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6 September 2019

A W Edwards Pty Ltd  
Level 1, 131 Sailors Bay Road  
Northbridge NSW 2063

**Attention:** Mr D DiPaolo

Dear Dino



**Re: Lane Cove Data Centre – summary of changes for resubmission  
Addendum Bushfire Protection Assessment, Vegetation Management Plan,  
Watercourse Assessment Report  
1 Sirius Road, Lane Cove West**

*Travers bushfire & ecology (TBE)* has been requested to provide a summary of the changes undertaken to the following reports since the previous July issue of the reports;

- Watercourse Assessment Report – dated July 2019
- Vegetation Management Plan – dated August 2019
- Tree Assessment Report – dated August 2019
- Bushfire Protection Assessment Report (addendum) – dated August 2019

The changes to these reports were a result of the revised scheme and layout of the proposed Lane Cove Data Centre as summarised below;

- reduced data hall footprint to increase the building setbacks from the western and eastern boundaries;
- increased building height (i.e. increase from five (5) stories to six (6) stories);
- diesel fuel storage has been moved from the basement level and the generators have been deleted from the roof and are now located on multiple storey platforms on the western, northern and eastern sides of the building; and
- modifications to the fire trail and access roads.

A summary of the changes to each of these reports is provided below:

***Bushfire Protection Assessment Report (Addendum)***

The most recent addendum bushfire report prepared in August provided a Table within the executive summary outlining the revised schemes compliance with the conditions of consent issued by the NSW RFS. The changes within the August report since the issue of the bushfire review undertaken by this firm via the 2 July 2019 letter include:

**Asset Protection Zones**

The revised scheme has resulted in a decrease to the building footprint and therefore provides for a larger 36m APZ to the west (previously 10m). This coupled with a BAL FZ construction to the western building façade will reduce the bushfire risk posed to the building and generators on this aspect.

There are no substantial changes to the APZ in the north, east or south-west.

It is understood that the revised scheme has been amended (in part) to address Lane Cove Council's response to consider the existing environment and to seek a better balance between site analysis, building design and environmental response. In particular Council raised concerns regarding the unacceptable loss of tree canopy and requested a larger proportion of the associated trees to be retained.

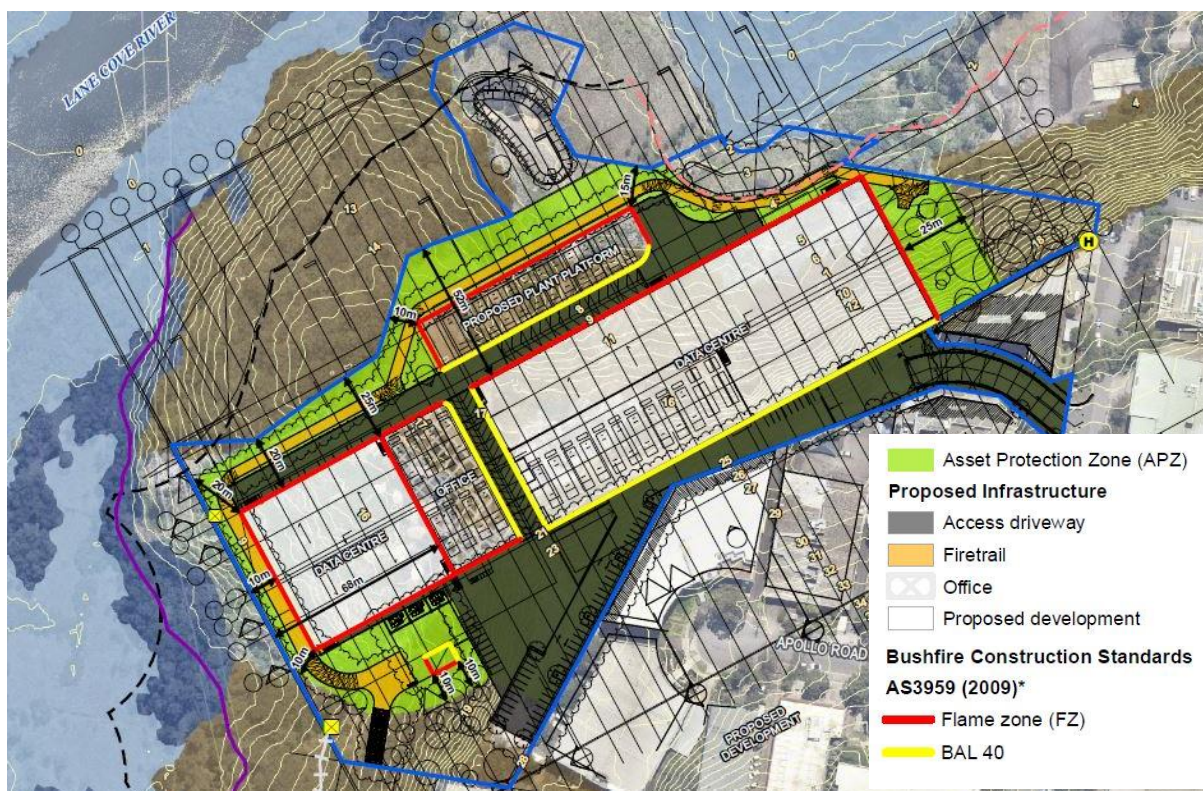
The revised scheme has reduced the extent of tree removal by amending the location of the substation to below the roadway deck, reconfiguring the fire trail and rearrangement of the car parking layout. The amended data center location has resulted in the retention of a 10m strip of land along the western boundary (i.e. outside of the APZ). This will allow the retention / replanting of further trees along this boundary.

### Water, Electricity and Gas

The revised scheme will maintain compliance with the requirements for water, electricity and gas. No substantial changes to these aspects of the design have been made since the issue of the bushfire review undertaken by this firm via the 2 July 2019.

### Property Access

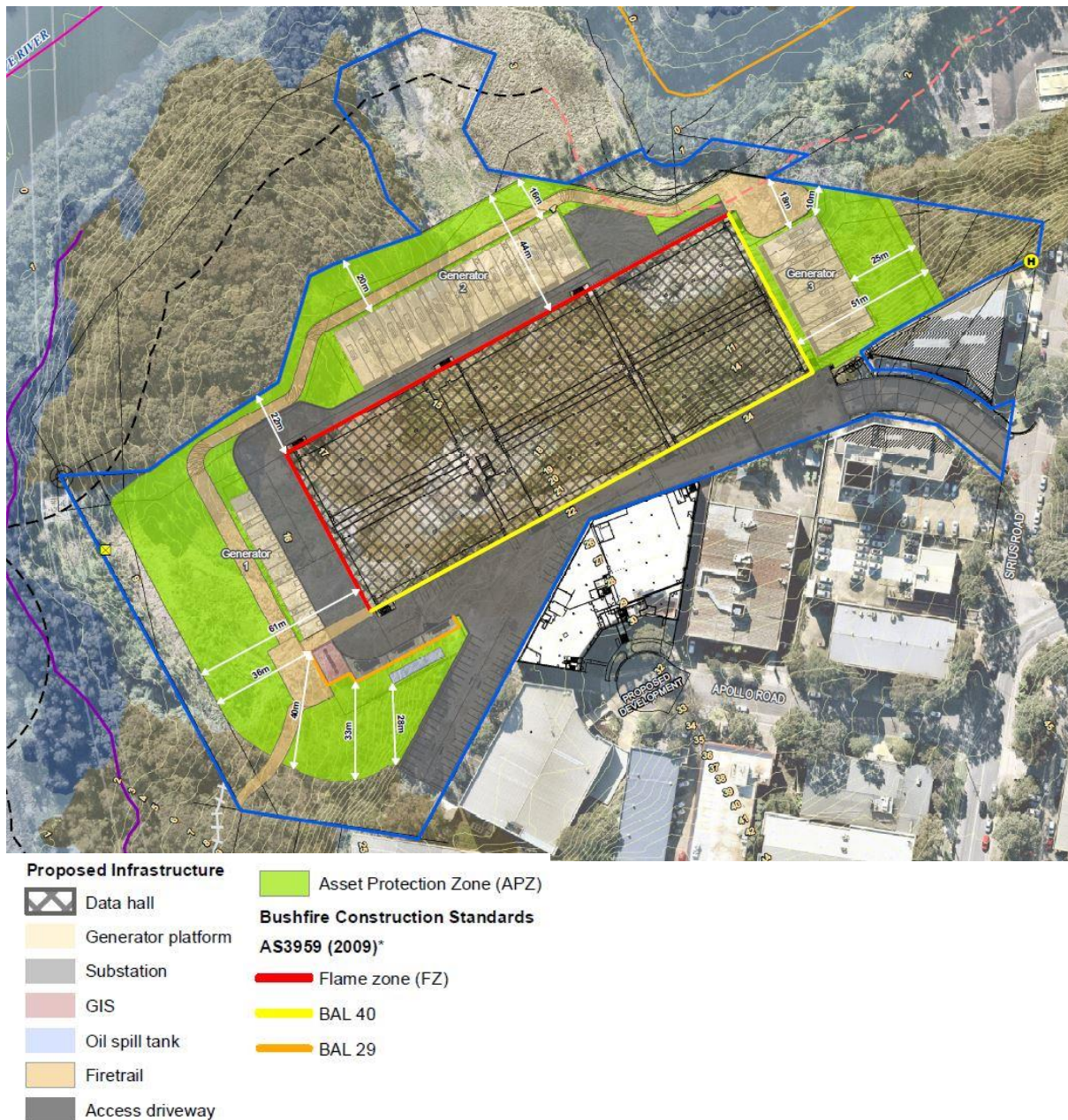
Changes to the driveway include the provision of property access road around the southern, western and northern perimeter of the data centre building. The previous design depicted an access road through the centre of the site between the office and the data centre (refer Figure 1 – access in grey)



**Figure 1 – Access design (July scheme)**

(Source: Lane Cove Data Centre – bushfire review prepared by Travers bushfire & ecology, dated 2<sup>nd</sup> July 2019)





**Figure 2 – Access design (new August scheme)**

(Source: Bushfire Protection Assessment (addendum) prepared by *Travers bushfire & ecology*, dated August 2019)

As outlined in the addendum bushfire report the revised scheme maintains compliance with the NSW RFS conditions for private roads. The revised scheme provides additional firefighting access and increased defendable space around the perimeter of the building therefore improving the bushfire protection measures afforded to the development.

### Fire Trails

The changes to the fire trail design are outlined in Figure 1 & 2 above. The general alignment of the fire trail in the north remains the same. The fire trail in the west now runs adjacent to the generator platform and not adjacent to the western boundary therefore allowing for the retention / regeneration of trees within the western site boundary.

As outlined in the bushfire protection assessment report the revised scheme will comply with the RFS condition to include the following:

- A minimum vertical clearance of 4 metres is provided to any overhanging obstructions (tree branches or the building itself).
- A passing bay passing bay will be provided every 200m (20m long by 3m wide (making a minimum trafficable width of seven metres).
- Turning heads will be designed to ensure Category 1 fire tankers can undertake a three (3) point maneuver.

It is noted that Council recommend a non-hard surface option to include polymer-based grass pavers, grids and geocell with inclusion of native grass species. These options can be considered and will take into account fire tanker capacity (15 tonnes) in order to comply with this condition and to take into consideration Councils request.

### Emergency and Evacuation

The revised scheme will maintain compliance with the requirements for emergency evacuation. As outlined in the bushfire protection assessment report a bushfire evacuation plan will be prepared prior to occupation.

### Building construction standards

#### *Data centre*

Changes in terms of building construction standards are highlighted in Figures 1 & 2. Based on the amended simplified design the roof, northern and western building facades of the data centre are to comply with BAL FZ. The remaining facades can step down to BAL 40. This is consistent with the recommendations from the NSW RFS.

#### *Generator platforms*

The location of the proposed generators and diesel fuel tanks have been amended in the new scheme. The previous scheme allowed for this infrastructure to be located on the roof. The proposed new scheme provides for three (3) separated generator platforms located on the outer extremities of the building (north, east and west). Based on the new locations these platforms will be constructed using non-combustible materials and will be housed within a non-combustible structure. In addition, radiant heat shields will be provided to prevent flame contact and reduce radiant heat exposure on the structures / machinery.

#### *Substation*

The revised scheme has resulted in a relocation of the substation to below the suspended roadway deck. The substation will be open with blast walls between each transformer. The blast walls, suspended roadway deck and asset protection zone will provide the required shielding to prevent flame zone contact and reduce radiant heat impact to the non-enclosed substation elements.

The GIS switch gear will be within a roofed enclosure, whilst the asset protection zone extent has not changed the amended location of the GIS switch gear has increased the setback afforded to the structure and it can therefore comply with a BAL 29 construction standard (as opposed to BAL FZ as per previous design).

### ***Vegetation Management Plan***

The following changes have been made to the document that was previously submitted 4 July 2019:



- Figure 2 updated plan
- No notable changes in section 1 or 2
- Changes made in section 3.1.4 regarding numbers of hollow-bearing trees to be consistent throughout the document. Numbers listed in July report in this section were incorrect.
- Section 3.3.1 updated to include more revegetation and restoration areas. New planting area in the south-western APZ to provide a managed bushland interface with vegetation offsite that will filter any development impacts to that bushland. A screen planting of canopy trees to be planted along north-western side of the development area to provide some partial screening to the development from residences near to Pittwater Road and Magdala Road. The screen planting will also assist in mitigating the loss of trees for the development proposal that will provide an overall replacement surplus. Areas of stormwater works at the peripheral edges of the site (south-west and north) to be mitigated through rock dissipaters and macrophyte planting to limit sediment and erosion impacts and contain them to the site.
- Section 3.3.3 updated. The fully-structured revegetation area has effectively been doubled in size. The density of planting remains the same however the number of plants has been increased to match the area of planting.
- Section 3.3.4 updated. The area of contaminated lands has been revised slightly and is slightly smaller. Numbers of plants revised to reflect the area change. The density of plantings is the same.
- APZ planting on western edge of site, screen planting in north-western APZ and macrophyte planting sections have been added to the report, detailing the type of plants, areas, densities and numbers. The number of trees being removed for the development was revised at 114. The proposed increase in revegetation works sees the planting of 120 trees, therefore essentially replacing those lost at a 1:1 ratio. The previous submission only had 43 trees to be planted. This provides a much more balanced outcome to the proposal. The overall number of plants to be re-established has increased from 14,610 to 29,818.
- Section 3.5 on hollow-bearing trees has been revised to match 3.1.4. Inconsistencies in the July report were noted.
- 1 additional paragraph added to section 4.2 (3<sup>rd</sup> last in section) regarding monitoring of stormwater outlet areas.
- Section 4.5 restoration performance targets updated to align with new planting numbers and to account for stormwater outlet areas.
- Table A1 updated planting densities and added macrophyte planting. Added species to the Swamp Oak Floodplain Forest & Ecotonal Species list.
- Schedule 1 - modifications based on CAD changes, outlet areas, updated APZs and additional planting areas.

### ***Arborist Report***

The following updates have been made to the tree report submitted 4 July 2019:

- In the executive summary, the number of trees being removed or retained has been altered to accommodate the change in development. There are 2 additional trees being retained than previous. The number of visually significant trees being removed has been reduced from 22 to 18.
- Figure 1 updated to show new layout of the development.
- The number of hollow-bearing trees being removed has changed from 9 to 8. The number of nest boxes proposed is at a ratio of 1:1 not 2:1. There will not be sufficient room to place more on site. This matches the proposed measures in the VMP.
- Section 4.1, 4.2 and 4.3 numbers updated.

- Section 6.1 numbers in conclusion updated.
- Schedule 1 trees removed vs retained updated to reflect the CAD and APZ. T-G026, T-G027 and T-G069 SRZ calculation added.
- Schedule 2 plan updated to show locations of trees removed / retained and the changed CAD and APZ.

### ***Watercourse Assessment***

The following updates have been made to the watercourse report submitted 17 July 2019:

- The table on the second page of the executive summary updated to show a larger gain in the riparian zone.
- Figures 2-8 showing new CAD.
- Figure 13-14 updated with new CAD and stormwater lines.
- Final paragraph in section 4.4.1 has the area of gain in riparian area noted.
- Page 34 setback numbers altered.
- Figure 15 updated with new CAD.
- Table 3 updated with riparian gain.
- Review the impacts in light of question from Council (please refer to attachment 1).

Should you require further assistance please contact the undersigned on 02 4340 5331 or at [info@traverseecology.com.au](mailto:info@traverseecology.com.au).

Yours faithfully



Michael Sheather-Reid  
Managing Director - ***Travers bushfire & ecology***

*Travers bushfire & ecology* employs  
Bushfire Planning and Design (BPAD) Accredited  
Practitioners

*Travers bushfire & ecology* employs  
Accredited BioBanking and Biodiversity Assessors



# ATTACHMENT 1 - COUNCIL RESPONSE

Agency Issue	Response – Amended Scheme
<p><b><u>Lane Cove Council</u></b></p> <p><b>Reduction of Porous Surfaces:</b></p> <p>The proposed development would significantly reduce the amount of porous surfaces on the site which would significantly affect groundwater flows. The application proposes that 26% of total site area be retained as landscaped area. Although the proposal complies with the minimum 20% landscape requirements of Part E9 of the Lane Cove DCP, the proposal is not considered acceptable in this instance given the local landscape and environmental constraints.</p> <p>The site is unique in terms of its close proximity to adjoining Endangered Ecological Communities including Coastal Freshwater Swamp, Estuarine Swamp Oak Forest, and Estuarine Saltmarsh. These areas are downhill of the proposed Data Centre development. The topography and the reduction of approximately 74% of porous areas would result in significant increases of stormwater flowing directly into these sensitive areas.</p> <p>There does not appear to be an adequate or completed study on the overall impacts of the collecting, piping and redirecting a large percentage of the catchment area. An in-depth study needs to be carried out to determine the potential risks to the Ecologically Endangered and Sensitive Vegetation in close proximity.</p> <p>The proposal in its presentation is considered to be contrary to the objectives of Clause 6.3 Riparian Land in the Lane Cove LEP 2009 and Part H 4 (a) IV Bushland Protection of the Lane Cove DCP 2010. It would adversely impact the adjoining riparian land. The proposed drainage and hydraulics plan would see an unacceptable alteration to the water shed and the ground water recharge as well as putting a high volume of water into Stringybark Creek at times of heavy</p>	<p>In response to the concerns raised by Council, the proposed development has been reduced in size and the stormwater management system has been redesigned. This has resulted in a number of improvements.</p> <ul style="list-style-type: none"> <li>• The buffer setback to the adjoining wetland to the west has been increased to 88m to the building wall and 57m to the proposed fire trail. In the July concept plan the separation distance was 27m to the proposed building wall and 21 m to the fire trail.</li> <li>• The proposed northern stormwater basin has been removed and incorporated into the design of the building in accordance with WSUD principles. These are in the form of OSD basins underneath the proposed building.</li> <li>• A stormwater outlet has been provided to the western aspect of the site to deliver stormwater from the site and delivered through a level spreader stormwater outlet system.</li> <li>• The northern outlet to Stringybark Creek has been retained, with an expected reduction in flows and two 2 outlets are delivered to Stringybark Creek at one point.</li> </ul> <p>We make reference to the updated vegetation management plan (VMP) which illustrated concept stormwater outlets into Stringybark Creek and the western wetland areas such that the erosion is minimised at the discharge point.</p> <p>As a consequence of these design changes the porous area within the site has been increased to 38%, in addition, stormwater is internally managed and delivered to both Stringybark Creek and the adjoining western wetlands subject to the detailed design of the outlet structures as illustrated in the VMP, the impacts on both will be minimised.</p>

rains which would likely be detrimental to the local water quality and ecology.

At the moment rain falling on the site drains to the south and southwest feeding the wetland areas in Ventemans Reach Reserve. This must be preserved with any development. Some of the stormwater should continue to be directed towards south and southwest to the wetland areas in Ventemans Reach Reserve and controlled in its discharge by an Onsite Stormwater Detention (OSD) as well as subsurface drainage trenches so that the water is slowly released to the wetland and its vegetation. Stormwater directed to the north and Stringybark Creek must also be controlled by OSD and dissipation so that there is no scouring of the creek with the rush of large volumes of water in times of heavy rain.

It is recommended water sensitive urban design measures in the form of raingardens and other approved biofiltration measures be incorporated into the Hydraulic Engineering drawings to allow for enough volume of rainwater to continue to hydrate the Coastal Freshwater Swamp following best horticultural practices.

Council calls for a more considered approach which is more environmentally sophisticated and responsive to the collection and treatment of water. The environmentally sensitive areas such as the salt marsh, freshwater swamp forest and swamp oak forest and the riparian corridor require specialized treatment and design solutions that have not been demonstrated in the current submission.

The northern outlet is placed in an existing disturbed area which is to be discharged at an appropriate invert level (I.L) to minimise the risk of erosion within the adjoining mangrove areas.

The western outlet is also to be designed to deliver stormwater at an appropriate invert level (I.L) to minimise the risk channelisation and erosion within the wetland.





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# Travers

bushfire & ecology

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## bushfire protection assessment (addendum)

**Proposed Data Centre  
Warehouse / Distribution Centre**

Lot 1 DP 1151370  
1 Sirius Road, Lane Cove West

State Significant Development (SSD)

August 2019  
(REF: 18AWE02.4B)







## Bushfire Protection Assessment Addendum

**Proposed Data Centre / Warehouse Distribution Centre  
Lot 1 DP 1151370  
1 Sirius Road, Lane Cove West**

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Date:	23/08/19
File:	18AWE02.4B

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### Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person, including the client, then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be relied upon as meaning it reflects any advice by this firm. The report does not suggest or guarantee that a bush or grass fire will not occur and or impact the development. This report advises on matters published by the NSW Rural Fire Service in their guideline *Planning for Bush Fire Protection 2006* and other advice available from that organisation.

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 is to be confirmed by a registered surveyor.



## EXECUTIVE SUMMARY

*Travers bushfire & ecology* prepared a bushfire protection assessment for the construction of a data centre within Lot 1 DP 1151370, No. 1 Sirius Road, Lane Cove West in February 2019. The NSW Rural Fire Service (RFS) issued recommended conditions of consent via a letter dated 3/6/2019 (ref:D18/8341) as outlined in Table E1.

The proposed changes subject to the design review include:

- reduced data hall footprint to increase the building setbacks from the western and eastern boundaries;
- increased building height (i.e. increase from five (5) stories to six (6) stories);
- diesel fuel storage has been moved from the basement level and the generators have been deleted from the roof and are now located on multiple storey platforms on the western, northern and eastern sides of the building; and
- modifications to the fire trail and access roads.

The proposed development is considered a state significant development (SSD). As a result, the NSW Department of Planning and Environment (DPE) is responsible for assessing the revised scheme, with the Minister for Planning being the consent authority.

The DPE has issued SEARs (application no. SSD 9741). This includes the requirement to address the following specific matters in relation to bushfire:

- details of the storage of any flammable materials;
- an assessment against the requirements of *Planning for Bush Fire Protection 2006 (PBP)*;
- a description of measures to ensure the proposal will not increase the bushfire risk to adjoining lands.

The proposed data centre (i.e. industrial development) is identified within *PBP* as being 'other development'. The NSW Rural Fire Service (RFS) stipulate that 'other development' applications should satisfy the aims and objectives of *PBP*, propose a combination of bushfire protection measures and provide evidence that the intent of each measure can be satisfied.

This assessment has found that bushfire can potentially affect the proposed data centre from the forest, forested wetland and grassland vegetation located to the south-west, west, north and north-east resulting in possible flame, ember and radiant heat attack.

This assessment has concluded that the proposed development will provide compliance with the aims and objectives of *PBP*, with the implementation of the following combination of bushfire protection measures:

- The new data centre building will comply with *AS3959 (2009) Construction of buildings in bushfire prone areas (BAL FZ & BAL 40)*. Whilst this standard generally does not apply to industrial development, it has been used in this instance due to the high economical risk associated with the development and need for the data centre to maintain operation during potential bushfire events.
- The proposed generators and diesel fuel tanks will be constructed using non-combustible materials and will be housed within a non-combustible structure. In addition, radiant heat shields will be provided to prevent flame contact and reduce radiant heat exposure on the structures / machinery.

- Management of the vegetation surrounding the building to ensure the new building is provided with asset protection zones (APZs) and a defensible space for firefighting operations.
- Provision of a fire trail to ensure firefighting access along the northern boundary and to the east and west of the site. This will also provide access to the electrical easement adjoining the site to the west.
- Provision of firefighting access to the roof with hydrants located at strategic locations (refer Figure 3.1).
- Hydrant points on roof and along road (in flame zone locations) are provided with a 2m high defence wall (via concrete parapet extension) at 60m centres along the perimeter of the building to provide safety for fire fighters.
- Preparation of a bushfire emergency evacuation plan to address the bushfire risk and to outline procedures to follow during a bushfire event. This will include the establishment of an emergency planning committee responsible for implementing evacuation procedures.

The following Table E1 provides a summary of the proposed revised schemes compliance with the conditions of consent issued by the NSW RFS.

NSW RFS Condition	Response
<b>Condition 1</b> – At the commencement of building works and in perpetuity, the area around the proposed buildings shall be managed as outlined within Section 4.1.3 and Appendix 5 of <i>PBP 2006</i> and the NSW Rural Fire Service's Standards for asset protection zones as follows; <ul style="list-style-type: none"> <li>• North-east: IPA for a distance of 25 metres (residue of site located towards the north-east to be revegetated to a riparian corridor) and,</li> <li>• All other directions: IPA to the property boundaries.</li> </ul>	<p>Refer Section 2.3 of this report.</p> <p>The revised scheme maintains a 25m inner protection area (IPA) to the east of the generators as per the RFS condition.</p> <p>However the APZ does <u>not</u> extend to the property boundary in all directions. The APZ is measured north: for a distance of between 16m -22m, west: for a distance of 36m and south-west: to a distance of 28-33m as per Schedule 1 attached.</p> <p>The revised scheme has resulted in a decrease to the building footprint and therefore provides for a larger 36m APZ to the west (previously 10m).</p>
<b>Condition 2</b> – The provision of water, electricity and gas shall comply with Section 4.1.3 of <i>PBP 2006</i> .	Refer Section 3.5. The revised scheme will maintain compliance with this condition.
<b>Condition 3</b> – The proposed property access road (driveway) shall comply with Section 4.1.3 (2) of <i>PBP 2006</i> .	Refer Section 3.4. The revised scheme will maintain compliance with this condition.
<b>Condition 4</b> – Fire trails shall comply with section 4.1.3 (3) of <i>PBP 2006</i> .	Refer Section 3.4. The revised scheme will maintain compliance with this condition.



NSW RFS Condition	Response
<b>Condition 5</b> – Arrangements for emergency and evacuation are to comply with Section 4.2.7 of <i>PBP 2006</i> , including the preparation of an emergency / evacuation plan consistent with the NSW RFS document titled <i>Guidelines for the Preparation of Emergency / Evacuation Plan</i> .	Refer Section 3.8. The revised scheme will maintain compliance with this condition.
<b>Condition 6</b> – Construction of the proposed data hall and office buildings north western, south western and south eastern elevations and roofing shall comply with Sections 3 & 9 (BAL FZ) of <i>AS3959 – 2009</i> or <i>NASH Standard – 2014</i> as appropriate. Except for windows, flaming of the specimen is not permitted and there shall be no exposed timber.	The revised scheme now involves a continuous façade along the whole length of the northern, southern, eastern and western elevations.  As a result, the northern and western elevations and roofing of the data hall shall comply with BAL FZ.
<b>Condition 7</b> – Construction of the proposed data hall and office buildings north eastern elevations and roofing shall comply with Sections 3 & 8 (BAL 40) of <i>AS3959 – 2009</i> or <i>NASH Standard – 2014</i> as appropriate and Section A3.7 Addendum Appendix 3 of <i>PBP 2006</i> .	As per the above the southern and eastern elevation of the data hall is to comply with BAL 40.
<b>Condition 8</b> – Construction of the proposed plant platform north western, south western and north eastern elevations and roofing shall comply with Sections 3 & 9 (BAL FZ) of <i>AS3959 – 2009</i> or <i>NASH Standard – 2014</i> as appropriate. Except for windows, flaming of the specimen is not permitted and there shall be no exposed timber.	The revised scheme now includes an open generator platform on the northern, eastern and western elevations.  A BAL FZ rating will apply to the generator platforms coupled with the provision of a radiant heat barrier.
<b>Condition 10</b> – Construction of the proposed data centres north western and north eastern elevations and roofing shall comply with Sections 3 & 9 (BAL FZ) of <i>AS3959 – 2009</i> or <i>NASH Standard – 2014</i> as appropriate. Except for windows, flaming of the specimen is not permitted and there shall be no exposed timber.	Refer Conditions 6 & 7 above.

NSW RFS Condition	Response
<b>Condition 11</b> – Construction of the proposed data centres south eastern and south western elevations and roofing shall comply with Section 3 & 8 (BAL 40) of <i>AS3959 – 2009</i> or <i>NASH Standard – 2014</i> as appropriate and Section A3.7 Addendum Appendix 3 of <i>PBP 2006</i> .	Refer Conditions 6 & 7 above.
<b>Condition 12</b> – Construction of the proposed indoor substations north western and south western elevations and roofing shall comply with Section 3 & 9 (BAL FZ) of <i>AS3959 – 2009</i> or <i>NASH Standard – 2014</i> as appropriate. Except for windows, flaming of the specimen is not permitted and there shall be no exposed timber.	Refer Section 3.2.  The revised scheme has repositioned the substation to reduce the impact on existing vegetation.  This condition is to be amended to state that all elevations of the substation are to comply with BAL 29.
<b>Condition 13</b> – Construction of the proposed indoor substations north eastern and south eastern elevations and roofing shall comply with Section 3 & 8 (BAL 40) of <i>AS3959 – 2009</i> or <i>NASH Standard – 2014</i> as appropriate and Section A3.7 Addendum Appendix 3 of <i>PBP 2006</i> .	Refer Condition 12 above.
<b>Condition 14</b> – Landscaping to the site is to comply with the principles of Appendix 5 of <i>PBP 2006</i> .	The revised scheme will maintain compliance with this condition.

## GLOSSARY OF TERMS

APZ	asset protection zone
AS1596	<i>Australian Standard – The storage and handling of LP Gas</i>
AS2419	<i>Australian Standard – Fire hydrant installations</i>
AS3745	<i>Australian Standard – Planning for emergencies in facilities</i>
AS3959	<i>Australian Standard – Construction of buildings in bushfire-prone areas 2009</i>
BAL	Bushfire attack level
BSA	bushfire safety authority
BCA	<i>Building Code of Australia</i>
BSA	bushfire safety authority
DPE	Department of Planning and Environment
EEC	endangered ecological community
<i>EP&amp;A Act</i>	<i>Environmental Planning &amp; Assessment Act 1979</i>
FDI	fire danger index
IPA	inner protection area
LGA	local government area
m	metres
OPA	outer protection area
<i>PBP</i>	<i>Planning for Bush Fire Protection 2006</i>
RFS	NSW Rural Fire Service
SEARs	Secretary's environmental assessment requirements
SSD	state significant development

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# Introduction

# 1

*Travers bushfire & ecology* has been requested to undertake an updated bushfire protection assessment in support of a Section 4.55 application for the proposed data centre within Lot 1 DP 1151370, No. 1 Sirius Road, Lane Cove West.

The proposed development is located on land mapped by *Lane Cove Council* as being bushfire prone. This triggers a formal assessment against the provisions of *Planning for Bush Fire Protection 2006 (PBP)*. The proposed development is considered state significant development (SSD). As a result, the NSW Department of Planning and Environment (DPE) is responsible for assessing the development application, with the Minister for Planning being the consent authority.

## 1.1 Aims of the assessment

The aims of the bushfire protection assessment are to:

- address the requirement of the Secretary's Environmental Assessment Requirements (SEARs) to demonstrate the project's compliance with *Planning for Bush Fire Protection (PBP) 2006*;
- assess the proposed scheme in relation to the conditions of consent issue by the NSW RFS;
- review the bushfire threat to the landscape;
- undertake a bushfire attack assessment in accordance with *PBP*;
- provide advice on mitigation measures, including the provision of asset protection zones (APZs), construction standards and other specific fire management issues;
- review the potential to carry out hazard management over the landscape.

## 1.2 Project synopsis

The proposal involves the construction of a data centre within Lot 1 DP 1151370 (refer Figure 1.1). Identified as a warehouse / distribution centre, the proposed facility will be operated 24/7 and will provide cloud computing services to its clients.

Approval is sought for the construction of a six (6) storey data centre building with associated plant and equipment (refer Figures 1.2-1.6). This includes;

- electrical substation and associated infrastructure;
- three (3) generators and diesel fuel platforms; and
- associated works including landscaping, earthworks, and servicing upgrades.

### Data centre operations and procedures

Once the development project is fully commissioned and handed over to the operations team, staff and contractors manage the ongoing health and safety of the site. This includes the implementation and management of a thorough maintenance program. Established

robust tools, systems and procedures will ensure the site remains compliant with government regulations and best in class global standards for data centre operations.

The main facets of the data centre operations are as follows:

- minimising unplanned outages and critical equipment failures through well documented management processes and procedures;
- reducing operating risks including those related to security; and
- providing continuous customer support on a 24x7x365 basis.

### Access

Access to the proposed development will be provided from an existing road extending from Sirius Road in the east, with staff car parking provided within the southern portion of the site. An internal road network will be constructed to provide vehicular access to both the southern and northern building façades, terminating in the north-east.

Secondary emergency egress points for firefighting operations are provided via 4m wide fire trails which run parallel to the northern and western building façades. Fire trails will also provide access to the eastern building facade, with the western trail also servicing the electrical transmission tower external to the site's western boundary. Each fire trail will terminate with a 'T-turning' or 'Y-turning' head and will link to the internal access road via a vehicle ramp. Roof access will also be available for firefighting services in the event of an emergency with enclosed concrete stairs permitting safe pedestrian egress / exit routes located towards Sirius Road.

Schedule 1 shows the proposed extent of the proposed development and bushfire protection measures, including APZs.

### **1.3 Secretary's environmental assessment requirements (SEARs)**

The DPE has issued SEARs (application no. SSD 9741). This includes the requirement to address the following specific matters in relation to bushfire:

- an assessment against the requirements of *Planning for Bush Fire Protection (PBP) 2006*;
- details of the storage of any flammable materials;
- a description of measures to ensure the proposal will not increase the bushfire risk to adjoining lands.

This report has been prepared to address the bushfire hazard posed to the development and to address the aims and objectives outlined in *PBP*.

The proposed data centre is adjoined by forest, forested wetland and grassland vegetation to the south-west, west, north and north-east, which does expose the development to potential flame, ember and radiant heat attack. The bushfire risk posed by this vegetation is reduced by the presence of saline wetland and the Lane Cove River which is not considered bushfire prone. As a result, the fire run potential has been reduced with full flame widths of 100m not expected.

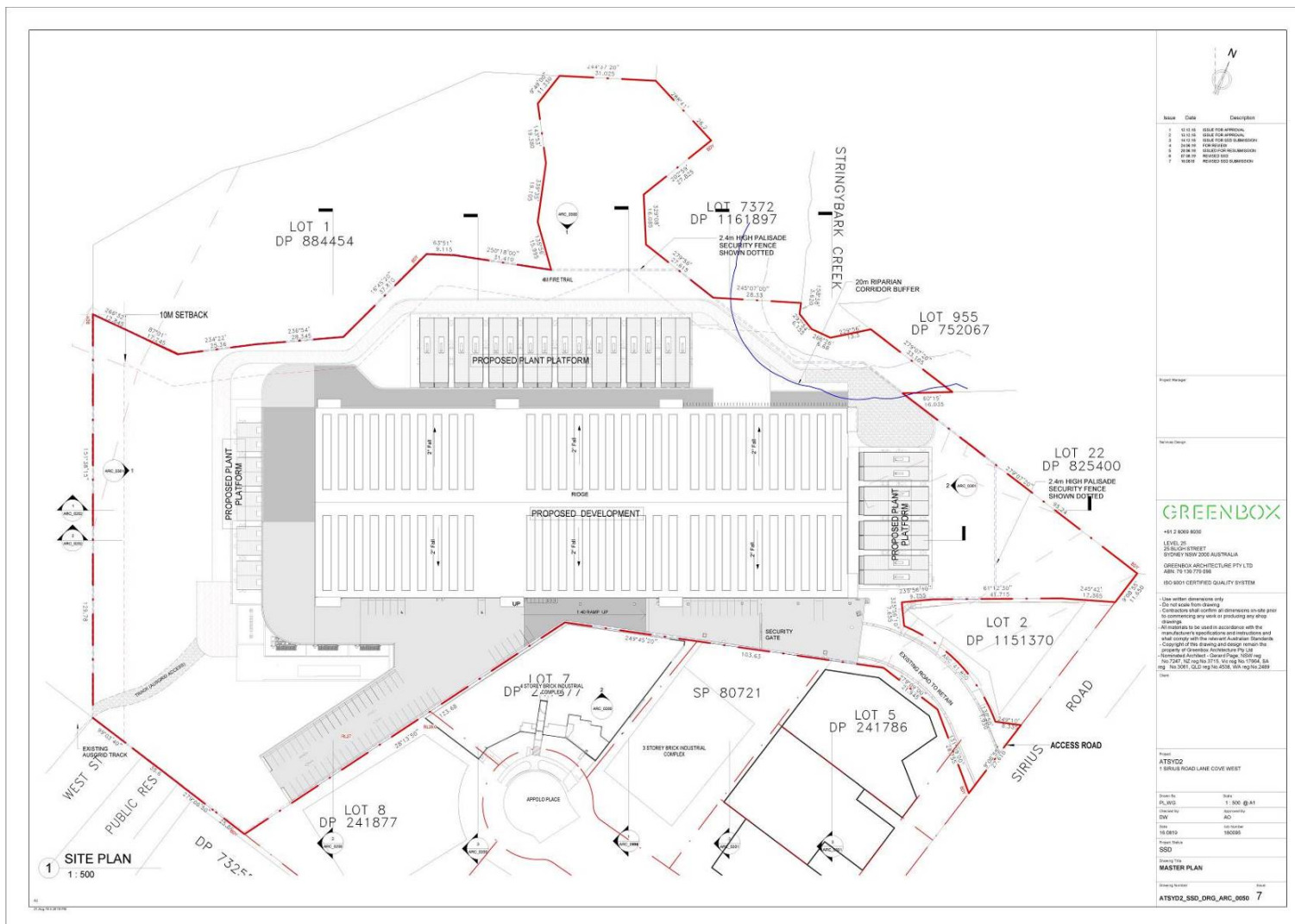
The proposed development, however, is located in close proximity to the site boundaries therefore exposing some building facades to potential flame zone contact. Therefore, the bushfire risk has been mitigated with the provision of APZs to ensure defensible space is

achieved non-compliance with the aims and objectives and performance criteria outlined in *PBP*.

In addition, the majority of the building will be constructed to comply with BAL FZ and the proposal will provide for increased provision of water supply, access, fire trails, hydrants and evacuation as detailed within Section 3 of this report.

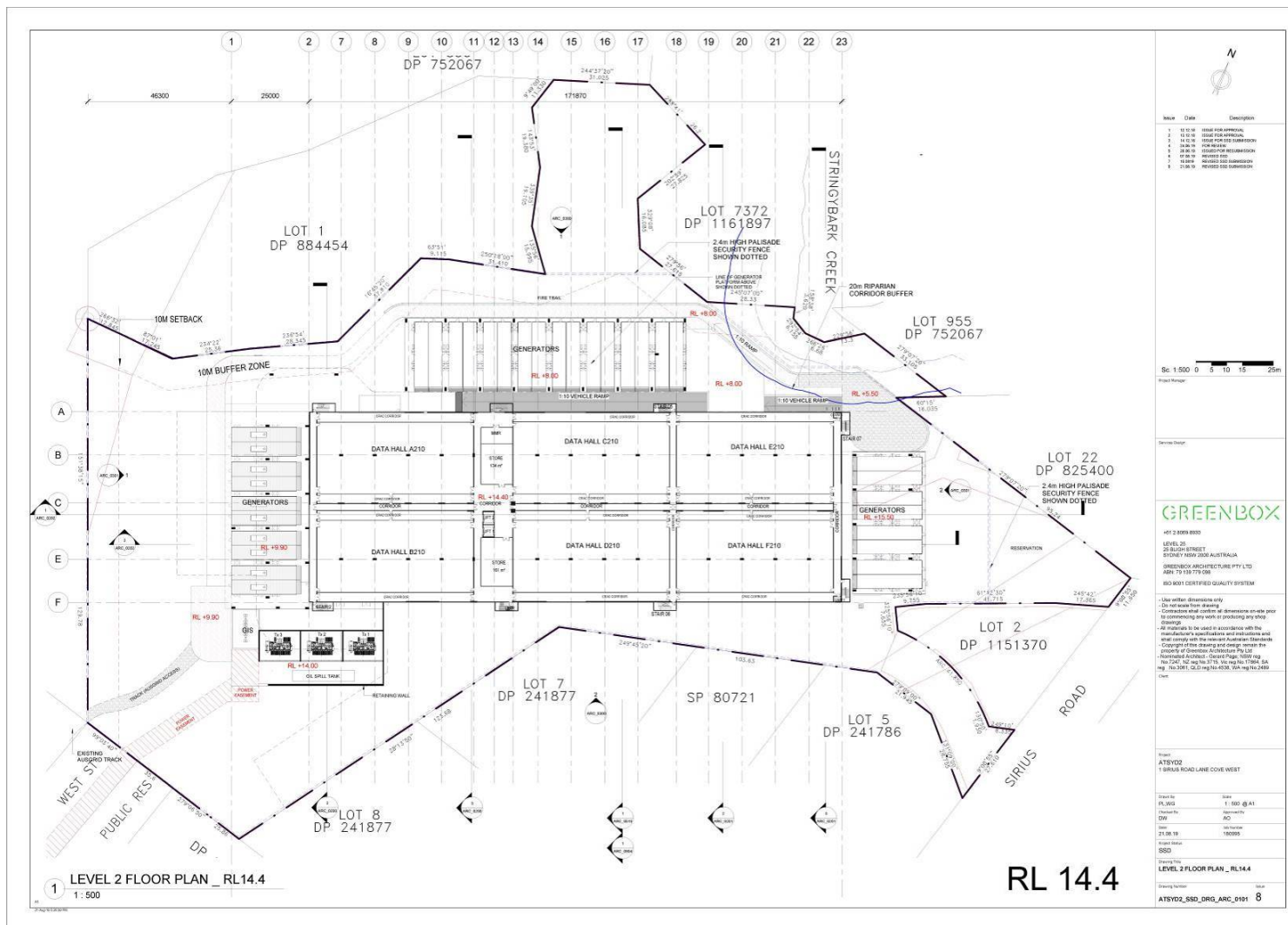
Proposed flammable materials are restricted to the storage of diesel fuel. Diesel tanks are to be located on the generator platforms and will be stored within metal containers and within structures that comply with a BAL FZ rating. In addition, radiant heat barriers will be constructed to limit direct exposure to potential bushfire attack.

The proposed development and the associated APZs will reduce the bushfire risk posed to adjoining land through further management of vegetation, increased access to the perimeter of the site and through the provision of fire hydrants to aid in firefighting operations.

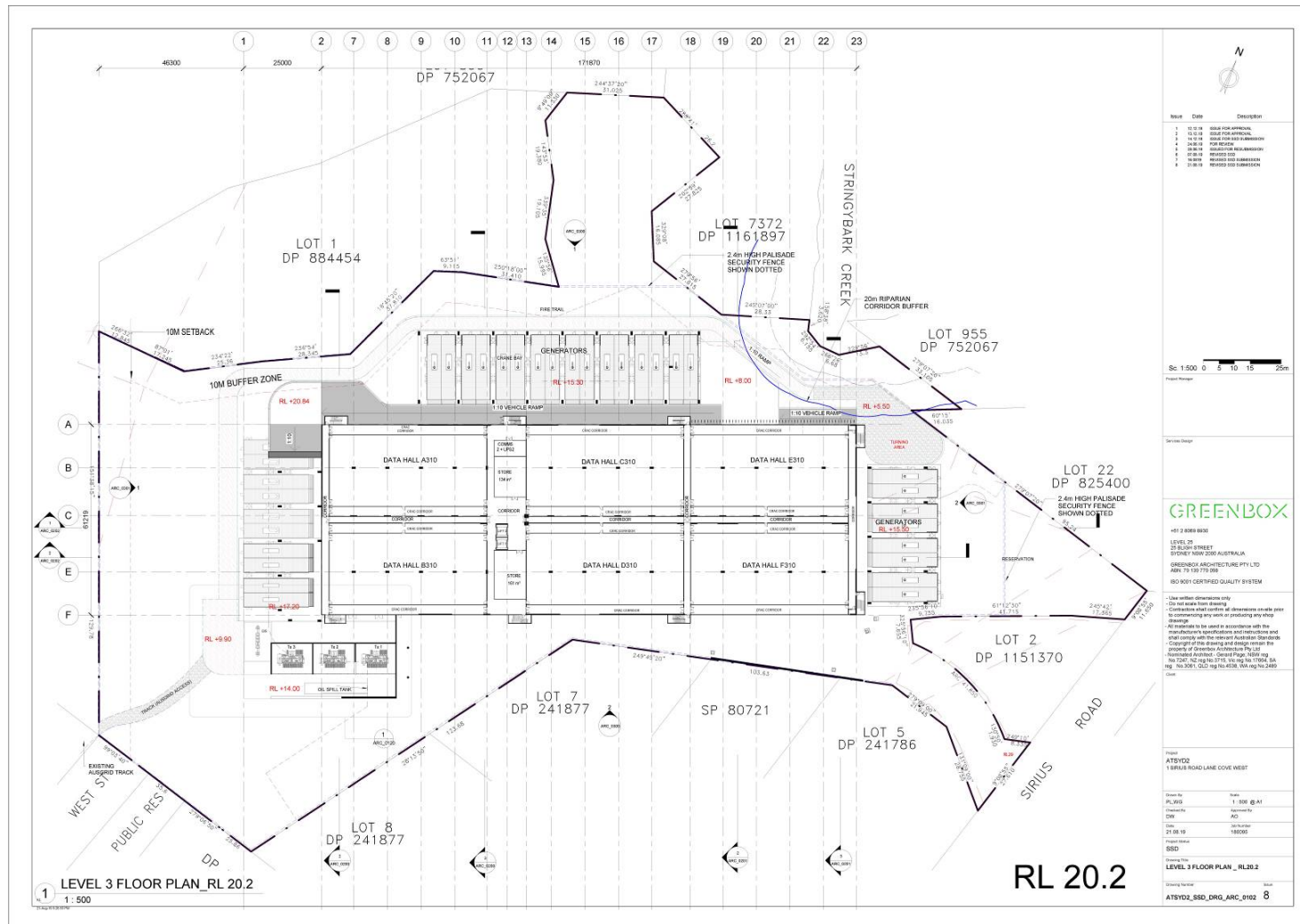




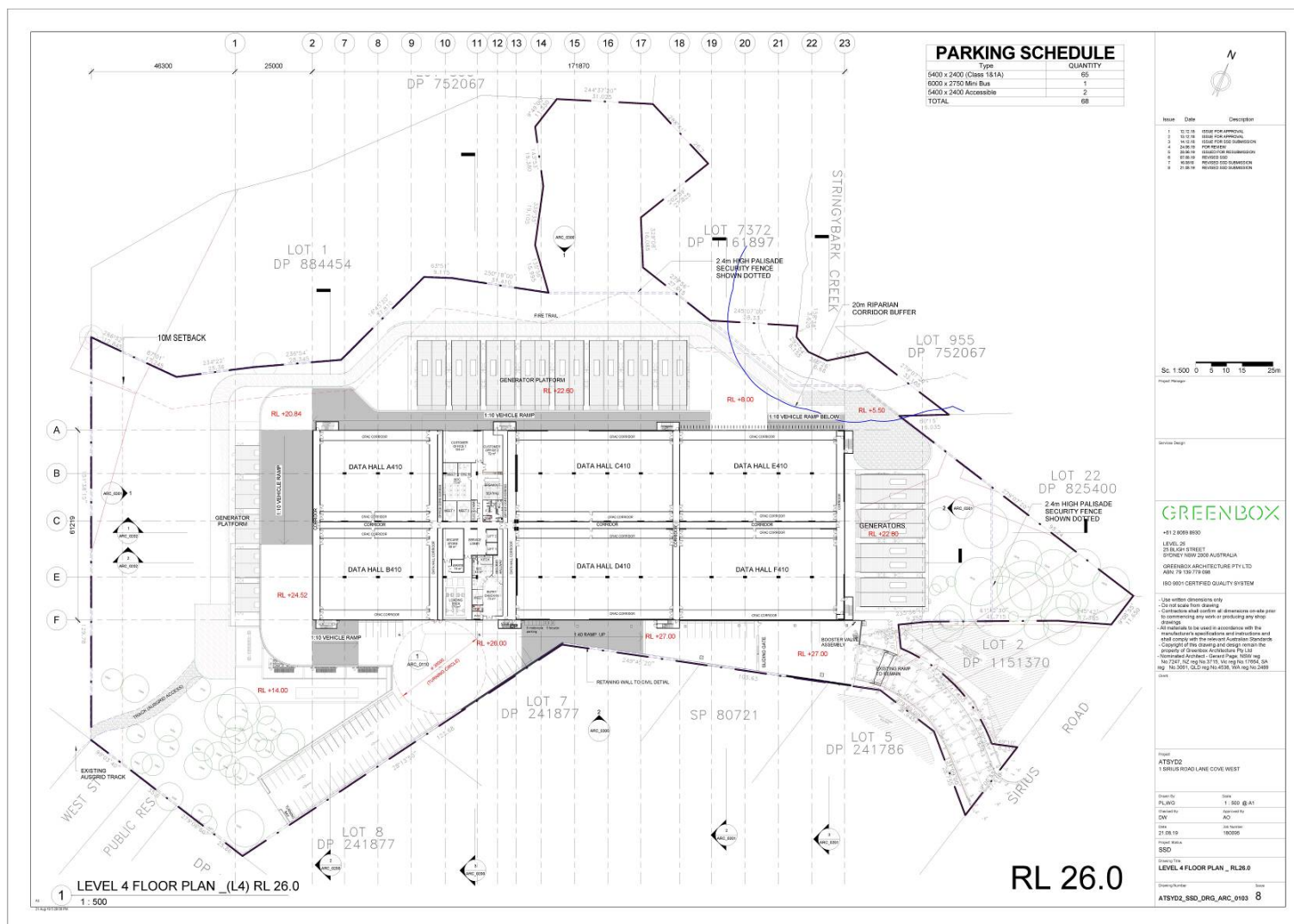




**Figure 1.3 – Level 2 floor plan**  
(source: Greenbox, dated 21.08.2019, drawing no. ATSYD02\_SSD\_DRG\_ARC\_0101 Issue 8)

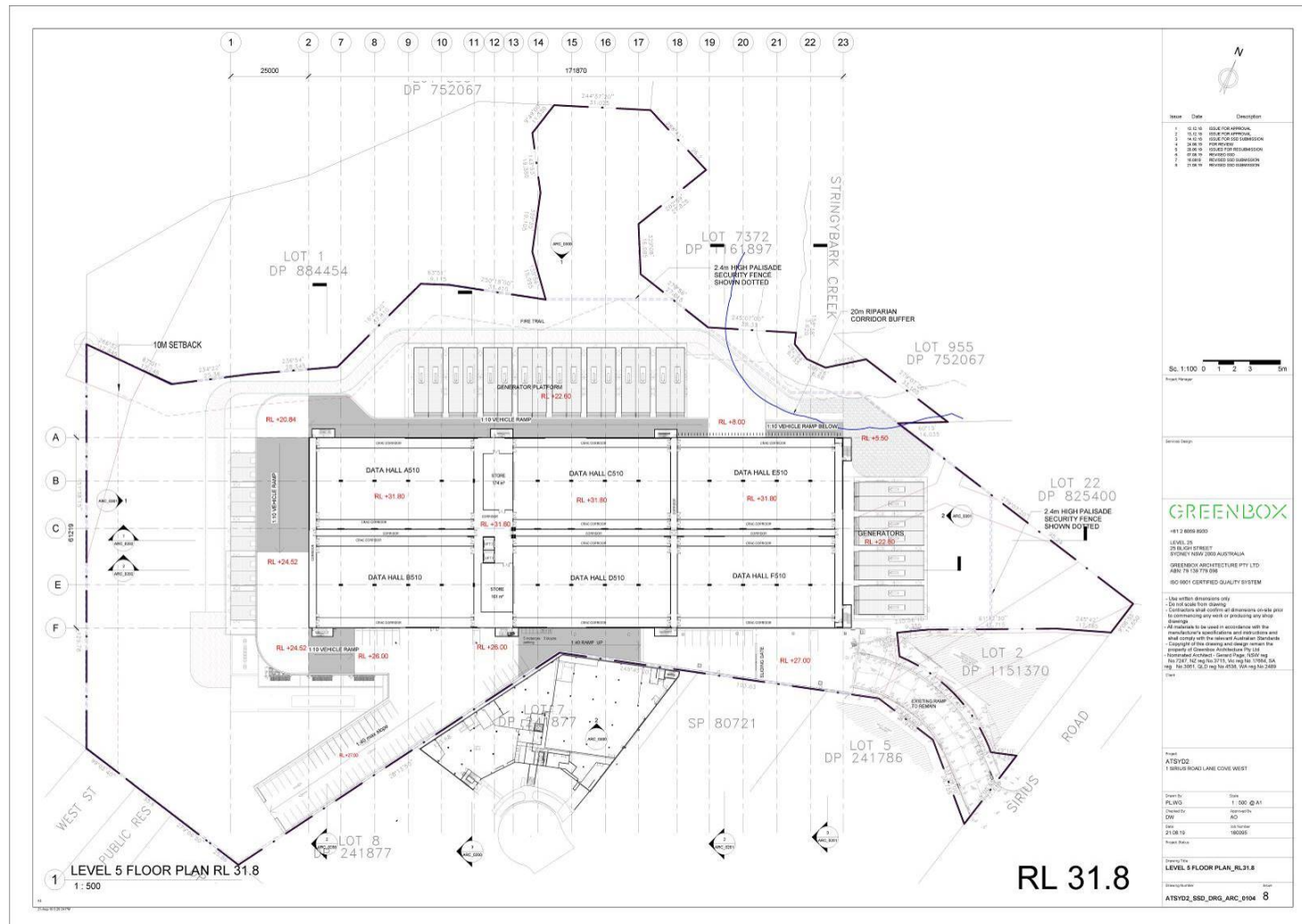


**Figure 1.4 – Level 3 floor plan**  
(source: Greenbox, dated 21.08.2019, drawing no. ATSYD02\_SSD\_DRG\_ARC\_0102 Issue 8)



**Figure 1.5 – Level 4 floor plan**  
(source: Greenbox, dated 21.08.2019, drawing no. ATSYD02\_SSD\_DRG\_ARC\_0103 Issue 8)





**Figure 1.6 – Level 5 floor plan**  
(source: Greenbox, dated 21.08.2019, drawing no. ATSYD02\_SSD\_DRG\_ARC\_0104 Issue 8)





## 1.4 Information collation

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

- NSW RFS conditions of consent issued 3/3/2019 (NSW RFS Ref: D18/8341)
- Request for Secretary's Environmental Assessment Requirements – Proposed Data Centre prepared by *Willow Tree Planning*, dated 19 November 2018
- Tree Impact Assessment Report prepared by *Travers bushfire & ecology*, dated August 2019
- Vegetation Management Plan prepared by *Travers bushfire & ecology*, dated August 2019
- Masterplan, level and elevation plans prepared by *GreenBox Architecture Pty Ltd*, Job number 180095 dated 21.08.2019
- Site detail and contour plan prepared by *Strata Survey*, ref 1833det-03, dated 08/07/2005
- *NearMap* aerial photography
- Topographical maps DLPI of NSW 1:25,000
- *Australian Standard 3959 Construction of buildings in bushfire-prone areas (AS3959)*
- *Planning for Bush Fire Protection (PBP) 2006 (RFS)*.

An inspection of the proposed development site and surrounds was undertaken by Nicole van Dorst to assess the topography, slopes, aspect, drainage, vegetation and adjoining land use. The identification of existing bushfire measures and a visual appraisal of bushfire hazard and risk were also undertaken.

## 1.5 Site description

The subject site is located within the Lane Cove Light Industrial Area, to the west of Sirius Road and east of Lane Cove River / Lane Cove National Park, within the local government area (LGA) of Lane Cove.

The site, formally identified as Lot 1 DP 1151370, is currently undeveloped and is interspersed with vegetation and rocky outcrops. The site is adjoined to the north-west, north-east and south-west by a mixture of forest, remnant forested wetland and grassland vegetation, with saline wetland and mangroves (associated with Lane Cove River) providing a fire break (>100m) from further vegetation to the west and north.

Existing access to the site is provided via Sirius Road to the east. It is also noted that an electricity transmission tower is located within close proximity to the site with overhead power lines running in a north to south direction adjacent to the western site boundary.



**Figure 1.8 – Aerial appraisal**  
(source: NearMap, 2018)

## **1.6 Legislation and planning instruments**

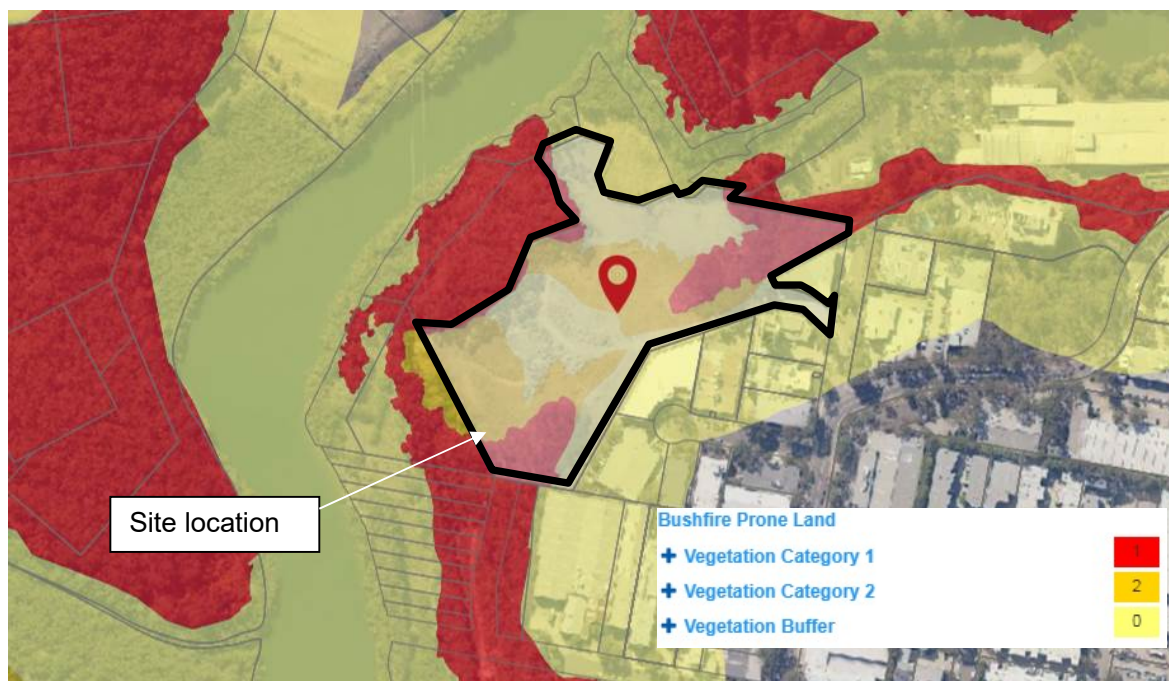
### **1.6.1 Environmental Planning and Assessment Act (EP&A Act)**

The *EP&A Act* governs environmental and land use planning and assessment within New South Wales. It provides for the establishment of environmental planning instruments, development controls and the operation of construction controls through the *BCA*.

The proposed development is considered an SSD. As a result, DPE is responsible for assessing the development application, with the Minister for Planning being the consent authority. The SSD is exempt from requiring a bushfire safety authority (BSA) and is not required to be assessed under s4.14 of the *EP&A Act*.

### **1.6.2 Bushfire prone land**

Bushfire prone land maps provide a trigger for the development assessment provisions. The proposed development is located on land that is mapped by *Lane Cove Council* as being bushfire prone (refer Figure 1.9).



**Figure 1.9 – Bushfire prone land map**  
 (source: Planning Portal, 2018)

### **1.6.3 Lane Cove Local Environmental Plan 2009**

A LEP provides for a range of zonings which list development that is permissible or not permissible, as well as the objectives for development within a zone.

The site is zoned according to the Lane Cove Local Environmental Plan 2009 as IN2 Light Industrial (refer Figure 1.10).



**Figure 1.10 – Bushfire prone land map**  
(source: Planning Portal, 2018)

The proposal, including the provision of APZs, would seek to comply with the objectives of the proposal.

#### **1.6.4 Planning for Bush Fire Protection (PBP) 2006**

Bushfire protection planning requires the consideration of the RFS planning document entitled *PBP*. *PBP* provides planning controls for building in bushfire prone areas as well as guidance on effective bushfire protection measures.

*PBP* outlines the bushfire protection measures required to be assessed for new development in bushfire prone areas. The range of bushfire protection measures include:

- asset protection zones (APZs);
- building construction and design;
- access arrangements;
- water supply and utilities;
- landscaping; and
- emergency management arrangements.

*PBP* stipulates that applications that are not residential / rural subdivision, SFPPs or residential infill should:

- note the range of available bushfire protection measures (refer dot points above)
- satisfy the aims and objectives of *PBP*; and
- propose an appropriate combination of bushfire protection measures, with evidence that the intent of each measure (with reference to Sections 4.1.3 and 4.2.7 of *PBP*) is satisfied (refer Section 3 below).



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

The *BCA* is given effect through the *EP&A Act* and forms part of the regulatory environment of construction standards and building controls. The *BCA* outlines objectives, functional statements, performance requirements and deemed to satisfy provisions.

In NSW, the construction of buildings in bushfire prone areas relates to Classes 1, 2, 3, 4 and Class 9 buildings that are a special fire protection purpose (SFPP) or a Class 10a building or deck associated with the aforementioned building classes. The design and construction manual for the deemed to satisfy requirements is the *Australian Standard AS3959 Construction of buildings in bushfire-prone areas 2009 (AS3959)*. These classes of buildings must therefore be constructed in accordance with *AS3959*.

The *BCA* does not provide for any bushfire specific performance requirements for commercial and industrial buildings (Classes 5–8) and, as such, *AS3959* does not apply as a set of deemed to satisfy provisions. The general fire safety construction provisions are taken as acceptable solutions.

## **1.7 Environmental and cultural constraints**

### **1.7.1 Environmental**

*Travers bushfire & ecology* prepared a Tree Impact Assessment Report and Vegetation Management Plan for the proposal.

These reports recommend revegetation within areas outside of the APZ, as well as rehabilitation of the riparian corridor (20m buffer) to the north-east of the development.

### **1.7.2 Cultural**

A basic search was conducted on the Aboriginal Heritage Information System (AHIMS). The results show that there are no identified Aboriginal sites of significance within Lot 1 DP 1151370, or within 50m of the site.



# Bushfire Threat Assessment

## 2

Bushfire protection planning requires the consideration of the RFS planning document entitled *Planning for Bush Fire Protection 2006 (PBP)*. *PBP* provides planning controls for building in bushfire prone areas, as well as guidance on effective bushfire protection measures.

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

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

Development in bushfire prone areas requires consideration of the overall threat upon a site and the way occupants of a site are potentially able to cope in the event of a bushfire.

To assess the bushfire threat that is likely to occur and thus affect the subject site, a review of the elements that comprise the overall threat needs to be completed. These elements include the potential hazardous landscape that may affect the site, the subsequent extent of the bushfire risk and the expected level of vulnerability that is likely to affect occupants and / or fire fighters.

### 2.1 Hazardous fuels

*PBP* guidelines require the identification of the predominant vegetation formation in accordance with David Keith (2004) to determine APZ distances. The hazardous vegetation is calculated for a distance of at least 140m from a proposed building envelope.

The hazardous vegetation within 140m of the proposed data centre development consists of:

- Dry sclerophyll forest to the south-west (refer Photos 1 & 2), north-west (refer Photo 3) & north-east (Photo 4)
- Forested wetland located to the west (refer Photo 5)
- Remnant / exotic vegetation located to the north-east (refer Photo 6).



- Grassland to the north (refer Photo 7). This area has been identified as contaminated. The area is proposed to be planted with grass / low shrubs less than 2m high.

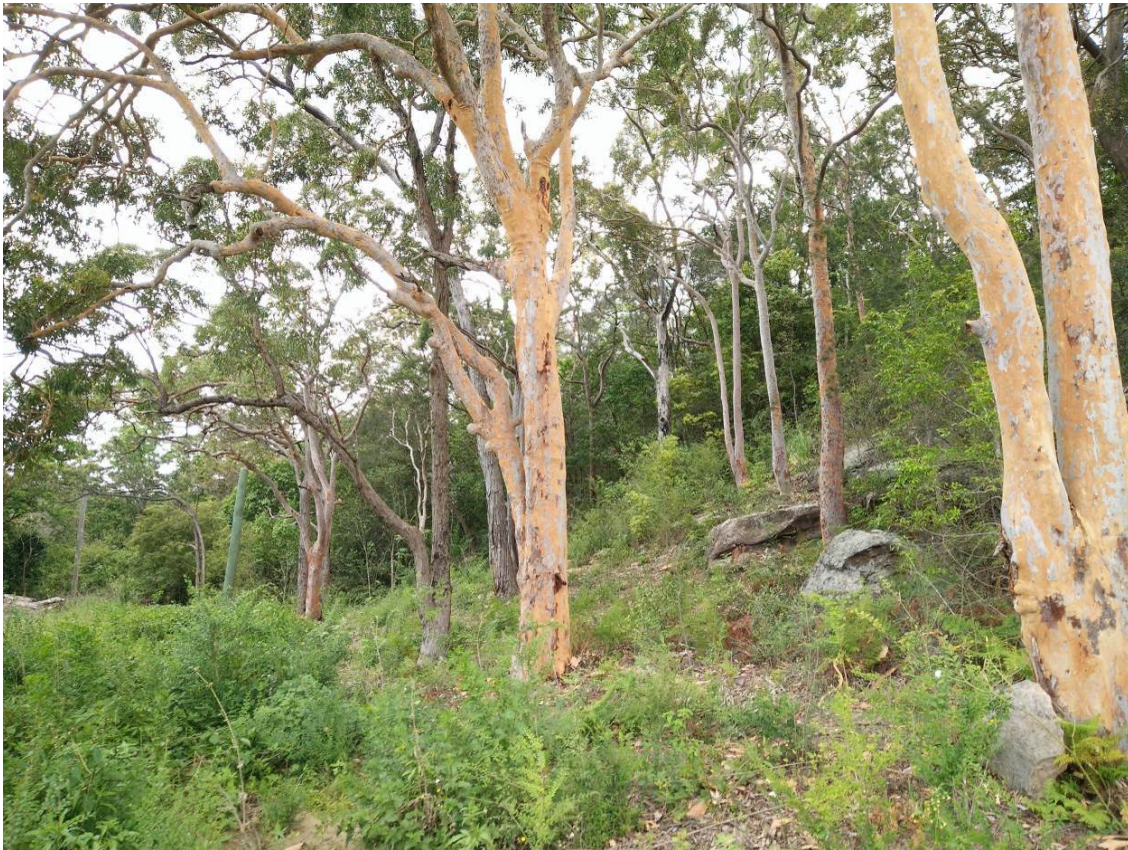


**Photos 1 & 2 – Forest vegetation located to the south-west**





**Photo 3** – Forest to the north-west (left of photo)



**Photo 4** – Forest to the north-east





**Photo 5**–Forested wetland located to the west



**Photo 6**– Remnant / exotic vegetation to the north-east





**Photo 7**– Grassland to the north (proposed to be revegetated to a low shrubland)

The saline wetland and mangrove swamps associated with Lane Cover River are not mapped as bushfire prone and are unable to sustain a fire, therefore effectively providing a fire break and limiting fire run potential.

## **2.2 Effective slope**

The effective slope is assessed for a distance of up to 100m. Effective slope refers to that slope which provides the most effect upon likely fire behaviour.

The effective slope within the hazardous vegetation is:

- 0-5 degrees cross slope within the forest to the south-west;
- 5 – 10 degrees downslope within the forested wetland to the west;
- 5 – 10 degrees downslope within the forest to the north;
- 0- 5 degrees within the proposed planted shrubland to the north;
- 0- 5 degrees downslope within the remnant / exotic vegetation to the north-east; and
- 0- 5 degrees cross slope within the forest to the east.

## **2.3 Bushfire attack assessment**

A fire danger index (FDI) of 100 has been used to calculate bushfire behaviour on the site based on its location within the Greater Sydney region. Table 2.1 provides a summary of the bushfire attack assessment.

Note: There are no predetermined minimum APZ requirements for industrial / warehouse development under *PBP*. The distances provided in Column 5 (of Table 2.1), coupled with the provision of access and fire trails will provide appropriate defendable space for the data centre. The defendable space is designed to allow fire fighters room and safety to fight fires. Setbacks depicted in bold (column 5) represents potential flame contact on the building / platform.

**Table 2.1 – Bushfire attack assessment**

Aspect	Vegetation formation within 140m of development	Effective slope of land	Calculated flame length	Setback provided (metres)
<b>Data hall</b>				
South	Managed land / industrial development	N/A	N/A	N/A
South-west	Forest	0-5 <sup>0D</sup>	25.2m flame length	60
West	Forested wetland	5-10 <sup>0D</sup>	25.72 flame length	61
North	Forest	5-10 <sup>0D</sup>	<b>34.1m flame length</b>	<b>22</b>
	Short heath	0-5 <sup>0D</sup>	9.07 flame length	44
	Remnant / exotic vegetation (refer Note 1)	4.5 <sup>0D</sup>	9.7m flame length	14
East	Forest	0-5 <sup>0D</sup> Cross slope	25.2m flame length	51
<b>Substation</b>				
South	Forest	0-5 <sup>0D</sup>	25.2m flame length	33
West	Forested wetland	5-10 <sup>0D</sup>	25.72 flame length	36
North & east	Managed land / industrial development	N/A	N/A	>100
<b>Generator Platform 1</b>				
West	Forested wetland	5-10 <sup>0D</sup>	25.72 flame length	36
North	Forest	5-10 <sup>0D</sup>	<b>34.1m flame length</b>	<b>25</b>
<b>Generator Platform 2</b>				
North	Forest	5-10 <sup>0D</sup>	<b>34.1m flame length</b>	<b>20</b>
	Short heath	0-5 <sup>0D</sup>	9.07 flame length	16
East	Remnant / exotic vegetation (refer Note 1)	4.5 <sup>0D</sup>	9.7 flame length	10
<b>Generator Platform 3</b>				
North	Remnant / exotic vegetation (refer Note 1)	4.5 <sup>0D</sup>	9.7 flame length	10

Aspect	Vegetation formation within 140m of development	Effective slope of land	Calculated flame length	Setback provided (metres)
East	Forest	0-5 <sup>0D</sup> Cross slope	25.2m flame length	25

Notes: \* Slope is either 'U' meaning up slope or 'C' meaning cross slope or 'D' meaning down slope

**Note 1:** *Community Resilience Fast Fact 2/08* outlines the requirements for the assessment of exotic vegetation. The vegetation to the north-east is dominated by woody weeds, lantana and privet, (i.e. >70% canopy cover) and therefore the corresponding vegetation type is 'rainforest'. As a result, the threat posed is considered low and APZ setbacks for this aspect are the same as for the rainforest category outlined in *PBP*.





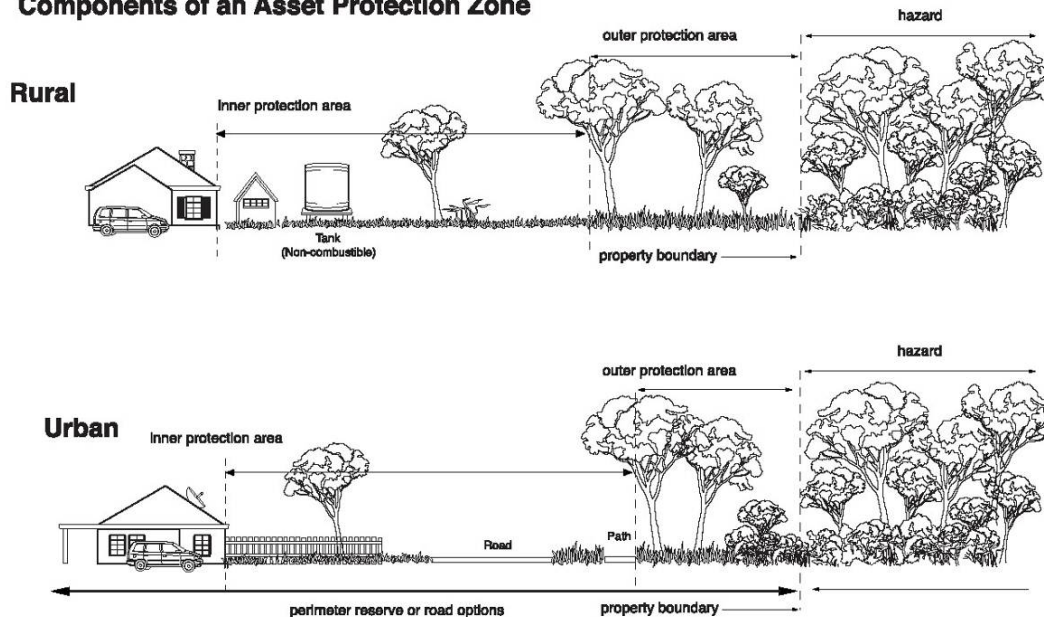
# Specific Protection Issues

## 3

### 3.1 Asset protection zones

APZs are areas of defensible space separating hazardous vegetation from buildings. The APZ generally consists of two subordinate areas, an inner protection area (IPA) and an outer protection area (OPA). The OPA is closest to the bush and the IPA is closest to the building. A typical APZ and therefore defensible space is graphically represented below:

#### Components of an Asset Protection Zone



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

**Note:** Vegetation management as shown is for illustrative purposes only. Specific advice is to be sought regarding vegetation removal and retention from a qualified and experienced expert to ensure APZs comply with the *RFS* performance criteria.

The APZs provided for the commercial development are to comply with the aims and objectives of *PBP*. These include:

1. Afford occupants of any building adequate protection from exposure to a bushfire.
2. Provide for a defensible space to be located around buildings.
3. Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition.
4. Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the APZ.

In accordance with *PBP*, appropriate defensible space, coupled with the provision of access and building construction requirements has been provided to comply with the aims and

objectives listed above, which include providing occupants with adequate protection from bushfire and upgrade in building construction to prevent material ignition.

Table 3.1 outlines the proposal's compliance with the performance criteria for APZs.

**Table 3.1 – Performance criteria for asset protection zones (*PBP* guidelines pg. 19)**

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
Radiant heat levels at any point on a proposed building will not exceed 29kW/m <sup>2</sup>	APZs are provided in accordance with Appendix 2.  APZs are wholly within the boundary of the development site.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Refer Section 2.3. Whilst radiant heat level exposure on the data hall and generator platforms exceeds 29kW/m <sup>2</sup> a defensible space has been provided for fire fighting operations and the data centre building and generator platforms will be constructed to withstand flame attack.
APZs are managed and maintained to prevent the spread of fire towards the building.	In accordance with the requirements of <i>Standards for Asset Protection Zones</i> (RFS 2005).	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The APZ consists of landscaped areas, roads and turf areas.
APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is negated.	The APZ is located on lands with a slope of less than 18°	<input type="checkbox"/>	<input checked="" type="checkbox"/>	APZs are located on slopes exceeding 18°. Refer Note 1 below.

**Note 1** - APZs on steep land. The APZ does encroach upon land with slopes >18 degrees. In accordance with the acceptable solutions under *PBP*, APZs are to be avoided where slopes are greater than 18 degrees due to potential problems and practicality associated with maintenance and the potential for crown fires to develop.

The impact of crown fires developing and impacting the development is negated by the angle of the slope and potential fire run which will direct fire intensity away from the development. In addition, the area earmarked for APZ management is restricted (for the most part) to rocky escarpments that do not require the removal of tree species.

In terms of the practicality and soil stability, this is negated by the rock benches (particularly in the south) which provide a natural terrace therefore preventing soil erosion. It is recommended however that a geo-technical report is prepared for the steep APZ areas where they exceed 18 degrees to ensure site stability.

Generally, maintenance of the APZ within the steep land (>18 degrees) will be undertaken using hand machinery only. Tree removal on slopes of >18 degrees would be subject to the geotechnical report, but it is assumed the sandstone geological landscape can be protected by suitable treatments recommended in their report. At this stage, it is to be assumed that stability can be provided and APZ management can go ahead as planned. Typically in the APZ tree canopies should be separated by 2-5m.

### 3.2 Building protection

The BCA does not provide any bushfire specific requirements for Classes 5-8 industrial / buildings. The general fire safety construction provisions are taken as acceptable solutions.

*PBP* recommends that bushfire construction standards for Classes 5-8 buildings should be considered on a case by case basis. Bushfire construction recommendations are dependent on the level of bushfire risk and the provision of adequate access opportunities.

Whilst the bushfire risk is reduced by the presence of saline wetland and the Lane Cove River, the proposed size of the data centre, limited setbacks and high commercial / economical risk associated with the development does necessitate that additional bushfire protection measures are incorporated into the building design to prevent material ignition via the following measures;

- The data centre will be constructed using concrete and will comply with BAL FZ & 40 as outlined in *AS3959 (2009) – Construction of buildings in bushfire prone areas*.
- The substation (southern portion of site) is to comply with BAL 29 for all facades.
- Service openings will be screened with a metal mesh (aperture of 2mm). This may impact on required airflow quantities and should therefore be engineered to ensure efficiency.
- Fire exits and stairs in flame zone areas are to be enclosed with fire rated doors and seals.
- The generator platforms are not enclosed. The equipment is provided over the three (3) levels on generator platforms 2 & 3 and over two (2) levels on generator platform 1. The proposed generators and diesel fuel tanks will be constructed using non-combustible materials and will be housed within a non-combustible structure. In addition, radiant heat shields will be provided to prevent flame contact and reduce radiant heat exposure on the structures / machinery.

### 3.3 Hazard management

The APZ consists of car parking and road access as well as landscaped areas. The APZ is to be managed in accordance with RFS guidelines *Standards for Asset Protection Zones* (RFS, 2005) with landscaping to comply with Appendix 5 of *PBP*. A summary of the guidelines for managing APZs is attached as Appendix 1 to this report.

The APZ is situated on slopes exceeding 18 degrees. In terms of the practicality and soil stability, this is negated by the rock benches (particularly in the south) which provides a natural terrace therefore preventing soil erosion. It is recommended however that a geo-technical report is prepared for the APZ areas to ensure site stability.

### 3.4 Access for firefighting operations

Access to the development will be provided via Sirius Road in the east with staff car parking provided within the southern portion of the site. An internal road network will be constructed to provide vehicular access to both the southern and northern building façades, terminating in the north-east. This road is greater than 6.5m wide.

Additional emergency egress points for firefighting operations will be provided via a 4m wide fire trail which runs parallel to the northern building façade. Fire trails will provide access to the eastern and western building facades, with the western trail also servicing the electrical transmission tower external to the site's western boundary. This trail will terminate with a 'T-turning' or 'Y-turning' head. Roof access will also be available for firefighting services in the event of an emergency, with enclosed concrete stairs permitting safe egress / exit routes

located towards Sirius Road. The proposed access complies with the aims and objectives of *PBP*.

The proposed property access road, in compliance with the acceptable solutions outlined in Section 4.1.3 (2), is outlined in the table below.

**Table 3.2 – Performance criteria for public roads (*PBP* guidelines pg. 22)**

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
Access to properties is provided in recognition of the risk to fire fighters and / or evacuating occupants.	At least one alternative property access road is provided for individual dwellings (or groups of dwellings) that are located more than 200m from a public through road.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Site constraints prevent an additional access road being provided. The property access road provides safe egress to the south and away from the direct impact of bushfire.
The capacity of road surfaces and bridges is enough to carry fully loaded fire fighting vehicles.	Bridges clearly indicate load rating and pavements and bridges are capable of carrying a load of 15 tonnes.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The proposed suspended road is to comply with this requirement.
All weather access is provided.	Roads do not traverse a wetland or other land potentially subject to periodic inundation (other than a flood or storm surge).	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The road does not traverse a wetland.
Road widths and design enable safe access for vehicles.	A minimum carriageway width of 4m for dwellings with a distance of greater than 70m from the nearest hydrant point to the most external part of a proposed building.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies. The road with is greater than 4m.
	In forest, woodland and heath situations, rural property access roads have passing bays every 200m that are 20m long x 2m wide (min. width 6m).	<input checked="" type="checkbox"/>	<input type="checkbox"/>	N/A
	A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be a condition of consent.
	Internal roads for rural properties provide a loop road around any dwelling or incorporate a turning circle with a minimum outer radius of 12m.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	N/A
	Curves have a minimum inner radius of 6m and are minimal in number to allow rapid access / egress.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be a condition of consent.
	The minimum distance between inner and outer curves is 6m.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
	The cross fall is not more than 10°.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	Maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

**Table 3.3 – Performance criteria for fire trails**

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
The width and design of the fire trails enables safe and ready access for fire fighting vehicles.	A minimum carriageway width of 4m with an additional 1m strip on each side of the trail clear of bushes and long grass.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The fire trail will comply with this requirement.
	Sealed trails have a maximum grade of 15° and not more than 10° for unsealed roads.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Grades do not exceed 15 degrees.
	A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The fire trail will comply with this requirement.
	The cross fall of the trail is not more than 10°.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Cross fall does not exceed 10 degrees
	The trail has the capacity for passing by: <ul style="list-style-type: none"> <li>reversing bays using the access to properties to reverse fire tankers, which are 6m wide &amp; 8m deep to any gates, with a minimum turning radius of 6m and outer minimum radius of 12m and / or</li> <li>a passing bay every 200m, 20m long x 3m wide, making a minimum trafficable width of 7m at the passing bay.</li> </ul>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies. Turning heads have been provided to allow for Category 1 tanker access and manoeuvring to allow for a three-point turn.
Fire trails are trafficable under all weather conditions. Where the fire trail joins a public road, access shall be controlled to prevent use by unauthorised persons.	The fire trail is accessible to fire fighters and maintained in a serviceable condition by the owner of the land.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be a condition of consent.
	Appropriate drainage and erosion controls are provided.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be a condition of consent.
	The fire trail system is connected to the property access road and / or through road system at intervals of at least 200m.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies.
	Fire trails do not traverse a wetland or other land subject to periodic inundation (other than a flood or storm surge).	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies
	Gates for fire trails are provided and locked with a key / lock system authorised by the local RFS.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
Fire trails designed to prevent weed infestation, soil erosion and other land degradation.	Fire trail design does not adversely impact on natural hydrological flows.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies
	Fire trail design acts as an effective barrier to the spread of weeds and nutrients.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies
	Fire trail construction does not expose acid-sulphate soils.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Complies

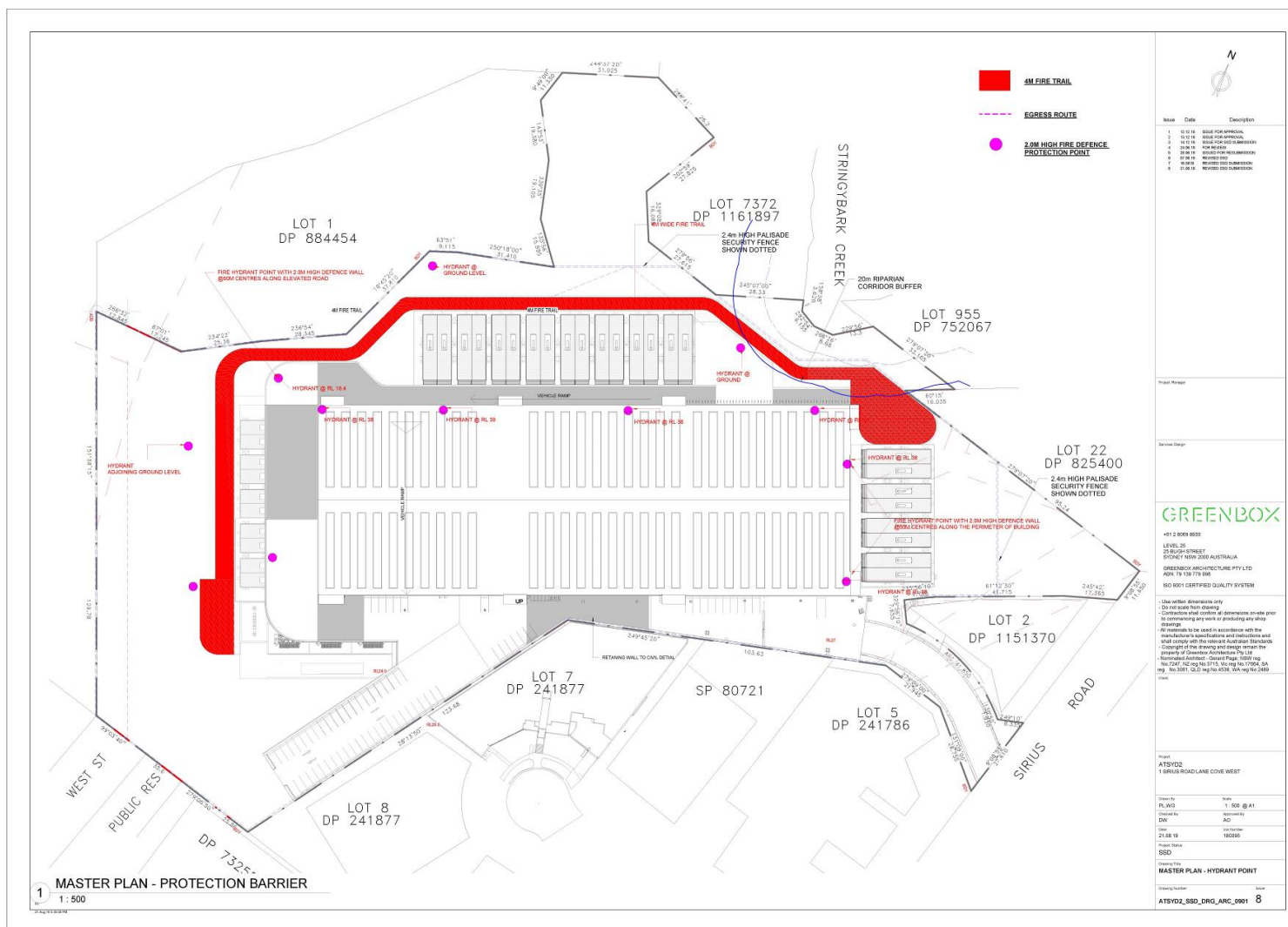
### 3.5 Water supplies

Town reticulated water supply is available to the development in the form of an underground reticulated water system. As depicted in Figure 3.1 hydrants will be located along the internal road, fire trails and on the roof which will also offer access points for firefighting operations. Hydrant points on roof and along road (in flame zone locations) are provided with a 2m high defence wall (via concrete parapet extension) at 60m centres along the perimeter of the building to provide safety for fire fighters. Proposed internal hydrants are to comply with *PBP*. The acceptable solutions are:

**Table 3.4 – Performance criteria for reticulated water supplies (*PBP* guidelines pg. 27)**

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
Water supplies are easily accessible and located at regular intervals.	Reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be made a condition of consent.
	Fire hydrant spacing, sizing and pressures comply with <i>AS2419.1</i> . Where this cannot be met, the RFS will require a test report of the water pressures anticipated by the relevant water supply authority, once development has been completed. In such cases, the location, number and sizing of hydrants shall be determined using fire engineering principles.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be made a condition of consent.
	Hydrants are not located within any road carriageway	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be made a condition of consent.
	All above ground water and gas service pipes external to the building are metal, including and up to any taps.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be made a condition of consent.
	The provisions of public roads are met.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hydrants will be located outside of parking bays.





### 3.6 Gas supply

There is no intended gas supply for the project.

### 3.7 Electricity

Table 3.5 outlines the required performance criteria for the site's electricity supply.

**Table 3.5 – Performance criteria for electricity services (PBP guidelines pg. 27)**

Performance criteria	Acceptable Solutions	Acceptable solution	Performance solution	Comment
Location of electricity services limit the possibility of ignition of surrounding bushland or the fabric of buildings	Where practicable, electrical transmission lines are underground	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be made a condition of consent.
Regular inspection of lines in undertaken to ensure they are not fouled by branches.	Where overhead electrical transmission lines are proposed: <ul style="list-style-type: none"> <li>• Lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas: and</li> <li>• No part of a tree is closer to a power line than the distance set out in accordance with the specification in <i>Vegetation Safety Clearances</i> issued by <i>Energy Australia</i> (NS179, April 2002)</li> </ul>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Can be made a condition of consent.

### 3.8 Emergency and evacuation planning

PBP does not require the preparation of evacuation plans for industrial, warehouse developments. However, due to the bushfire risk posed to the site and the potential economic impact on the data centre if bushfire were to affect its operations it is recommended that an evacuation plan is prepared. This will outline the procedures and triggers for evacuation and the contact details for the emergency services.

Table 3.6 outlines the required performance criteria for the proposal's emergency procedures

**Table 3.6 – Performance criteria for emergency and evacuation planning (PBP guidelines pg.39)**

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



# Conclusion & Recommendations

## 4

### 4.1 Conclusion

An addendum bushfire protection assessment has been prepared to address the revised scheme for the data centre within Lot 1 DP 1151370, No. 1 Sirius Road, Lane Cove West.

Whilst the proposed development has the potential to be affected by flame contact, the structural design and materials proposed will reduce the bushfire risk posed to the development. However, there can be no guarantee that the shielding will be effective to the extent that the land use could be compromised. In this case, it is imperative that APZ management has a 'critical path' approach to its ongoing maintenance and annual auditing of its compliance. Failure to apply this will render the development subject to unplanned impact from flame, radiant heat and ember attack

This assessment has concluded that the proposed development will provide compliance with the aims and objectives of *PBP*, with the implementation of the following combination of bushfire protection measures:

- The new data centre building will comply with *AS3959 (2009) Construction of buildings in bushfire prone areas (BAL FZ & BAL 40)*. Whilst this standard generally does not apply to industrial development, it has been used in this instance due to the high economical risk associated with the development and need for the data centre to maintain operation during potential bushfire events.
- The proposed generators and diesel fuel tanks will be constructed using non-combustible materials and will be housed within a non-combustible structure. In addition, radiant heat shields will be provided to prevent flame contact and reduce radiant heat exposure on the structures / machinery.
- Management of the vegetation surrounding the building to ensure the new building is provided with APZs and a defendable space for firefighting operations.
- Provision of a fire trail to ensure firefighting access along the northern boundary and to the east and west of the site. This will also provide access to the electrical easement adjoining the site to the west.
- Provision of firefighting access to the roof with hydrants located at strategic locations (refer Figure 3.1).
- Hydrant points on roof and along road (in flame zone locations) are provided with a 2m high defence wall (via concrete parapet extension) at 60m centres along the perimeter of the building to provide safety for fire fighters.
- Preparation of a bushfire emergency evacuation plan to address the bushfire risk and to outline procedures to follow during a bushfire event. This will include the

establishment of an emergency planning committee responsible for implementing evacuation procedures.

The following recommendations are to apply to the development:

**Recommendation 1** - At the commencement of building works and in perpetuity, the area around the proposed buildings shall be managed as an inner protection area (IPA) as depicted in Schedule 1 – Bushfire Protection Measures (ref: 18AWE02\_BF001) dated 8/8/2019 prepared by *Travers bushfire & ecology* and as outlined within Section 4.1.3 and Appendix 5 of *PBP 2006* and the NSW Rural Fire Service's *Standards for asset protection zones as follows*;

- north-east: IPA for a distance of 25m (residue of site located towards the north-east to be revegetated to a riparian corridor);
- south-west: IPA for a distance of 33m;
- south: IPA for a distance of 36m: and,
- north: IPA for a distance of 16-22m.

**Recommendation 2** – The provision of water, electricity and gas shall comply with Section 4.1.3 of *PBP 2006*.

**Recommendation 3** – The proposed property access road (driveway) shall comply with Section 4.1.3 (2) of *PBP 2006*.

**Recommendation 4** – Fire trails shall comply with the performance criteria outlined in section 4.1.3 (3) of *PBP 2006*.

**Recommendation 5** – Arrangements for emergency and evacuation are to comply with Section 4.2.7 of *PBP 2006*, including the preparation of an emergency/ evacuation plan consistent with the NSW RFS document titled *Guidelines for the Preparation of Emergency / Evacuation Plan*

**Recommendation 6** – Construction of the proposed data hall's southern and eastern elevation shall comply with Sections 3 & 8 (BAL 40) of *AS3959 – 2009* or *NASH Standard – 2014* as appropriate and section A3.7 Addendum Appendix 3 of *PBP 2006*.

**Recommendation 7** – Construction of the proposed data halls northern and western elevations and roofing shall comply with Section's 3 & 9 (BAL FZ) of *AS3959 – 2009* or *NASH Standard – 2014* as appropriate. Except for windows, flaming of the specimen is not permitted and there shall be no exposed timber.

**Recommendation 8** – Construction of the proposed substation shall comply with Sections 3 & 7 (BAL 29) of *AS3959 – 2009* or *NASH Standard – 2014* as appropriate.

**Recommendation 9** – Construction of the proposed generator platforms shall comply with Sections 3 & 9 (BAL FZ) of *AS3959 – 2009* or *NASH Standard – 2014* as appropriate. Except for windows, flaming of the specimen is not permitted and there shall be no exposed timber.

**Recommendation 10** – Radiant heat shields are to be provided to the generator platforms to prevent flame contact and reduce radiant heat exposure on the structures / machinery.

**Recommendation 11** – Landscaping to the site is to comply with the principles of Appendix 5 of *PBP 2006*.

## REFERENCES

- Australian Building Codes Board (2010) – *Building Code of Australia*, Class 1 and Class 10 Buildings Housing Provisions Volume 2
- Chan, K.W. (2001) – *The suitability of the use of various treated timbers for building constructions in bushfire prone areas*. Warrington Fire Research
- Councils of Standards Australia AS3959 (2009) – *Australian Standard Construction of buildings in bush fire-prone areas*
- Keith, David (2004) – *Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT*. The Department of Environment and Climate Change
- Rural Fire Service (2006) - *Planning for bushfire protection – a guide for councils, planners, fire authorities and developers*. NSW Rural Fire Service
- Rural Fire Service (2006) - Bushfire Attack Software on RFS web site
- Tan, B., Midgley, S., Douglas, G. and Short (2004) - *A methodology for assessing bushfire attack*. RFS Development Control Service





# Plan of Bushfire Protection Measures

S1





DISCLAIMER: ARC\_0104-LEVEL 5 FLOOR PLAN\_RL31.8\_DWG\_[8]-1.0.dwg is not georeferenced. It has been aligned to other, georeferenced CAD linework relating to this project. Verification by a registered surveyor is required prior to finalisation.

**Legend**

- Subject site (source: CAD)
- Contour (1m) (source: LiDAR)
- Gate (existing)
- Hydrant (existing)
- Unformed road/ access to easement
- Walking track

**Proposed Infrastructure**

- Data hall
- Generator platform
- Substation
- GIS
- Oil spill tank
- Firetrail
- Access driveway

**Vegetation Formation**

- Forest
- Forested Wetland
- Saline Wetland (not bushfire prone)

**Riparian corridor**

- 20m buffer
- 40m buffer

**Asset Protection Zone (APZ)**

- Bushfire Construction Standards AS3959 (2009)\*
- Flame zone (FZ)
- BAL 40
- BAL 29

Aerial source: Nearmap

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  
1 Sirius Road, Lane Cove West  
18AWE02\_BF001

DATE & ISSUE NUMBER  
23/08/2019  
Issue 1  
AH

SCALE & COORDINATE SYSTEM  
1:1,500 @A3  
GDA 1994 MGA Zone 56

TITLE  
**Schedule 1 - Bushfire Protection Measures**  
Document Path: N:\GIS STORAGE\N Drive\18AWE02\_SiriusRd\_LaneCoveWest\MXD\18AWE02\_BF001.mxd







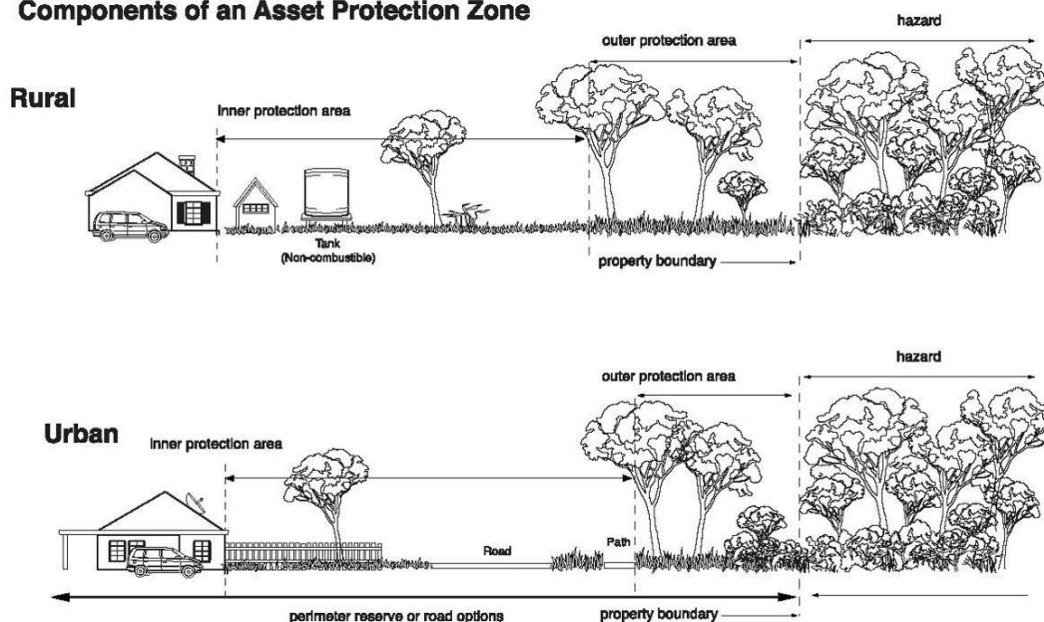
# Management of Asset Protection Zones

# A1

The RFS provides basic advice in respect of managing APZs through documents such as, *Standards for Asset Protection Zones* (RFS, 2005), with landscaping to comply with Appendix 5 of *PBP*.

The APZ generally consists of two subordinate areas, an inner protection area (IPA) and an outer protection area (OPA). The OPA is closest to the bush and the IPA is closest to the building. The property is to be managed to IPA standards only. A typical APZ is graphically represented below:

## Components of an Asset Protection Zone



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

**Note:** Vegetation management as shown is for illustrative purposes only. Specific advice is to be sought regarding vegetation removal and retention from a qualified and experienced expert to ensure APZs comply with the RFS performance criteria.

The following provides maintenance advice for vegetation within the IPA and OPA.

### Inner protection area (IPA)

Fuel loads within the IPA are to be maintained so it does not exceed 4t/ha.

Trees are to be maintained to ensure;

- Canopy cover does not exceed 15%
- Trees (at maturity) do not touch or overhang the building
- Tree canopies (at maturity) should be well spread out and not form a continuous canopy

- There should be no unmanaged vegetation within 10m of windows, doorways, eaves and gutters
- Lower limbs should be removed up to a height of 2m above ground

Shrubs are to be maintained to ensure;

- Large discontinuities or gaps in vegetation
- Shrubs should not be located under trees
- Shrubs should be in clumps no greater than 5m<sup>2</sup>
- Shrubs should be no closer than 10 metres from an exposed window or door.

Grass is to be maintained to ensure:

- A height of 10cm or less
- Leaves and debris are removed.



# Performance based assessment

# A2



Calculated August 8, 2019, 11:33 am (MDc v.4.8)

North - Forest

Minimum Distance Calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	4.78 km/h
Vegetation classification	Forest	Flame length	34.1 m
Surface fuel load	20 t/ha	Flame angle	49 °, 57 °, 63 °, 67 °, 69 ° & 78 °
Overall fuel load	25 t/ha	Elevation of receiver	12.86 m, 14.3 m, 15.19 m, 15.69 m, 15.91 m & 16.67 m
Vegetation height	n/a	Fire intensity	61,805 kW/m
Effective slope	10 °	Transmissivity	0.843, 0.8159999999999999, 0.785, 0.761, 0.75 & 0.694
Site slope	0 °	Viewfactor	0.6216, 0.4672, 0.3175, 0.2154, 0.1751 & 0.0472
Flame width	100 m	Minimum distance to < 40 kW/m <sup>2</sup>	27.00000000000011 m
Windspeed	n/a	Minimum distance to < 29 kW/m <sup>2</sup>	34.70000000000022 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m <sup>2</sup>	47.00000000000004 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m <sup>2</sup>	61.50000000000006 m
		Minimum distance to < 10 kW/m <sup>2</sup>	70.20000000000029 m

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 August 21, 2019, 10:30 am (MDC v.4.8)

**North - Remnant Forest**

Minimum Distance Calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	1.3 km/h
Vegetation classification	Rainforest	Flame length	9.710000000000001 m
Surface fuel load	8 t/ha	Flame angle	54 °, 64 °, 72 °, 77 °, 79 ° & 84 °
Overall fuel load	10 t/ha	Elevation of receiver	3.92 m, 4.36 m, 4.61 m, 4.73 m, 4.76 m & 4.82 m
Vegetation height	n/a	Fire intensity	6,765 kW/m
Effective slope	4.5 °	Transmissivity	0.881, 0.867, 0.847, 0.823, 0.8100000000000001 & 0.741
Site slope	0 °	Viewfactor	0.5918, 0.4363, 0.2947, 0.1992, 0.162 & 0.0442
Flame width	100 m	Minimum distance to < 40 kW/m <sup>2</sup>	8.199999999999987 m
Windspeed	n/a	Minimum distance to < 29 kW/m <sup>2</sup>	11.099999999999998 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m <sup>2</sup>	16.299999999999996 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m <sup>2</sup>	23.600000000000007 m
		Minimum distance to < 10 kW/m <sup>2</sup>	28.400000000000013 m

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 August 8, 2019, 2:42 pm (MDc v.4.8)

North - short heath

Minimum Distance Calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	4.04 km/h
Vegetation classification	Shrubland	Flame length	9.07 m
Surface fuel load	15 t/ha	Flame angle	54 °, 64 °, 72 °, 77 °, 79 ° & 84 °
Overall fuel load	15 t/ha	Elevation of receiver	3.66 m, 4.07 m, 4.31 m, 4.41 m, 4.45 m & 4.51 m
Vegetation height	m	Fire intensity	31,357 kW/m
Effective slope	5 °	Transmissivity	0.883, 0.869, 0.85, 0.827, 0.8139999999999999 & 0.744
Site slope	0 °	Viewfactor	0.5886, 0.4351, 0.2938, 0.1977, 0.1609 & 0.0441
Flame width	100 m	Minimum distance to < 40 kW/m <sup>2</sup>	7.699999999999999 m
Windspeed	45 km/h	Minimum distance to < 29 kW/m <sup>2</sup>	10.399999999999998 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m <sup>2</sup>	15.299999999999996 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m <sup>2</sup>	22.300000000000005 m
		Minimum distance to < 10 kW/m <sup>2</sup>	26.900000000000011 m

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 August 8, 2019, 11:47 am (MDC v.4.8)

South-west- Forest

Minimum Distance Calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	3.38 km/h
Vegetation classification	Forest	Flame length	25.02 m
Surface fuel load	20 t/ha	Flame angle	51 °, 60 °, 66 °, 70 °, 72 ° & 80 °
Overall fuel load	25 t/ha	Elevation of receiver	9.720000000000001 m, 10.83 m, 11.43 m, 11.75 m, 11.9 m & 12.32 m
Vegetation height	n/a	Fire intensity	43,771 kW/m
Effective slope	5 °	Transmissivity	0.855, 0.83, 0.8, 0.774, 0.763 & 0.707
Site slope	0 °	Viewfactor	0.6148, 0.4576, 0.3115, 0.2116, 0.1721 & 0.0464
Flame width	100 m	Minimum distance to < 40 kW/m <sup>2</sup>	20.20000000000002 m
Windspeed	n/a	Minimum distance to < 29 kW/m <sup>2</sup>	26.60000000000011 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m <sup>2</sup>	37.00000000000026 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m <sup>2</sup>	49.70000000000044 m
		Minimum distance to < 10 kW/m <sup>2</sup>	57.40000000000055 m

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 August 8, 2019, 11:27 am (MDc v.4.8)

**West - Forested Wetland**

Minimum Distance Calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	3.58 km/h
Vegetation classification	Forest	Flame length	25.72 m
Surface fuel load	15 t/ha	Flame angle	51 °, 60 °, 66 °, 70 °, 72 ° & 80 °
Overall fuel load	20 t/ha	Elevation of receiver	9.99 m, 11.13 m, 11.75 m, 12.08 m, 12.23 m & 12.66 m
Vegetation height	n/a	Fire intensity	37,083 kW/m
Effective slope	10 °	Transmissivity	0.854, 0.828, 0.799, 0.773, 0.761 & 0.706
Site slope	0 °	Viewfactor	0.6133, 0.4594, 0.3122, 0.2124, 0.1722 & 0.0464
Flame width	100 m	Minimum distance to < 40 kW/m <sup>2</sup>	20.80000000000003 m
Windspeed	n/a	Minimum distance to < 29 kW/m <sup>2</sup>	27.20000000000012 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m <sup>2</sup>	37.80000000000027 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m <sup>2</sup>	50.60000000000045 m
		Minimum distance to < 10 kW/m <sup>2</sup>	58.50000000000056 m

Rate of Spread - Mearthur, 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