in a Development Delivery Plan (DDP) under the Planning Systems State Environmental Planning Policy 2021 (Aboriginal Land).

The DDP initiatives a framework for identified development sites and pathway to investigation and potential approval, including rezoning if required.

PART 2

CONSULTATION AND PEER REVIEWS

2.0 CONSULTATION AND PEER REVIEWS

2.1 Determining stakeholders

The stakeholders have been identified as;

- The landowner being the Metropolitan Local Aboriginal Land Council has a committed interest in the delivery of land for their community and hope to seek an economic outcome that benefits the wider first nations community.
- The Rural Fire Service are responsible for integrated development planning in bushfire prone areas.
- Fire & Rescue NSW has occurred but they deferred to the RFS.
- Northern Beaches Council has a role in local planning.
- NSW State Emergency Service has a role in emergency response and recovery.
- Transport NSW has a role in transport delivery and road management.

Consultation with NSW Environment & Heritage has occurred in regard to APZ impacts upon biodiversity however the responses are not dealt with herein as they are comments on biodiversity impacts not bushfire impacts.

Consultation is also being undertaken with the following organisations by the planning proposal applicant and will be provided to the Department of Planning, Housing and Infrastructure (DPHI) for review. Arising from the fact that these organizations do not have a specific bushfire interest they are not dealt with herein.

- Sydney Water
- Jemena
- Ausgrid
- NBN Co
- NSW Environment and Heritage
- NSW Environment Protection Authority
- Commonwealth Department of Climate Change, Energy, the Environment and Water
- Natural Resource Access Regulator
- Department of Education
- NSW Health – Northern Local Health District

2.2 Consultation with RFS

A pre-planning proposal assessment of the likely development was lodged with the RFS in late August 2021.

On 1 October 2021 the RFS provided comments which were both favourable and supportive. Most importantly the RFS provided advice on what should be covered in the next iteration of the bushfire assessment. Their advice is provided in Column 1 and advice in respect of those comments by the undersigned is provided in Column 2.

Contact with RFS	RFS comments	Response
August 2021	Bushfire protection assessment submission made to RFS	
October 2021	Additional information should be provided on the nature of the proposed community centre/offices and retail space.	This was provided in an amended report on 6 October 2021
	The use of Short Fire Run (SFR) Methodology is not supported, and any mention of SFR should be removed from the bush fire report.	This was a typographical error and was omitted
	The APZ distances shown in the bush fire report must be updated as discussed with John Travers, with the thin riparian areas (less than 20 metre width) treated as remnant, and the wider riparian trunk treated as Forest.	This was provided in an amended report on 6 October 2021
	As some areas of the proposed APZs are on slopes greater than 18°, a management plan must be submitted at the development application (DA) stage to demonstrate how the APZ will be implemented and maintained as per Section 3.2.2 of *Planning for Bush Fire Protection (PBP) 2019*.	A Geotech statement from a qualified practitioner will be provided at DA stage and this is normally acceptable and satisfactory to the RFS. As advised within the report these slopes are on land mainly composed of sandstone bedrock and escarpments which are solid and stable landscapes.
	Sector S2 will require the provision of a compliant perimeter road.	This is noted and a preliminary engineering design has been prepared for a PBP compliant 200m long road.
	The proposed slip-road on Forest Way is seen as essential to enable vehicles to enter Forest Way from Morgan Road and head easterly without being subject to traffic light control.	Agreed. This is why it was designed that way with the Draft Structure Plan now amended to show its presence.
	As suggested in the bush fire report, a Bush Fire Emergency Management and Evacuation Plan must be prepared consistent with *Development Planning- A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan December 2014*.	These documents are typically required for DA and they will be thoroughly considered and assessed prior to their lodgement with DA documentation.
17 March 2022	The report was re-submitted back to the RFS in early 2022 Direct consultation with the RFS occurred on the 17th March 2022 where representatives of the RFS and the applicant met on zoom for a specific bushfire session that also involved traffic and biodiversity consultants - as these disciplines are central to effective bushfire planning in terms of traffic safety and fuel management of the residual hazardous vegetation assemblages. The meeting sought to provide an overview for the participants of the meeting such that they	The RFS provided comments on 13 May 2022 and again they advised they had no specific objections. Arising from the meeting was a request from the RFS to provide detail in respect of traffic evacuation scenarios for example to provide further detail on the slip road design and to undertake traffic scenario modelling on various scenarios such as when the emergency Oates Place gate was closed, any flood restrictions, tonnage limits, rat run etc); provide road designs assurances that roads would be designed as specified in PBP. *JMT Consulting* were engaged to

Contact with RFS	RFS comments	Response
	were all on the same page in terms of bushfire, traffic planning and ecology. Indeed, the meeting enabled the RFS to express any concerns they may have had with other members of the government team especially with DPIE staff and had there been misunderstandings then the applicant's consultants were there to clarify or to go away and reflect. In terms of fuel management of the asset protection zones the RFS sought information on 'who and how' fuel management would occur within those APZs. The RFS sought to know how the emergency egress gate at Oakes Road.	undertake the requested modelling and their report was produced in June 2022 and amended in December 2023. The bushfire author herein advised that significant field work with *Hayes Consulting* discussing and reviewing the various vegetation assemblages on the site was thus able to provide clarity on bushfire APZ's and fire trails. Day to day access from Oates Place to be controlled
9 October 2023	Zoom meeting with RFS arranged by DPIE	
	As a follow up to that zoom meeting Deputy Commissioner Matt Smith to upgrade the load rating to reflect RFS requirements for development within a bushfire prone area.	The concrete bridge was built and finished in 2023 and is capable of supporting Cat 1 tankers.
Letter from RFS 9 November 23	RFS letter (9 November 2023) states in its last paragraph; "Compliance with the minimum standards of Planning for Bush Fire Protection 2019 at the development application stage, as proposed in the Bushfire Protection Assessment prepared by Travers bushfire & ecology dated 28 July 2023 (REF: 18CR12), is not an appropriate solution to minimise the risk for high risk sites at the strategic planning stage. Additional bushfire protection measures will need to be proposed to further mitigate the risk	"minimum standards of planning" is not a concept contained in PBP 2019PBP refers to 'minimum distances for APZs and the proposal satisfies these requirements. A conservative approach to identifying indicative APZs have been included in the PP. Further detail on APZs and other bushfire protection measures will be confirmed at DA stage.
Zoom with RFS 17 Nov 2023	Matt Smith (RFS) raised issues in respect of the strategic assessment criteria used for the project where he believed a higher level of strategic assessment should be used in the assessment of this project. Notwithstanding that belief there was no methodology suggested nor provided to aid that belief. Alastair Patton advised he believed there was anomalies in the strategic bushfire assessment and said the site was a high-risk site. He referred to the current Warringah Bushfire Risk Management Plan (2011) which identified the site as having an extreme risk whilst the draft 2023 Northern Beaches Bushfire Risk Management Plan identifies the site as high risk to highest risk	A revised strategic assessment using a risk management protocol was undertaken and submitted on 18 January 2024. The current site conditions would deem the site high risk however with the removal of substantial vegetation hazards changes that categorisation dramatically. Indeed, our modelling demonstrates that the amended risk is not high.
	After the meeting John Travers sought clarification on this from Alistair Patton. He replied by email on 18 November 2023.	

Contact with RFS	RFS comments	Response
	Alistair, in his reply, stated in an email 'To clarify, the intent of that paragraph was to point out that strategic issues such as landscape risk and access etc, cannot always be mitigated by simply complying with the standard site specific PBP Bushfire Protection Measures at the DA stage. Otherwise, there would be no point to strategic planning.'	This explanation is better understood and the amendment to the bushfire strategic study is now attached
Question from DPIE	Tegan Harris (DPIE) asked the question of the R–S - would the development be better for the community in terms of hazardous fuels reduction. Alastair Patton responded by stating PBP was about reducing risk but stopped short about making such a prediction	The PP proposes a removal of risk for the existing community and the proposed community. The bushfire design provides a marked improvement affect upon the existing residential communities living along Morgan Road, Hilversum Crescent, Slippery Dip Trail, Oates Place, Lyndhurst Way, Caleyi Way and Ocean View Way. In addition, there will be a significant benefit gained for the adjacent special protection facilities such as the; • Uniting Church Pre School and the Uniting Church aged Care facility on the corner of Morgan Road and Forest Way, and • The proposed aged care facility at 181 Forest Way Belrose • The evacuation capabilities of the OPTUS radar unit on Oxford Falls Road. The assessment has concluded that future development on site will provide compliance with the planning principles of *PBP* 2019 and the RFS *Community Resilience Practice Note 2/12– Planning Instruments and Policies.*
17 November 2023	A zoom meeting occurred whereby DPIE managed the event. DPIE, RFS and a full consultant team from the Patyegarang Project attended. The meeting was chaired by Rohan Johnson from DPIE.	
	RFS provided further detail of their assessment highlighting the methodology and data that underpinned their submission. RFS raised that there was no clear assessed on the risk profile of the site, noting that it relied on previous report. RFS noted that there was some inconsistencies in the risk of exposure of the site and importantly, the conclusions of the report are unclear. RS acknowledge that to mitigate the risk they seek to apply the requirements of PBP including for future development.	The project team and the RFS at a convenient confirm the methodology of methodology to be used to undertake additional assessment, and the RFS is to undertake broad landscape bushfire modelling to assist

Contact with RFS	RFS comments	Response
	Bushfire modelling was also discussed noting that the recently endorsed Warringah BFRMP identifies nearby assets are exposed to extreme risk and are high risk intersections and access roads and in proximity to the site	Noted
	RFS also provided further advice regarding evacuation, noting that one of the main concerns is that the strategic bushfire assessment did not adequately assess this, and additional modelling is required, including the secondary evacuation areas	Traffic Modelling provided in December 2023 version of Traffic report by JMT Consulting
	RFS provided comment that whilst this I can achieve compliance with the minimum standards of Planning for Bushfire Protection 2019 at the development application stage, however given the complexity of the site the surrounding context, further measures may be required. It was noted that the surrounding area is affected in a wider context, with Forest Way serving as an evacuation route for regional catchment. It was recognised that this is the existing issue, and the planning proposal should be considered in this context.	Further discussion is required including by the RFS and the LEMC.
	<u>Actions arising;</u>	PDU to coordinate RFS and proponent team and review risk methodology and undertake bushfire modelling to determine exposure decide to bushfire risk. RFS advise of modelling outputs
		RFS to provide risk management plan Travers to confirm the update of the strategic bushfire risk assessment
		RFS to commence discussions with the local emergency management committee to progress baseline assessment of regional evacuation medicine requirements

2.3 Northern Beaches Council

Author of the peer review	Basis, extent and commentary of the review	Responses by *Travers bushfire & ecology*
Blackash Bushfire Consultants	In 2022 Northern Beaches Council engaged Blackash Bushfire Consultants to undertake a review of the Patyegarang site and in particular the following documents; Bushfire Protection Assessment prepared by Travers bushfire & ecology 13 October 2022. Strategic Bushfire Study prepared by Travers bushfire & ecology 6 September 2022 Transport Assessment prepared by JMT Consulting June 2022 Blackash produced their advice in November 2022 whereby they concluded; The PP and associated technical documents relating to bushfire provide a coherent, evidence-based assessment of the proposal which has responded to the bushfire risk within and external to the site (Blackash, November 2022 Section 6 page 28). They went on to advise that emergency egress slip land ownership was not proven as the land was owned by Council and that Council had not issued their consent. Blackash advised this was a fundamental matter that required compliance before the PP could pass Gateway. Blackash recommended other matters which can be addressed in the DA stage of development.	We can advise this has been proven through design by Craig & Rhodes (2023) and their most recent design undertaken in collaboration with the traffic consultants JMT Consulting. This revised design does not rely on land owned by Northern Beaches Council. Most matters were dealt with in subsequent reports e.g. the Bushfire protection assessment was amended in July 2023 or will be amended by recommendations in this report. Traffic report was amended in December 2023 and the July 2022 The Strategic Bushfire Study was completely amended in January 2024 with measures recommended by Blackash having been undertaken.
Meridian Urban	In 2021 Northern Beaches Council engaged Meridian Urban to undertake a review of Deferred Lands. Their assessment was carried out in consultation with Northern Beaches Council and the RFS, and was prepared in accordance with the current PBP 2019 statutory guideline, and Planning Ministerial Direction 4.3 – Planning for Bush Fire Protection (pursuant to Section 9.1(2) of the EP&A Act 1979).	NERAG is the same protocol used in this bushfire strategic study prepared by Travers bushfire & ecology, Jan 2024. The outcome of the Meridian Urban assessment was the production of ‘fire line intensity mapping’ which seeks to advise on how a site is affected by incoming fire-runs and through the visual mapping demonstration of those modelled fire runs and their fire line intensities.

Author of the peer review	Basis, extent and commentary of the review	Responses by *Travers bushfire & ecology*
	They advised that 'the risk assessment process was undertaken through the specific lens of risk-based land use planning and using the processes outlined by the National Emergency Risk Assessment Guidelines (NERAG) published by the Australian Institute for Disaster Resilience (AIDR) as well as AS/NZS ISO 31000: 2018 Risk management: principles and guidelines (ISO 31000)'. Meridian Urban advised that their report constituted a Strategic Bush Fire Study for the purposes of Planning for Bush Fire Protection (PBP) 2019. They stated that they 'undertook a detailed review whereby the purpose of this landscape-scale strategic risk assessment is to recommend land use planning controls for the area under the new Northern Beaches LEP and DCP which respond to the bush fire risk profile of the area. Their assessment included a review of; a review of past, current and future data on bush fire behaviour and management; a review of relevant ecological and environmental data; the identification of the exposure and vulnerability of the Deferred Lands to risk from bush fire events, including fire run analysis; the identification of key resilience factors to bush fire; an examination of the adequacy of existing measures to address bush fire risk now and into the future, including e.g. asset protection zone impacts versus risks to loss of valued bushland and biodiversity, and implications for evacuation; a review of the probability and consequences of major bush fire events including consideration of impacts on people, property, vulnerable land-uses, infrastructure, the environment, and the economy; and the identification of actions to reduce bush fire risk now and into the future, with specific recommendations for future land	Their mapping (particularly, Figure 14 and replicated in Appendix A within their report) showed that 95% of the PP site is affected by the classification 4,000 to 20,000 k/Wm when assessed against an FFDI of 100. This is the medium category. This is fully explained in this strategic bushfire study at section 3.4. In short, their light-yellow colour represent low fire line intensity fully covered the PP site area and clarifies that the PP site is not in close proximity to their modelled higher intensity fire scenarios which are mapped as rick red colours. We do note a small area of steep forest in the southeast sector of the site. In conclusion the Meridian report provided no quantitative reasoning nor subjective opposition to residential development of the Patyegarang site.

Author of the peer review	Basis, extent and commentary of the review	Responses by *Travers bushfire & ecology*
	use planning provisions including LEP and DCP controls that balance effective bush fire management and protection with the ecological value of the Deferred Lands.'	
Meridian Urban	In 2023 Meridian Urban were again engaged by Northern Beaches Council whereby they provided amended advice regarding the Patyegarang site. We note that no additional modelling or field work was undertaken for the new assessment. This time Meridian Urban emphasised the proximity of the higher fire line intensities as having an affectation upon the Patyegarang site. See Section 3.4 herein for a fuller explanation. Meridian Urban then addressed the 2022 Blackash Report by dissecting their recommendations and creating a series of critical elements which they deemed as needing to be resolved before a planning proposal could proceed.	Meridian Again, there is no demonstrable quantitative or subject assessment that leads to why residential development should be reconsidered for the Patyegarang site. Meridian replicated points made by Blackash but they (Meridian) failed to undertake their own due diligence to determine that most of those points were either in error or were amended in subsequent reporting.

2.4 Consultation with State Emergency Services (SES)

12 October 2023	SES advised bushfire was not in their role and spoke mainly on flood matters and especially in relation to additional flood date required to be considered e.g. likely flood levels, flood velocity, depth of flooding and roads likely to be impacted by flooding	Craig & Rhodes to update their report with new flood data after liaising further with SES.

2.5 Consultation with Transport NSW

17 March 2022	Pete Mann – expectation of PP – end of FY for gazetted, PP in July and Gateway Nika Fomin (RFS) – better understanding. More scenarios and risk scenarios – go through the things that are not obvious. Transport feedback for the slip road – Pete Mann (offline) – merge & safety concern – network & safety & action plan	JMT Consulting to respond in their traffic assessment report
3 March 2023	No readable Minutes available of the meeting but notes taken indicate a general discussion on traffic detail and	JMT Consulting to respond in their traffic assessment report

	nothing specific to bushfire apart from the proposed slip road.	
23 May 2023	Queries by Fiona Chan Transport Planning Manager – Eastern City Land Use and Network Planning, Planning and Programs, Greater Sydney - via email. How do the residents connect to the Public Transport and the Active transport routes? Do the buses have the capacity at the moment, would there need to be more services to cater for the residences or would it be more likely to be private vehicle access. Please show this in your next report. Check with SES about how the people in the 500 residences will impact the overall evacuation strategy for the region, not just your development. Is the Morgan Road intersection and travelling south – does this impact adversely the existing evacuation route for SES.	Matters are addressed by JMT Consulting in their traffic assessment report

2.6 Consultation with Fire & Rescue NSW

1 September 2023	Fire & Rescue advised DPE James Shelton that they believe RFS and SES cover their issues and will not be involved till DA stage.

PART 3

HAZARD IDENTIFICATION AND EXPLANATION

3.0 HAZARD IDENTIFICATION AND EXPLANATION

3.1 Landscape assessment

The development site is located within the local government area (LGA) of Northern Beaches Council and situated to the south of Morgan Road in the north, east and west of Morgan Road, Belrose in the central area; and north of the Telstra Satellite facility in the south.

The site is predominately covered in native vegetation with varying levels of disturbance. Several identified (AHIMS report, Appendix 3) Aboriginal cultural sites are located within and adjacent to the proposal area.

Snake Creek flows through the site in an approximate north to south orientation. Existing development in the west includes rural residential development, residential development and the Uniting Wesley Gardens Aged Care Facility. To the north and east is a mixture of bushland and rural residential land whilst an existing Telstra Satellite Telecommunication facility is located further to the south.

The remaining southern edge of the proposal area comprises gentle to steep sloping sandstone escarpments that consist of a variety of vegetation formations ranging from forest to heathland communities.

3.1.1 Vegetation

A vegetation survey has been prepared by Hayes Environmental (2023) and they produced a plan of the vegetation communities – see Figure 3.1.

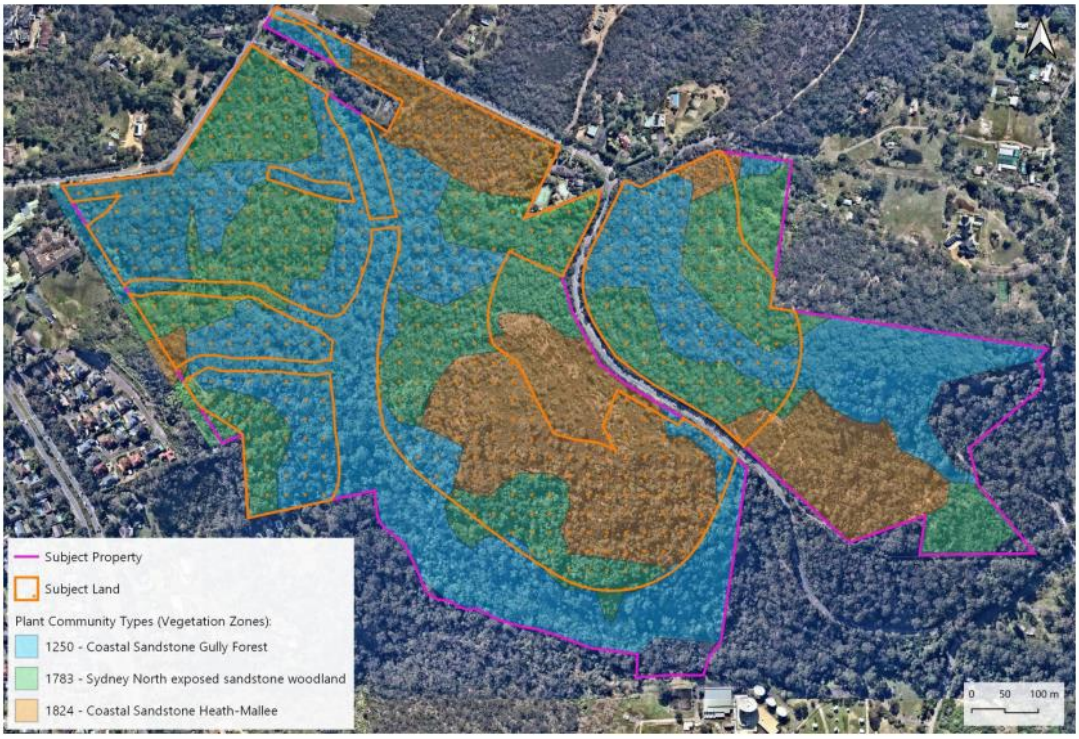


Figure 3.1 – Vegetation communities of PP site (Hayes Environmental, 2023)

Table 3.1 – Identified vegetation communities (Hayez Environmental, 2023)

Vegetation PCT	Vegetation formation	Vegetation classification
1250	Coastal sandstone gully forest	Dry Sclerophyll Forests (Shrubby sub-formation)
1783	Sydney North exposed sandstone woodland	Dry Sclerophyll Forests (Shrubby sub-formation)
1824	Coastal sandstone Heath Mallee	Heathland

A broader vegetation mapping exercise has been undertaken by NSW Department of Planning and Environment (DPIE 2021) via their State Vegetation Type Map (SVTM) – see Figure 3.2 – Vegetation communities (DPIE 2021).

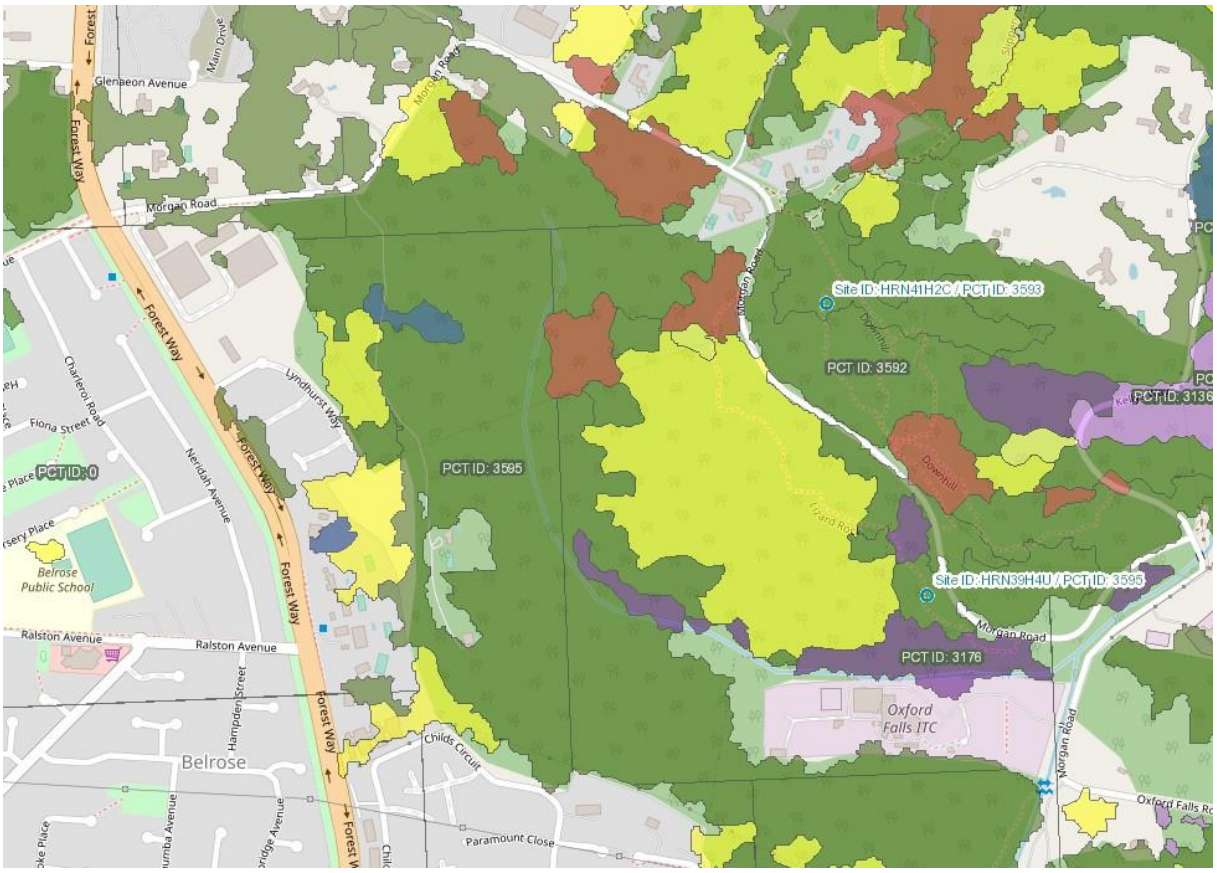


Figure 3.2 – Vegetation communities (DPIE 2021)

3.2 Climate and weather

Long term climate and weather data has been provided by the Bureau of Meteorology (BOM) for the Sydney (Observatory Hill)' [066062] for the period 1858-2020. The Sydney weather Station is the closest station (approx.14.5 km south) that can provide full records of weather and climate. BOM data for station 066062 is shown in Table 3.2.

Table 3.2 – Long Term climate and weather data for Sydney (Observatory Hill) [066062] station (source: BOM); and max temp per month since 2009

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Max temp (°C) 1859 to 2020	45.1	37.88	38.4	29.22	28.58	22.60	23.02	25.33	33.81	37.33	40.92	39.31	39.63
Mean max temp (° C) 1859 to 2020	26	25.8	25	23	19.5	17	16	17.9	20.1	22	23.7	25.2	21.8
Mean min temp(° C) 1859 to 2020	19	18.9	18	15	11.6	9.3	8.1	9	11.1	14	15.7	17.6	13.8
Mean rainfall (mm) 1858 to 2020	101	119	132	127	117	133	96	80.2	68.1	77	83.8	77.1	121 3.4
Max wind gust speed (km/h) 1955 to 1992	150	111	97	106	135	135	106	113	131	113	118	121	150
Mean 9am temp (° C) 1955 to 2010	23	22.3	21	18	14.6	12	11	12.5	15.7	19	19.9	21.6	17.5
Mean 9am rel humidity (%) 1955 to 2010	71	74	74	72	74	74	71	66	62	61	66	67	69
Mean 9am wind speed (km/h) 1955 to 1992	8.6	8.2	7.9	8.8	10.5	12	13	13.3	12.4	12	11	9.8	10.6
Mean 3pm temp (° C) 1955 to 2010	25	24.9	24	22	19.4	17	16	17.5	19.2	21	22.1	23.8	21
Mean 3pm rel humidity (%) 1955 to 2010	62	64	62	59	57	57	51	49	51	56	58	59	57
Mean 3pm wind speed (km/h) 1955 to	18	16.8	15	14	12.7	14	15	17.6	18.3	19	19.4	19.5	16.6

The Warringah Pittwater Bushfire Risk Management Plan 2010 (BFRMP), prepared by the Warringah Pittwater Bushfire Management Committee, provides the following description of weather and climate for the wider northern beaches area.

- *The typical / average climate in the Warringah Pittwater BFMC area is for uniform rainfall throughout the year, although higher rainfall can be experienced in the months of February to March and the bushfire season generally runs from October to March.*

- *Prevailing weather conditions associated with the bushfire season in the Warringah Pittwater BFMC area are north-westerly winds accompanied by high daytime temperatures and low relative humidity*.

The data retrieved from station 066062 differs from the BFMC description in that wind direction during the fire season (generally October to March) is predominately from the east; and this season delivers the highest wind speeds.

The BFMC description refers to low relative humidity during the fire season, however this should be understood within the context of the coastal influenced location, which combined with predominate easterly winds, ranges from long terms averages of between 56% and 62% during the fire season. These figures are relatively high in terms of fire intensity potential, and not consistent with high intensity, difficult to control fire events.

It should not be accepted that this commentary would preclude the possibility of a high intensity fire occurring, from any direction. However, the historical data shows that the most likely highest fire threat would occur from the east, north-east of the site, during the October to December period in the latter part of the day, where wind speeds and temperatures are (relative to the location and annual averages) high, and relative humidity low.

3.3 Fire history

Fire history has been assessed using the resources supplied by the National Parks and Wildlife Service mapping data available from the NSW Government SEED website (NPWS 2022).

The site and surrounding area has a history of regular and widespread hazard reduction burns having been conducted. Bushland in the surrounding area has been burnt in a mosaic pattern over an extended period.

Uncontrolled fire in the surrounding area has predominately consisted of two major fires which occurred to the east in 1994 and 2006/07.

A major fire occurred on the site in 2014 as a result of an escaped hazard reduction.

The major fires which occurred to the east of the site did not directly threaten the site and were either the result of a flank impact (1994) or from suppression actions such as aerial backburning in 2006.

As seen in the fire history mapping dating back to 1994, the site does not have a recorded history of major unplanned fire which on first thought is considered strange. It is more than likely the quick actions of responding authorities that have mitigated wildfire events in the west. History shows that the continuation of the current hazard reduction burn regime would assist unplanned fire ignition and burning opportunities.

It is recognised that wildfire burnt initially over three days between January 7-9th 1994 burning from Cottage Point to Oxford Falls fire beaks (and a slight outbreak near Beacon Hill) in an overall southerly direction. 30 houses were lost in the early days (in the north) but no property losses in the vicinity of the PP site. The fires were held on the 5 Mile Creek Trail and The Slippery Dip Trail and did not progress to Morgan Road. Aerial photo evidence shows controlled burning and lack of penetration in the south down to Oxford Falls. The fire was extinguished by 13 January 1994.

Analysis of the fire threat has been conducted in surrounding areas for similar proposals. The Meridian Urban Bushfire Risk Assessment for the Ingleside Planned Precinct 2018 (Meridian) concluded that while the 1994 fire event was a serious threat to life and property in the Northern Beaches area, many aspects of the response to the 1994 fire have been analysed and lessons learnt.

Major changes in firefighting technique through aerial suppression by water carrying units such as helicopters, small planes and large planes have brought efficiencies that greatly assist broadscale and localised fire suppression operations.

Other changes to emergency services coordination and communications have occurred and there is an expectation that fires such as the 1994 event, should they reoccur, would be managed and controlled in a more effective fashion, leading to a reduced community threat in the southern landscapes of Ingleside and further south whilst recognizing that Duffys Forest and Terry Hills remain open to such fires reoccurring.

Figure 3.3 depicts the landscape after the 1994 fires whilst fire history mapping is shown in Figure 3.4. This shows that the fire affectation north of Morgan Road was sporadic and did not arrive as a wall of flame and stop at Morgan Road. The fire was held on the fire breaks as shown by blue dashed lines in Figure 3.4 and the northern edges of rural residential properties; and through the actions of strategic back burning from those locations – as shown on Figure 3.4.

The combination of down slope topography, rural residential properties with no appreciable bushfire hazards and well placed fire trails enable the landscape north of Morgan Road to provide an almost text book bushfire protection landscape.

Figure 3.3 – Extent of 1994 bushfires in the north and east of Morgan Road
(source: *https://imagery.aerialphotography.fsdf.org.au/)*

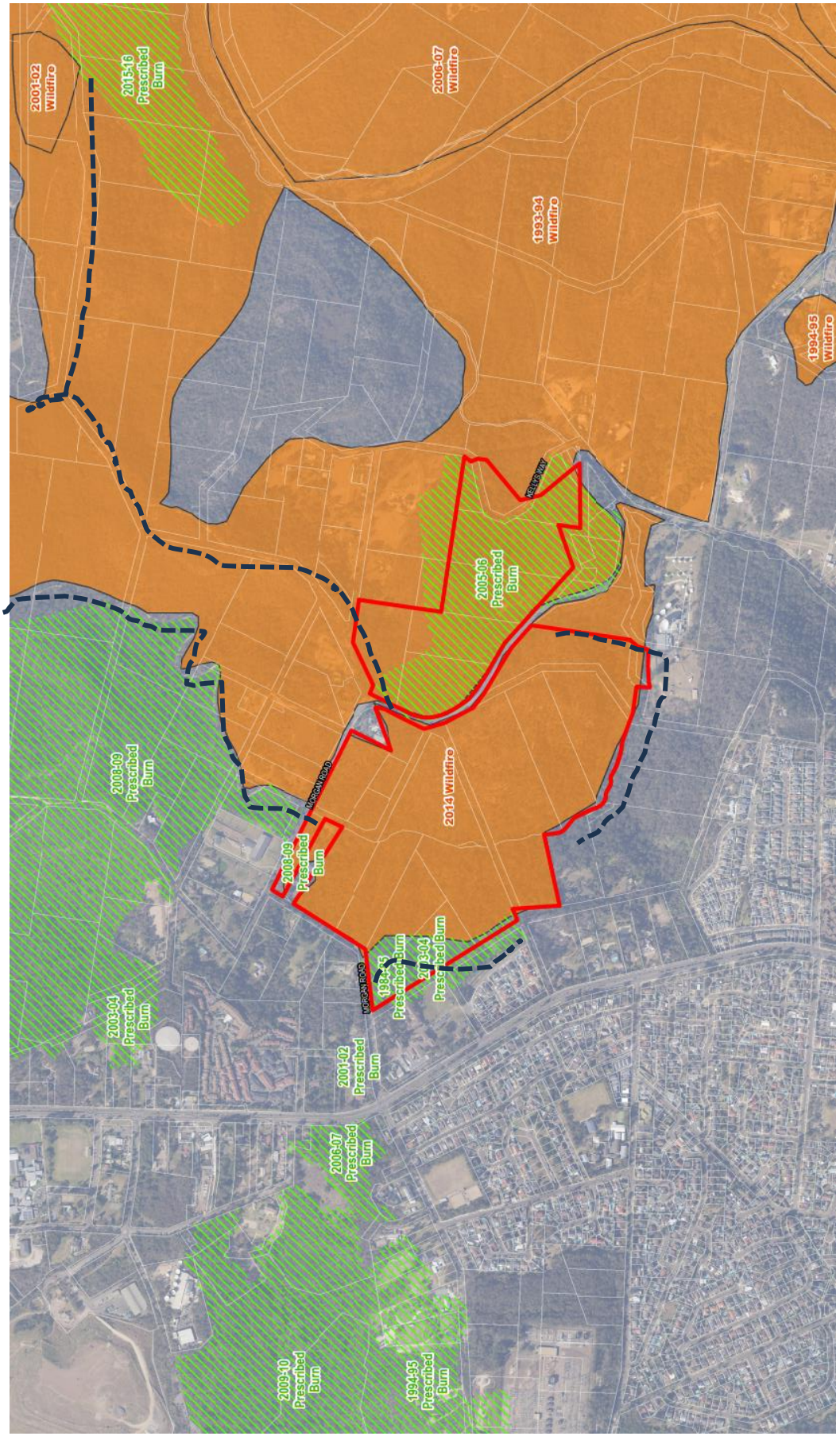


Figure 3.4 – Fire history (Source NPWS/RFS – Blue lines indicate fire trail (fire breaks)

3.4 Fire behaviour

The proposed site is located downhill of fire threats and potential fire runs located to the northwest, north and northeast which mitigate fire intensity significantly whilst upslope scenarios can potentially occur from the south and southeast aspects.

3.4.1 Potential fire threats to current unmanaged landscape

The mixed vegetation landscape that surrounds the PP site is a combination of forest and tall heath both of which can produce ember attack which advance into unburnt country and begin new fire ignitions.

Fire history shows that no wildfires have occurred in the PP area over the past 30 years apart from a fire started from a hazard reduction burn gone wrong. Onsite investigations by the undersigned recognized that the former bush rock quarry, that was in the middle of the site on the west bank of Snake Creek, may have a lot to do with that lack of fire history as staff were on site to suppress any ignitions. There is clear evidence of former trails on the site, extending all over, which are most likely to have been used for bush rock collection, and as a result would have assisted any early fire suppression or simply as fire breaks.

The potential fire runs are shown on Figure 3.5 and represent possible directions of fire runs.

Bushfires and ember attack from the north

In the case of the PP area fires from the north would need to burn downslope from their highest point 484m in distance to the north. The fires were held on the 5 Mile Creek Trail and The Slippery Dip Trail and did not progress to Morgan Road north but did penetrate towards Beacon Hill and Oxford Falls.

Bushfires and ember attack from the East

In the case of the PP area fires from the west would need to burn downslope from their highest point 302m in distance to the northeast. Wildfires near the coastal zone can burn from the northeast but it is highly likely to burn from the east and also probable during the autumn cool period, albeit with its moist conditions, where winds from the southeast are common. These are not threatening bushfire conditions.

Bushfires and ember attack from the south

To the south, potential fire runs are reduced by the presence of existing cleared areas (Telstra telecommunications facility) and a reduced fire front width. Further mitigation is provided by the presence of Morgan Road, acting as a fire break to the southeast and east. However, fires from the south are possible and would run up steep slopes towards the more reduced slopes within the PP area and beyond to rural residential areas north and east of Morgan Road.

Bushfires and ember attack from the west

Traditionally fires are worst from the northwest when they are often fanned by hot dry winds and, in many cases, they are also exacerbated from southerly busters during summer months from late afternoon wind changes from the south. In the case of the PP area fires from the west would need to burn downslope from their highest point 474m in distance from the west. The vegetation within the PP site enables fires to threaten the rural residential estates north and east of Morgan Road.

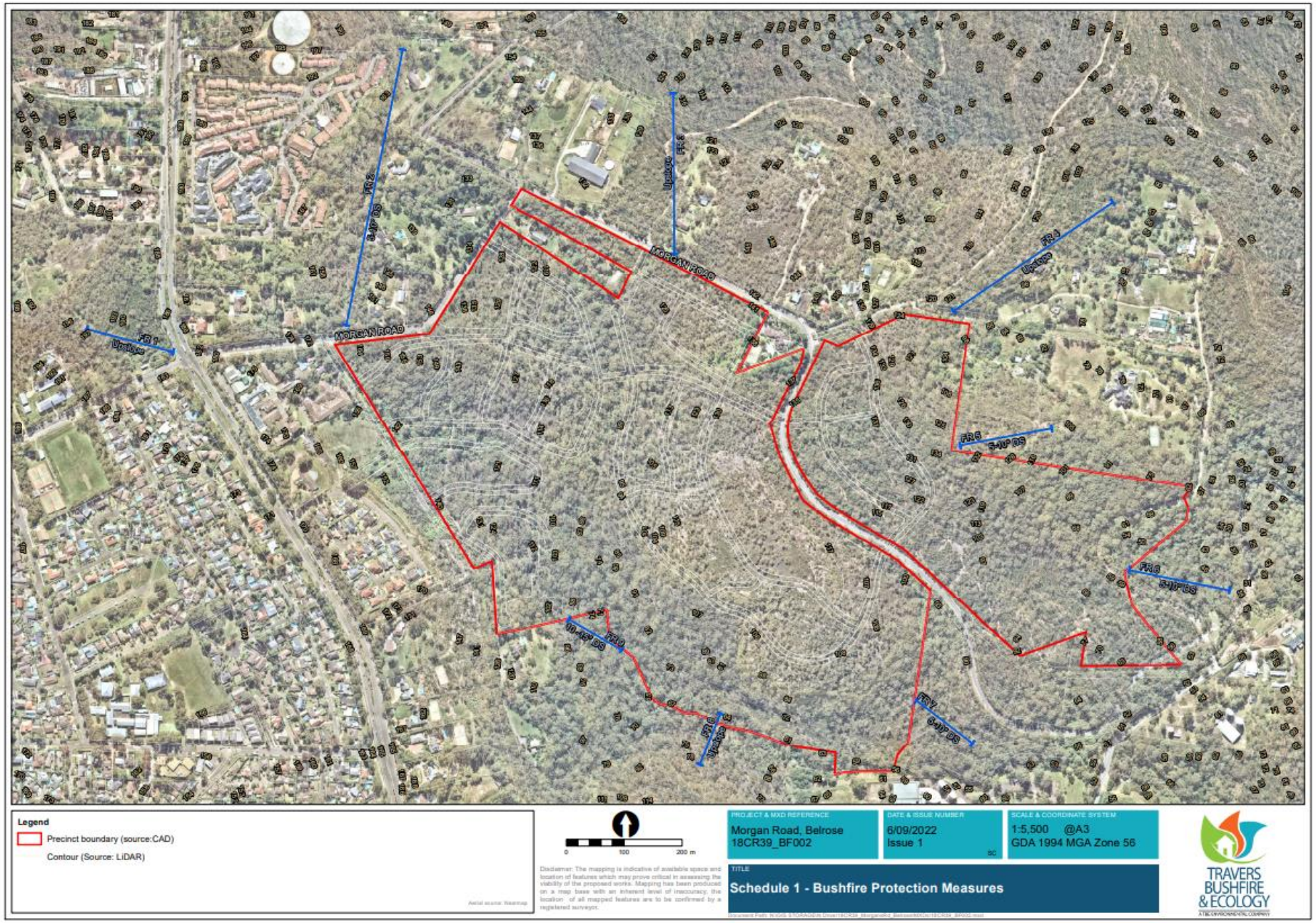


Figure 3.5 – Potential fire runs

3.4.2 Potential fire threats post development

Post development will see the retention of a conservation zone along Snake Creek and a rectangular shape in the east which can be subject ember attack from external areas - as demonstrated on Figure 3.5.

3.4.2.1 Bushfires and ember attack affecting Snake Creek environ

The Snake Creek retained bushland reserve is a forest vegetation assemblage and is approximately 300m in length and 120m in width. This vegetation is capable of being ignited by bushfires burning from all peripheral aspects external to the site.

Bushfire protection to this landscape is provided by way of perimeter roads and or asset protection zones that comply with PBP 2019. It is not perceived that any additional protection is required.

Should a bushfire occur within this landscape then its travel direction is limited to north or south directions; except in the south where the width of the bushland could enable a fire to move from west to east and or northeast to southwest in summer months. East to west is highly unlikely given the dominant wind directions in summer.

The positioning of Snake Creek bushland is not an unusual scenario and is well reflected in many bushland settings in bushfire prone areas and reflects the need to protect our environmental whilst applying asset protection zones between future dwellings and that bushland. This is especially so in the northern suburbs that surround the harbour with its river and or creek tributaries.

3.4.2.2 Bushfires and ember attack affecting the rectangular Lizard Rock vegetation assemblage

The Lizard Rock retained bushland reserve is a tall heath vegetation assemblage and is approximately 300m in length and approximately 120m in width. This vegetation is capable of being ignited by bushfires burning from all peripheral aspects external to the site.

Bushfire protection is provided by way of perimeter roads and or asset protection zones that comply with PBP 2019. It is not perceived that any additional protection is required apart from a small additional zone in the northwestern corner between the proposed roadway and a short escarpment some 20m from the roadway. This can be determined as DA stage.

Should a bushfire occur within this environment it could be subject to a variety of wind directions. The rocky nature of the landscape means soil is minimal and fuel moisture content is mostly low so the vegetation assemblage is able to burn freely.

The positioning of this rectangular shape is not an unusual scenario in Western Sydney where endangered ecological communities are regularly protected and require separation from proposed dwellings that are part of new urban subdivisions.

3.4.2.3 Post development separation from bushland

Modelling has been undertaken to demonstrate *radiant heat flux* (RHF) affectation upon the various fire runs shown in Figure 3.5. Table 3.3 provides the modelled results in Column 4 against the various fire runs considered.

Radiant heat flux is, in effect, the edge of the flame – and measures the radiated heat in 'kilowatts per square metre – k/Wm^2. The RFS permit residential subdivisions to be located where RHF upon any building in that subdivision is subject to <29 k/wm^2

Table 3.3 – Potential fire runs and RH outputs

Fire run ID	Slope	Vegetation classification (PBP 2019)	Modelled radiant heat outputs k/Wm^2	Impact on site
FR-1	Flat to upslope	Forest	1.81	FR-1 models the likely impact of radiant heat upon the proposed slip lane which is 230m from the nearest portion of the development site.
FR-2	5-10° downslope	Forest	17.41	FR-2 has been calculated on the basis of a 55m wide forest width on a slope of 10 degrees; from the nearest residential buildings
FR-3	Flat to upslope	Shrubland	10.13	FR - 3 has been calculated on the basis of an 8 degree upslope and allowing for 25m to the nearest residential buildings
FR-4	Flat to upslope	Forest	16.33	FR-4 is shown as occurring to the northeast of the site, outside the area understood to be retained as a fuel managed landscape.
FR-5	5-10° downslope	Forest	5.68	FR-5 has been calculated on the basis of a 100m wide forest width on a slope of 10 degrees and with a 100m wide APZ to the nearest residential buildings
FR-6	5-10° downslope	Forest	5.68	FR-6 has been calculated on the basis of a 100m wide forest width on a slope of 10 degrees and with a 100m wide APZ to the nearest residential buildings
FR-7	5-10° downslope	Forest	5.68	FR-7 has been calculated on the basis of a 100m wide forest width on a slope of 10 degrees and with a 100m wide APZ to the nearest residential buildings
FR-8	Flat to upslope	Forest	1.94	FR-8 has been calculated on the basis of an 8 degree upslope and allowing for 100m to the nearest residential buildings
FR-9	10-15° downslope	Forest	13.73	FR-9 has been calculated on a 15 degree downslope in forest with a 75m APZ

3.4.2.4 What do the potential fire run RH outputs mean

The calculated radiant heat outputs on the periphery of the development range from low 1.81 k/Wm^2 to a moderate 16.33 k/Wm^2.

PBP permits residential development to be constructed with a radiant heat affectation is 29 k/Wm^2 or lower. This means that the proposed development footprint is well below the Catastrophic (FDI 100) design tolerances of *PBP*.

Importantly, the calculated radiant heat outputs also clarify the fact that, of the nine Fire Runs (FR) analysed, only four fire runs are above 10 k/Wm^2 with five below 10 k/Wm^2.

Of significant note is that the calculated radiant outputs;

- For FR 2, 3 & 4 in the north-east and east are less than 17.41 k/Wm^2.
- The proposed 100 m asset protection zones in the south (covered by FR 5,6,7 & 8 produce very low radiant heat output of 5.68 k/Wm^2.
- Only FR 9 provided a higher RH of 13.73 k/Wm^2.

3.5 Land use assessment

PBP (p. 19) notes that: The most important objective for strategic planning is to identify whether new development is appropriate subject to the identified bushfire risk on a landscape scale.

An assessment of proposed land uses and potential for development to impact on existing infrastructure is also a key element of the strategic planning process in bushfire prone areas. Land use planning policies can be introduced to limit the number of people exposed to unacceptable risk.

PBP does not articulate threshold limits for what constitutes an unacceptable risk.

3.5.1 Development assessment pathway

The strategic plan for the area is undefined as the site and much of the surrounding area is currently zoned as a deferred matter. The site is identified in a Development Delivery Plan (DDP) under the Planning Systems State Environmental Planning Policy 2021 (Aboriginal Land). The DDP initiatives a framework for identified development sites and pathway to investigation and potential approval, including rezoning if required.

3.5.2 Development location in a bushfire environment

The Patyegarang Planning Proposal is located in a bushfire prone landscape as shown on Figure 1.4.

3.5.3 Peer review land use assessment

Northern Beaches Council engaged Meridian Urban to undertake a strategic bush fire risk assessment on the Deferred Lands investigation area. They produced their report[1] in March 2021.
They analysed and identified land, including the PP site, for potential *fire line intensity* and inferred fire risk. The approach they used was mapping fire line intensity which measured the generated heat power – which is measured in k/Wm.

Note: Meridian advised they modelled in k/W per square metre but fire intensity is measured per metre not per square meter. Radiant heat flux modelling is measured in k/Wm^2 (per square metre).

Fire intensity is a measure of heat power. It measures energy released in k/Wm. It is a function of fuel characteristics (vegetation types, fuel load and fuel arrangement) and the relationship with fire weather which influences potential rate of spread.
Modelling is also able to be replicated at the development interface in a more accurate manner using Method 2 as found in Appendix B of AS959. The method is entitled 'Detailed method for determining the bushfire attack level (BAL) – Method 2'. This method was developed by Douglas G.B. and Tan, Z. (2005).
Radiant heat flux is better method of modelling fire line intensity as it measures the specific zone of affectation at the urban bushland interface. RHF modelling is provided in Table 3.3 above.

The Morgan Road site is, of all potential development sites identified within the Deferred Lands investigation area, a preferred site for development in that it is located in an area identified as not high bushfire risk.

This was established by the Meridian Urban which modelled fire line intensity (using a (Forest) Fire Danger Index (FDI) of 100). The graphical representation of that modelling is shown in Figure 3.6.

Meridian used a yellow hue to indicate cooler burn areas less than 20,000 k/Wm whilst the red coloured areas illustrate hot to very hot burn intensity areas over 20,000 k/Wm and up to and greater than 60,000 k/Wm.

Meridian determined the PP site is located within an area mapped by the study as being of lower potential fire intensity (Medium category) and by inference a lower bush fire risk. Their assessment found no significant fire intensity likely over 95% of the PP site based on their Figure 14. This has been verified by the radiant heat flux data provided in Table 3.3 above.

The topographic difference on why their modelling produces a vast difference to other areas is the concave shape of the PP site as opposed to the exposed higher forested elevations in the northeast. In that locality there are steep slopes that are exposed to prevailing winds which enable localized turbulence to create high fire intensities in the steeper zones when coupled with heavier fuel loads. These areas are located between 450 and 1200m from Morgan Road and the eastern edge of the PP site.

[1] Deferred Land Strategic Bushfire Risk Assessment – Meridian Urban / Ten Rivers (2021)

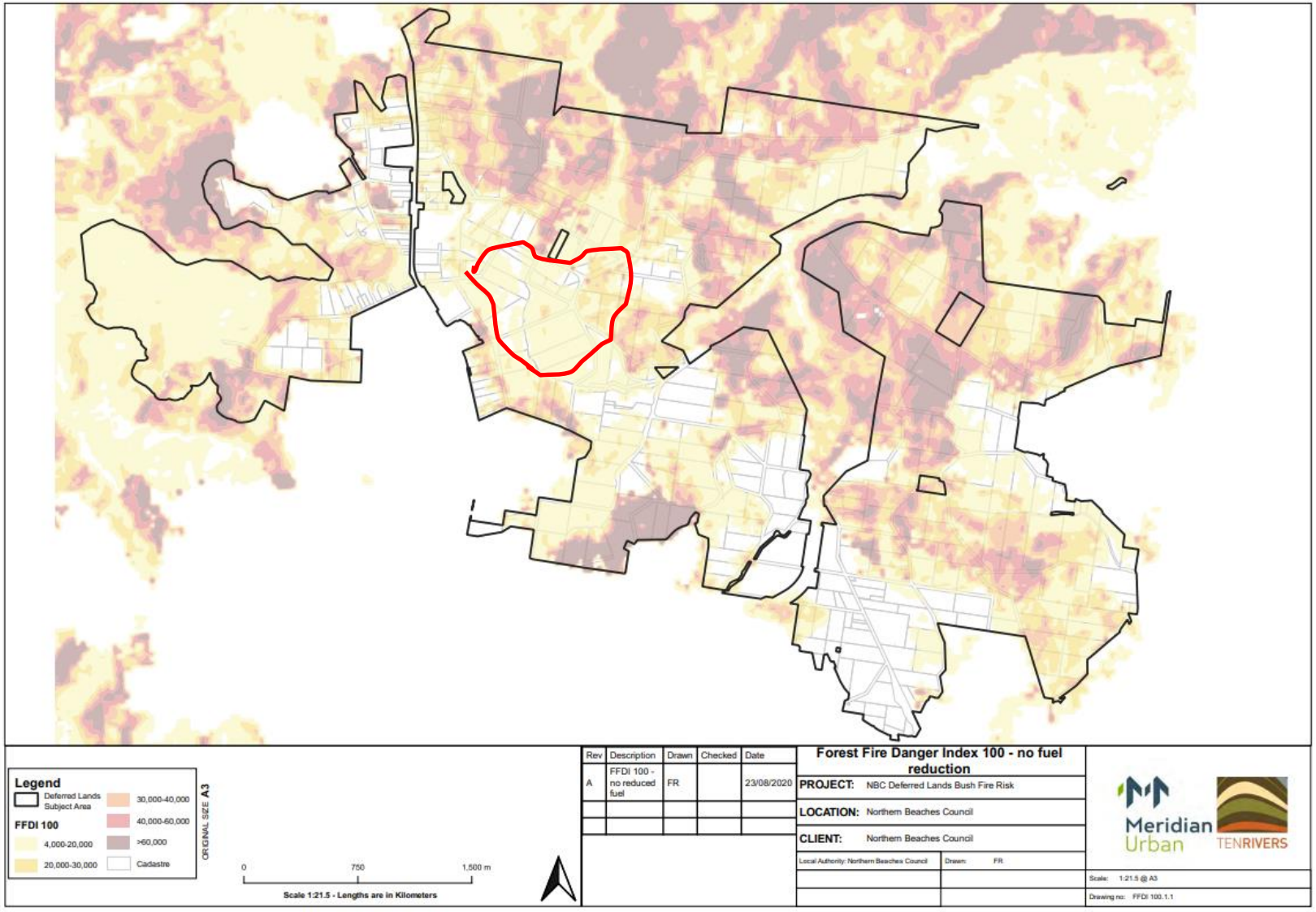


Figure 3.6 – Potential fire intensity under Forest fire danger index (FFDI) 100 (Source; Meridian Urban 2022)

3.5.4 Inappropriate development

Ministerial Direction 4.3 also provides a direction at 2(b) whereby they seek to introduce controls that *avoid placing inappropriate developments in hazardous areas*. Identifies the need to exclude 'inappropriate development.'

The overwhelming approach is to avoid placing inappropriate developments in hazardous areas and *PBP* is used as the compliance policy which applies a number of compliance checks using performance criteria and acceptable solutions.

PBP advises that land use planning can be an effective tool in minimising or avoiding the impact of natural hazards such as bush fire. From a risk management perspective, the safest approach is always to avoid high risk areas and placing inappropriate development in those areas.

PBP further states that strategic planning should provide for the exclusion of inappropriate development in bush fire prone areas as follows:

- The development area is exposed to a high bush fire risk and should be avoided.
- the development is likely to be difficult to evacuate during a bush fire due to its siting in the landscape.
- access limitations.
- fire history and/or size and scale.
- the development will adversely effect other bush fire protection strategies or place existing development at increased risk.
- the development is within an area of high bush fire risk where density of existing development may cause evacuation issues for both existing and new occupants.
- and the development has environmental constraints to the area which cannot be overcome.

Specifically, inappropriate developments include hospitals, schools and retirement villages and whilst they can be located in certain bushfire prone areas, they should a much higher level of consideration and assessment.

3.6 Access and egress

Morgan Road will be reconstructed to a collector road standard from Forest Way to the south eastern location of Morgan Road as shown on the plans. The road will be a 13m wide pavement width with 3.5m wide pedestrian verges and pathways on both sides.

Kerb and gutter will be on both sides together with vegetation removed from both sides. Street trees will be planted. The road will be a bus route and will allow access for garbage trucks and fire trucks at all times.

3.6.1 General vehicle access (outside of emergencies)

JMT Consulting (JMT) are the traffic consultants engaged in the PP project and they undertook a traffic assessment in Mid 2021 and amended the report several times in response to RFS and TfNSW matters raised with the latest report provided in December 2023.

The purpose of the JMT transport assessment was to understand the implications of the planning proposal on the adjacent transport network and identify any upgrades or mitigation measures required to support the future site development.

Specifically, their assessment considered the following items:

1 Existing transport conditions around the site, including:
   - Road network
   - Public transport
   - Walking and cycling network
   - Existing travel behaviours
2 Forecast volume of traffic generated by the uses envisaged under the Planning Proposal in the critical peak hours, including the likely direction of travel.
3 The overall net change in traffic flows at the Forest Way / Morgan Road intersection (key site access point) and the ability of the adjacent road network to accommodate the level of development proposed.
4 Proposed vehicle access arrangements from the broader road network
5 Proposed internal street network including proposed connections to the external road network.
6 Ability of the road network to accommodate vehicle demands from the site during a major bushfire evacuation event.
7 Staging and sequencing of any necessary infrastructure upgrades.

The JMT assessment considered the following with respect to internal vehicle circulation outside of an emergency evacuation scenario:

- New streets and perimeter / fire access trails to generally following existing contour lines to avoid steep slopes and improve vehicle sight lines.
- Provision of an interconnected street network that provides linkages to the various access points located on Morgan Road.
- Provision of appropriate access and egress for vehicles in a bushfire emergency including a bridge link connecting the eastern and western precincts of the site.
- Egress via Oates Place to Forest Way only provided during an emergency and will not be available for day to day traffic movements.
- Street network designed to limit through traffic movements within the site to minimise traffic flows and provide for a safer environment for pedestrians.
- Suitable street cross sections provided to allow for the safe and efficient movement of various vehicle types (including first-responder vehicles) as well as allow for on-street car parking and pedestrian and cycle paths.

Key findings of the JMT assessment were;

- There has been a reduction in daily traffic volumes on Forest Way since records began in 2008 (as sourced from Transport for NSW, traffic station 57025).
- The surrounding road network, including Forest Way and the signalised intersection of Morgan Road / Forest Way can accommodate the expected level of day to day traffic generated under the rezoning proposal. The traffic modelling results demonstrated that the Morgan Road / Forest Way intersection will perform acceptably following the full development of the site at ‘Level of Service D’ during the AM peak hour and PM peak hours of the day.
- The project would deliver upgrades to the road network to improve traffic capacity for both site users and the general public, including:
  - Introduction a new slip lane from Morgan Road into Forest Way; and

    - Extension of 40m to achieve an 80m lane northbound right turn bay from Forest Way into Morgan Road
- Suitable site access arrangements can be provided along Morgan Road with multiple accesses envisaged to distribute traffic movements across the site. No direct vehicle access would be provided from Forest Way given its function as a State classified road.
- The upgrade of the existing bridge at Morgan Road and Oxford Falls Road West (opened in late 2023) provides for improved access to the site and is capable of carrying Cat 1 fire tankers.
- The internal street network will be designed to limit through traffic movements within the site, accommodate movement of pedestrians and cyclists and allow for the safe and efficient movement of various vehicle types (including first responder vehicles).

Morgan Road eastbound has the capacity in pre-bushfire event to be a valuable evacuation route such as when Extreme and or Catastrophic weather condition are known – usually 3-4 days in advance.

3.6.2 Evacuation Opportunities

JMT undertook investigations to understand the ability of the road network to accommodate traffic flows during a major bushfire evacuation event. The key inputs forming this work were as follows:

- Maximum yield of 450 residential dwellings for the site. In addition, the existing community dwellings adjacent to Morgan Road east of Forest Way have been taken into consideration, which number approximately 50 households.

- 100% of all dwellings in the precinct are considered at risk and would be required to evacuate the precinct during a major bushfire event. This is considered a conservative assumption given the development will remove part of vegetated areas which would in turn reduce the number of dwellings at risk, meaning not all of the population would need to evacuate the area and instead could remain in place. As a comparison the bushfire evacuation modelling undertaken for the Ingleside Precinct assumed 25% of residents would 'stay and defend' rather than evacuate.
- Average of two vehicles per dwelling.

- The number of dwellings occupied at any given time is 90%. Importantly, JMT state that this is conservative as it is highly unlikely that a fire would suddenly threaten the suburb during the night when most people are home. It is likely that it would occur during the day and, most likely late in the day. Therefore, many people will not be home when the fire threatens. Accordingly, the number of dwellings occupied at the time of day that the fire threatens is likely to be considerably less than the number of occupied dwellings on the day of the fire.

- During a bushfire evacuation the following traffic egress routes would be available to residents (see Figure 3.7):

    - Morgan Road (westbound) via the Morgan Road / Forest Way intersection. This is assumed to be the primary egress route and would accommodate approximately 80% of traffic movements.
    - Via the Oates Place / Forest Way intersection as a secondary egress route which is used only in the event of a bushfire emergency and would accommodate 20% of traffic movements.
    - Morgan Road (eastbound) is not considered safe in a bushfire event and is not considered further.

- JMT advised that a study undertaken analysing behavioural aspects of the 2009 Victoria Bushfires indicated that 54% of residents evacuated during a bushfire, and of those residents that evacuated 47% left prior to the last hour before the bushfire arrived. Given the site's more urban location, as well as again considering a highly conservative scenario, only 75% of dwellings have been assumed to depart prior to the final hour before any possible bushfire arrives.

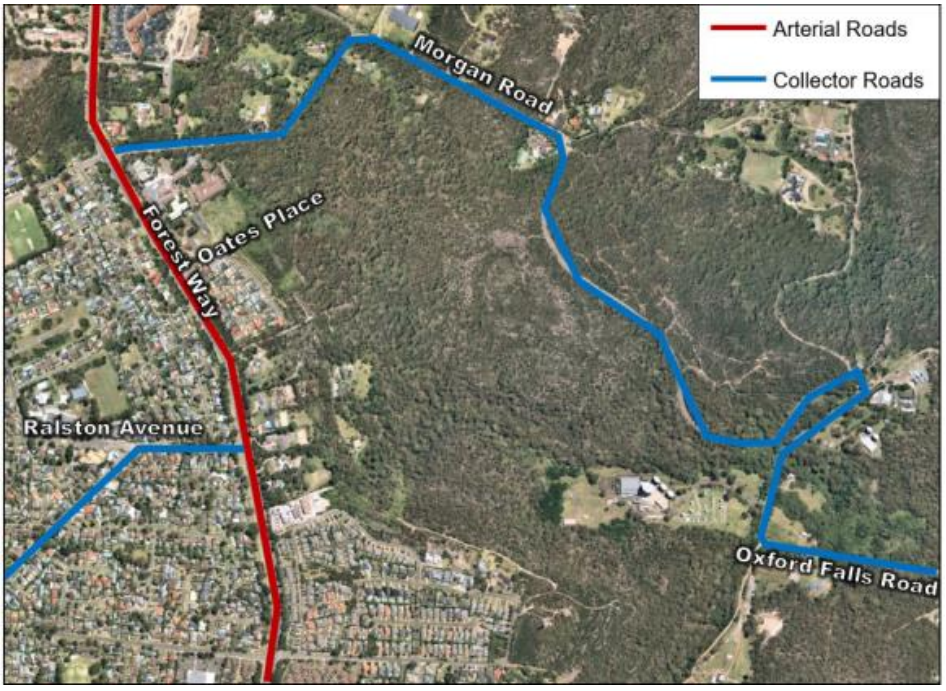


Figure 3.7 – Road hierarchy (Extracted from JMT Consulting report December 2023)

3.6.3 Road evacuation network

The RFS raised the issue of Forest Way being inundated with vehicles evacuating from Terry Hills and Duffys Forest and thereabouts and the subsequent impact of adding a further array of vehicles from the PP project.

Terry Hills is a mostly rural residential community and partly urban residential community located to the northeast of the intersection of Forest Way and Mona Vale Road and adjoins the rural residential community of Duffys Forest and combined they have 1,196 dwellings (2021, Mecone).

This area could evacuate to the east to Mona Vale, or to the west to St Ives or to the south to Frenches Forest or a combination of the above; but it is reasonably assumed that the predominant evacuation route for the majority would be to the east via Ingleside to the coastal suburbs of Mona Vale and Warriewood.

The community that adjoins Mona Vale Road is more likely to evacuate to Forest Way as they are located closer to that roadway. It is highly unlikely that evacuation to St Ives would not occur as it requires far too much passage through unmanaged hazard with the national park.

It is also the case that emergency services would create controlled intersections at St Ives, Mona Vale and Belrose to stop traffic movements into the bushfire affected lands. Figure 3.8 depicts the likely traffic control locations by way of red lines with the intersection of Morgan Road and Forest Way as the location of the northern termination for safe traffic movement –

see Figure 3.7.

Figure 3.8 – Regional overview of road network for peripheral suburbs

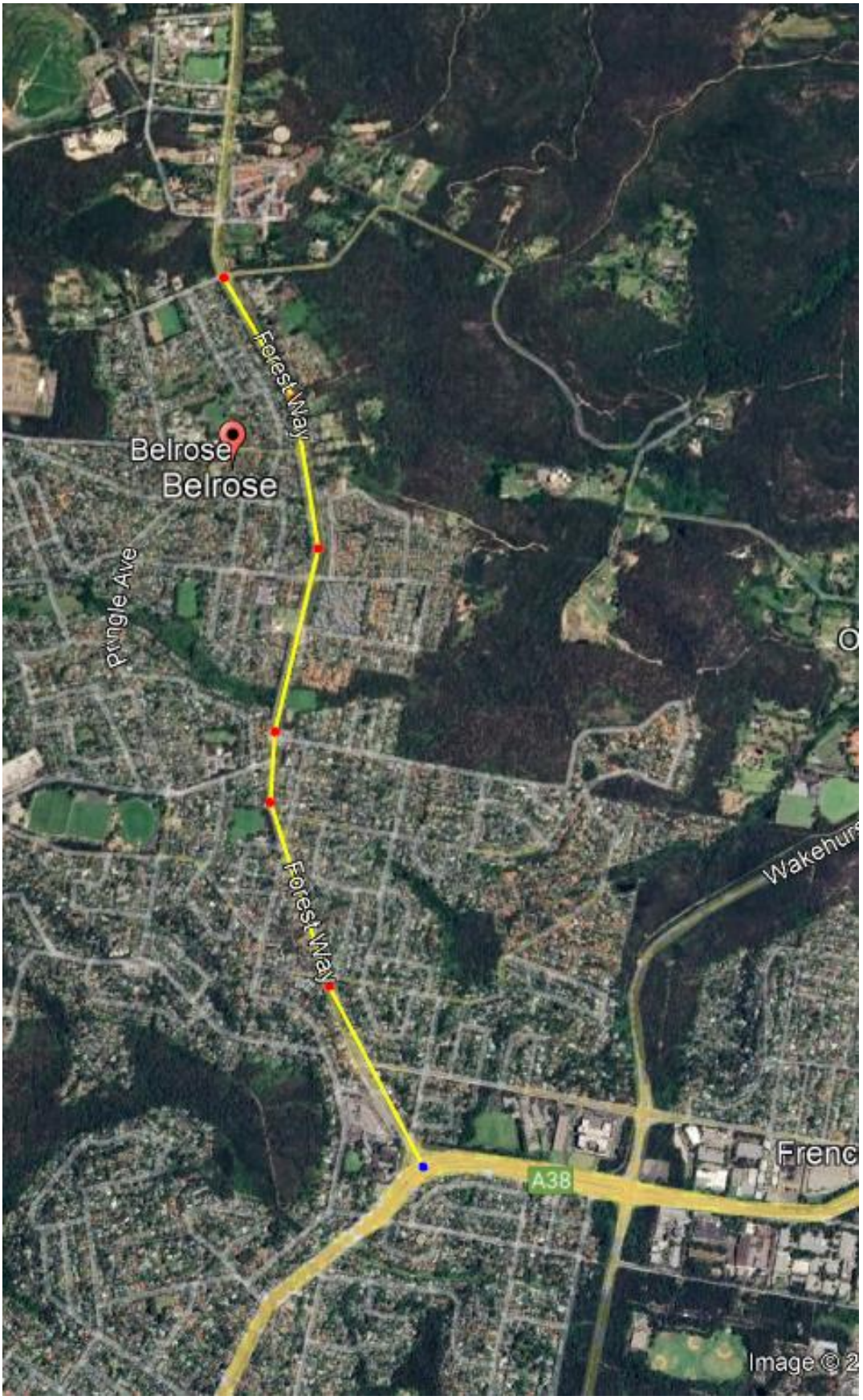


Figure 3.9 – Unhindered evacuation route to Warringah Road

It is recognized that the road between the Mona Vale Road / Forest Way intersection and the Morgan Road / Forest Way intersection, being 2.43 km, is partly affected by forest on the eastern side of the road. This would bring with it the question of when this section should this road section be closed.

This would depend on where a fire was burning but we expect this portion of the roadway to be closed last therefore enabling traffic to head south towards Warringah Road as it is eminently safer than the westward route to St Ives.

This raises the scenario that Duffys Forest and Terry Hill would be encouraged to evacuate early on the likelihood that a fire would be occurring to the northwest or in the north within the Ku-ring-gai national park and therefore affecting Mona Vale Road.

This would also mean that the likely evacuation timing for Terrey Hills / Duffys Forest would not be at the same time as a similarly enforced evacuation from the Patyegarang site.

As a point of significant difference, the evacuation from the Patyegarang site along Forest Way is not affected by hazardous vegetation along the 3.5 km Forest way route to the major intersection with Warringah Road – see Figure 3.9 – as that is a fully urbanized landscape.

Upon arriving at Warringah Road, the southwestern route has three (3) lanes to turn right and one lane to turn left – see Figure 3.10.

Figure 3.10 – Photo showing new intersection with Warringah Road and Forest Way

3.6.4 New Slip Lane onto Forest Way

JMT (December 2023) advised;

- During the development of the concept plan for the site it was identified that safe and efficient vehicle egress from the site would be required during major bushfire events. Given the likely bushfire conditions in this scenario, all traffic would need to be directed to the west to access Forest Way and depart the area.
- Under current conditions traffic leaving the site via Morgan Road needs to stop at the traffic lights before then turning left onto Forest Way. In this context an upgrade of the Morgan Road / Forest Way intersection has been identified (initially by *Travers bushfire & ecology*) to facilitate safe and efficient access out of the precinct. This involves the creation of a slip lane from Morgan Road onto Forest Way which includes an acceleration lane as per Austroads requirements. This upgrade will allow traffic leaving Morgan Road to bypass the existing traffic lights and enter directly onto Forest Way without delay.
- A detailed concept design, including extent of civil and infrastructure works required, has separately been prepared by Craig and Rhodes as illustrated in Figure 3.11 below.
- Separate traffic modelling for a bushfire emergency evacuation event indicates the upgrade will be required once more than 230 dwellings have been developed and are occupied on the site.

Figure 3.11 – Proposed new slip lane on Forest Way – NOT on land owned by Council

3.6.5 Road network performance during a bushfire emergency

JMT provided advice in relation to road network performance during a bushfire emergency and specifically on the ability of the road network to accommodate additional traffic flows. Traffic modelling was undertaken at the Forest Way / Morgan Road intersection which considers existing traffic movements, background traffic growth and traffic movements generated by the rezoning.

The modelling takes into consideration the upgrade of the Forest Way / Morgan Road intersection through a new slip lane. The traffic modelling has considered the performance of the specific traffic movement from Morgan Road onto Forest Way, which is critical with respect to bushfire evacuation. The modelling has summarized the following inputs:

- Traffic movements during the busiest hour of the day (5pm – 6pm) representing the commuter PM peak hour, as previously detailed in Section 2.3 of this document.
- Expected traffic growth over a 10 year period.
- Traffic demands generated by the site and turning left at the Forest Way / Morgan Road intersection (see Section 6.2)

The traffic modelling indicated that the existing intersection of Forest Way and Morgan Road would have a 296m queue length whilst the upgraded intersection with slip lane would have a zero queue length. Without the slip lane in place (i.e. under the current intersection configuration) vehicles attempting to egress the site from Morgan Road will experience a Level of Service 'F' with delays nearly 90 seconds and a queue length of almost 300m. These results therefore trigger the requirement to implement upgrades in the form of the slip lane.

The introduction of the slip lane as proposed allows a free flow of traffic from Morgan Road onto Forest Way, with no queues expected to form. The slip lane provides enough capacity for the evacuating vehicles to turn left onto Forest Way, as well as spare capacity to accommodate vehicles external to the proposed site travelling along Morgan Road during a major evacuation event.

JMT undertook a sensitivity analysis to determine the trigger point when the slip lane would be required and they based that on a maximum queue length of 90m which represents 14 vehicles queued at any one time. The determined this would be when more than 200 dwellings have been developed and are occupied on the site.

3.6.6 Radiant heat impact upon slip lane

Radiant heat affectation has been modelled for the slip lane using *Flamesol* software.

The measured affectation is 1.81 k/Wm^2 based on a flame width of 35m (see Figure 3.12) on a downslope of minus 8 degrees in forest with fuel load of 21.3 / 27.3 tph and a distance of 66m to the slip lane – see Flamesol outputs at Figure 3.13 below.

This is a very low RH level and enables the slip lane to be used when and if a bushfire is occurring in the nearby hazard west of Forest Way.

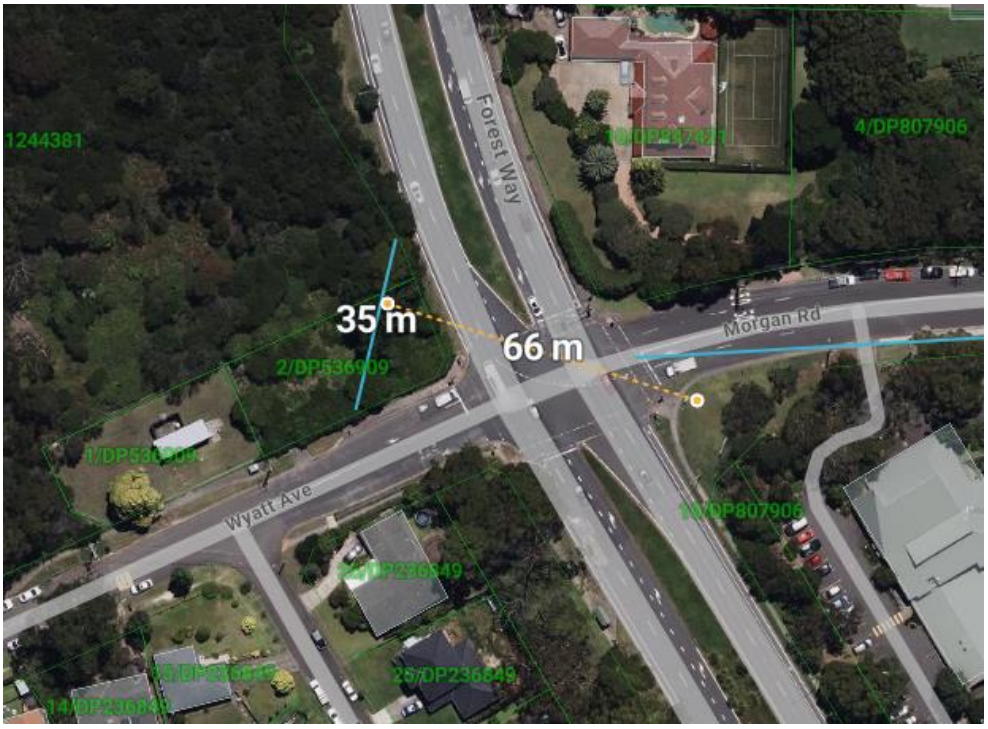


Figure 3.12 – Location of the 35m flame width

FPA AUSTRALIA

Calculated January 10, 2024, 2:51 pm (BALc v.4.9)

FR - 1

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	1.47 km/h
Vegetation classification	Forest	Flame length	12.84 m
Understorey fuel load	21.3 t/ha	Flame angle	79 °
Total fuel load	27.3 t/ha	Panel height	12.6 m
Vegetation height	n/a	Elevation of receiver	6.3 m
Effective slope	-8 °	Fire intensity	20,758 kW/m
Site slope	0 °	Transmissivity	0.749
Distance to vegetation	66 m	Viewfactor	0.0317
Flame width	35 m	Radiant heat flux	1.81 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Figure 3.13 – Flamesol calculated modelling output

3.7 Emergency services

Analysis of the existing emergency services capacity shows a high density of NSW Rural Fire Service (RFS) Brigades operating in the area surrounding the site. Outside of the Northern Beaches Fire District are similar high densities of NSW RFS and Fire and Rescue NSW brigades which would presumably be in a position to support local resources in the event of a major fire.

Discussions with Northern Beaches fire control staff indicate that the current capacity of local RFS Brigades is sufficient to meet the increased demand posed by the addition of the proposed development. Travel time from local RFS stations to the site is shown in Table 3.4.

Table 3.4 – Travel time from local RFS stations to Morgan Road (source; Google maps)

RFS Station	Travel time to site
Belrose	<5 minutes
Terrey Hills	<8 minutes
Davidson	<11 minutes
Narraweena	<11 minutes
Tumbledown Dick	<12 minutes
Coal and Candle	<12 minutes
Duffys Forest	<16 minutes

3.8 Infrastructure

Sydney Water was consulted by Colliers / Craig & Rhodes to determine the likely configuration of the potable water servicing strategy for the Precinct.

Preliminary investigations by Sydney Water indicate that the existing water main would not have capacity to service the entire Precinct and amplification of the water main will be required. This amplification will be required from its connection to the existing 500mm trunk water main in Forest Way. The trunk water main has adequate capacity to service the development.

However, Sydney Water has indicated they will not support a proposal without a secondary water supply connection for reliability. A secondary water supply could be via a new water main in a potential road located adjacent to the Northern boundary of 181 Forest Way (located South of the development). It is currently an unformed road. This information must be incorporated in the development rezoning proposal.

An existing high voltage transmission line traverses the site. It is understood that the line is proposed to be relocated to a more appropriate site or preferably, underground. The existing capacity of the natural gas network is unknown. No major natural gas lines within or adjacent to the site are known.

3.9 Adjoining development

The Patyegarang Planning Proposal is located in the suburb of Belrose within the Northern Beaches LGA. Belrose is represented below in Figure 3.14 by a red dashed line whilst the PP site is depicted by a yellow circle.

Belrose is a suburb of Sydney 19 kilometres north-east of the Sydney central business district in the local government area of Northern Beaches Council. Belrose is also considered to be part of the Forest District, colloquially known as *The Forest*.

Belrose is primarily a residential area with a population of 8,700. The suburb contains the Austlink Business Park, two shopping centres including Glenrose Village Shopping Centre, Glen St theatre, Belrose library, Bunnings Warehouse and Homemakers Supa Centa with over 35 shops including established retailers such as Harvey Norman, Nick Scali Furniture, and JB Hi-Fi. (Source: Wikipedia, 2024)

Figure 3.14 – Location of PP site in relation to the suburb of Belrose

Figure 3.15 identifies the PP site in a red polygon and shows specific and varying land use areas of interest by way of an alphabetical indicie;

- Low density residential west of Forest Way south of Wyatt Avenue at A.
- Seniors Living located at B.
- Aged Care located on the corner of Forest way and Morgan Road at C.
- Approved aged care facility at 187 Forest Way but yet to be constructed at C.
- Over 55's located within Oates Place at D.
- Rural residential off Morgan Road and Hillversum Place at E.
- OPTUS satellite communications facility located to the south of the PP site on Morgan Road at F where Optus manages its five satellites currently in orbit.
- Ausgrid Power station at G.
- School at H.
- Quarry at I.

Figure 3.15 – Local land use mix

3.9.1 How the Planning Proposal will benefit adjoining development

As required by PBP 2019 in Section 4 Table 4.2.1 there is a need to review *'the impact upon adjoining landowners and their ability to undertaken bushfire management'*.

In essence the pre-development bushfire risk within the Patyegarang site (see White coloured boundary in Figure 3.16) will continue to threaten and potentially impact the landscape through the retention of insitu bushfire hazards and the ongoing threat of fire runs from afar. Those fire threats are specifically;

- Bushfires from the east and northeast will affect land shown in the yellow polygon in Figure 3.16 including;
  - Adjacent aged care and child care development/s on the corner of Forest Way and Morgan Road.
  - The over 55's development off Lyndhurst Way and Oates Place in the west.
  - The two rural residential lots.
  - OPTUS infrastructure in the south.
- Bushfires from the south will affect land shown in the Green polygon/s shown in Figure 3.16 including;
  - Many rural residential development to the north and east of Morgan Road.
  - Two rural residential allotments to the immediate south of the PP site.
  - The residential estate to the southeast of the PP site south of Childs Circuit and Laurie Place.
- Bushfire from the west will affect land shown in the Orange polygon/s shown in Figure 3.16 including;
  - Many rural residential development to the north and east of Morgan Road.

The bushfire benefits can be identified as;

- The extensive removal of bushfire hazards there will be a significantly reduced threat to the above areas and increase of asset protection zones and other managed zones for the broader Belrose community - see Figure 3.17.
- The creation of a better road systems for the residents of Morgan Road with a fully constructed road with 13m of road pavement and pedestrian pathways on each side of the road.
- Greater evacuation capability for those existing residents.
- Safe access and egress for fire fighters and emergency services in the using of the new road.
- The new slip land at the intersection of Forest Way and Morgan Road will eliminate traffic buildup as it is now.

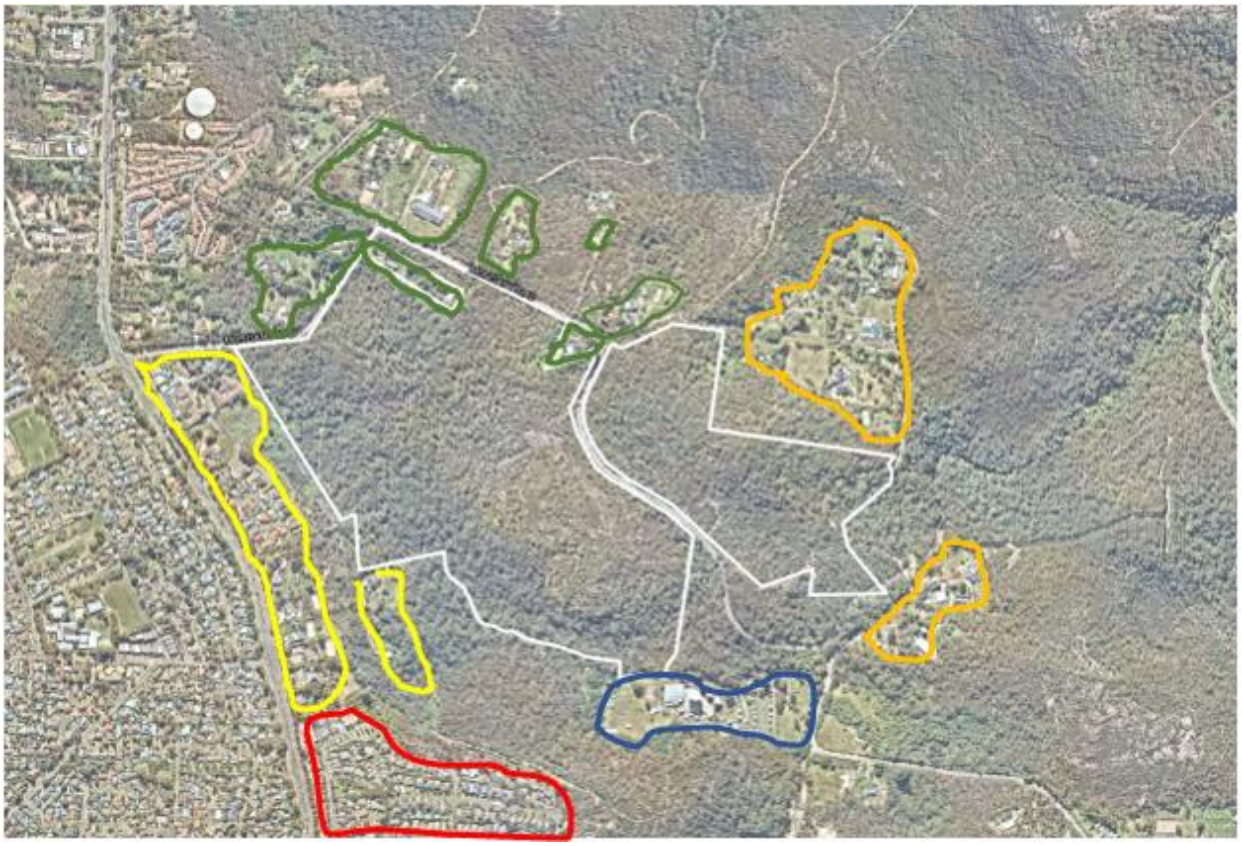


Figure 3.16 – Location of existing residential precincts benefiting from the planning proposal

Figure 3.17 – Proposed extent of asset protection zones and managed zones post development of the planning proposal

PART 4

RISK ASSESSMENT PROTOCOL

4.0 RISK ASSESSMENT PROTOCOL

4.1 Applying a risk management protocol to a bushfire prone area

A strategic assessment of a planning proposal in a bushfire prone area is a statutory requirement of Ministerial Direction 4.3 which then requires the compliance with *PBP* Chapter 4 entitled Strategic Planning. Strategic planning is necessary to ensure that settlements, businesses and infrastructure are, as far as is practicable, not exposed to an unacceptable risk of bush fire.

The basis of strategic planning is provided in Chapter 4 of *PBP* and is based on years of learned lessons from the emergency services and the application of fire science.

Therefore, *PBP* represents a subjective and quantitative assessment protocol based on a proven risk adverse methodology such that the subsequent 'bushfire design process' for new development areas which are embedded through compliance mechanisms (to *PBP*) with an array of specific evidence-based designed 'acceptable solutions' provided by *PBP*.

4.1.1 RFS request for higher level of risk assessment

The RFS have recently requested in a zoom meeting, held on 17 November 2023, that the PP should be supported by a higher strategic threshold responsive to a risk management protocol.

There is currently no accepted protocol for bushfire risk assessment apart from *PBP* Section 4.

It is understood the RFS have applied a methodology for assessing bushfire risk in the 2023 Coff Coast bushfire risk management plan.

This uses a risk quantification methodology based on fire behaviour modelling (*Phoenix RapidFire*) which involves a fire simulation process applying an ignition model, local historical weather and historical fire information to determine where fires are most likely to occur in the landscape. A model is then used to quantify the bush fire risk to each asset in the landscape based on relevant vulnerability criteria.

This approach has been undertaken by Meridian Urban over the PP site and surrounding lands with the results demonstrating the convex shape of the PP site has a lower fire line intensity rating. This is discussed further in section 3.4 herein.

The Coffs Coast BFRMP also advises that bush fire risks may also be identified during the process from qualitative assessment methodologies. They advise, for example, where expert local knowledge identifies a significant area of concern, challenges in firefighting or locally significant values.

This is a tried and true scenario and to that extent the consultation with the RFS between 2021 and mid 2023 mimicked that process and approach and ultimately arrived at supporting the PP before they changed their position.

Quantitative modelling of the radiant heat production has been undertaken and the results are provided Table 3.3 in Section 3.4.2. The detailed modelling supports the more broad based Meridian fire line intensity landscape mapping.

The modelling results confirm the low radiant heat affectation upon the planning proposal site and supports the results of the Meridian Urban analysis that (over 95%) the site is not mapped as being affected by high bushfire risk.

4.2 Framework for risk assessment

In the absence of an established framework as discussed in Section 4.1, a qualitative process that applies the logic of scientific analysis and qualitative analysis has been applied.

The central theme of risk management is to define in quantitative terms how a risk is assessed and then how it is mitigated to the extent that the risk is qualified as being acceptable for the intended purpose.

The National Emergency Risk Assessment Guidelines (NERAG) Handbook (2019) states that it provides a methodology to contextualize, assess and manage emergency risks so that action can be taken and good decisions made to minimise harm and loss when shocks and stresses occur.

NERAG seeks to improve the evidence base on emergency risks and associated varying levels of confidence and to that end adopts the ISO 31000:2018 definitions of risk management, risk framework and risk assessment in ISO Guide 73:2009 Risk management – vocabulary. The NERAG process involves the;

- establishment of site risk
- quantification of risk
- consequences and likelihood of the risk
- acceptability of landscape and development design risk
- treatment of the risk.

See Figure 4.1 below which defines the context of NERAG in risk management planning.

Figure 4.2 is a revision to Figure 4.1 in that is has had the benefit of the NERAG Peer Review Assessment Report dated February 2018 which provided bushfire integration.

Whilst NERAG is designed for a varying uses it is the case that bushfire planning causes a basic change to its application in that development in bushfire prone areas requires compliance with safety designs inherent to *PBP*.

These safety designs are not suggestive in *PBP* …. they are inherent in their intent and meaning and after several iterations of *PBP* in 1991, 2002, 2006, 2018, 2019 & 2022 one could say that over 30 years the RFS, through *PBP*, have honed their cycle of land use design in bushfire prone areas. Added to this is the infusion of bushfire planning into Local Environmental Plans and Development Control Plans / Area Plans then one could say that bushfire planning is both competent and risk adverse.

Risk management plans are prepared for each local government area by the local bushfire risk management committee. They seek to identify all bushfire risks on public land and large private landholders lands. It is therefore the case that risk management plans portray the

current risk not a risk that is reduced or removed through the actions of development. Therefore, the application of NERAG must be tempered when making any reference to the Warringah Bush Fire Risk Management Plan (2011) or the draft Northern Beaches BFRMP (2023).

This, in effect, recognizes the need for NERAG to accept ‘compliance procedures’ as per the acceptable solutions tables in sections 5, 6, 7 & 8 as well as other performance solutions possible by the actions of specialist experts in bushfire design e.g. BPAD certified persons.

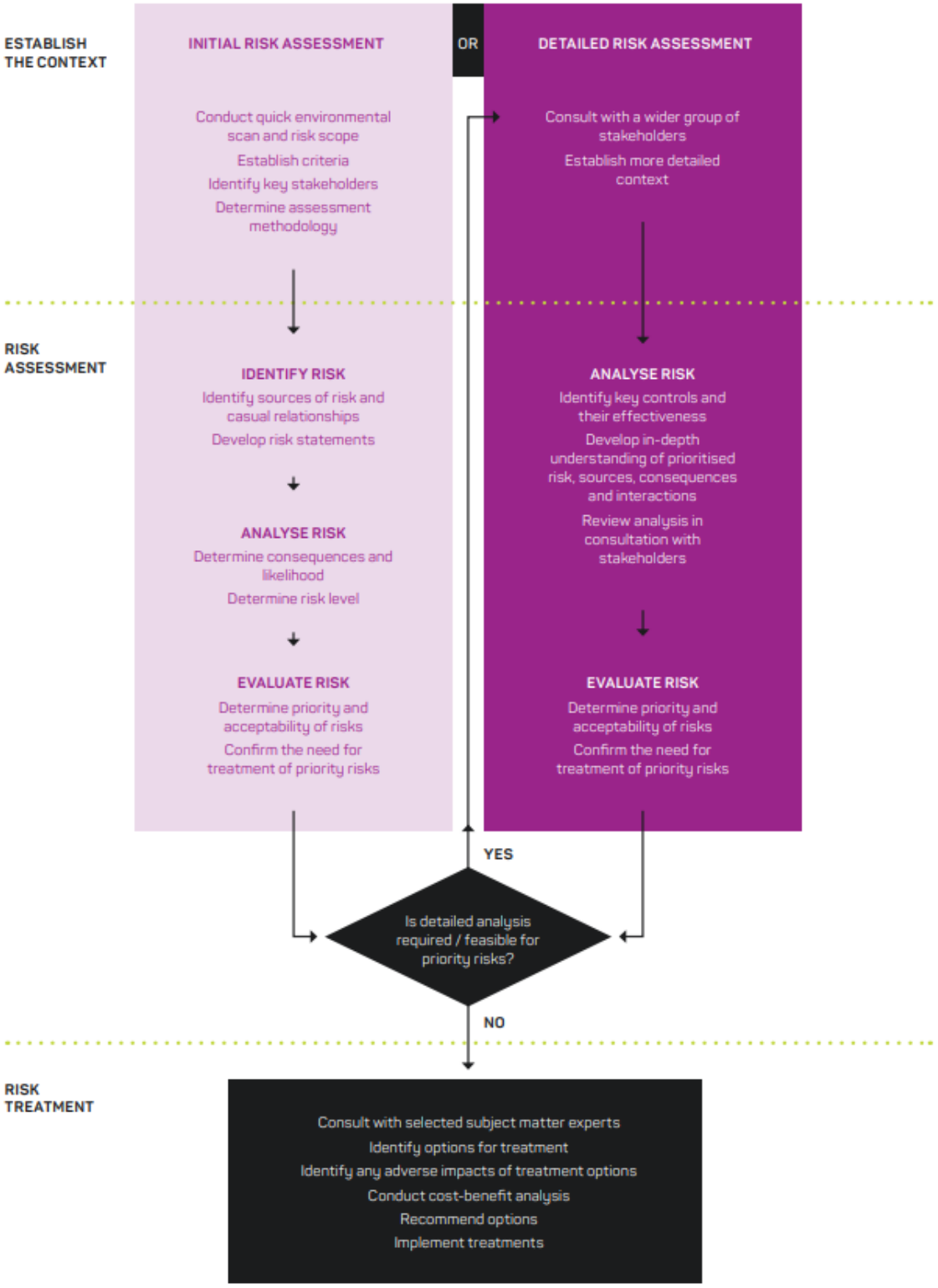


Figure 4.1 – NERAG framework of risk assessment

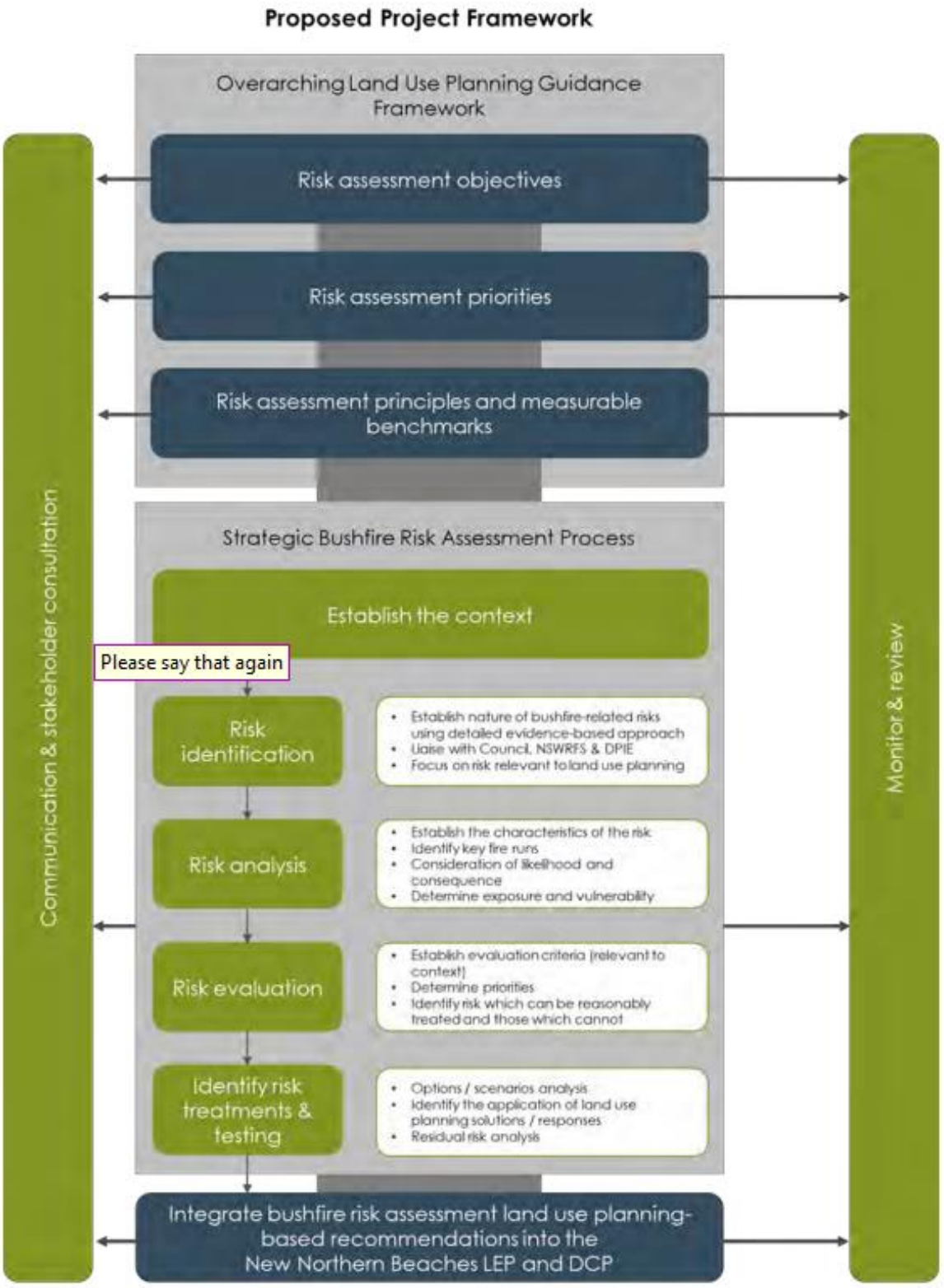


Figure 4.2 – NERAG framework of bush risk assessment

Evidence based solutions can be derived from well established bushfire science and to that extent there a number of tools that are readily available that can be used to annunciate the extent of bushfire risk at a certain location. For example, modelling can be undertaken to identify flame height, flame intensity, rate of spread and radiant heat given off from advancing

flames; and traffic modelling can predict traffic movements.

In the determination of 'risk context' a review of the current situation is required to establish the elements of the risk and only then can a risk mitigation process again. In the assessment of risk context the tables below provide that approach. Table 1 (Risk assessment prior to development) identifies the current risk and provides both subjective and quantifiable explanations.

4.3 Development in bushfire prone areas

Bushfire prone areas mapping serve to enable authorities a clear understanding of where the risk is whilst RFS bushfire risk management plans clarify the level of risk.

Where bushfire prone areas are located adjacent to existing developed areas it is readily assumed the local road networks can be extended, honed or widened to ensure that the primary evacuation capability of new development satisfies not only *PBP* but other measures of vehicular movements such as traffic guidelines. New developments that connect with existing developed areas automatically enable traffic assimilation into the already developed areas through the existing network of roads meaning evacuation can occur in a fluid manner.

Alternatively, where a development is to be located in remote bushfire prone area then issues arise on evacuation capability and specifically the type of development being considered.

By reviewing Table 4.1 below it can be seen that a rural residential land use is a better option for remote development as it provided low density in terms of population and greater areas of managed defendable space in the form of APZs. This brings in the concept of 'land use density and development suitability' within bushfire prone areas.

Table 4.1 assumes typical development densities and may vary but for the purpose of the exercise Table 1 offers a degree of clarity on how PBP has been designed and how its solutions are defined. The capability of self reliance is also clear for some land uses and not possible for others.

4.4 How PBP provides planning in bushfire prone areas

PBP deals with land use suitability and population density as a basis of their assessment and advises through acceptable solutions on how to manage or control the risk for those varying land uses.

Firstly, by recognizing population density and self reliance as a measure of land use suitability in bushfire prone areas. *PBP* actively addresses the varying types of land use and provides detailed performance solutions in order that there can be no doubt on what is permissible and therefore compliant for each one of the land uses covered by *PBP*.

Table 4.1 below replicates the land uses covered by *PBP*. In effect Table 4.1 provides a linear progression on those land uses by way of an example primitive camping through to high-density aged care facilities. The table identifies the incumbent risk associated with those land uses.

Secondly *PBP* applies two (2) radiant heat measures to protect the most 'at risk' in comparison to the 'acceptable risk'. For example, for special protection developments the measure is 10 k/Wm^2 based on a flame temperature of 1200° whilst on all other land uses apply 29 k/Wm^2 based on a flame temperature of 1090° – see Table 4.2 below.

Table 4.2 provides a recognition of how the varying land uses are protected by one of the two radiant heat measures required by *PBP* – which, by default, requires a much greater APZ dimension for special protection developments whilst having a minimal building construction standard.

This dichotomy of bushfire planning addresses resilience by recognising the special protection developments should be located at the safest location away from a hazard whilst non-special protection developments retain the benefit of greater flexibility.

Typically, this also means that evacuation for special protection developments is unlikely, in most cases, because science and experience has contributed to the acceptable APZ space to achieve safe bushfire design for that land use.

Alternatively, where persons are more self-reliant and resilient then the more practical approach is permissible within *PBP* using the 1090° for flame temperature and the much higher application of radiant heat being 29 k/Wm^2.

PBP is about integrated bushfire design and to that extent the RFS state in *PBP* section 3.1 that bushfire design is about the implementation of appropriate 'measures in combination' to offset the likely effects of fire behaviour – see Figure 4.3.

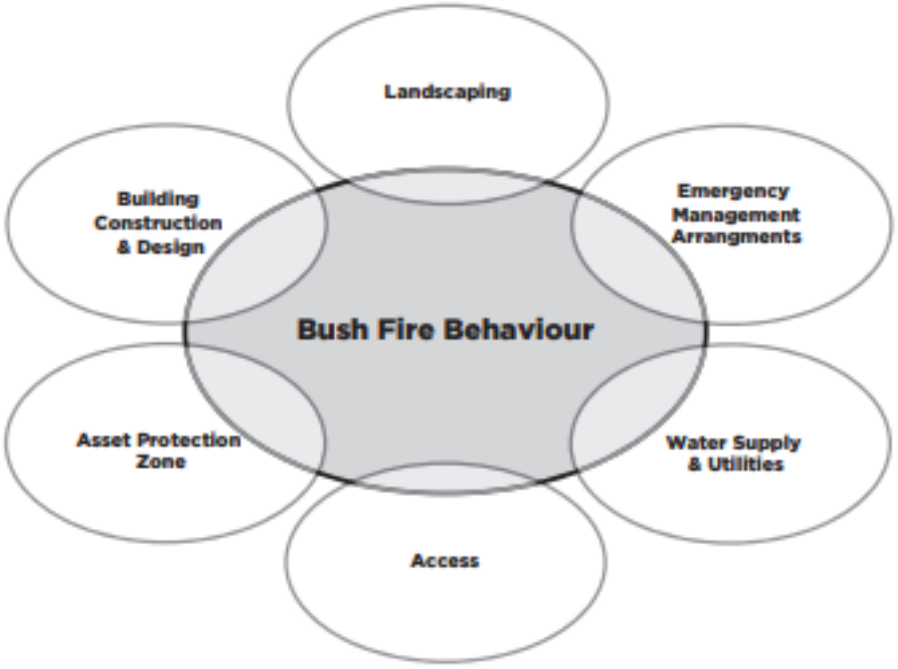


Figure 4.3 – Measures in combination (PBP 2019)

The key drivers are asset protection zones, access and building construction / design. The remaining elements such as water supply / utilities, emergency management arrangements and landscaping are peripheral matters. Indeed, an APZ design over-rides landscaping through the requirements of *PBP* in Appendix 4 for APZ design.

Bushfire design planning can be explained as less difficult when designing future development is adjacent to existing developed communities such that safe access and egress enable an acceptable load on the transport system. Indeed, bushfire planning is about providing not only separation from hazardous vegetation but also ensuring transport systems are capable of supporting a new development.

Planning becomes more difficult and potentially not possible when the design includes a remote envelope with no adjacent community development thus relying on egress and access options. Of greater concern is when bushfire planning alone cannot resolve a basic land use conflict as enunciated in Table 4.1 e.g. a development with high density and high risk.

PBP provides clarity on what the RFS expect from the simplest development e.g. primitive camping development which can be evacuated in advance of catastrophic bushfire weather arriving. This is in stark comparison to an aged care facility which may well require evacuation of each patient by a single ambulance as a result of their infirmity. This operational requirement must be presumed on the assumption of impending extreme and or catastrophic fire weather arriving.

What this shows is that *PBP* deals with population density as a linear progression and applies treatments on how to manage or control the subsequent risk. What may not be effectively dealt with by *PBP* is how people move around in high density areas and the cumulative impacts of additional people on existing road systems. That requires an expert report.

What Table 4.1 does imply is that there are land uses which are unsuitable as the associated risk is simply too high and is therefore not acceptable. Equally there are other land uses of a lower density that can be considered as being acceptable.

As discussed before the location of a specific land use to existing developed communities has a large bearing on what is acceptable risk and this leads to the likelihood of risk and the consequence of that risk. If a development is remote and has a high density then the likelihood of that risk is at least high and the consequence of that risk must also be high.

Should a development be attached to existing urban development then a safer scenario occurs regardless of the bushfire hazard that remains. Simply put, by expanding the urban bushland interface a development can not only transfer the hazard but also mitigate that hazard from a current steep slope affectation to a lesser steep slope affectation.

Table 4.1 – Population density Vs self reliance capability

Landuse noted in PBP	Typical expanse	Population Projection (persons)	PBP Control/s	Low risk	Medium risk	High risk	Extreme risk	Reliance	Reliant on
Primitive camping in national parks	Low site numbers	<100	Evacuation and low density					Self reliant	Park closures and other communications to enable early evacuation
Rural residential development	<50 lots	250-350	Evacuation and APZ's					Self reliant	RFS signs, RFS messaging, TV, radio, phone, social messaging, neighbours, emergency services and internet
Eco-tourism development	12 units	24-30	Evacuation and APZ's					Self reliant	RFS signs, RFS messaging, TV, radio, phone, social messaging, neighbours, emergency services and internet
Caravan park	50-350 sites	<1,000	Evacuation and APZ's					Assisted evacuation	RFS signs, RFS messaging, TV, radio, phone, social messaging, neighbours, emergency services and internet
Low density residential subdivision	300 lots	<650	Evacuation, APZ's and building construction					Self reliant and assisted evacuation	RFS signs, RFS messaging, TV, radio, phone, social messaging, neighbours, emergency services and internet
Rural farm	Low numbers	<5	Nil on most farms as they are not subject to PBP					Self reliant and assisted evacuation	RFS signs, RFS messaging, TV, radio, phone, social messaging, neighbours, emergency services and internet and sighting of smoke.
Multi story building	50 units	120	Evacuation and APZ's					Assisted evacuation	RFS signs, RFS messaging, TV, radio, phone, social messaging, neighbours, emergency services and internet and sighting of smoke.
Tourist facility (Hotel or motel)	200 rooms	400	Evacuation and expansive APZ's					Assisted evacuation	Mostly directions from management
Seniors living with	80 units	160	Evacuation and expansive APZ's					Self reliant and	RFS signs, RFS messaging, TV, radio, phone, social messaging,

Independent living								assisted evacuation	neighbours, emergency services and internet and sighting of smoke .
Seniors living with assisted living	80 units	160	Evacuation and expansive APZ's					Assisted evacuation	Directions from management & emergency services
Group home with handicapped residents	1 unit	8-12	Evacuation and expansive APZ's					Assisted evacuation	Directions from management & emergency services
Child care	Mixed	80-120	Evacuation and expansive APZ's						Directions from management & emergency services for
Hospital	Mixed	Approx' 1,000	Evacuation and expansive APZ's					Assisted evacuation	Directions from management & emergency services
Aged care facility with full care provided	Variable	80-160	Evacuation and expansive APZ's					Assisted evacuation	Directions from management & emergency services

Table 4.2 – Land use protection by a radiant heat k/Wm² measure

Landuse noted in PBP	APZ required	Radiant heat measure (k/Wm²)	Building construction standard applied (AS3959)
Primitive camping in national parks	No	Nil	No
Rural residential development	Yes	29	BAL 29
Eco-tourism development	Yes	29	BAL 29
Caravan park	Yes	29	BAL 29
Low density residential subdivision	Yes	29	BAL 29
Rural farm	Yes	29	BAL 29
Multi story building	Yes	29	BAL 29
Tourist facility (Hotel or motel)	Yes	10	BAL 12.5
Seniors living with Independent living	Yes	10	BAL 12.5
Seniors living with assisted living	Yes	10	BAL 12.5
Group home with handicapped residents	Yes	10	BAL 12.5
Child care	Yes	10	BAL 12.5
Hospital	Yes	10	BAL 12.5
Aged care facility with full care provided	Yes	10	BAL 12.5

4.5 Benchmarks for planning developments in bushfire prone areas

In the final assessment when evaluating a risk management strategy there needs to be an assessment method that is both practical and acceptable such that there is a consistent approach to bushfire risk management planning. Meridian Urban (2022) used twelve (12) benchmarks so we will used those as a basis with additional eight (8) benchmarks relevant to *PBP* and Ministerial Direction 4.3 – see Table 5.4 Risk Evaluation in Part 5 of this study.

1. The context of landscape, fire history, likelihood / probability and fire behaviour and intensity is considered and potential consequences can be avoided, mitigated, transferred or accepted
2. Valued habitat, environmental values, assets, corridors and functions are maintained
3. Various land use scenarios are contemplated to examine and assess the potential impact of different fire behaviour intensities and mitigation measures
4. Balancing environmental values and land use allocation incorporates consideration of disaster risk reduction
5. Special fire protection purposes are strategically considered in terms of appropriateness in bush fire prone areas
6. The planning outcome is capable of facilitating local Neighbourhood Safer Places, community refuges or evacuation centres within the area for shelter in place options
7. Consideration for locating inappropriate development
8. Strategic planning is capable of facilitating appropriate and effective evacuation, based on key assumption
9. The evacuation ability of existing residents or occupants is not worsened
10. Increased demand on emergency services is avoided or reasonably mitigated
11. Essential, community and strategic infrastructure avoids high risk exposure
12. The water supply network is protected from or avoids exposure to bush fire attack which may compromise its function, including pump stations and other assets
13. Ongoing land management and hazard reduction implications are considered
14. Determine the acceptable peripheral defendable space to a development polygon and development land use
15. Review if defendable space is suitable for the specific development land use
16. Will subsequent post development bushfire mapping create a better overall risk ‘exposure’ to the development
17. Will the existing community gain from a better bushfire hazard result
18. Is the development land use suitable for the locality such as habitable low density residential, multi storey special protection developments and or non-habitable developments that increase population density or hazardous goods developments.
19. Review of population density and proposed land use suitability
20. Traffic evacuation capability for the new development design.

PART 5

RISK ASSESSMENT

PRE-DEVELOPMENT

5.0 RISK ASSESSMENT PRE-DEVELOPMENT

5.1 Risk assessment

This risk assessment is undertaken on the basis of the NERAG protocol and honed to validate bushfire risk in bushfire prone areas.

For the risk to be able to be assessed it must be primarily responsive to a quantification measure and if not then a qualification measure. Table's 5.1 to 5.5 provide the various measures that will be used in the detailed assessments.

The risk attribute used in column 1 of those tables provides criteria for assessment that 'can be measured'. They are not the only risk attributes that will be considered.

The assessment will review all peripheral and internal risks associated with the planning proposal within Part 4. Initially the assessment will provide clarity of what elements will be assessed and how they will be assessed by the qualitatively or qualitatively to derive a valid risk assessment. This is provided in the following tables which include;

- Table 5.1 - Identification of landscape risk
- Table 5.2 - Quantification of landscape risk
- Table 5.3 - Analysis of risk – consequences and likelihood
- Table 5.4 - Risk evaluation - acceptability of landscape and development design risk
- Tabel 5.5 - Risk treatments

5.2 Pre-development assessment

All associated risks to the planning proposal are identified in Table 5.6. There are 13 identified risks of which 8 are bushfire related and 5 are access related. Upon completion of the complete risk assessment in Table 5.6 a risk analysis will occur in Table 5.7 and a risk evaluation will be provided in Tabel 5.8.

Post development option

A second complete risk assessment will be undertaken in Part 6 reviewing the planning proposal following development and taking into consideration all the theoretical risk aspects found in Part 4.

Upon the quantification of consequence being addressed the subsequent treatment options of risk elimination or risk mitigation are assessed and applied. Alternatively, if risk cannot be successfully mitigated then the development must change so that it can be made acceptable for habitable residential developments.

Note for the Table/s 5.1 to 5.5: All attributes in brown colour text is a 'strategic requirement' question from PBP 2019 Chapter 4. Matters referred to in Ministerial Direction 4.3 are also dealt with below.

As can be seen in the Ministerial Direction the overwhelming approach is to avoid placing inappropriate developments such as schools, hospitals and aged care facilities in hazardous areas and PBP 2019 is used as the compliance policy which applies a number of compliance checks using performance criteria and acceptable solutions. These matters are fleshed out in the following but due to the general nature and the non-specific nature they are not drawn out as individual risk elements.

Table 5.1 – Identification of landscape risk context

Risk attribute	ID Risk	
Identification of landscape risk context	Subjective measure	Quantifiable measure
Define the extent of bushfire prone mapping as either forest, woodland or grassland and proceed to apply a varying distance buffer in metres to each formation.	Assesses bushfire prone mapping as vegetation 'formation' which enables level of risk to be assigned	Quantifiable in terms of forest in comparison with say heath or grass
The bush fire hazard in the surrounding area, including: • Vegetation Topography Weather The potential fire behaviour that might be generated based on the above; • History of bush fire in the area; Potential fire runs into the site and the intensity of such fire runs. • The difficulty in accessing and suppressing a fire, the continuity of bush fire hazards or the fragmentation of landscape fuels and the complexity of the associated terrain.	Slope gradient and aspect History mapping Design of access / tracks	Slope in degrees Area burnt Length of tracks
Define the extent of bushfire risk the site is subject to	Position in the landscape and exposure to peripheral bushfire possibilities	Fire runs likely to affect the site
Define the fire danger index (FDI) applicable to the area	Determine daily FDI index based on RFS fire district mapping	Sydney fire district is FDI 100
Defining the probable affectation upon a development caused by ember, radiant heat and or flame attack and or a combination of all if the development is less than 100m from the hazard; as either Low or not Low.	Mapping vegetation extent	Less or greater than 100m in extent
Road hierarchy and access during bushfire events	Road widths, controlled lights at intersections which can be a blockade	Road design and traffic report modelling
Road pinch points	The location and the extent of the pinch	Measured in metres
Adjoining land - consideration of the implications of a change in land use on adjoining land including increased pressure on BPMs through the implementation of Bush Fire Management Plans.	Review of bushfire risk management plan	Level of risk assigned
Infrastructure • The ability of the reticulated water system to deal with a major bush fire event in terms of pressures, flows, and spacing of hydrants. • Life safety issues associated with fire and proximity to high voltage power lines, natural gas supply lines etc	Trunk main capacity advice from Sydney water. Overhead high voltage power lines	

Table 5.2 – Quantification of landscape risk

Quantification of landscape risk	Subjective measure	Quantifiable measure
The hazard is further defined by mapping the edges of the vegetation formations so that bushfire attack can be further calculated.	Accurately map formation proximity to the development footprint as a remnant <0.5 ha or non-remnant	Defendable space as an APZ
Defining slope gradients of the hazardous vegetation a steeper down slopes create greater intensities and flame lengths whilst upslopes create lesser intensities and shorter flame lengths	Up or down slope	In degrees and comparison to PBP tables
Calculating the actual affectation (i.e. radiant heat flux and or flame contact likelihood) through the use of quantitative metrics identified by the RFS as applying PBP DTS or AS3959 App 2 after (Douglas & Tan) / OPTUS (2000 and 2005) as acceptable, or not.	Not subjective	Calculate using Appendix 2 of AS3959 of apply DTS standards in PBP
By applying a different flame temperature metric for habitable special fire protection developments as opposed to habitable residential developments; and applying lower metric/s as a basis for non-habitable developments such as commercial developments or industrial developments.	Apply appropriate flame temperature of 1090 or 1200 degrees as fit for purpose	Calibrate calculation input variable
Evacuation capability and impact from peripheral traffic flows and from perceived blockages • The capacity for the proposed road network to deal with evacuating residents and responding emergency services, based on the existing and proposed community profile. • The location of key access routes and direction of travel. • The potential for development to be isolated in the event of a bush fire.	Traffic modelling	Vehicle movements

Table 5.3 – Analysis of risk consequences and likelihood

Analysis of risk – consequences and likelihood	Subjective measure	Quantifiable measure
Exposure to hazards with expected long fire runs and high fire intensities	Review of retained peripheral hazard mapping	Depth and perimeter of hazards
Exposure to high impact bushfire prone mapping and in relation to peripheral road system design	Review of retained peripheral hazard mapping	Depth and perimeter of hazards
Exposure to high wind velocities from Northwest or seasonally dominant weather systems	Review of weather opportunities and history	Exposure could be less or more
Exposure to internal and external flame pinch points	Review of retained hazard mapping	Area comparisons made in terms of area and or length of hazards
Exposure to internal retained vegetation assemblages	Review of retained hazard mapping	Area comparisons made in terms of area and or length of hazards
Review of population density and proposed land use • The risk profile of different areas of the development layout based on the above landscape study. • The proposed land use zones and permitted uses. • The most appropriate siting of different land uses based on risk profiles within the site (i.e. not locating development on ridge tops, SFPP development to be located in lower risk areas of the site). • The impact of the siting of these uses on APZ provision.	Land use density as per Table 4.1 (as a guide)	Population numbers and vehicle numbers
Poor traffic design and flow capability	Review traffic design	Review traffic modelling

Table 5.4 – Risk evaluation

Risk Evaluation – acceptability of landscape and development design risk	Subjective measure	Quantifiable measure
Benchmark 1 – The context of landscape, fire history, likelihood / probability and fire behaviour and intensity is considered and potential consequences can be avoided, mitigated, transferred or accepted	Review of all elements that affect fire behaviour potential before development and after development	Transfer of hazard and mitigation of fire behaviour
Benchmark 2 – Valued habitat, environmental values, assets, corridors and functions are maintained	Review of environmental values	Area affected
Benchmark 3 – Various land use scenarios are contemplated to examine and assess the potential impact of different fire behaviour intensities and mitigation measures	Review of possible designs	Areas planned
Benchmark 4 – Balancing environmental values and land use allocation incorporates consideration of disaster risk reduction	Review of current values	Extent of the values
Benchmark 5 – Special fire protection purposes are strategically considered in terms of appropriateness in bush fire prone areas	What SFPD are in situ	Area of affectation
Benchmark 6 – The planning outcome is capable of facilitating local Neighbourhood Safer Places, community refuges or evacuation centres within the area for shelter in place options	benefit gained	The NSP is compliant with PBP for radiant heat affection which is <2 k/Wm^2.
Benchmark 7 - Consideration for locating inappropriate development	Demonstration by exposures to high risk	Radiant heat affectation above 29k/Wm^2
Benchmark 8 – Strategic planning is capable of facilitating appropriate and effective evacuation, based on key assumptions	Evacuation capability has been well proven	Traffic modelling
Benchmark 9 – The evacuation ability of existing residents or occupants is not worsened	Demonstration by traffic modelling	Vehicle movements
Benchmark 10 – Increased demand on emergency services is avoided or reasonably mitigated	Demonstrate current infrastructure	
Benchmark 11 – Essential, community and strategic infrastructure avoids high risk exposure	Demonstrate any exposures	Not applicable
Benchmark 12 – The water supply network is protected from or avoids exposure to bush fire attack which may compromise its function, including pump stations and other assets	Demonstrate availability	Not applicable

Benchmark 13 – Ongoing land management and hazard reduction implications are considered	Fuel management planning and funding base	Costs to be identified at a later stage
Benchmark 14 - Determine the acceptable peripheral defendable space to a development polygon and development land use	Review development density on interface of bushfire prone lands	Apply acceptable solutions and or performance measures
Benchmark 15 - Review if defendable space is suitable for the specific development land use	Review population vs defendable space	Compliant APZ dimensions as per PBP or greater
Benchmark 16 - Will subsequent post development bushfire mapping create a better overall risk 'exposure' to the development	Demonstrate exposure	Reduced exposure footprint in hectares and or metres
Benchmark 17 - Will the existing community gain from a better bushfire hazard result	Demonstrate benefits gained	Amended mapping could show marked change on perimeter of possible fire attack
Benchmark 18 - Is the development land use suitable for the locality such as habitable low density residential, multi storey special protection developments and or non-habitable developments that increase population density or hazardous goods developments.	ID of land use and density	Population and vehicles
Benchmark 19 - Review of population density and proposed land use suitability	Land use density as per Table 4.1	Population numbers and vehicle numbers
Benchmark 20 - Traffic evacuation capability	Determining risk	New road design specifications and an evacuation time metric suitable for site conditions

Table 5.5 – Risk treatments

Risk Treatments	Subjective measure	Quantifiable measure
Identify how PBP can cope with the development design	PBP provides for varying density land uses as expressed in Table 4.1 in Section 4 above. This recognizes that PBP provides a series of performance criteria that must be designed into a development; and PBP provided in parallel a series of acceptable solutions that achieve the performance criteria. The performance criteria and acceptable solutions are provided within section/s 5, 6, 7 & 8 of PBP and are based on the use of 'measures in combination', as defined in section 3.1 on page 26, dealing with development planning design.	The primary measures are APZ's and access design. APZ's have been calculated by OPTUS and RFS and found to be commensurate with PBP APZ dimensions as expressed in Table A1.12.1 of PBP. Effective access is defined as ensuring safe access and egress from a development by way of road width, road slope, road treatment, road cross gradient and most importantly where the road is dangerously affected by vegetated pinch points on both sides or acceptable perimeter roads with vegetation on one side of the road.
Identify where PBP is inadequate	PBP is deficient on steeper land above 20 degrees such as the southern boundary and part eastern boundary which vary between 15-22 degrees and are outside the acceptable limits of PBP. PBP does not deal with narrow riparian zones that are above 20m in width. If they are 20m in width or less then PBP accepts low hazard but there is no sliding table for areas between 20m and 50m. PBP does not identify how the extent of internal conservation areas within a development boundary should be handled apart from APZ's alone and peripheral access.	Quantify through modelling
Identify development design changes	Suggest changes arising from risk assessment	Not applicable

Table 5.6 – Risk Identification prior to development

Risk no	Risk descriptor	Source of risk (See fire history figure below) (Aspect is taken as from the PP site boundary)	Consequence history	Prevention preparedness controls	Response and recovery controls
1.	Bushfire northwest of Forest Way	Part forest and part tall heath fire burning within the national park and Sandstone Bloodwood shrub forest burning on private unmanaged northwest of Forest Way on a very long downslope towards Forest Way	No recorded wildfires but is expected to burn	Permanent fire break in the form of the 46m wide Forest Way intersection and the 18m wide Wyatt Avenue Preparedness in the form of; - Hazard reduction burn in 2009-10 - Hazard reduction burn in 2006-07 - Hazard reduction burn in 1994-95	46m of defendable space via Forest Way and Wyatt Avenue on long downslope Active firefighting response from the two fire agencies and police for traffic control
2.	Bushfire Northwest – Between Forest Way and PP site	Grass fire between Forest Way and PP site within aged care site	No recorded grass fires	Regular mowing of grassland North south fire tail within PP site which acts as a fire break	Well managed grassland for self reliance of aged care facility Active firefighting response from the two fire agencies
3.	Bushfire burning within the 72 ha site	Dry sclerophyll forest fire burning downslope within northwestern corner of PP site and expanding with PP site; or upslope towards the Morgan Road / Forest Way intersection	No recorded wildfires apart from a wildfire that started from a hazard reduction burn by the RFS	Regular access by landowner/s Preparedness in the form of; - Hazard reduction burn in 2003-04 - Hazard reduction burn in 1984-85	No onsite management One fire trail in west sector Active firefighting response from the two fire agencies.
4.	Bushfire to the northeast	Tall heath / shrubby forest fire burning amidst rural residential ‘horse yard’ properties from corner of Morgan Road / Forest Way to the east at 5 Mile Creek Trail	No recorded wildfires but could burn albeit sporadically in the fragmented patch of bushland	Low density land use Managed grassland by landowners that create fragmentation of the vegetation fragments. Provision of large horse yards which	Active firefighting response from the two fire agencies

				have no hazardous vegetation and stop fire progression. Downslope burning in the northeast reduces fire intensity, ember production and radiant heat affectation Preparedness in the form of; - Hazard reduction burn in 2008/09 - Hazard reduction burn in 2003/04 - Hazard reduction burn in 2001-2002	
5.	Bushfire to the northeast	Tall heath fire burning downslope between 5 Mile Creek Trail and Slippery Dip Trail (off Morgan Road)	Wildfire burnt 13,000 ha over three days between January 7-9th 1994 burning from Cottage Point to Oxford Falls fire beaks (and a slight outbreak near Beacon Hill) in an overall southerly direction. 30 houses were lost in the early days (in the north) but no property losses in the vicinity of the PP site. Note: The area mapped by the RFS on the figure below is not entirely accurate as aerial photography shows. The 1994 fire mainly burnt down to an area between 5 Mile Creek Trail and The Slippery Dip Trail and not down to Morgan Road. Aerial photo evidence shows controlled burning and lack of penetration in the south down to Oxford	Low density land use Provision of large horse yards which have no hazardous vegetation together with the north south 5 Mile Creek Trail and the Slippery Dip Trail fire breaks plus Morgan Road as a platform. Preparedness in the form of; Hazard reduction burn in 2001-2002	Active firefighting response from the two fire agencies

			Falls.		
6.	Bushfire burning within the PP area and burning in southerly direction towards OPTUS	Dry Sclerophyll forest fire burning downslope within central PP site and east to OPTUS lands	Wildfire in 2014 as a result of an escaped hazard reduction burn. No property losses within the vicinity of the fire.	No onsite management Insitu fire trail, public road and rocky nature of Snake Creek watercourse and bed (meaning a lack of fuels which acts as a reliable fire break). Morgan Road and OPTUS lands provided eastern fire breaks.	The 'clean lines' strongly indicate the burn was controlled and held at readily available points such as the northern boundary of 954 Morgan Road (Rural Res lot), Snake Creek bed and Morgan Road in the east and north
7.	Bushfire burning from the south of PP area South of PP site on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail.	South of PP site on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail. +	No recorded fire events	No defined fire breaks other than a 10m vertical escarpment east of Snake Creek which runs for 100m and the fire break capabilities of Morgan Road.	Low probability from the south but highly possible
8.	Vehicular evacuation denial from a bushfire pinch point Morgan Road intersection with Forest Way	Peripheral bushfire in the north/northwest of Morgan Road and northwest of Forest Way (likely southeasterly path of possible high intensity fires)	No recorded events	Hazard reduction burning during cooler periods of the year to reduce fuels buildup in those areas	Morgan Road is relatively narrow and roadside vegetation encroaches to the road edge No slip lane from Morgan Road to ease likely congestion Likely to be a manned

					intersection to control congestion
9.	Vehicular evacuation denial from pinch point on Morgan Road near Hilversum Crescent	Forest on south side of Morgan Road for 420m east of the Forest Way intersection; and a narrow zone of unmanaged forest on the north side of Morgan Road	Wildfire in 2014 as a result of an escaped hazard reduction burn.	No active management apart from occasional hazard reduction works	Morgan Road is relatively narrow and roadside vegetation encroaches to the road edge Active suppression to enable existing community of Hilversum Crescent and along with the insitu 20 private properties along that road and Morgan Road; to evacuate area
10.	Vehicular evacuation denial from a bushfire pinch point on Morgan Road Near Slippery Dip trail area	Northeast of Morgan Road amongst Sandstone Bloodwood Shrub forest, Tall heath and Heath	Wildfire in 1993-94 burning from north to south	Fire break via the Slippery Dip Trail fire break and Morgan Road.	Morgan Road is relatively narrow and roadside vegetation encroaches to the road edge Active firefighting response from the two fire agencies
11.	Vehicular evacuation denial from a bushfire pinch point along the eastern and southeastern portions of Morgan Road towards OPTUS area	Peripheral vegetation on both sides of the road	Subject to 1994 and 2014 wildfires	Peripheral hazard reduction possibly but likely to be a successful action over time	Morgan Road is relatively narrow and roadside vegetation encroaches to the road edge Not known
12.	Controlled intersection with Forest Way and likely blockade to Morgan Road	Bushfire smoke making evacuation of Morgan Road dangerous	Road closure southeast of development footprint on Morgan Road	No road blockage known	No action required

Table 5.7 – Risk analysis (Pre-Development)

Risk no (as per Table 5.6)	Risk description	Level of prevention and preparedness	Level of response and recovery controls	Consequence level	Likelihood Level	Risk Level	Confidence Level
1	Bushfire West of Forest Way	Fire break via Forest Way	Active suppression by fire services	High expectation of ember attack but low radiant heat and no flame contact as flames are 230m away from PP site	Likely	Likely, 1 to <10 years	High
2	Bushfire Northwest – Between Forest Way and PP site	Mowed grasslands	Active suppression by fire services	Ember attack but low radiant heat and possible flame contact burning downslope	Unlikely	Unlikely, 10-100 years	High
3	Bushfire burning from within the PP 72 ha area	No current management other than irregular hazard reduction burning	Active suppression by fire services	Rapid Flame rate of spread to the north and or east/southeast	Likely	Likely, 1 to <10 years	
4	Bushfire burning from northeast – between Forest Way and fire trail off Morgan Road (411m east of Hilversum Crescent)	Fire trail is actively used	Active suppression by fire services	Ember attack and radiant heat attack burning downslope and no flame contact	Likely	Likely, 1 to <10 years	High
5	Bushfire from the northeast to southeast between 5 Mile Creek Trail and Slippery Dip Trail (off Morgan Road)	Fire trails x 2 and the Morgan Road fire break barrier along with managed grass in the rural residential lots	Active suppression by fire services	Ember attack and radiant heat attack burning downslope and no flame contact	Likely	Likely, 1 to <10 years	High
6	Bushfire burning within the PP area	Fire trails x 2 and the Morgan	Active suppression by fire services	Ember attack and radiant heat attack burning	Likely	Likely,	High

	and burning in southerly direction towards OPTUS	Road fire break barrier plus rural horse yards in rural residential lots		downslope and no flame contact			
7	Bushfire burning from the south of PP area on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail.	Nil	Active suppression by fire services	Flame run to the north	Likely	1 to <10 years	High
8	Vehicular evacuation denial from a bushfire pinch point or other at Morgan Road intersection with Forest Way	Nil	Active suppression by fire services	Flame run to the north	Likely	Unlikely	High
9	Vehicular evacuation denial from a bushfire pinch point or other on Morgan Road near Hilversum Crescent	Nil	Active suppression by fire services	Flame run from the north	Likely	Likely, 1 to <10 years	High
10	Vehicular evacuation denial from a bushfire pinch point on Morgan Road Near Slippery Dip trail area	Nil	Active suppression by fire services	Trapped vehicles	Likely	Likely, 1 to <10 years	High
11	Vehicular evacuation denial from a bushfire pinch point along the eastern and southeastern portions	Nil	Active suppression by fire services	Trapped vehicles	Likely	Likely, 1 to <10 years	High

	of Morgan Rd towards OPTUS area						
12	Oxford Falls bridge not operating	Nil	Roads being controlled by emergency services	Reduced evacuation route from 3 to 2	Likely	Likely, 1 to <10 years	High

Table 5.8 – Existing risk evaluation (Pre-development)

Risk No (from Table 5.6)	Risk Priority	Risk Level	Treatment Plan
1	Bushfire event	High risk to all rural residential properties north and east of Morgan Road	No treatment other than irregular hazard reduction burning within PP site
2	Bushfire event	Low risk as the land is managed	Continue to mow and manage
3	Bushfire event	High risk to all rural residential properties north and east of Morgan Road, OPTUS site, residential properties off Oates Place / Lyndhurst Way and residential estate south of Childs Crescent and Laurie Place	No treatment other than irregular hazard reduction burning within PP site
4	Bushfire event	High risk to all rural residential properties north and east of Morgan Road and off Hillversum Crescent.	No treatment other than irregular hazard reduction burning within PP site
5	Bushfire event	High risk to all rural residential properties east of 5 Mile Creek trail and Slippery Dip trail	No treatment other than irregular hazard reduction burning within PP site
6	Bushfire event	High risk to Optus infrastructure and residential estate south of Childs Crescent and Laurie Place	No treatment other than irregular hazard reduction burning within PP site
7	Bushfire event	Extreme risk burning from the south of PP area on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail.	No treatment other than irregular hazard reduction burning within PP site
8	Evacuation event	High risk as no apparent road edge management is undertaken by land owners and or council	No treatment other than irregular hazard reduction burning within PP site
9	Evacuation event	High risk as no apparent road edge management is undertaken by land owners and or council	No treatment other than irregular hazard reduction burning within PP site
10	Evacuation event	High risk as no apparent road edge management is undertaken by land owners and or council	No treatment other than irregular hazard reduction burning within PP site

11	Evacuation event	High risk as no apparent road edge management is undertaken by land owners and or council	No treatment other than irregular hazard reduction burning within PP site
12	Evacuation event	High risk as no apparent road edge management is undertaken by land owners and or council	Bridge reconstruction

PART 6

RISK ASSESSMENT POST DEVELOPMENT

6.0 RISK ASSESSMENT POST DEVELOPMENT

The Patyegarang Planning Proposal seeks to provide for 450 low density dwellings within 44.89 ha of a 72.0 ha site; whilst retaining 27.11 ha of native vegetation in the form of riparian zones and two conservation zones.

In the delivery of a strategic bushfire study this report has been structured as follows;

- Part 1 provides a detailed explanation of the planning proposal.
- Part 2 provides background to the consultation and peer reviews undertaken by Meridian Urban and Blackash Bushfire Consulting.
- Part 3 provides a complete background to the site, its context and contributing background such as fire history, fire behaviour, potential bushfire threats and traffic assessment. This section also deals with land use density as a measure of how *PBP* deals with development control.
- Part 4 begins the risk assessment process by introducing a framework for risk assessment and identifies the theoretical manner in which a bushfire assessment should be considered and undertaken.
- Part 5 addresses the risk assessment of the site in terms of what the risk is pre-development and places a context to that risk in terms of bushfire related issues and traffic related issues.
- Part 6 then addresses how the planning proposal changes the current risk and creates a safer environment for the proposed community and the current community as required by *PBP*.
- Part 7 provides a conclusion and recommendations.

6.1 Basis of assessment

Ministerial direction 4.3 requires that inappropriate development not be located on bushfire prone areas and subsequently proceeds to recommend the use of *PBP* as a compliance mechanism.

PBP provides a detailed basis of strategically assessing any future developments in Section 4 through a series of tailored measures designed to investigate strategic merit, or not.

PBP section/s 5, 6, 7 & 8 are provided as development controls based on land use density and risk probability within those densities - all set within the context of catastrophic bushfire conditions relevant to an FDI of 100.

Having been developed over 30 years *PBP* has had the contributions of learnt lessons and fire inquiries and, together with *AS3959 Construction of buildings in bushfire prone areas,* provides acceptable solutions when developing within bushfire prone areas.

As found above, the key issue in regards to risk within bushfire prone areas is the location of new developments either adjacent to existing developed areas or remote from developed areas. The latter may lead to a significant increase in risk not only from the bushfire hazards but also from evacuation capability. Thus, any new development that is adjacent to existing urban development simply transfers the hazard whilst that may not occur with remote developments.

The risk however must be further analysed on how the transfer of any hazards is made worse, or made better, for the existing community; and also for the proposed community.

In the final assessment when evaluating a risk management strategy there needs to be an assessment method that is both practical and acceptable such that there is a consistent approach to bushfire risk management planning.

6.2 The pre-development risk

The predevelopment bushfire risk is principally the manner in which the PP site provides a major threat to;

- A mix of urban development in the west and continues on the western side of Forest Way.
- Residential development south of Childs Close and Laurie Place.
- Rural residential development to the north and east of Morgan Road.
- Two rural residential allotments to the immediate south of the PP site.
- OPTUS unit in the south.

The insitu bushfire hazards include the whole of the 72 ha site and provide a significant bushfire risk to the;

- Adjacent aged care and child care development/s on the corner of Forest Way.
- Morgan Road, the over 55's development off Lyndhurst Way and Oates Place in the west.
- The rural residential landscape in the west and also in the north of Morgan Road.
- The OPTUS infrastructure in the south.

Fire behaviour

A peer review assessment by Meridian Urban mapped the site as having lower bushfire intensity (<20,000 k/Wm) whilst land further east of Morgan Road within steep and complex topographic exposures were mapped at up to and higher than 60,000 k/Wm.

Fire history

Fire history (Fig 3.4) found that no wildfires have burnt from the northwest despite expectations given the potential for hot dry winds in dry periods of spring / summer.

Fires have burnt from the north in 1994 and were held through hazard reduction operations undertaken off the two existing and strategically located fire trails in the east. A further wildfire occurred southeast of Morgan Road in 2006-07 and again in 2014.

Fire history shows the RFS are active in the undertaking of hazard reduction burns in the immediate vicinity over the past 40 years e.g. 1984-85, 1994-95, 2001/02, 2003-04, 2005-06, 2006-07, 2009-10 and 2014.The latter became a wildfire as a result of the RFS losing control.

6.3 Demonstration of risk

The fire risk assessment undertaken in Table 5.8 determined that of the 12 bushfire risks identified seven (7) were bushfire related and five (5) were traffic evacuation related with high risk associated with eight of those identified risk factors with the remaining risks identified as low and or medium.

The current urban and rural residential landscape that surrounds the PP site can be seen in Figure 6.1 below.

The current bushfire prone map is shown in Figure 6.2 which depicts a significant amount of Red colour over the landscape and places a full frontal attack upon;

- The existing community that resides on the eastern side of Forest Way (see Yellow polygon/s on Figure 6.1) or
- The existing residential community to the south of the PP area (see Red polygon on Figure 6.1) and a lesser extent,
- The rural residential community as shown in the Orange and Green polygon/s.
- The OPTUS facility (See Blue polygon).

The vegetation removal proposed by the planning proposal will significantly lessen the bushfire threat upon the land uses noted above – see the revised bushfire prone mapping in Figure 6.4.

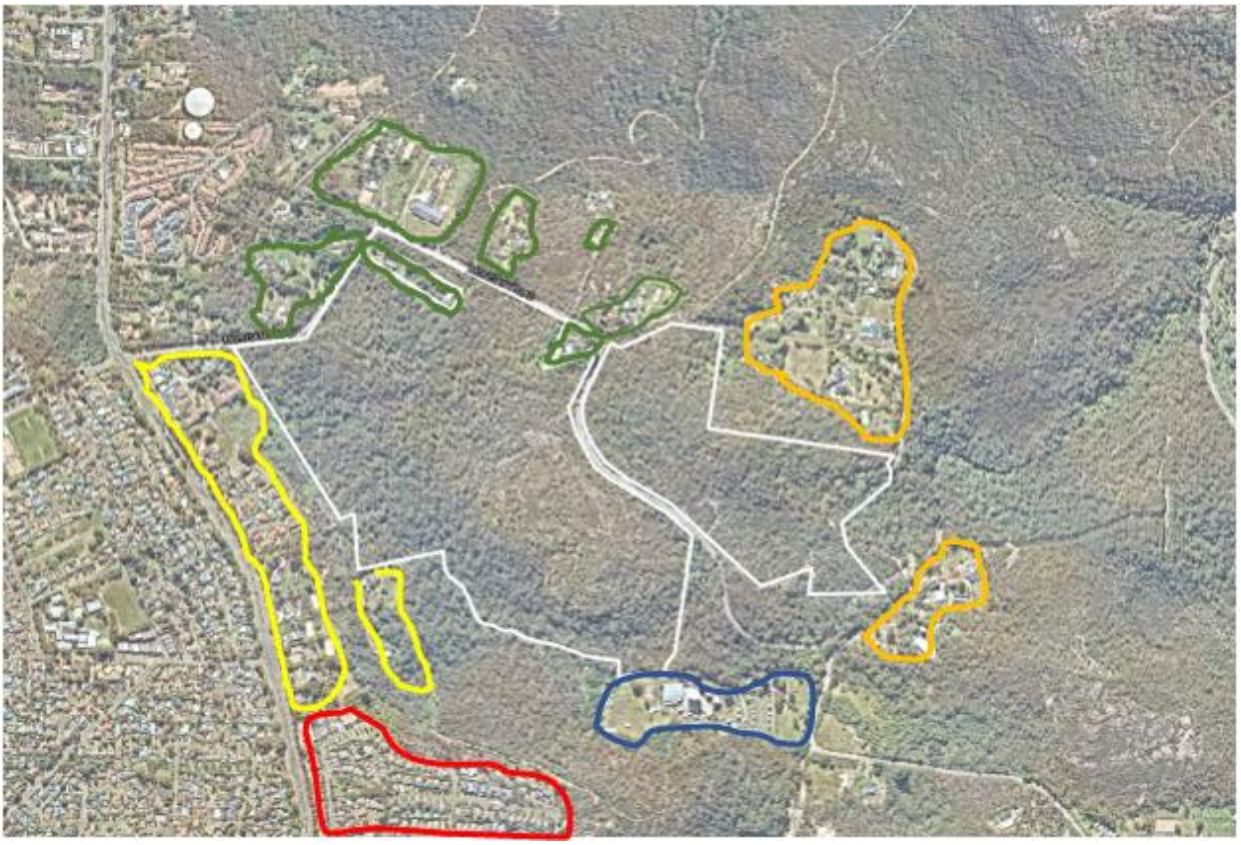


Figure 6.1 – Current land use surrounding the PP site

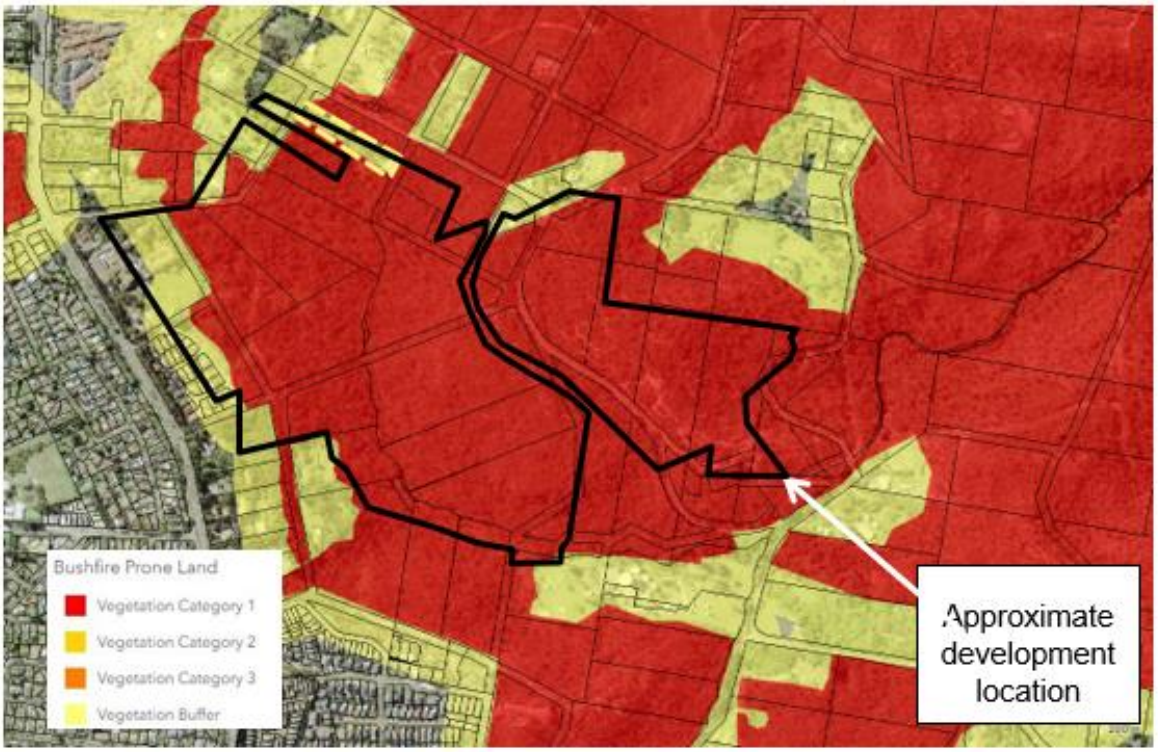


Figure 6.2 – Current bushfire prone mapping

6.4 The post development bushfire risk

The PP development is shown in Figure 6.3.

In its simplest terms the post development risk transfers the current bushfire risk to the south and to the east and provides a perimeter road to separate the proposal from remaining hazards.

Figure 6.3 – Proposed development design for the PP site showing the extensive asset protection zones

Figure 6.4 – Post development bushfire prone mapping
(Blue shaded areas will eventually become red coloured bushfire prone lands)

The development will remove a strategic array of bushfire hazards (see Figure 6.4) and enable a protective landscape through reduced bushfire risk and a positive benefit upon;

- The existing community through the new width of Morgan Road will be paved for a width of 13m with 3.5m verges on both sides of the roads.
- The Uniting Church Pre School and the Uniting Church aged Care facility on the corner of Morgan Road and Forest Way.
- The residential communities living along Hilversum Crescent, Slippery Dip Trail, Oates Place, Lyndhurst Way, Caleyi Way and Ocean View; and the proposed aged care facility at 181 Forest Way Belrose. In addition, there is also one landowner who accesses their rural residential property through the Patyegarang site.
- The many residential properties south of Childs Cloise and Laurie Place.
- The many rural residential landowners (estimated at 50 families) along the eastern section of Morgan Road
- The staff whom operate the OPTUS satellite control unit (staff numbers unknown) on Oxford Falls Road.

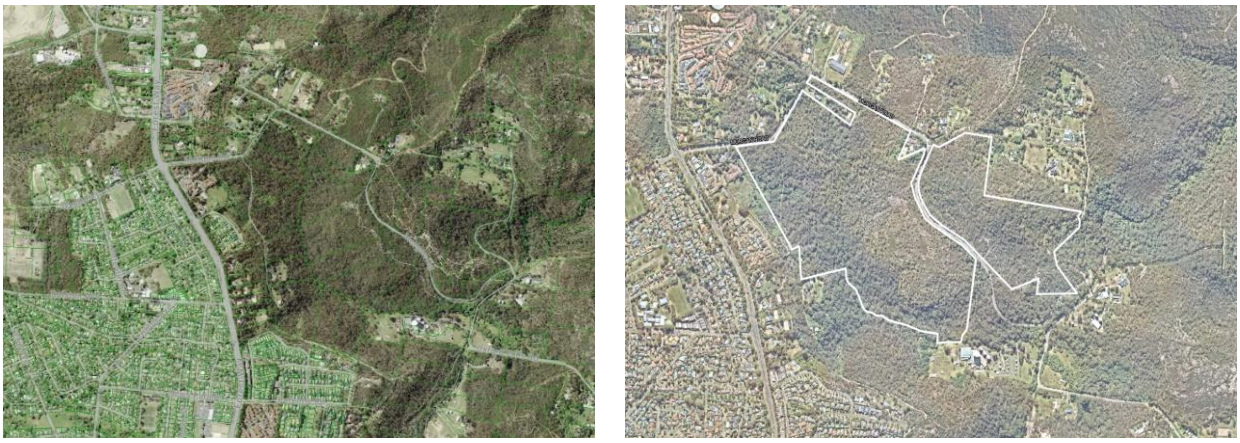
In terms of comparing the current hazardous landscape with the future landscape Figure/s 6.5 provides a comparative level of appreciation. Whilst Figure 6.6 is not entirely 'pictorially' accurate it does provide clarity on the current and the future development landscape and where the hazards will remain and importantly their fragmented shape compared to now.

The OPTUS infrastructure, while still having hazards located to the north, will be exposed to less ignition probability through the removal of hazardous bushland and the provision of a perimeter road on the south of the development.

Currently, there is no perimeter road giving some form of protection to the adjacent aged care / child care facility on the eastern and southern boundary and the extent of the existing bushland creates a permanent hazard to the peripheral community – see Figure 6.1.

The proposed development as shown in Figure 6.3 will largely resolve those community risks and Figure 6.5 shows an approximate aerial representation of the final development as proposed by the PP. This show a significant APZ in the south and east and the protection from rural residential in the north and northeast leaving only several bands of bushfire prone lands as can be seen in Figure 6.4.

Figure 6.6 graphically represents the post development asset protection zones and other managed zones.



Existing *Proposed*

Figure 6.5 – Comparison of current and future impact upon hazard removal

Figure 6.6 – Represents the post-development asset protection zones and other managed zones

Bushfire modelling has been undertaken to demonstrate the future affectation from radiant heat on the basis of the planning proposal going ahead. The results are provided in Table 3.3 and were based on probable Fire Runs as depicted on Figure 3.5 and range from a low of 1.81 k/Wm^2 to a moderate of 16.33 k/Wm^2 which are very low when measured against those industry standards.

Importantly, the calculated radiant heat outputs also clarify the fact that, of the nine Fire Runs (FR) analysed, only four Fire Runs are above 10 k/Wm^2 with five below 10 k/Wm^2. Of significant note is that the calculated radiant outputs;

- For FR 2, 3 & 4 in the north-east and east are less than 17.41 k/Wm^2.
- The proposed 100m asset protection zones in the south (covered by FR 5,6,7 & 8 produce very low radiant heat output of 5.68 k/Wm^2.
- Only FR 9 provided a higher RH of 13.73 k/Wm^2.

The 100m wide APZ in the south will act in a significant manner to reduce radiant heat affectation in the southeast (from forest / heath based on a 15-22 degree slope gradient – see Table 3.3).

These numbers are very low meaning that any dwellings in the proximity of FR 1, 5, 6, 7 & 8 can be constructed to BAL12.5 AS3959; whilst any dwellings in the proximity of FR 2, 3, 4 & 9 can be constructed to BAL 19 AS3959.

Peer review assessments

The peer review assessment by Meridian Urban mapped the site as having lower bushfire intensity (<20,000 k/Wm) whilst land further east of Morgan Road within steep and complex topographic exposures were mapped at up to and higher than 60,000 k/Wm.

The peer review assessment by Blackash Bushfire Consultants found the development site suitable for residential development and made a series of recommendations which have either been undertaken in recent amendments to date or would normally be undertaken at the DA stage of development planning.

PBP permits residential development to be constructed where radiant heat affectation is lower than 29 k/Wm^2. The results generated in Table 3.3 are well below 29k/Wm^2.

6.5 The post development traffic and evacuation capability

The findings of the traffic modelling are summarised in their Table 6 which advised that the existing intersection of Forest Way and Morgan Road would have a 296m queue length whilst the upgraded intersection with slip lane would have a zero length queue length.

Without the slip lane in place (i.e. under the current intersection configuration) vehicles attempting to egress the site from Morgan Road will experience a Level of Service ‘F’ with delays nearly 90 seconds and a queue length of 296 m. These results therefore trigger the requirement to implement upgrades in the form of the slip lane.

The introduction of the slip lane as proposed allows a free flow of traffic from Morgan Road onto Forest Way, with no queues expected to form. The slip lane provides enough capacity for the evacuating vehicles to turn left onto Forest Way, as well as spare capacity to accommodate vehicles external to the proposed site travelling along Morgan Road.

JMT (December 2023) advised;

- During the development of the concept plan for the site it was identified that safe and efficient vehicle egress from the site would be required during major bushfire events. Given the likely bushfire conditions in this scenario, all traffic would need to be directed to the west to access Forest Way and depart the area.

- Under current conditions traffic leaving the site via Morgan Road needs to stop at the traffic lights before then turning left onto Forest Way. In this context an upgrade of the Morgan Road / Forest Way intersection has been identified (initially by *Travers bushfire & ecology*) to facilitate safe and efficient access out of the precinct.

- This involves the creation of a slip lane from Morgan Road onto Forest Way which includes an acceleration lane as per Austroads requirements. This upgrade will allow traffic leaving Morgan Road to bypass the existing traffic lights and enter directly onto Forest Way without delay.

- A detailed concept design, including extent of civil and infrastructure works required, has separately been prepared by Craig and Rhodes. The land required to facilitate the upgrade is owned by the State Government (not Council) making it suitable for the purposes of road widening.

- Separate traffic modelling for a bushfire emergency evacuation event indicates the upgrade will be required once more than 230 dwellings have been developed and are occupied on the site.

SIDRA modelling has been undertaken at the Forest Way / Morgan Road intersection which considers existing traffic movements as well as those generated by the rezoning, taking into consideration the upgrade of the intersection through a new slip lane as summarised in Section 5.6.2 of their report. The traffic modelling has considered both:

- The performance of the overall intersection (taking into account traffic movements from all directions); and
- The performance of the specific traffic movement from Morgan Road onto Forest Way, which is critical with respect to bushfire evacuation.

The modelling has concluded that, subject to the implementation of the Morgan Road slip lane, traffic can efficiently exit the precinct during a bushfire evacuation.

JMT undertook a sensitivity analysis to determine the trigger point when the slip lane would be required and they based that on a maximum queue length of 90m which represents 14 vehicles queued at any one time. The determined this would be when more than 230 dwellings have been developed and are occupied on the site.

6.6 Revised risk identification and risk evaluation

The NERAG assessment undertaken in Part 5 and the explanations of the post development landscape undertaken in Part 6 and Part 7 require a final review of the tables.
Table 6.1 provides a revised view of the post development risks.
Table 6.3 provides a revised view of the post development risk analysis.
Table 6.3 provides a revised view of the post development evaluation.

Table 6.1 – Post development risk identification

Risk number (as defined in Table 5.6)	Risk descriptor	Source of risk (See fire history figure below) (Aspect is taken as from the PP site boundary)	Consequence history	Prevention preparedness controls	Response and recovery controls
1.	Bushfire west - northwest of Forest Way	Tall heath fire burning within the national park and Sandstone Bloodwood Shrub forest burning on private unmanaged northwest of Forest Way on a long downslope not Forest Way	No recorded wildfires	Permanent fire break in the form of the 46m wide Forest Way intersection and the 18m wide Wyatt Avenue Historical preparedness in the form of; - Hazard reduction burn in 2009-10 - Hazard reduction burn in 2006-07 - Hazard reduction burn in 1994-95	The site is only affected by a long downslope of hazardous mixed heath and low height forest. The measured radiant heat at the slip lane west edge is 1.81 k/Wm^2 which is very low. Risk is also significantly diminished by the 46m width of defendable space on the aggregate of both Forest Way and Wyatt Avenue.
2.	Bushfire in grass to immediate northwest and west	Grass fire between Forest Way and PP site within aged care site	No recorded wildfires	Regular mowing of grassland by landowner is recognized by PBP as Managed Land equivalent to an APZ New 20m wide public road separating that land from PP site	Low risk removed by new perimeter road.
3.	Bushfire burning within the PP site	Snake Creek riparian zone between 45-1230m in width	No recorded wildfires	Implementation of 23m wide APZ on each side of Snake Creek inclusive of the dual lane public road provided permanent APZ.	No onsite management The narrow riparian zone is not a risk to any future development because of the narrow width and the puerperal APZ and public

					road.
4.	Bushfire burning from northeast – between Forest Way and fire trail off Morgan Road (411m east of Hilversum Crescent)	Tall heath / shrubby forest fire burning amidst rural residential 'horse yard' properties from corner of Morgan Road / Forest Way to the east at 5 Mile Creek Trail	No recorded wildfires	Low density land use Managed grassland by landowners that create fragmentation of the vegetation fragments Provision of large horse yards which have no hazardous vegetation Downslope burning in the northeast reduces fire intensity an ember production and radiant heat affectation Preparedness in the form of; - Hazard reduction burn in 2008/09 - Hazard reduction burn in 2003/04 - Hazard reduction burn in 2001-2002	Grazing and mowing of horse yards Maintenance of fire trails Active firefighting response from the two fire agencies
5.	Bushfire from the northeast to southeast between 5 Mile Creek Trail and Slippery Dip Trail (off Morgan Road)	Tall heath fire burning downslope between 5 Mile Creek Trail and Slippery Dip Trail (off Morgan Road)	Wildfire in 1993/94 burning from Cottage Point to Beacon Hill in an overall southerly direction. No property losses in the vicinity of the site. Note: The area mapped by the RFS on the figure below is not entirely accurate as aerial photography shows. The 1994 fire mainly burnt down to an area between 5 Mile Creek Trail and The	Low density land use. Provision of large horse yards which have no hazardous vegetation together with the north south 5 Mile Creek Trail and the Slippery Dip Trail fire breaks plus Morgan Road as a platform. Preparedness in the form of; Hazard reduction burn in 2001-2002	The landscape is a long downhill slope meaning fire intensity and radiant heat is significantly lower as depicted in Table 3.3 in Part 3. RH measures 10.18 k/wm^2 at Morgan Road southern edge. This well below the PBP permissible 29 k/Wm^2.

			Slippery Dip Trail and not down to Morgan Road. Aerial photo evidence shows controlled burning and lack of penetration in the south.		
6.	Bushfire burning within the PP area and burning in southerly direction towards OPTUS	The width of the vegetation is substantially reduced from a width of 670m to between 45-123m in the Snake Creek watercourse.	Wildfire in 2014 as a result of an escaped hazard reduction burn. No property losses within the vicinity of the fire.	APZ management in the 100m width Conservation zone with have 12-30 yr cycle prescription burning for ecological reasons.	Low risk as bushland mostly removed and the location of the new perimeter road with APZ's measuring 100m in width and substantially reduced fuel width. RH measures 5.68 k/Wm^2 which is very low in comparison to the PBP acceptable measure of 29 k/Wm^2.
7.	Bushfire burning from the south of PP area on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail.	South of PP area on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail.	No southerly fires recorded	APZ management in the 100m width The development west of Morgan Road will remove significant amount of hazardous fuels and will provide a southern and westerly protection for the eight properties.	Low risk as bushland mostly removed and the location of the new perimeter road with APZ's measuring 100m in width and substantially reduced fuel width RH measures 5.68 k/Wm^2 which is very low in comparison to the PBP acceptable measure of 29 k/Wm^2.
8.	Vehicular evacuation denial from a bushfire pinch point Morgan Road	Both sides of Morgan Road	Denial of road egress in an evacuation	New slip lane not limited or restricted by traffic lights means ready egress by vehicles	Slip lane is separated from possible hazard west of Forest Way by a 46m width and the RH affectation is measured

	intersection with Forest Way				at 1.81 k/Wm^2 which is extremely low when measured against PBP.
9.	Vehicular evacuation denial from a bushfire pinch point or other on Morgan Road near Hilversum Crescent	Both sides of Morgan Road	Denial of road egress in an evacuation	Upgrade of Morgan Road will reduce roadside reserve hazards plus the new development on the southern side of Morgan Road removes hazardous fuels	This is a better overall outcome for the existing community as it moves the pinch point south to the southern edge of the proposed APZ which is equal on both sides of Morgan Road
10.	Vehicular evacuation denial from a bushfire pinch point on Morgan Road Near Slippery Dip trail area	Both sides of Morgan Road	Denial of road egress in an evacuation	Upgrade of Morgan Road will reduce roadside reserve hazards plus the new development on the southern side of Morgan Road removes hazardous fuels.	This is a better overall outcome for the existing community as it moves the pinch point south to the southern edge of the proposed APZ which is equal on both sides of Morgan Road
11.	Vehicular evacuation denial from a bushfire pinch point along the eastern and southeastern portions of Morgan Road towards OPTUS area	Both sides of Morgan Road	Denial of road egress in an evacuation	Upgrade of Morgan Road will reduce roadside reserve hazards	This is a better overall outcome for the existing community as it moves the pinch point south to the southern edge of the proposed APZ which is equal on both sides of Morgan Road
12.	Oxford Falls bridge not operating	Peripheral vegetation to the north and bridge could be denied access from bushfire thus southeastern evacuation route cut	Fire history mapping portrays bridge area was part of the 1994 hazard reduction back burn	Prescribed burns in 1984-85 and 2003-04	New concrete 2 lane bridge opened in Nov 2023 Active firefighting response from the two fire agencies and initiated hazard reduction efforts

Table 6.2 – Post development risk analysis

Risk no (as per Table 5.6)	Risk description	Level of prevention and preparedness	Level of response and recovery controls	Consequence level	Likelihood Level	Risk Level	Confidence Level
1	Bushfire West of Forest Way	Land is not managed	Fire break via Forest Way	Ember attack but due to the 600m distance to the Snake Creek retained vegetation zone; there would be no radiant heat affectation and no flame contact.	Possible and likely	Low to medium	High
2	Bushfire Northwest – Between Forest Way and PP site	High	Mowed grasslands	Ember attack but low radiant heat and possible flame contact burning downslope	Unlikely	Low	High
3	Bushfire burning from within the PP 72 ha area	44 ha of hazard fuel removed with only 27 ha remaining	Significant reduction of hazard fuels and high implementation of APZ's which limit risk areas	Ember attack only as radiant heat and flame contact eliminated due to lower BAL levels calculated and shown in Table 3.3 in Part 3.	Likely	Low	High
4	Bushfire North – between Forest Way and fire trail off Morgan Road (411m east of Hilversum Crescent)	Rural residential land use along with managed fuels within the horse yards limits hazardous areas	Fire trail is actively used	Ember attack only as radiant heat and flame contact eliminated due to lower BAL levels calculated and shown in Table 3.3 in Part 3.	Possible	Medium	High

5	Bushfire from the northeast to southeast between 5 Mile Creek Trail and Slippery Dip Trail (off Morgan Road)	large area of bushland connectivity to the north	Fire trails x 2 and the Morgan Road fire break barrier	Ember attack only as radiant heat and flame contact eliminated due to lower BAL levels calculated and shown in Table 3.3 in Part 3	Possible	High	High
6	Bushfire burning within the PP area and burning in southerly direction towards OPTUS	Significant reduction of hazard fuels and high implementation of APZ's which limit risk areas		Ember attack only as radiant heat and flame contact eliminated due to lower BAL levels calculated and shown in Table 3.3 in Part 3	Possible	High	High
7	Bushfire burning from the south of PP area on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail.	Significant reduction of hazard fuels and high implementation of APZ's which limit risk areas	Southern APZ being 100m acts as a very large fire break and together with Morgan Road there is a significant managed area in position	Ember attack only as radiant heat and flame contact eliminated due to lower BAL levels calculated and shown in Table 3.3 in Part 3	Likely	…	High
8	Vehicular evacuation denial from a bushfire pinch point or other at Morgan Road intersection with Forest Way	The PP development will remove substantial hazard fuels and deny any pinch points in that area. The new road reconstruction of Morgan Road	No substantial vegetation is within 600m of this western hazard post development	Flame run to the north	Unlikely due to distance	Low	Low

		will widen the pavement 13m and remove roadside vegetation.					
9	Vehicular evacuation denial from a bushfire pinch point or other on Morgan Road near Hilversum Crescent	The PP development will remove substantial hazard fuels and deny any pinch points in that area The new road reconstruction of Morgan Road will widen the pavement 13m and remove roadside vegetation.	Morgan Road upgrades and development / APZ on the southern side of Morgan Road Active suppresses advancing embers and radiant heat	Flame run from the north	Unlikely due to the extent of APZ's in this area	High	High
10	Vehicular evacuation denial from a bushfire pinch point near Slipper Dip trail	The PP development will remove substantial hazard fuels and deny any pinch points in that area The new road reconstruction of Morgan Road will widen the pavement 13m and remove roadside vegetation.	Significantly better road edges with removed and reduced hazards	Flame run to the north from the east and southeast	Unlikely due to the extent of APZ's in this area	Low	hh

11	Vehicular evacuation denial from a bushfire pinch point along the eastern and southeastern portions of Morgan Road towards OPTUS	No fuel to be removed in this area. Road works may assist with road edge hazards. The new road reconstruction of Morgan Road will widen the pavement 13m and remove roadside vegetation.	Low level of active response	Denial of egress and reduced evacuation route from 3 to 2	Likely	High	High
12	Oxford Falls bridge not operating	New bride constructed in late 2023	Roads being controlled by emergency services	Possible reduced evacuation route from 3 to 2	Possible but highly unlikely as bridge rebuilt in 2023 as concrete	Low	Low

Table 6.3 – Post development risk evaluation

Risk No	Risk Priority	Revised Risk Level	Treatment Plan
1	Bushfire West of Forest Way	Low to Medium	230m distance reduces ember impact upon development site and internal APZ's and their ongoing management will protect any ignitions in the retained vegetation parcels.
2	Bushfire Northwest – Between Forest Way and PP site	Low	Grassland mowing
3	Bushfire burning from within the PP 72 ha area	Low	Internal APZ's and their ongoing management will protect any ignitions in the retained vegetation parcels
4	Bushfire North – between Forest Way and fire trail off Morgan Road (411m east of Hilversum Crescent)	Medium	This is private land and their current fragmented fuels is expected to remain and with the widened Morgan Road this will lessen fire moving from the north.
5	Bushfire from the northeast to southeast between 5 Mile Creek Trail and Slippery Dip Trail (off Morgan Road)	The implied risk is High however the calculated radiant heat affectation of 10.3 k/Wm^2 is low due to the down slope	This will not change but the radiant heat affectation has been calculated to be 10.3 k/Wm^2 as demonstrated in Table 3.3.
6	Bushfire burning within the PP area and burning in southerly direction towards OPTUS	Low to Medium	A fire could potentially burn south along Snake Creek but the peripheral APZ's will protect residential properties and evacuation capability.
7	Bushfire burning from the south of PP area on steep forested lands and burning north into PP site and thence into the seven (7) rural residential properties located off Kellys Way and one (1) property off Slippery Dip Trail.	High and as a result a 100m APZ has been provided resulting in a low radiant heat affectation of 5.68 k/Wm^2	A 100m wide APZ has been provided to reduce radiant heat affectation to a maximum of 5.68 k/Wm^2 as demonstrated in Table 3.3.
8	Vehicular evacuation denial from a bushfire pinch point or other at Morgan Road intersection with Forest Way	Low	The low radiant heat levels from any such fire would be highly unlikely to deny left turn travel onto Forest Way from Morgan Road. The new road reconstruction of Morgan Road will widen the pavement 13m and remove roadside vegetation.
9	Vehicular evacuation denial from a bushfire pinch point or other on Morgan Road near Hilversum Crescent	High	This will not change and has been considered in the delivery of the second evacuation route via Oates Place to Forest Way The new road reconstruction of Morgan Road will

			widen the pavement 13m and remove roadside vegetation.
10	Vehicular evacuation denial from a bushfire pinch point near Slipper Dip trail	Low	The Patyegarang development will create a roundabout at this location and provide the existing residents the ability to bypass Morgan Road north and enter the development site and either egress using Oates Place or the new exit to Morgan Road and then use the new slip land onto Forest Way. The new road reconstruction of Morgan Road will widen the pavement 13m and remove roadside vegetation.
11	Vehicular evacuation denial from a bushfire pinch point along the eastern and southeastern portions of Morgan Road towards OPTUS	High	This will not change and has been considered in the delivery of the second evacuation route via Oates Place to Forest Way
13	Oxford Falls bridge not operating	Low	This will not change and has been considered in the delivery of the second evacuation route via Oates Place to Forest Way

6.7 Review of the planning proposal risk against benchmarks

The benchmarks are reconsidered in light of the Patyegarang Planning Proposal changes to the landscape as opposed to their original consideration in Section 4.5.

#	Benchmark	Considerations
1	The context of landscape, fire history, likelihood / probability and fire behaviour and intensity is considered and potential consequences can be avoided, mitigated, transferred or accepted	A comprehensive review of the fire history, likely fire intensities and future location of bushfire hazards has been undertaken. The results show Patyegarang Planning Proposal will not be a high bushfire risk.
2	Valued habitat, environmental values, assets, corridors and functions are maintained	The Patyegarang Planning Proposal seeks to retain 27.11 ha of native vegetation in the form of riparian zones and two conservation zones.
3	Various land use scenarios are contemplated to examine and assess the potential impact of different fire behaviour intensities and mitigation measures	Low density residential development is proposed along with an interpretation centre and office for the Aboriginal community. No schools, hospitals and or other special fire protection developments are proposed.
4	Balancing environmental values and land use allocation incorporates consideration of disaster risk reduction	The bushfire and ecological consultants met on several occasions on site and walked various areas reviewing options for conservation and development planning
5	Special fire protection purposes are strategically considered in terms of appropriateness in bush fire prone areas	No special fire protection developments are proposed.
6	The planning outcome is capable of facilitating local Neighbourhood Safer Places, community refuges or evacuation centres within the area for shelter in place options	NSP are not proposed as the development is not regarded as remote or subject high bushfire risk.
7	Consideration for locating inappropriate development	The planning proposal has been found not to be an inappropriate development
8	Strategic planning is capable of facilitating appropriate and effective evacuation, based on key assumption	This strategic bushfire study has determined that effective evacuation has been proven. This has followed extensive questions on the matters from the RFS and several revised traffic assessments being prepared dealing with the additional modelling undertaken.
9	The evacuation ability of existing residents or occupants is not worsened	The existing 50 families that use Morgan Road will gain a significant benefit from the proposed slip way on to Forest Way with no que length. The Uniting Church Pre School and the Uniting Church aged Care facility on the corner of Morgan Road and Forest Way will have the current bushfire risk removed from their eastern boundary. The 200 or so residents of Lyndhurst Way and Oates Place will benefit from having the current significant bushfire risk removed on their eastern aspect. The two rural residential allotments to the immediate south

		of the PP site will gain a safe access and egress road which at the moment requires them to travel through the bushland of the PP site to access their properties.
10	Increased demand on emergency services is avoided or reasonably mitigated	Given the evidence of hazard reduction works that have been undertaken since 1985 there could be a reduction of that effort as the residents in benchmark No 9 above would have no need for ongoing hazard reduction operations.
11	Essential, community and strategic infrastructure avoids high risk exposure	The existing high voltage line that crosses the valley of the PP site will be removed and laid underground.
12	The water supply network is protected from or avoids exposure to bush fire attack which may compromise its function, including pump stations and other assets	This is a design issue for the future but advice from Craig & Rhodes advised water supply is not an issue.
13	Ongoing land management and hazard reduction implications are considered	Fuel management of the retained conservation areas would be funded by the community association in the long run and initially funded by the Applicant. A formal fuel management plan would be prepared an submitted at the development application stage.
14	Determine the acceptable peripheral defendable space to a development polygon and development land use	Tabel 3.3 has defined the measure radiant heat affection and is less than the RFSD permitted 29 k/Wm^2 for residential, subdivisions.
15	Review if defendable space is suitable for the specific development land use	The southern, southeastern and northeastern defendable space is akin to 100m in depth which is far in excess of what is recommended within PBP 2019.
16	Will subsequent post development bushfire mapping create a better overall risk 'exposure' to the development	The post development bushfire mapping creates a better risk exposure through the implementation of perimeter roads and a significant reduction of steep lands below development envelopes.
17	Will the existing community gain from a better bushfire hazard result	The existing 50 families that use Morgan Road will gain a significant benefit from the removed hazards between Forest Way and Morgan Road. The Uniting Church Pre School and the Uniting Church aged Care facility on the corner of Morgan Road and Forest Way will have the current bushfire risk removed from their eastern boundary thus removing a significant threat to their existence. The 200 or so residents of Lyndhurst Way and Oates Place will benefit from having the current significant bushfire risk removed on their eastern aspect and being subject to potential evacuation at each and every bushfire that occurs within the PP site. The two rural residential allotments to the immediate south of the PP site will gain a safe access and egress road which at the moment requires them to travel through the bushland of the PP site to access their properties.
18	Is the development land use suitable for the locality such as habitable low density residential, multi storey special protection developments and or non-habitable developments that increase population density or hazardous goods developments.	The PP proposes low density residential use with no multi storey, special fire protection developments or petrol stations; or the like.

19	Review of population density and proposed land use suitability	The proposed 450 dwellings will lead to a population increase circa 1125 persons and the traffic modelling advises this is acceptable and the traffic solutions states there will be no traffic issues arising.
20	Traffic evacuation capability for the new development design	Traffic modelling advises the proposed traffic solutions state there will be no traffic issues arising. The new road reconstruction of Morgan Road will widen the pavement 13m and remove roadside vegetation.

PART 7

CONCLUSION

7.0 CONCLUSION

Travers bushfire & ecology has been engaged to undertake a strategic bushfire study (SBS) for the Patyegarang Planning Proposal located at Morgan Road, Belrose. The proposal will involve a rezoning of the site to support future low density residential housing and open space.

This report identifies matters for consideration for the planning proposal and highlights the required bushfire protection measures required for the future development of the site against *Planning for Bush Fire Protection (PBP) 2019* and Ministerial Direction 4.3.

The SBS has analysed the potential and historic threats to the site, the current and projected access provisions and any adverse impacts on the existing and projected infrastructure serving the community. The assessment was based on the determination of the current bushfire risks to the development site and the subsequent bushfire risk post development.

The analysis has required the provision of risk management protocol to be applied in order to ensure the likelihood consequences of the found risks well-qualified or qualified. In this regard the NERAG risk management protocol has been used.

Substantial consultation has occurred with a variety of sources and the commentary has been provided within the context of the SBS. This is included the review of Northern Beaches Council consultants namely Blackash Bushfire Consulting and Meridian Urban. Both assessments validated the PP site as suitable residential low density development.

As a result of discussions with the RFS that extensive review of the traffic management arrangements on Forest way of Morgan Road occur by JMT consulting their report being intrinsically loaded into this SBS review.

Applying the risk management methodology required a series of benchmarks to be developed such that the risk of evaluation could be undertaken in a matter that was both recognisable and acceptable to authorities. In this case 20 benchmarks have been identified and responded to such that *Travers bushfire & ecology* advise the Patyegarang Planning Proposal should proceed.

In addition, this report concludes that infrastructure is suitable for the expansion of residential development in the area. Demand on services is not considered to exceed the current provisions and will, in the future, be improved by natural growth, in response to projected increases in demand.

Outcomes of the study

The Patyegarang Planning Proposal has been found to comply with PBP section 4 and with Ministerial Direction 4.3 on strategic planning grounds.

<u>Benefit to the community</u>

- The strategic bushfire study found the Patyegarang Planning Proposal was a logical extension of existing urban landscape.
- The planning proposal will remove substantial bushfire hazards that threaten the existing community which will benefit approximately 50 local families either in the relocation of bushfire prone land or through increased evacuation capability with the reconstruction and widening of Morgan Road coupled with the new slip lane onto Forest Way.
- The planning proposal proposes a new slip lane from Morgan Road onto Forest Way and a full reconstruction of Morgan Road to a point 1.8 km from the intersection with Forest Way thus enabling free flowing traffic in the event of an emergency evacuation.

- Traffic modelling advises there will be no traffic queuing at the Forest Way / Morgan Road intersection and the reconstruction of Morgan Road will provide a safe platform for fire fighters and emergency services.

Reduction of bushfire hazards

- The existing bushfire hazards provide significant risk to the existing residential community and the aged care facility; and potentially denies safe evacuation in a bushfire emergency event.
- The study found the site was not a high risk bushfire site due to the non-remote nature of the proposal and the limited bushfire hazard exposures affecting the site.
- Strategically, the site is surrounded by rural residential development in the north and east and low density residential development in the west leaving only two unmanaged bushland areas in the north east and south both of which produce a moderate exposure to radiant heat (17.4 k/Wm2) which is well below the RFS permitted standard of 29k/Wm2.

Recommendation

The Patyegarang Planning Proposal has been found to comply with *PBP* section 4 on strategic planning grounds and also with Ministerial Direction 4.3 also on strategic planning grounds.

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APPENDICES

APPENDIX 1 - Development plan and asset protection zones

MORGAN ROAD

MORGAN ROAD

KELLYS WAY

4m
10m
20m
23m
22m
16m
19m
22m
25m
23m
16m
23m
16m
20m
17m
22m
16m
23m
57m
70m
60m
100m
75m
123m
20m
35m
15m
50m
28m
100m
100m

Legend

- Study Area (Source: CAD)
- Contour (Source: LiDAR)
- Creek lines
- Indicative fire trail (4m width)
- Proposed roads
- Ecological lands
- Publicly accessible green space
- Managed land

Asset Protection Zone (APZ)

- Inner Protection Area

Aerial source: Nearmap

0 100 200 m

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE	DATE & ISSUE NUMBER	SCALE & COORDINATE SYSTEM
Morgan Road, Belrose 18CR12_BF001	1/02/2024 Issue 1 AG	1:4,500 @A3 GDA 1994 MGA Zone 56

TITLE

Schedule 1 - Bushfire Protection Measures

Document Path: N:\GIS STORAGE\N Drive\18CR02_MorgansRd_Belrose\MXDs\18CR12_BF001.mxd

TRAVERS BUSHFIRE & ECOLOGY
A TBE ENVIRONMENTAL COMPANY

APPENDIX 2 - Flamesol modelling for Fire Runs identified in Table 3.3 in Part 3

FLAMESOL
FPA AUSTRALIA

Calculated January 10, 2024, 2:51 pm (BALc v.4.9)

FR - 1

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	1.47 km/h
Vegetation classification	Forest	Flame length	12.84 m
Understorey fuel load	21.3 t/ha	Flame angle	79 °
Total fuel load	27.3 t/ha	Panel height	12.6 m
Vegetation height	n/a	Elevation of receiver	6.3 m
Effective slope	-8 °	Fire intensity	20,758 kW/m
Site slope	0 °	Transmissivity	0.749
Distance to vegetation	66 m	Viewfactor	0.0317
Flame width	35 m	Radiant heat flux	1.81 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Calculated January 10, 2024, 2:13 pm (BALc v.4.9)

Belrose FZ 2

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	5.09 km/h
Vegetation classification	Forest	Flame length	36.39 m
Understorey fuel load	21.3 t/ha	Flame angle	55 °
Total fuel load	27.3 t/ha	Panel height	29.81 m
Vegetation height	n/a	Elevation of receiver	14.9 m
Effective slope	10 °	Fire intensity	71,878 kW/m
Site slope	0 °	Transmissivity	0.794
Distance to vegetation	45 m	Viewfactor	0.2881
Flame width	55 m	Radiant heat flux	17.41 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-19
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

FLAMESOL
FPA AUSTRALIA

Calculated January 10, 2024, 2:22 pm (BALc v.4.9)

FR 3

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	2.08 km/h
Vegetation classification	Scrub	Flame length	8.460000000000001 m
Understorey fuel load	25 t/ha	Flame angle	79 °
Total fuel load	25 t/ha	Panel height	8.31 m
Vegetation height	3 m	Elevation of receiver	4.15 m
Effective slope	-10 °	Fire intensity	26,992 kW/m
Site slope	0 °	Transmissivity	0.819
Distance to vegetation	25 m	Viewfactor	0.1628
Flame width	100 m	Radiant heat flux	10.14 kW/m²
Windspeed	45 km/h	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Catchpole et al. 1998

Flame length - Byram, 1959

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Calculated January 10, 2024, 2:28 pm (BALc v.4.9)

FR 4

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	1.57 km/h
Vegetation classification	Forest	Flame length	13.52 m
Understorey fuel load	21.3 t/ha	Flame angle	73 °
Total fuel load	27.3 t/ha	Panel height	12.93 m
Vegetation height	n/a	Elevation of receiver	6.46 m
Effective slope	-7 °	Fire intensity	22,241 kW/m
Site slope	0 °	Transmissivity	0.822
Distance to vegetation	25 m	Viewfactor	0.2612
Flame width	100 m	Radiant heat flux	16.33 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-19
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Calculated January 10, 2024, 2:34 pm (BALc v.4.9)

FR - 5

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	5.09 km/h
Vegetation classification	Forest	Flame length	36.39 m
Understorey fuel load	21.3 t/ha	Flame angle	72 °
Total fuel load	27.3 t/ha	Panel height	34.61 m
Vegetation height	n/a	Elevation of receiver	17.3 m
Effective slope	10 °	Fire intensity	71,878 kW/m
Site slope	0 °	Transmissivity	0.726
Distance to vegetation	100 m	Viewfactor	0.103
Flame width	100 m	Radiant heat flux	5.68 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

FLAMESOL
FPA AUSTRALIA

Calculated January 10, 2024, 2:41 pm (BALc v.4.9)

FR - 8

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	1.47 km/h
Vegetation classification	Forest	Flame length	12.84 m
Understorey fuel load	21.3 t/ha	Flame angle	84 °
Total fuel load	27.3 t/ha	Panel height	12.77 m
Vegetation height	n/a	Elevation of receiver	6.38 m
Effective slope	-8 °	Fire intensity	20,758 kW/m
Site slope	0 °	Transmissivity	0.722
Distance to vegetation	100 m	Viewfactor	0.0354
Flame width	100 m	Radiant heat flux	1.94 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Calculated January 10, 2024, 2:45 pm (BALc v.4.9)

FR - 9

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	7.19 km/h
Vegetation classification	Forest	Flame length	50.04 m
Understorey fuel load	21.3 t/ha	Flame angle	61 °
Total fuel load	27.3 t/ha	Panel height	43.77 m
Vegetation height	n/a	Elevation of receiver	21.88 m
Effective slope	15 °	Fire intensity	101,491 kW/m
Site slope	0 °	Transmissivity	0.751
Distance to vegetation	75 m	Viewfactor	0.2402
Flame width	100 m	Radiant heat flux	13.73 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-19
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

APPENDIX 3 - AHIMS REPORT

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Belrose
Client Service ID : 711524

TBE

Date: 25 August 2022

52 The Avenue,
Kariong New South Wales 2250

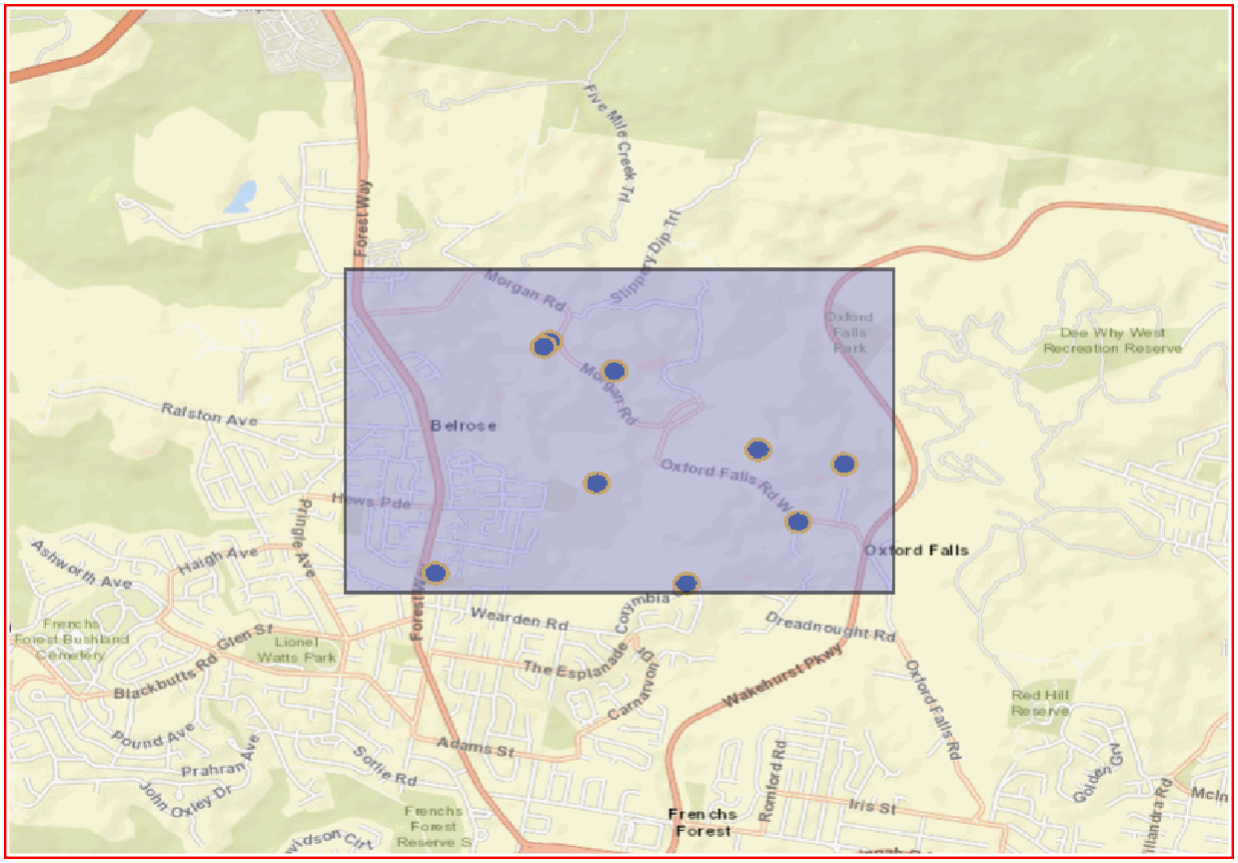
Attention: Tony Hawkins

Email: thawkins@traversecology.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -33.7374, 151.2162 - Lat, Long To : -33.7196, 151.2471, conducted by Tony Hawkins on 25 August 2022.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

9	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Heritage NSW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

Peer Review of Strategic Planning Report by Mr John Travers for the Patyegarang Planning Proposal.

A. Introduction.

Dr Grahame Douglas has been engaged by Gyde Consulting to undertake a 'peer review' of the Strategic Planning Report for the rezoning of land at Morgan Road, Belrose referred to as Patyegarang prepared by John Travers (JOHN TRAVERS Report). This peer review does not seek to address all the details of the JOHN TRAVERS Report, however, identifies key decision-making issues for consideration of the Department, NSW Rural Fire Service and Planning Panel.

The Patyegarang Planning Proposal seeks to deliver up to 450 dwellings and will:

- transfer the Site from Warringah Local Environmental Plan 2000 to Warringah Local Environmental Plan 2011 and implement standard instrument zones
- secure dual occupancies as an additional permitted use within the R2 low density residential zone
- secure additional permitted uses within the RE2 Private Recreation zone to enable environmental management works, stormwater services, APZ and bushfire works.
- utilities and servicing work where required.
- introduce maximum building heights (8.5 metres)
- introduce a range of small, medium to large residential lot sizes, and
- manage an appropriate number of dwellings based on the site capacity.

The current proposal, post Gateway determination, identifies three land use zones being:

a) R2 Low Density Residential which encompass residential development, roads, servicing, open space and recreation areas and will be subject to a future development application process.

b) RE2 Private Recreation – includes cultural heritage sites and riparian corridors, as well as APZs to be managed under community title arrangements; and

c) C2 Environmental Conservation which intends that no development occurring within these areas.

In seeking this review, I have been asked this review to address the following issues:

a) Is the site suitable for the intended use as residential dwellings?

b) Will occupants be able to safely evacuate in the event of a bushfire? and

c) Does the current proof of concept plan comply with PBP 2019, or can be reasonably made to comply at DA stage?

In addressing these issues, this review makes no commentary on the environmental and/or cultural values.

My other limitation is that I rely on the traffic advice by JMT Consulting Traffic Engineers in relation to access and the slipway configuration from Morgan Road to Forest Way.

B. Post-Gateway Process

Ministerial Direction 4.3 provides that: "In the preparation of a planning proposal the relevant planning authority must consult with the Commissioner of the NSW Rural Fire Service following receipt of a gateway determination under section 3.34 of the Act, and prior to undertaking community consultation in satisfaction of clause 4, Schedule 1 to the EP&A Act, and take into account any comments so made".

In effect, the planning proposal is required to comply with *Planning for Bush Fire Protection 2019* (PBP) and specifies some general principles regarding perimeter roads and asset protection zones (APZs). Other issues include general access, water, electricity and gas, as well as landscaping and emergency planning.

These are also addressed through the '*Specific objectives'* for residential/rural residential subdivision (p. 42 of PBP) which are:

- minimise perimeters of the subdivision exposed to the bush fire hazard (hourglass shapes, which maximise perimeters and create bottlenecks should be avoided);
- minimise vegetated corridors that permit the passage of bush fire towards buildings;
- provide for the siting of future dwellings away from ridge-tops and steep slopes, within saddles and narrow ridge crests;
- ensure that APZs between a bush fire hazard and future dwellings are effectively designed to address the relevant bush fire attack mechanisms;
- ensure the ongoing maintenance of APZs; provide adequate access from all properties to the wider road network for residents and emergency services;
- provide access to hazard vegetation to facilitate bush fire mitigation works and fire suppression; and
- ensure the provision of an adequate supply of water and other services to facilitate effective firefighting.

C. Bush Fire Strategic Study.

Chapter 4 (Strategic Planning) of PBP sets out some 'strategic principles' as well as the components (as a minimum) for a Bush Fire Strategic Study.

The principles enunciated are:

- *Ensuring land is suitable for development in the context of bushfire risk;*
- *Ensuring new development on BFPL, will comply with PBP;*
- *Minimizing reliance on performance-based solutions;*

- *Facilitating appropriate ongoing land management practices.*

PBP goes on to indicate that inappropriate development should be excluded such as:

- *The development area is exposed to a high bush fire risk and should be avoided;*
- *The development is likely to be difficult to evacuate during a bush fire due to its siting in the landscape, access limitations, fire history, and/or size and scale;*
- *The development will adversely affect other bush fire protection strategies or place existing development at increased risk;*
- *The development is within an area of high bush fire risk where density of existing development may cause issues for both existing and new occupants; and*
- *The development has environmental constraints to the area which cannot be overcome.*

The components of a bush fire strategic study which are identified within PBP 2019 are:

- Bush fire landscape assessment;
- Land use assessment;
- Access and egress;
- Emergency services;
- Infrastructure; and
- Adjoining land.

A significant feature of the JOHN TRAVERS Report is the use of a risk assessment framework (using NERAG) which considers not only risk, but the risk pre-development and post development, based on the range of suitable land use types.

D. Proposed Risk Assessment Model (NERAG).

Although not well recognized in NSW, the NERAG Guidelines provide a sound basis for the consideration of risk for a range of natural hazards within the landscape. Attempts by Western Australia for example, have attempted to use the NREAG, with mixed success. South Australia in contrast has used the NERAG in a range of areas, including flood risk.

The JOHN TRAVERS Report, has, in my view, made a genuine attempt to apply these principles to the current planning proposal. This is a significant advance upon the work of Meridian Urban and Blackash, who have also reviewed the current proposal.

The challenge for decision-makers only relate to the relative merits of the potential likelihoods and consequences which give rise to risk. These are judgement calls, and unless a regulator/decision-maker has a better view, the relative weighting provided in the "Post Development Scenario" represent best current knowledge.

Since its finalization in 2001 (prior to this it was titled 'draft'), Planning for Bush Fire Protection (1st Edition), has developed design bushfire conditions, which in the subsequent two decades indicates that fire weather conditions have shifted with the onset of climate change. The current PBP (3rd

Edition) still does not address climate change as part of strategic planning decision-making, and hence it would be difficult for any proponent to address this without a clear policy framework in which to address this issue of impacts of climate change.

It is also worth providing some context for the Northern Beaches (Draft) Bush Fire Risk Management Plan, prepared under the Rural Fires Act. It must be understood, that the current model framework addresses existing risks in the landscape and is less useful when addressing future risk, or changes in risk arising out of land use decision-making, including rezoning through a planning proposal. The current (post exhibited) bush fire risk management plan therefore cannot be considered directly relevant to the Patyegarang planning proposal.

E. Strategic Planning and Bushfire Components.

a. Bush fire landscape assessment

The intention of this section is to provide for an overall assessment of the impacts that the surrounding landscape may have on the development site. Landscape fires arise from adverse weather conditions, higher fuel vegetation types, steep lands, and a landscape which is not fragmented arising from clearance or disturbance, plus a significant time delay to commence suppression activities.

Section 3.1-3.4 of the JOHN TRAVERS report sets out the landscape assessment for the site. However, much of the assessment actually applies to the site, eg vegetation, rather than in adjoining areas and within the context of the broader landscape. Of course, the nature of the development is to remove a large proportion of the site's vegetation for development of housing.

The Patyegarang site lies within a broader landscape which has a history of bush fire events (1994 and 2006/07). Currently the major threat to the site from the surrounding landscape is to the west, east and north. The western aspects are significantly reduced in impact due to fragmentation of the extent of urban development, although more prevalent to the north-west. Part of the lands to the west however include Garigal National Park, which is still considered a major source of embers which would move into the areas to the north and east of the site.

To the north and north-east, the extent of retained vegetation is substantial and could lead to a landscape fire risk, both in its own right and as a results of ember showers from Garigal NP into the Deep Creek catchment. To the east, there is a substantial track of land up to and beyond the Wakehurst Parkway. Typically, the prevailing fire weather is from either the north or the west, hence, although is less likely to have the most adverse conditions, will still represent a risk to the Patyegarang site.

In relation to climatic conditions, the assessment in section 3.2 of climatic and weather conditions, for bushfire assessment purposes, is largely not relevant for strategic planning. Any consideration of climate conditions, for developing design bushfire conditions, should be based on statistically extreme events. For residential land uses, a 1:50 year assessment is usually considered appropriate, however, for more vulnerable uses (such as SFPP developments), then a 1:100-1:200 range is more appropriate. The current 1:50 year sits at about an FFDI=120, with an overall value of 132 (1974-2017). For the 1:100 and 1:200 values these correspond to 145 and 158 respectively. The annual fire weather conditions (1:1 year event) are likely to reach or exceed an FFDI=60 in any given year. As such, fire service standards should be designed to meet this weather condition as a minimum.

b. Land use assessment.

Section 3.5 of the JOHN TRAVERS report, identifies a range of development types, including SFPPs, which may arise. Note that APZ distances will be substantially larger for most SFPPs, including schools, hospitals and child care, if determined at the 1:100 or 1:200 levels. The fire run assessments (section 3.4.2) indicate that a number of areas can achieve a radiant heat flux of less than 10kW/m^2 (a requirement for SFPPs), based on a limited performance approach. On this basis (albeit conservative basis), there should be no need for future performance based assessments to be undertaken for the development of the site.

It should be noted that although subject to future DA considerations, seniors living style of developments would be permissible in the general R2 zoning (under the SEPP). The specific merits of this type of development would need to be tested at the time of DA lodgment, with areas closer to Forest Way, being more removed from the retained vegetation of the overall site. It should also be noted that any area of seniors living, or higher density housing, would need to meet the proposed LEP limit of 450 dwelling for the site.

However, the main issue is that of the provision of the R2 Residential zoned lands. This is related to lot size and density controls, rather than simply zoning permissibility. An appropriate way forward, is to have a future Master Plan indicate larger lot sizes of a square configuration closer to the interface, with smaller lot sizes as the development moves away from the bushfire threat. This is also somewhat related to the use of perimeter roads which allows for greater setbacks from creek lines. Section 3.6 of the JOHN TRAVERS Report discusses evacuation options based on 450 dwellings, which is the limit of units for the site.

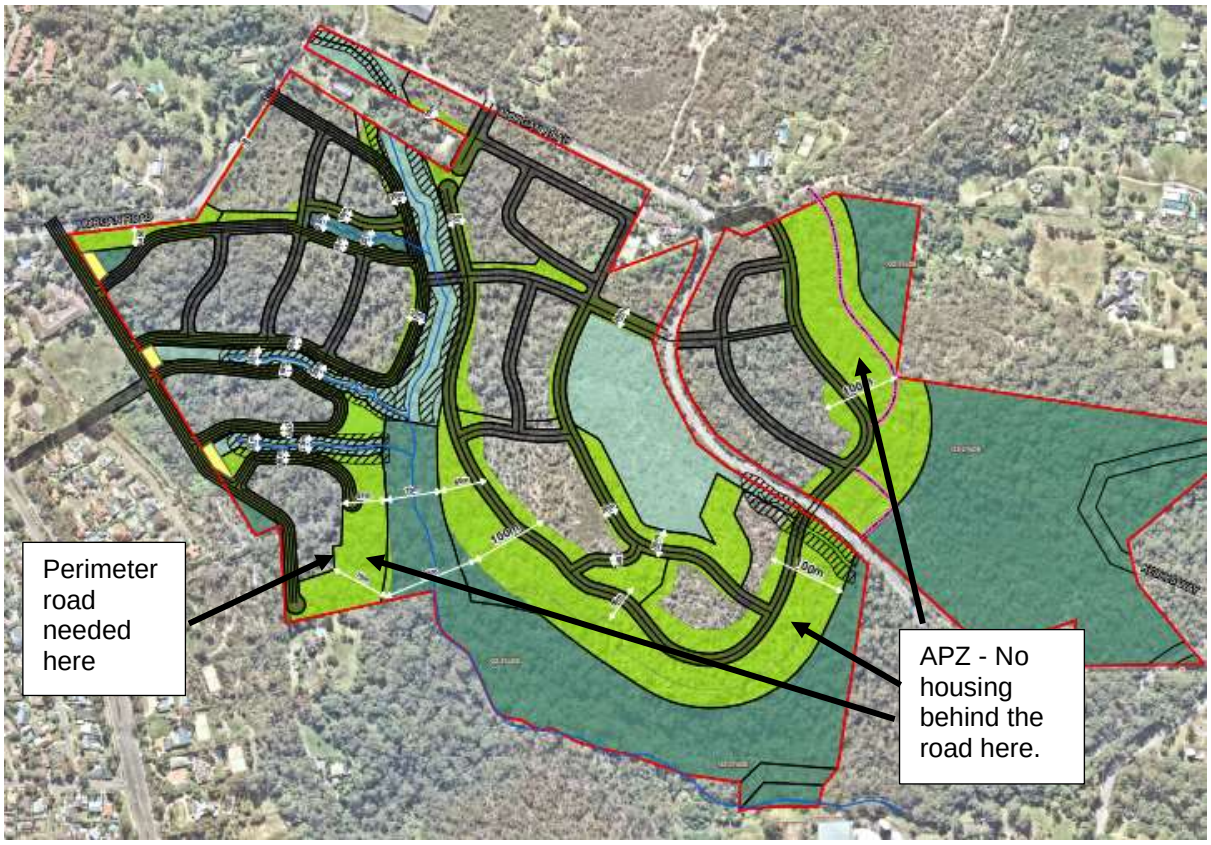


Figure 1: Concept Plan – Bushfire (lime APZs, dark green C2, pale green RE2) (JOHN TRAVERS Report)

c. Access and Egress.

The JOHN TRAVERS Report identifies the internal (and external) road network and section 3.6.2 discusses specifically the challenges for emergency evacuation arrangements. A key aspect of the Master Plan is the provision of improved access from Morgan Road to Forest Way through the use of a slipway for traffic turning left from Morgan Road. Access will also be improved for vehicles turning into Morgan Road.

A key aspect of residential forms of development in bush fire prone areas, is the requirement for a perimeter road system throughout the development, as identified in the Ministerial Directions.

d. Emergency Services.

The JOHN TRAVERS Report identifies 7 RFS brigades within the vicinity of the site (and within Northern Beaches LGA) and notes the presence of FRNSW brigades are also available. The greatest risk to the development arises from the immediacy of the initiation of a bushfire rather than as a campaign fire. In the latter case resources from out of area can be expected to support communities, however, in the early stages, local firefighting resources will be deployed.

The provision of emergency services is significant and does not, of itself, represent a limitation to the planning proposal. The concept plan includes provision for additional fire trail access within the APZs. In the southern connection, this provides continuous access to the existing fire trail network to the south and Morgan Road. Although the eastern section does much the same. On the basis of current information, there appears to be no significant impacts on access to fire trails, but would need to be assessed at DA stages.

e. Infrastructure.

The JOHN TRAVERS report has identified that water supplies are currently a limitation to development of the land for residential purposes. Sydney Water has provided a pathway for the provision of adequate water however, it is unclear from the JOHN TRAVERS report of the timing of this critical piece of infrastructure. In any event, failure to gain water supplies to the site would be a limitation to its development until such a service can be offered.

It appears that electricity is capable of being provided and will need to be an underground service.

Natural gas and bottled gas are a risk factor for any developments in bushfire prone areas. The JOHN TRAVERS report indicates that gas supplies are an uncertainty. In the light of this, it is appropriate to clarify upfront that natural gas will not be utilized and that restrictions on bottled gas should apply to the site and future dwellings.

f. Adjoining land.

The adjoining lands to the west will obtain a significant reduction in risk, arising from the development of the Patyegarang site. Although prevailing fire weather conditions are typically from the north and west, the precise direction on any given day is an uncertainty, so the development of the site will, by its very nature, reduce vegetation, hence reduce bushfire threat and hence risk.

Currently, there is little in the way of developments to the north, or east that provide enhancements to for adjoining lands. These include areas of rural-residential housing. There will be little difference in the potential impacts on the Telstra site to the south, although a lower frequency may be anticipated.

F. Meeting Specific Objectives of PBP.

I have also measured the John Travers report and Planning Proposal against the specific objectives for residential (and rural-residential) subdivision (Chapter 5 of PBP 2019). The assessment of compliance against these Specific Objectives are set out in the Table 1 below.

Table 1: Patyegarang Compliance against PBP Specific Objectives.

Specific Objective	Compliance	Comments
minimise perimeters of the subdivision exposed to the bush fire hazard (hourglass shapes, which maximise perimeters and create bottlenecks should be avoided)	Yes	Although the JOHN TRAVERS Report has identified key pinch points, these are addressed largely through APZs at key points. Creek increases perimeter but not bottlenecks.
minimise vegetated corridors that permit the passage of bush fire towards buildings	Partial	The proposal includes a drainage line to the north which is to be managed land for the current concept plan. The southern extension of the creek, does not include a perimeter road.
provide for the siting of future dwellings away from ridge-tops and steep slopes, within saddles and narrow ridge crests	Yes	No specific areas of ridge tops or saddles readily identifiable. Heath is upslope of housing.
ensure that APZs between a bush fire hazard and future dwellings are effectively designed to address the relevant bush fire attack mechanisms	Yes	APZs are designed to achieve a BAL 29 or less outcome. APZs for seniors living could be achieved in the north near Forest Way.
ensure the ongoing maintenance of APZs	Yes	Community title arrangements will facilitate this outcome.
provide adequate access from all properties to the wider road network for residents and emergency services	Partial	Access arrangements facilitates movement away from bushfire threat. One perimeter road (south) is not fully integrated into the proposal at this stage. Slipway from Morgan Road to Forest Way a significant enhancement. A DA assessment would need to consider the merits of the perimeter road.
provide access to hazard vegetation to facilitate bush fire mitigation works and fire suppression	Yes	Generally satisfactory and access to fire trails maintained. Southern perimeter road to be addressed at DA stage.

ensure the provision of an adequate supply of water and other services to facilitate effective firefighting	Assumed	Assumed Sydney Water can supply adequate water (see comments in JOHN TRAVERS Report). Electricity to be underground.

G. Conclusions.

In considering the overall strategic planning principles for the development, the following conclusions can be made:

a) Suitability of the land for development as R2, RE1 and C2 in the context of bush fire risk.

The JOHN TRAVERS Report provides a comprehensive consideration of land use suitability although does not directly address the RE2 and C2 lands as part of the overall assessment. Although the site is considered suitable for residential development, the zoning (R2) is not considered appropriate for some special fire protection developments such as schools, child care or hospitals. The planning proposal does not consider commercial or retail uses.

One issue not adequately addressed is the future of the C2 lands and their ongoing management. It is likely that some form of restriction to title or BCT agreement arrangement maybe required which includes a fire management component. However, this is not considered a barrier to development of the proposed residential land for, but rather an ongoing risk management arrangement.

b) Ensuring the development will comply with PBP.

In general, much of the development will be capable of compliance with PBP.

Water supplies is still an uncertainty but appears to be resolvable, although water pressure and quantity needs to be confirmed. Gas should not be supplied to the area. Electricity does not appear to be a constraint.

In general, APZ can be contained within the development area, however lot sizes will need to be larger in some areas close to creek lines and residual C2 lands to achieve the necessary setbacks. This may have a flow on effect in relation to lot yields, but not the 450 dwellings cap limit proposed.

In general, the access arrangements are appropriate and the provision of the slip way at Forest Way is a significant enhancement to access onto the main road infrastructure. It is hard to envisage any better arrangements to facilitate movement out of the area. Notwithstanding this, there are still challenges in meeting the requirements for perimeter roads in all areas. In particular, the section in the south-west of the site, needs to be resolved in any future DA approval. Bridges and road infrastructure across creeks need to be practical and economically feasible. Note that perimeter roads will need to be 8m wide, kerb to kerb.

c) Minimizing reliance on performance solutions.

The JOHN TRAVERS Report provides some preliminary calculations of radiant heat for key elements of the development. These provide some confidence in relation to the future need for not requiring performance-based solutions. These calculations should not however be seen as being relied upon, in relation to the establishment of APZs.

One area which needs clarity, is the southern perimeter road, which indicates 100m distance. This is a suitable arrangement, and will require ongoing maintenance by the community. However, this also needs to be interpreted as no buildings being permitted. A better outcome would be to bring the perimeter road further south (subject to topographical constraints) and providing a larger lot size with management on-site by residents and the community.

d) Providing adequate infrastructure associated with emergency evacuation and firefighting operations.

The provision of water and roads has been discussed above. With a community title arrangement, it is also possible to provide enhanced emergency procedures through a bushfire emergency and evacuation plan for the community. This should form part of any future DA consideration.

The road layout, subject to perimeter roads, can be effectively used for evacuation and firefighting. The risk assessment in the JOHN TRAVERS Report indicates that evacuation and firefighting operations are not hampered.

e) Facilitating appropriate ongoing land management practices.

The proposed use of land under the planning proposal for residential development does not address bushfire management specifically. The planning proposal will not impact or impede existing fire trail access and the retained C2 lands could be subject to enhanced bushfire management within biodiversity thresholds. Some future realignment of the trail may be warranted but for conceptual purposes is reasonable.

H. Summary.

The purpose of the peer review was to provide an opportunity for fresh considerations by a bushfire professional, which can provide some confidence of the methodology, approach and conclusions in relation to the Patyegarang Planning Proposal for the future development of 450 dwellings, recreational lands and conservation lands. The review makes no judgement about the relative merits of the different uses of the land, rather to provide an answer to the following three questions:

a. Is the site suitable for the intended use as residential dwellings?

Overall, the removal of areas of native vegetation will facilitate residential use, however, the extension of the creek in the south-west has the potential to bring some threat to the subdivision. The provision of APZs are strategic, compliant and well located.

b. Will occupants be able to safely evacuate in the event of a bushfire?

In general, occupants will have good access out of the development from Morgan Road to Forest Way. The internal road network is also generally satisfactory. The lack of perimeter roads in the south-west of concept plan is an area requiring some further improvements subject to cost and topographical constraints. This would need to be addressed at a future DA and may result in the loss of some developable land.

c. Does the current proof of concept plan comply with PBP 2019, or can be reasonably made to comply at DA stage?

The concept plan generally complies with PBP 2019, however, there are two areas requiring some attention. Firstly, the provision of perimeter roads in the south-west is a deviation from the provisions of PBP 2019. Secondly, confirmation at a suitable time by Sydney Water of the provision of adequate water supplies to the site.

The second of these issues is not in my view an absolute constraint to the planning proposal due to critical component of any future urban development of the site.

Dr Grahame Douglas, AM
23 February, 2024

Attachment: Curriculum Vitae.

Note: A reference to the JOHN TRAVERS Report is a reference to the report dated 14 February 2024 titled: Strategic Bushfire Study: Patyegarang Planning Proposal, Morgan Road Belrose (Ref. 18CR39).

Qualifications

University of Technology – Bachelor of Applied Science (Env. Bio).

Macquarie University – Masters in Environmental Studies.

University of Technology Sydney - Post Graduate Diploma Public Sector Management.

Australian Institute of Project Management – Post Graduate Diploma in Executive Leadership.

University of Western Sydney – Post Graduate Diploma Design in Bushfire Prone Areas (2006)

University of Western Sydney - PhD (2017).

Associations and Memberships

Member of the Australian Standards Committee - FP-020, Construction in Bushfire Prone Areas.

Life Member, Bushfire Protection Association of Aust.

Awards

NSW RFS – Service Medal – 2009
NSW RFS – Commission's Commendation – Manager, Planning Services -2004
Frazer Environment Award – Liverpool City Council, Australia Day -1994
Member of the Order of Australia (AM) Australia Day, 2024

Work History

Present: *Travers bushfire & ecology*, Principal Consultant Bushfire

Dr Grahame Douglas, AM

Principal Consultant Bushfire

Grahame has been involved in bushfire safety and associated policy development since the early 1990s. He participated initially on the Bush Fire Council of NSW and subsequently joined the Department of Bushfire Services (which became the NSW Rural Fire Service) in 1996.

With the introduction of the *Rural Fires Act 1996* and the extension of the coordinated system across the State, he was the leader in the development of the original framework and documentation of the bush fire risk management planning approaches used in NSW. Grahame revised the documentation which was endorsed by the Bush Fire Co-ordinating Committee in 2007.

Grahame has spent 10 years as Academic Course Advisor for the Post-Graduate Bushfire Program and have worked full-time at WSU prior to joining Travers Bushfire and Ecology.

Expertise

Grahames expertise includes:

- Planning and development control
- Building in bushfire prone areas
- Bushfire protection assessments
- Bushfire management plans
- Bushfire fighting and behaviour
- Emergency management in a bushfire prone area
- Disaster and Emergency Management
- BAL Assessments
- Project Management skills
- Project budgeting, forecasting, and planning.
- Understanding of state and commonwealth environmental protection legislation.
- Harboring and fostering of key client business and subcontractor relationships in a professional manner.

Publications

Refereed Journal Articles

- Douglas G.B. and He Y. 2019. "Design bushfire selection for bushfire protection in adaptation to global warming". *Frontiers in Mechanical Engineering.*
- Douglas G.B., Tan Z., Midgely S., and Short L. 2008. "Bushfire Building Damage: A NSW Perspective". *Proceedings of the Queensland Royal Society*. Special Edition: Selected papers from Bushfire 2006 Conference.
- Kwok, K.C.S., He, Y., and Douglas, G.B., 2012, "Bushfire-enhanced Wind Load on Structures". Proceedings of the Institution of Civil Engineers. *Engineering and Computational Mechanics*.

2014 – September 2023: Academic Course Advisor – Post- graduate Construction Management, School of Engineering, Design & Built Env. Western Sydney University

Previous positions with the NSW Rural Fire Service – Manager of Planning and Research, Manager of Planning and Environment, Manager of Development Control and Manager Natural Environment Services.

2002-2009 – Standards Australia Committee Member - FP-020, Construction in Bushfire Prone Areas

Consultancies

2010 - Busselton City Council (WA) *Report to Busselton Council in relation to bushfire protection and the adoption of AS3959-2009 by the Building Code of Australia in 2010*.

2011 - Country Fire Authority (Vic) *Report to the Country Fire Authority in relation to the Implementation of Defensible Space and BAL levels for planning and building in WMO Areas*. Centre for Local Government, University of Technology, Sydney.

2011-12 - Building Commission (Vic) *Expert Panel on Community Bushfire Refuges*.

2002-2019 -Centre for Local Government – University of Technology, Sydney. (Associate), *NSW Planning for Bushfire Prone Areas Course*.

2011-2014 - Centre for Local Government – University of Technology, Sydney. (Associate) *Victorian Building and Development for Bushfire Prone Areas Course*.

Various consultancies and expert witness to the Land and Environment Court in relation to bushfire protection (planning and building).

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Refereed Conference Articles

- Douglas G.B. He. Y. Xiang Y., Morris C.E. 2014. "Use of Extreme Value Analysis in Determining Annual Probabilities of Exceedance for Bushfire Protection." *Proceedings of the 11th International Association of Fire Safety Science*. Christchurch, New Zealand.
- Douglas G.B. 2012. "Using Extreme Value Analysis to enhance Defendable Space for fire fighters and residents". *Proceeding of the 12th International Association of Wildland Fire Safety Summit*. Sydney, 2012.
- Douglas G.B., Holland M. and Andreou A., 2012. "A new Site Assessment Framework for the Victorian Planning and Building Arrangements after the Black Saturday Bushfires" Australasian Fire and Emergency Services Conference. Perth.
- He, Y., Kwok, K. C. S., Douglas, G. B., Razali, I. M., 2011"Numerical Investigation of Bushfire-Wind Interaction and Its Impact on Building Structure", *Proceedings of the 10th International Symposium on Fire Safety Science*, University of Maryland, USA, 19-24 June.
- Kwok, K.C.S., He, Y. and Douglas, G.B., 2010, "Wind impacts on fire spread and structural failure during bushfire in complex terrain", Proceedings of 9th United Kingdom Conference on Wind Engineering, Bristol, UK, 20-22 September, pp. 3-14
- Douglas G.B., Short L. and Tan Z. 2007. "Developing new paradigms and recognising the limitations for the integration of Alternate Solutions and a Performance Environment in NSW bush fire prone areas". Fire Safety Engineering Conference 2007.
- Douglas G.B., L. Short and Z. Tan. 2006. "NSW Advances in Approaching Performance based Assessments of Residential Developments in Bushfire Prone Areas". Bushfire 2006 Conference, Brisbane, 6-9 June 2006.
- Douglas G.B., Z. Tan and S. Midgely. 2006. "A Verification Method for Evaluating Alternative Building Solutions in Bushfire-Prone Areas". *The Future of Fire Safety*. International Fire Safety Engineering Conference 2006, Gold Coast, 23 May 2006.
- Ramsay G. C., Wynn-Jones M., Wood C., Douglas G. and Robeson P. 2006. "The Australian Bushfire Safety Engineering Guidelines" *The Future of Fire Safety*. International Safety Engineering Conference, Gold Coast, 23 May 2006.
- Douglas G.B.and Tan X., 2006. "Integrating Site Assessment and Performance Planning Outcomes for Bushfire Prone Areas". *Planning for Natural Hazards - How we can Mitigate the Impacts?* Symposium Proceedings, University of Wollongong.

Presentations: State and national institutions on advanced bushfire safety design, emergency planning and site assessment methodology.

Our Ref: 18CR39

12 August 2024

Juliet Grant
Executive Director
Gyde Consulting
Level 6, 120 Sussex Street
SYDNEY NSW 2000

Re: Morgans Road, Belrose

I refer to your request of 1 August 2024 seeking confirmation that changes to the planning proposal at Morgans Road, Belrose including proposed Draft Structure Plan, Draft Zoning Plan, and Draft Minimum Lot Size Plan (dated August 2024) meet my suggestions set out in my peer review of 23 February 2024. These are appended to this letter.

As previously discussed, the revised structure plan identifies additional areas of conservation area (C2 zoned lands) along the classified creeks, an area of retained vegetation and the bulk of the area for residential lots as well as open space/asset protection areas.

In relation to the current Draft Zoning Plan, I note that the RE2 zone along the southern boundary/interface with the R2 zone represents a clearer intention to that of the original Draft Plan and as such provides greater certainty for the consideration of the Department of Planning, Housing and Infrastructure.

On the Minimum Lot Size interfacing between the western extent of the site and the central area (east and west) of the main creek line better reflects and is more consistent with the peer review discussed above. The new conceptual arrangement of 200m^2 lots to the north of the site and the larger 600m^2 further to the south is also consistent with my previous advice on the lot size arrangements for the subject planning proposal, from a bushfire protection perspective. Lot sizes of 450m^2 form the bulk and central part of the development footprint. Such an arrangement provides a progression of defendable lot sizes closer to the bushland interface transitioning to a more suitable higher density lot arrangements further away from associated bushfire threats. It is noted that the final layout of any subdivision pattern will be contingent on final topographical considerations and other site characteristics.

Yours sincerely

Dr Grahame Douglas AM
Principal Bushfire Consultant – ***Travers bushfire & ecology***

Draft Structure Plan

August 2024

Draft Zoning Plan

Conservation - C2
Residential - R2
Future Residential - R2
Recreation - RE2

0 50 100 200

Scale: 1:4000 @A3

Minimum Lot Size