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Fire Safety Strategy

Aspect Estate - Masterplan

Lots 1-5 DP1285305 Mamre Road, Kemps Creek

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Report Details

Project: Aspect Estate
Lots 1-5 DP1285305 Mamre Road, Kemps Creek
Document: Fire Safety Strategy
Report No.: F201262_Masterplan_FSS_11

Report Revision History

REV	DATE ISSUED	COMMENT	PREPARED BY	REVIEWED BY
01	09/01/2020	Draft Issue for comment	**Anson Lo** *BEng (Aerospace) (Hons)*	**Graham Morris** *MEng (Structural and Fire Safety)* *MIEAust, CPEng, NER (Fire Safety)*
02	02/06/2020	Revised for DA		
03	01/10/2020	Revised for updated masterplan for SSD DA		
04	16/10/2020	Revised for updated plans and comments		
05	28/01/2022	Revised for updated plans	**Christie Tran** *BEng (Mechanical)* *MEng (Fire Protection)*	
06	11/03/2022	Revised for updated plans (Mod 2)		
07	27/05/2022	Revised for updated plans (Mod 2)	**Dean Watt** *BEng (Chemical)(Hons)* *MEng (Fire Safety)*	
08	17/06/2022	Revised for updated plans (Mod 2)		
09	29/06/2022	Revised for design team comments		
10	29/07/2022	Revised for updated plans & renaming convention to Mod 3.		
11	19/08/2022	Revised for updated Lot and DP numbers		

DOCUMENT REVISION HISTORY

The following table summarises the changes incorporated in each revision of this report.

Report Revision History

REV	DATE ISSUED	COMMENT
05	28/01/2022	Updated issue to incorporate the following changes ('Mod 1'): • Relocation of Access Road 2 to the area located between Warehouse/Lot 1 and 2, and modifications to perimeter vehicular access. • Minor adjustment of Lots 1, 2 and 3. • Removal of café.
06	11/03/2022	Updated issue to incorporate the following changes ('Mod 2'): • Reconfiguration of the estate layout including reduction in overall lot/warehouses from 11 to 9. • New warehouse footprints and subsequent impact on fire services infrastructure and perimeter vehicular access paths. • Smoke hazard management strategy changed from manual smoke clearance system to a rationalised automatic smoke exhaust system (refer Section 8).
07	27/05/2022	Updated issue to incorporate the following changes ('Mod 2'): • Minor increase to the floor area of Warehouse 7, and a minor reduction to the floor area of Warehouse 9. • Addition of café to Warehouse 7.
08	17/06/2022	Updated issue to incorporate the following changes ('Mod 2'): • Change to allocation of carparking spaces serving Warehouse 8.
09	29/06/2022	Updated issue to incorporate minor comments from the design team regarding: • Lot 8 floor areas in Table 3-1. • Figure referencing.
10	29/07/2022	Updated issue to incorporate the following changes: • Renaming from 'Mod 2' to 'Mod 3'. • Amended floor areas and estate plan. • Access Roads 1 and 3 revert back to a road width of 26.4 m. • Removal of one office serving Warehouse 8.
11	19/08/2022	Updated issue to reference Lots 1-5 and DP1285305 for the proposed development.

EXECUTIVE SUMMARY

CORE Engineering Group has been engaged by Mirvac to develop a Fire Safety Strategy (FSS) for the construction of warehouse facilities at Aspect Estate on Lots 1-5 DP1285305 Mamre Road, Kemps Creek. Specifically, this report relates to the overall estate concept masterplan, including 9 warehouse buildings and the associated site infrastructure.

This FSS provides an overview of the design, construction and management requirements considered necessary to achieve an acceptable level of life safety within the building.

A fully prescriptive approach of complying with the Building Code of Australia 2019 Amendment 1 (BCA) [1] Deemed-to-Satisfy (DtS) provisions for occupant egress, fire resisting construction, fire services, and fire brigade intervention is unlikely to satisfy the desired architectural and client aspirations.

As such, Performance Solutions have been proposed to account for the following items which can satisfy the Performance Requirements of the BCA rather than the DtS Provisions:

- C2.4 – Vehicular Perimeter Access over adjoining lease boundaries
- D1.4 – Extended travel distances to the nearest exit within warehouse buildings
- D1.5 – Distances between alternative exits within warehouse buildings
- D1.10 – Egress paths on adjacent lots
- E1.3 – External hydrants positioned beneath awnings
- E1.5 – Sprinkler booster locations
- E2.2 – Rationalised automatic smoke exhaust system

This FSS provides a holistic summary of the fire and life safety measures anticipated to be necessary in developing the above listed Performance Solutions. These measures include passive and active fire protection systems, egress provisions, occupant first aid firefighting, fire brigade intervention, and future building management provisions.

The fire strategy presented herein shows that the built form proposed is capable of meeting the Performance Requirements of the BCA.

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1 INTRODUCTION

1.1 OVERVIEW

This Fire Safety Strategy has been undertaken to nominate proposed Performance Solutions for assessing compliance with the nominated Performance Requirements of the Building Code of Australia 2019 Amendment 1 (BCA) [1] in accordance with the methodologies defined in the International Fire Engineering Guideline IFEG [3].

In order to develop and assess the nominated non-compliances the following flowchart process is to be adopted.

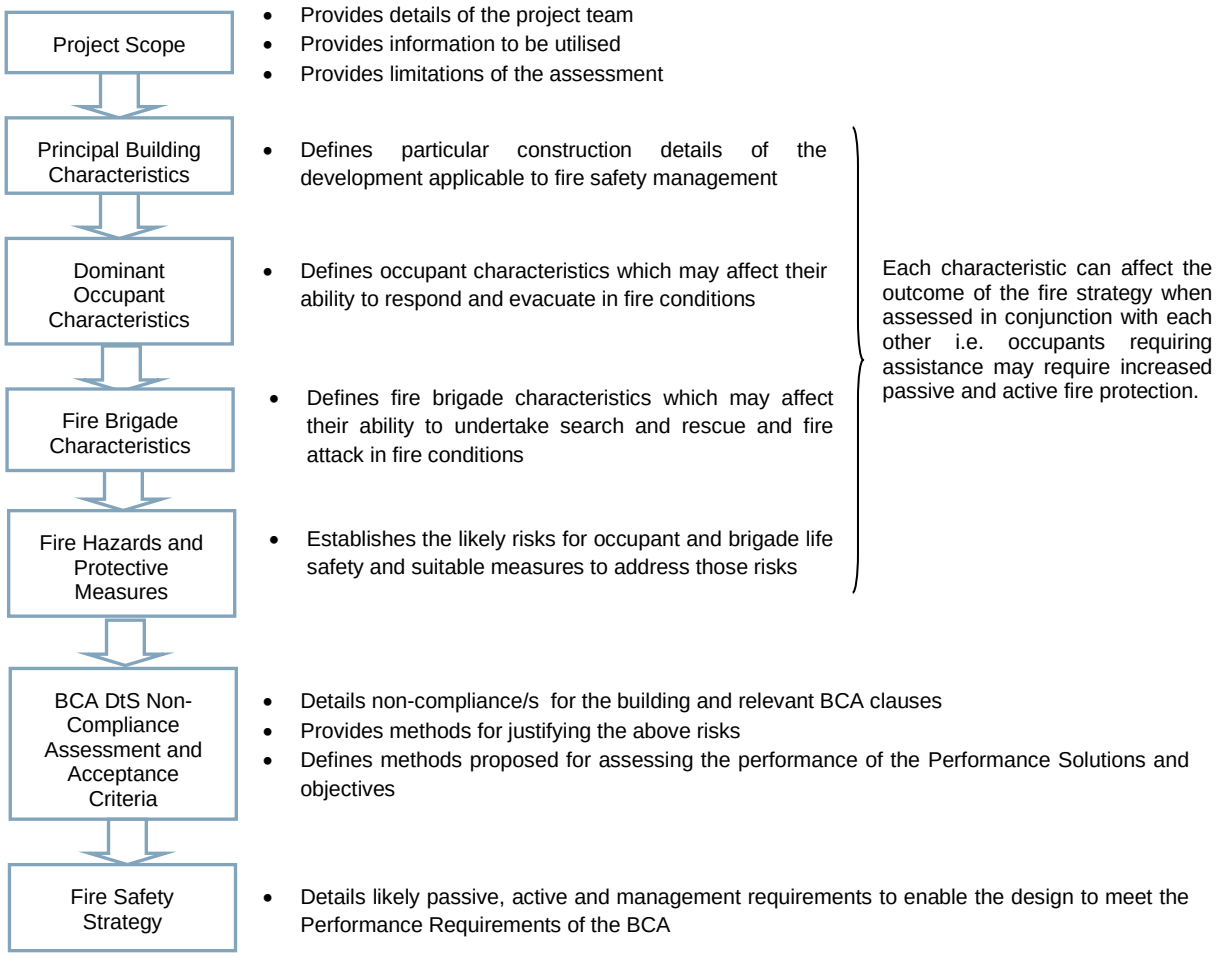


Figure 1-1: Fire Safety Strategy Process

The scope of the FSS is to detail the nominated departures that do not prescriptively meet the Deemed-to-Satisfy (DtS) Provisions of the BCA, assess these in regard to the appropriate Performance Requirements, and provide methodologies for establishing a workable and safe FSS through a trial design.

1.2 FIRE SAFETY OBJECTIVES

This FSS highlights the proposed Performance Solutions to be considered in the fire engineering assessment, for the development of a Fire Engineering Report (FER). This fire engineering assessment is one which will satisfy the performance requirements of the BCA whilst maintaining an acceptable level of life safety, protection of adjacent property, and provide adequate provisions for fire brigade intervention. At a community level, fire safety objectives are met if the relevant legislation and regulations (such as the BCA) are complied with. As stated in the BCA, "*A Building Solution will comply with the BCA if it satisfies the Performance Requirements*". In addition to this, certain non-regulatory objectives exist as detailed below.

Building regulatory objectives

The following items are a summary of the fire and life safety objectives of the BCA:

- **Life safety of occupants -** the occupants must be able to leave the building (or remain in a safe refuge) without being subject to hazardous or untenable conditions. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of exposing building occupants to hazardous or untenable conditions in an event of a fire.
- **Life safety of fire fighters -** firefighters must be given a reasonable time to rescue any remaining occupants before the onset of hazardous conditions or building collapse occurs. The objective of the fire engineering assessment is to demonstrate that the proposed building design and fire safety systems would facilitate fire brigade intervention and minimise the risk of exposing firefighters to hazardous or untenable conditions in an event of a fire.

1.2.1

- **Protection of adjoining buildings** - structures must not collapse onto adjacent property and fire spread by radiation should not occur. The objective of the fire engineering assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of fire spreading from one building to another.

Fire Brigade objectives

The overall philosophical Fire Brigade objectives throughout Australia are to protect life, property and the environment from fire according to the Fire Brigade Intervention Model (FBIM) [5] as per the Fire Services State and Territory Acts and Regulations.

1.2.2

Over and above the requirements of the BCA, the Fire Brigade has functions with regard to property and environmental protection and considerations regarding occupational health and safety for its employees.

Non-prescribed objectives

1.2.3 Fire Engineering has an overarching benefit to many facets of the built environment where non-prescribed objectives can have an influence on the FSS adopted. Although not assessed within, the following can be considered if requested.

- **Business continuity -** will the loss of a particular facility due to fire / smoke damage result in excessive financial impact on the client? For example, is the facility critical to business continuity?
- **Public perception -** should a fire occur within the facility is there likely to be questionable public perception about the safety and operation of the facility?
- **Environmental protection -** fires of excessive sizes can have significant effects on the environment which may require a detailed risk assessment to minimise such outcomes.
- **Heritage salvation -** buildings can have a heritage value for both cultural and educational purposes which can be destroyed by insufficient fire protection.
- **Risk mitigation / insurance limitations -** are there specific limitations on insurance with respect to risk mitigation and fire safety design? i.e. Does the relevant insurer have concerns with respect to open voids through the building?
- **Future proofing (isolation of systems) -** what flexibility is required in the overall design to allow for future development or changes in building layout?

1.3.1

- **Occupational Health and Safety (OHS) requirements -** buildings may have specific fire safety requirements pertaining to OHS requirements.

1.3 REGULATORY FRAMEWORK OF THE FIRE ENGINEERING ASSESSMENT

Building Code of Australia

One of the goals of the BCA is the achievement and maintenance of acceptable standards of safety from fire for the benefit of the community. This goal extends no further than is necessary in the public interest and is considered to be cost effective and not needlessly onerous in its application.

Section A2.1 of the BCA [1] outlines how compliance with the Performance Requirements can be achieved, being satisfied by one of the following:

(a) A Performance Solution which demonstrates–

  (i) Compliance with all relevant Performance Requirements; or

  (ii) The solution is at least equivalent to the Deemed-to-Satisfy Provisions; or

(b) A Deemed-to-Satisfy Solution; or

(c) a combination of (1) and (2).

Section A2.2 of the BCA provides several different methods for assessing that a Performance Solution complies with the Performance Requirements, through one or a combination of the following Assessment Methods:

(a) Evidence of suitability that shows the use of a material, product, form of construction or design meets the relevant Performance Requirements.

(b) A Verification Method including the following:

  (i) the Verifications Methods in the NCC; or

  (ii) other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements.

(c) Expert Judgement.

(d) Comparison with the Deemed-to-Satisfy Provisions.

Where a Performance Requirement is satisfied entirely by a Performance Solution, the following method must be used to determine the Performance Requirements relevant to the Performance Solution:

(a) Identify the relevant Performance Requirement from the Sections or Part to which the Performance Solution applies.

(b) Identify Performance Requirements from other Sections of Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Performance Solution.

Under Section A2.4, the following method must be used to determine the relevant Performance Requirements when using a Performance Solution in combination with a Deemed-to-Satisfy Solution: These methods are summarised as follows:

(a) Identify the relevant Deemed-to-Satisfy Provisions of each Section or Part that are to be the subject of the Performance Solution.

(b) Identify the Performance Requirements from the same Section or Part that are relevant to the identified Deemed-to-Satisfy Provisions.

  (i) Identify Performance Requirements from the other Sections and Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Deemed-to-Satisfy Provisions that are the subject of the Performance Solution.

1.3.2

International Fire Engineering Guidelines

The IFEG [3] document has been developed for use in fire safety design and assessment of buildings, and reflects international best practice. The document is intended to provide guidance for fire engineers as they work to develop and assess strategies that provide acceptable levels of safety.

The document is particularly useful in providing guidance in the design and assessment of Performance Solutions against the Performance Requirements of the BCA. The prescribed methodology set out in the IFEG will be generally adopted in the FER.

2 PROJECT SCOPE

2.1 OVERVIEW

CORE Engineering Group has been engaged by Mirvac to develop a Fire Safety Strategy (FSS) for the construction of warehouse facilities at Aspect Estate on Lots 1-5 DP1285305 Mamre Road, Kemps Creek. Specifically, this report relates to the overall estate concept masterplan, including 9 warehouse buildings and the associated site infrastructure.

The purpose of this FSS is to outline the fire engineering principles to be considered in ensuring that built form proposed is capable of meeting the Performance Requirements of the BCA and thus permitting development approval.

The complete fire engineering analysis will be included within the FER, and as such is not documented herein. This document does however outline the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building as a result of the Performance Solution and to satisfy the Performance Requirements of the BCA.

2.2 RELEVANT STAKEHOLDERS

This Performance Solution has been developed collaboratively with the relevant stakeholders as identified below:

Table 2-1: Relevant Stakeholders

ROLE	NAME	ORGANISATION
Development Director	Daniel Brook Stephen Foster	Mirvac
BCA Consultant	Dean Goldsmith	Blackett Maguire + Goldsmith
Architect	Richard Prince	SBA Architects
Fire Safety Engineer	Dean Watt	CORE Engineering Group
C10 Accredited Fire Engineer	Graham Morris	

It should be noted that at times some parties may have a vested interest in the outcome of the Fire Engineering assessment. Such parties can include local fire brigades, insurers, Environmental Protection Authority (EPA), project control groups, end users and community representatives. Although not always a legislative requirement, the design team should give due consideration to their inclusion in the Fire Engineering process. Where not required by legislation it is the client's decision to involve such parties, especially local fire brigade, to ensure a transparent and adequate fire safety solution for all. Where we are not notified of the inclusion of such parties it is assumed the client / representative has given due consideration to the above.

2.3 SOURCES OF INFORMATION

The following sources of information have been provided by the design team:

- SSDA-Mod 3 Estate Masterplan – MP3-02 (Rev A), dated 28 July 2022.

2.4 LIMITATIONS AND ASSUMPTIONS

In this instance the FSS is developed based on applicable limitations and assumptions for the development which are listed as follows:

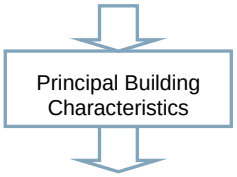
- The report is specifically limited to the project described in Section 3.
- The report is based on the information provided by the team as listed above in Section 2.3.
- Building and occupant characteristics are as per Section 3 and 4 respectively of this report. Variations to these assumptions may affect the FSS and FER, and therefore should be reviewed by a suitably qualified Fire Engineer should they differ.
- As per any building design, DtS or otherwise, the report is limited to the fire hazards and fuel loads as prescribed in the IFEG [3]. The report does not provide guidance in respect to areas which are used for

Dangerous Goods (DG) storage, processing of flammable liquids, explosive materials, multiple fire ignitions, or sabotage of fire safety systems.

- The development complies with the fire safety DtS provisions of the BCA [1] with all aspects in regards to fire and life safety unless otherwise stated in this report. Where not specifically mentioned, the design is expected to meet the BCA DtS requirements of all relevant codes and legislation at the time of construction and/or at the time of issue of this report.
- The assessment is limited to the objectives of the BCA and does not consider property damage such as building and contents damage caused by fire, potential increased insurance liability, and loss of business continuity.
- Malicious acts or arson with respect to fire ignition and safety systems are limited in nature and are outside the objectives of the BCA. Such acts can potentially overwhelm fire safety systems and therefore further strategies such as security, housekeeping, and management procedures may better mitigate such risks.
- This report is prepared in good faith and with due care for information purposes only, and should not be relied upon as providing any warranty or guarantee that ignition or a fire will not occur.
- The FSS and FER is only applicable to the completed building. This report is not suitable, unless approved otherwise, to the building in a staged handover.
- Where parties nominated in Section 2.2 have not been consulted or legislatively are not required to be, this report does not take into account, nor warrant, that fire safety requirements specific to their needs have been complied with.

3 PRINCIPAL BUILDING CHARACTERISTICS

3.1 OVERVIEW



Building characteristics are assessed as part of the fire engineering assessment due to the following:

1. The location can affect the time for fire brigade intervention and potential external fire exposure issues.
2. The structure will impact on the ability to resist a developing fire and support condition to allow occupants to escape the building and the fire brigade to undertake fire fighting to the degree necessary.
3. The floor area determines the potential fire size and area required to be evacuated in the event of a fire.
4. BCA details such as Type of Construction, Class and Height will dictate passive and active fire safety systems.

3.2 SITE LOCATION

The development site is located in Kemps Creek, approximately 40 km west of Sydney's central business district. The Kemps Creek site consisting of eleven lots is located on Mamre Road, Lots 1-5 on DP1285305. The internal roads within the estate are yet to be named.

Figure 3-1: Site Location

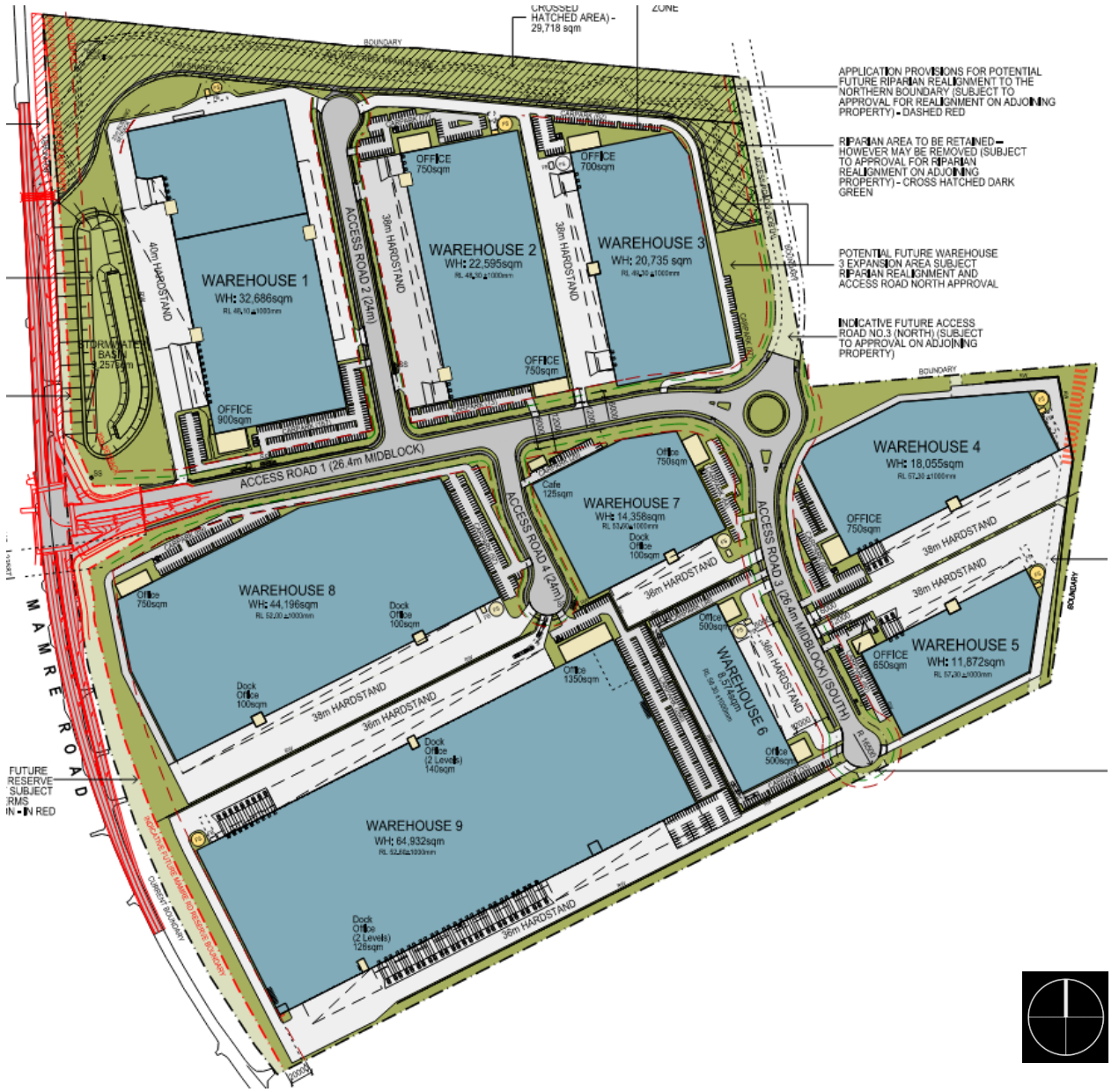


Figure 3-2: Estate Masterplan

The building site influences the likely fire brigade intervention times and given the close proximity to the nearest fire station is expected to facilitate a relatively convenient and expedient fire brigade response. Furthermore, being located in an outer suburb of a major city, the development is provided with the services and facilities expected in an urban setting. The two nearest fire brigade stations provided with permanent staff are St Marys and Bonnyrigg Heights approximately 10 km and 11 km from the site respectively when considering actual driving directions.

3.3 SITE LAYOUT

This development site consists of 9 warehouses as illustrated in Figure 3-2. Warehouses 1 and 3 are proposed to be constructed in stage 1 of the development plan. All constructed facilities will be leased to third party businesses. This report addresses fire safety strategies for the entire site.

The total area of the estate is approximately 560,000 m². The majority of the warehouses exceed 18,000 m² with the largest being 66,610 m² (total GFA). There are three buildings (total GFA) less than 18,000 m², being Lot 5, 6, and 7. The ridge height of the warehouses is 13.7 m. Lots 1, 2, 6 and 8 have the potential to be split into two tenancies, with a dedicated two-storey office provided to serve each tenancy. The remaining buildings are initially proposed as a single tenant building with a single ancillary two-storey office. Each allotment has carparks within the tenancies. The floor area of the proposed buildings on each lots are shown in Figure 3-3 and Table 3-1.

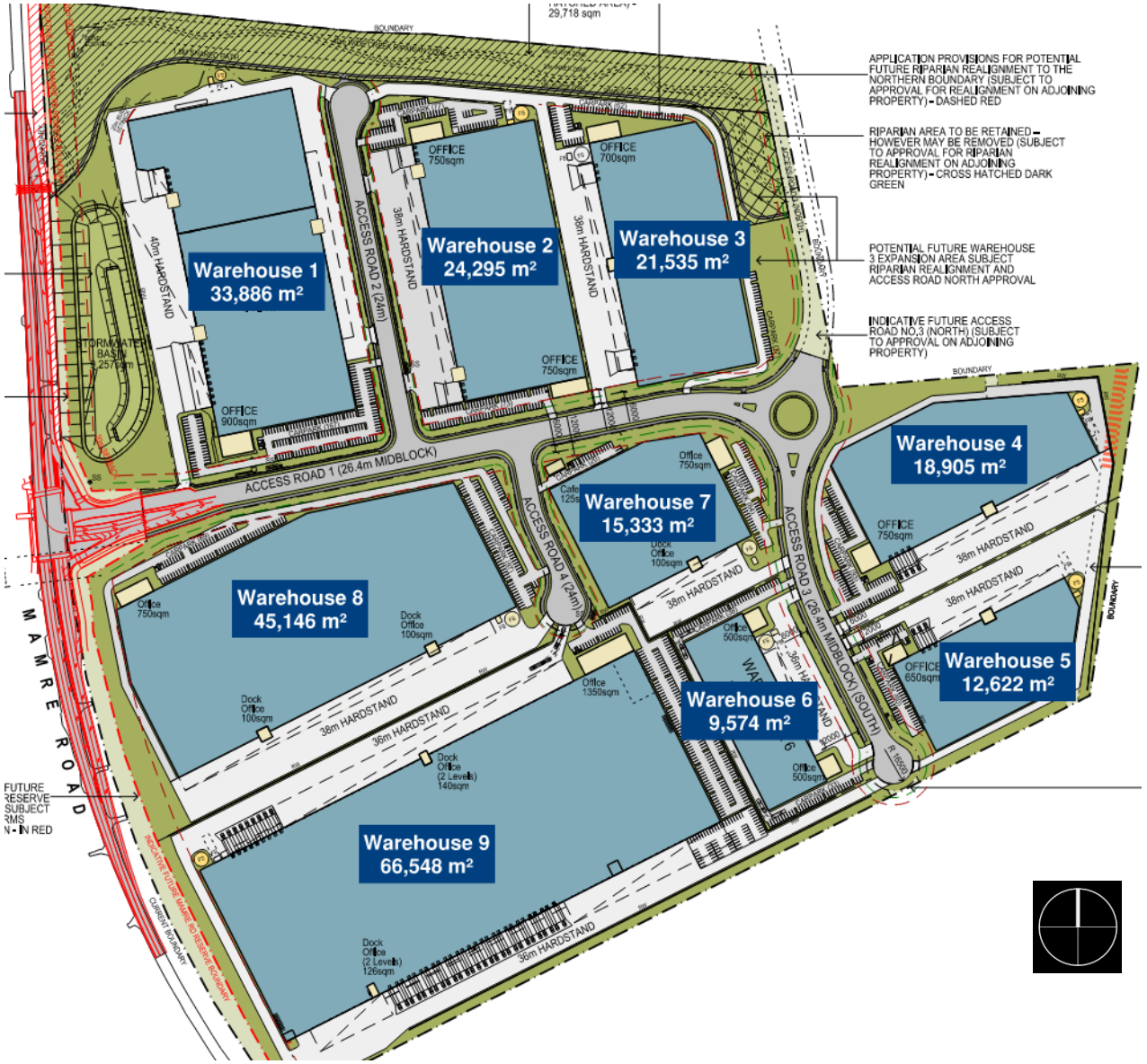


Figure 3-3: Site Plan - Building Floor Areas

Table 3-1: Building Floor Areas

BUILDING	Warehouse Floor Area	Office Floor Area	Building Floor Area
Lot 1	32,686 m²	1,200 m²	33,886 m²
Lot 2	22,595 m²	1,700 m²	24,295 m²
Lot 3	20,735 m²	800 m²	21,535 m²
Lot 4	18,055 m²	850 m²	18,905 m²
Lot 5	11,872 m²	750 m²	12,622 m²
Lot 6	8,574 m²	1,000 m²	9,574 m²
Lot 7	14,358 m²	850 m²	15,333 m² (with café)
Lot 8	44,196 m²	750 m² (+ 200 m² dock office)	45,156 m²
Lot 9	64,932 m²	1,616 m²	66,548 m²

3.4 BUILDING STRUCTURE

The warehouse shall be constructed as a steel portal frame structure with dado panel walls and a metal sheet roof. All materials and elements should achieve the requisite Fire Resistance Levels (FRL) and fire hazard properties associated with Type C construction.

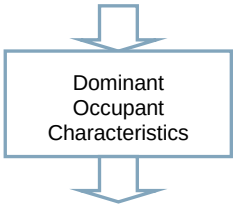
3.5 BCA ASSESSMENT SUMMARY

Table 3-2: BCA Building Characteristics

CHARACTERISTIC	DESCRIPTION (Relevant to all buildings)
Classification	Class 7b (Warehouse) and Class 5 (Office)
Construction Type	Type C (Large-Isolated Building)
Rise in Storeys	Two (2)
Effective Height	Less than 12 m
Floor Area and Volume	Greater than 18,000 m² and/or 108,000 m³

4 DOMINANT OCCUPANT CHARACTERISTICS

4.1 OVERVIEW



The occupant characteristics are assessed within the Fire Safety Strategy due to the following:

1. Population numbers can dictate the time required to evacuate the building and the required life safety systems to be provided due to evacuation times.
2. Physical and mental attributes affect the occupants' capacity to respond to various fire cues and react accordingly.
3. Familiarity of occupants can affect the time taken to evacuate the building and subsequent active / passive requirements.

4.2 OCCUPANT NUMBERS AND DISTRIBUTION

The BCA assumes the following occupant densities per an area's function and use according to Table D1.13 [10]:

- Warehouse: 30m² per person
- Office: 10m² per person

In the absence of specific occupant numbers provided by the tenant, the population estimated from Table D1.13 of the BCA DtS Provisions will be utilised in the analysis, therefore providing a conservative population in the warehouse parts.

It is noted that these numbers provide conservative inputs to the fire engineering analysis and do not form the requirements for amenities and the like.

4.3 OCCUPANT ATTRIBUTES

Occupants in the building may be of mixed age, although the elderly and children are not expected to be present. The population is therefore expected to be that of the general working public and be adults between the ages of 16 to 70. Due to the nature of the work conducted the majority of occupants are assumed to be able bodied people, however there may be a small number of less mobile or visually impaired occupants in the office portion of the building.

All occupants are expected to be awake and alert adults or in the direct company of an adult, capable of entering the leaving the building under their own volition. Occupants in all of these areas are not expected to be adversely impaired by drugs, alcohol, fatigue or other adverse conditions to degrees greater than in other warehouse and office buildings.

4.4 OCCUPANT FAMILIARITY

The majority of occupants within the building are expected to be staff and therefore the population in general are likely to react favourably in an emergency situation.

- Staff, Maintenance and Security can be expected to have a good familiarity with the building and the fire safety systems provided and may be trained in emergency procedures; and
- Clients / Visitors may or may not be familiar with the layout of the building and may require assistance in locating the exits; and
- External Maintenance Contractors are expected to have a reasonable familiarity with the building as they would have to undergo site specific induction prior to commencement of work on site; and
- FRNSW are not expected to have any familiarity of the building layout, however are assumed to obtain the required information from the site block plans and tactical fire plans available prior to entering the building.

4.5 EMERGENCY TRAINING

Occupants should be familiar with escape procedures through fire drills and designated fire wardens being appointed to mitigate risks under Workplace Health and Safety legislation (AS3745:2010). Clear escape routes should be maintained with doors unlocked, and no obstructions or rubbish to hinder evacuation.

Staff and visitors are not expected to have fire suppression training and such training is not relied upon for this building population; however staff are expected to possibly attempt to extinguish a fire or limit fire spread by removing objects in the vicinity of the fire in order to defend their belongings.

5 FIRE BRIGADE CHARACTERISTICS

5.1 OVERVIEW

Fire brigade characteristics are assessed within the FSS as brigade characteristics can dictate the time required for fire brigade intervention including search and rescue, and fire attack.

5.2 FIRE BRIGADE ASSESSMENT

Figure 5-1 to Figure 5-3 illustrate the site plan with respect to the fire services provided to each building on the development site. These include:

- Vehicular perimeter access
- Fire sprinkler tank, pump room and sprinkler booster
- Fire Control Centre
- Fire hydrant booster

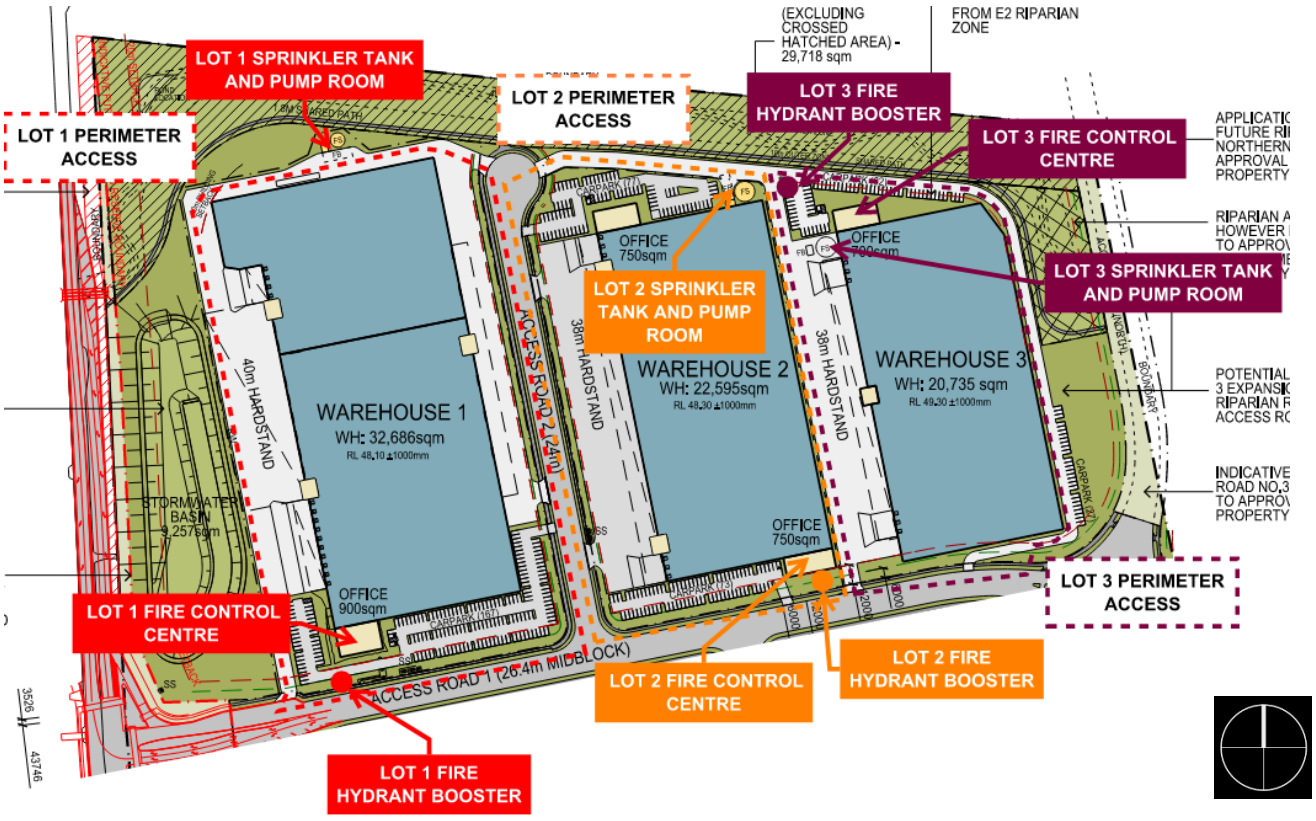


Figure 5-1: Fire Brigade Access and Site Facilities – Northern Side

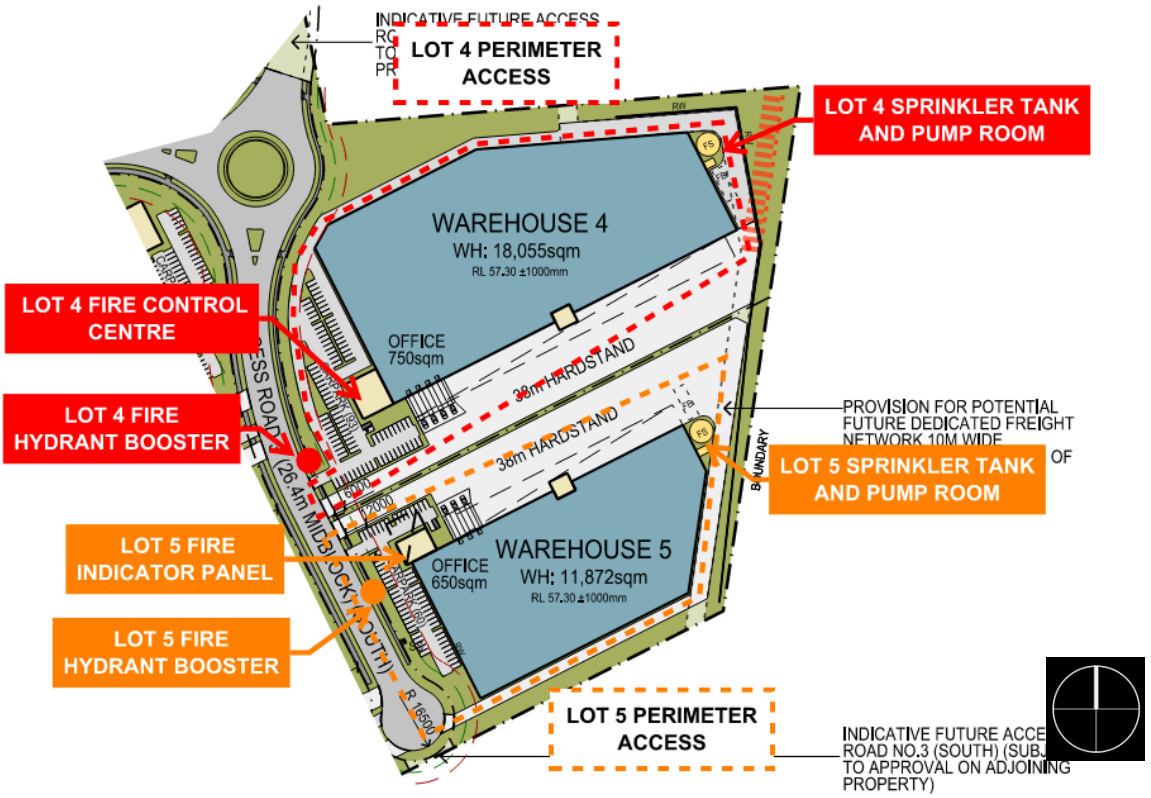


Figure 5-2: Fire Brigade Access and Site Facilities – South-Eastern Side

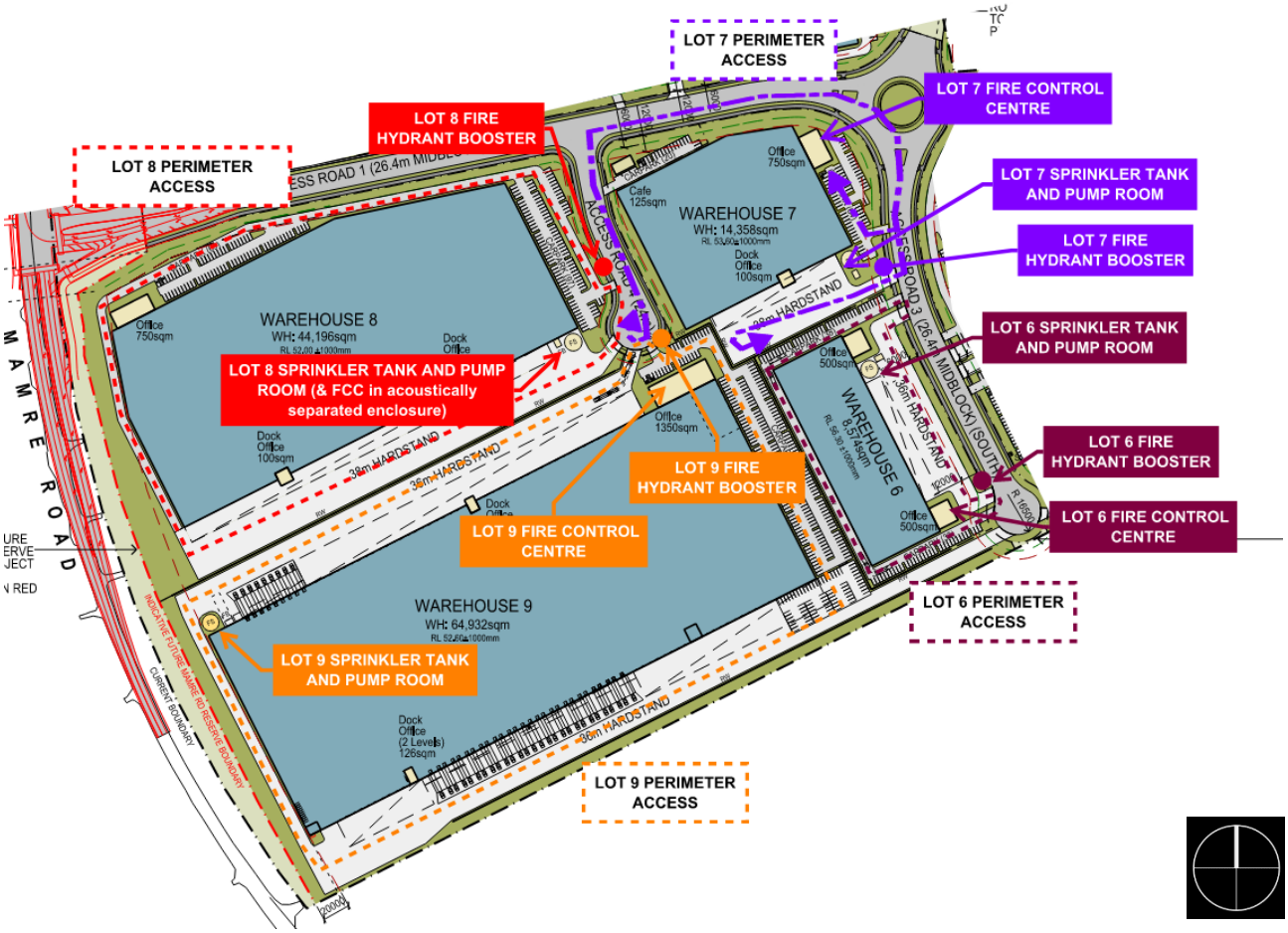


Figure 5-3: Fire Brigade Access and Site Facilities – Southern Side

The building is located within the Fire and Rescue New South Wales (FRNSW) jurisdictional turnout area. The closest two fire stations to the site that are provided with permanent staff are located in St Marys and Bonnyrigg Heights approximately 10 km and 11 km.

6 FIRE HAZARDS AND PROTECTIVE MEASURES

6.1 OVERVIEW

The fire hazard analysis forms the basis for the review of non-compliances within the building. In assessing expected and statistically validated hazards, preventative and protective measures are developed commensurate with those expected risks. The following section reviews applicable hazards and recommends possible measures to address those risks. Furthermore, the hazards identified can form a justified basis for selected scenarios.

6.2 FIRE HAZARDS

Subsequent to a review of the relevant documentation, the identified fire hazards specific to this building are summarised below.

Combustible External Cladding

6.2.1 As the buildings require Type C construction, there is no restriction on combustible materials within the external walls of the buildings. Regardless, should the design propose any combustible elements, a detailed review and risk assessment is recommended.

Photovoltaic Cells

6.2.2 No PV cells have been identified at this stage, however it is anticipated that these will be incorporated in the design. The following general design guidance is provided in order to limit any electrical exposure to evacuating occupants or attending fire fighters.

- Warning signs are to be provided on or adjacent to Fire Indicator Panels which:
  - Shall be of all-weather fade resistant material with lettering on a contrasting coloured background; and
  - Provide notice of the type of alternative electrical generation system and the location of any isolation/shut off switches.

Insulated Sandwich Panels

6.2.3 Where insulated sandwich panels are proposed within the facility (typically temperature-controlled areas or clean rooms), these shall be installed in accordance with the Code of Practice, IPCA Ltd Code of Practice (CoP) Version 4.3 dated 2017.

- ISPs must have a Group 1 Certificate when tested to AS ISO 9705 2003, or Class 1 to FM 4881 (relevant to PIR) and their fire performance is to be in accordance with the CoP.
- Certification should be provided from the accredited installer (e.g. a Code Compliant Company with the Code of Practice) that the panels (All EPS must meet AS 1366.3 1992, use only 100% FR bead) and the installation complies with the requirements of the CoP.
- The use of ISP's should be identified in accordance with the requirements of the CoP e.g. labels (see Annexure B of CoP for examples) being placed on all doors leading into the rooms that have utilised ISP Systems;

6.2.4

- The key diagram required by the CoP is to be located at the fire indicator panel. The key diagrams shall indicate the locations and specification of all ISPs in the building and can assist firefighters when making operational decisions.

Dangerous Goods

At this stage of the project, no tenants have been identified and so no Dangerous Goods storage requirements have been identified.

Should the storage of Dangerous Goods be proposed, this must be in accordance with the relevant workplace health and safety regulations which will apply governing storage allowances (quantity) and requirements. The presence of DGs can also impact on the fire safety strategy and therefore must be reviewed in the context of fire spread, occupant evacuation and fire brigade intervention.

Automatic Storage and Retrieval Systems

There are various automated racking systems in the market for storage facilities as a general trend towards efficiency in distribution facilities. With the efficiency comes additional fire hazards to be considered. While automated racking systems have not been proposed in these facilities at this stage, the following potential hazards will need further consideration if such a system is proposed:

- The dense storage arrangement restricts access to maintenance personnel only, with subsequent egress being typically complex in nature.

6.2.5

- The restricted access limits the ability for firefighters by conventional means to access the racking arrangement to suppress a fire and/or confirm a fire is extinguished.
- The live electrical system can create additional hazards for attending firefighters.
- The automated nature (moving parts) can contribute to fire spread and result in multiple sprinkler heads operating.

Should an automated system be design, this is likely to alter the fire safety strategy and so detailed consideration of the inherent risks to fire spread, occupant evacuation and fire brigade intervention is required.

6.3 PREVENTATIVE AND PROTECTIVE MEASURES

The following measures are anticipated within the building to limit fire spread and the exposure to occupants and fire brigade. These are categorised in accordance with the sub-systems listed in the IFEG.

Fire Initiation and Development and Control (Sub-System A)

6.3.1

To minimise the risk of fires initiating and growing to a size which may impact on the building occupants, fire safety systems are to be utilised within the building as listed in the following sections. The following general advice may also be provided to limit the likelihood of fire initiation and development.

- Flammable materials should be stored away from ignition sources where possible.
- Scheduled maintenance of all electrical equipment / switchboards
- Adhere to safe operating procedures for ‘hot work’ (e.g. welding).
- No smoking policy

6.3.2

Smoke Development and Spread and Control (Sub-System B)

It is recognised that smoke is one of the most serious threats to life safety in the event of a fire. Whilst the automatic smoke exhaust system for this facility shall be rationalised, the following are anticipated:

- Large smoke reservoir due to volume of each building.

6.3.3

- Automatic smoke exhaust system initiated upon sprinkler activation, achieving a capacity of 1 volume air change per hour.

Fire Spread and Impact and Control (Sub-System C)

To limit the extent and impact of fire spread through the buildings, the following are to be implemented in the building.

- Type C construction

6.3.4

- Fire sprinkler system, as documented in Sub System D
- The distances from the nearest fire source feature (site boundary) are greater than 3 m on all sides.
- Automatic shutdown of automated equipment (if any)

Fire Detection, Warning and Suppression (Sub-System D)

The following active systems are to be used within the buildings to facilitate occupant warning and suppress a potential fire.

- Occupant warning system
- Storage / suppression mode sprinkler system at warehouse roof level and under the super awning
- Sprinkler system throughout all other areas
- Fire hose reels
- Fire extinguishers

Occupant Evacuation and Control (Sub-System E)

The buildings are to be provided with the following systems to assist in the evacuation of occupants:

- Emergency lighting
- Exit signage
- Exits direct to outside
- Multiple exits located on all four sides of each building

6.3.5

Fire Services Intervention (Sub-System F)

The building is to be provided with the following systems to assist in fire brigade intervention:

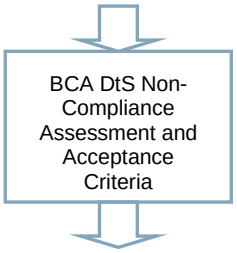
- Fire hydrant system, using external hydrants where possible
- Automatic link to fire brigade
- Perimeter vehicular perimeter access in a forward motion with minor non-conformances.

6.3.6

- Fire hydrant booster for each Lot
- FCC for each Lot
- Sprinkler tank, pump and booster for each building
- Local fire brigades in close vicinity supported by full time staff

7 BCA DTS NON-COMPLIANCE ASSESSMENT

7.1 OVERVIEW



In this instance the BCA DtS non-compliances have been formulated based on the regulatory review as provided by the principal certifying authority. Where not listed herein the building is required to achieve compliance with relevant DtS provisions or if existing, comply with relevant codes, reports and / or Standards approved at the time of consideration.

The following table lists the departures from the DtS provisions of the BCA for the proposed building and the analysis methodology proposed for the Fire Engineering assessment, which is to be generally in accordance with the IFEG [3].

7.2 BCA DTS NON-COMPLIANCE ASSESSMENT

Table 7-1: Summary of Performance Solutions

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
Vehicular Perimeter Access **BCA DtS Provisions** Provision C2.4: Requirements for open spaces and vehicular access **Performance Requirements** CP9	**Relevant BCA DtS Provisions** Provision C2.4: Each building must be provided with continuous vehicular access with a minimum unobstructed width 6 m where the furthest distance from the external wall of the building and the path is not more than 18 m for emergency vehicle access. **DtS Variation** The following non-conformances are present: • The eastern part of the Lot 2 perimeter access path is on Lot 3. • The perimeter access path of Lot 7 is discontinuous at the southern corner. • In various locations for Lots 1-9, the perimeter vehicular access paths are greater than 18 m from the external wall of the subject building. **Performance Solution** For Lot 2 , the Performance Solution shall rely upon the access path over the adjoining lots being maintained clear and unobstructed, primarily via a restriction on use easement registered with the Department for Lands and Property Information. For Lot 7, he Performance Solution shall rely upon staging afforded at all corners of the building, and sufficient turnaround area (without reversing) where the pathway is discontinuous. For the distance greater than 18 m, the Performance Solution shall rely upon the fact that staging locations are available at the corners of the warehouses for firefighting and pedestrian access and smaller emergency vehicles can provide firefighters access to the building in areas of non-conformance.
Extended Travel Distances **BCA DtS Provisions** Provision D1.4: Exit travel distances Provision D1.5: Distance between alternative exits	**Relevant BCA DtS Provisions** Provision D1.4: In a Class 7b building, the maximum travel distance must not exceed 40 m when 2 or more exits are available. Provision D1.5: The distances between alternative exits must not exceed 60 m. Provision E2.2: Automatic smoke exhaust must be provided in Class 7b buildings which exceed 18,000 m² in floor area or 108,000 m³ in volume. **DtS Variation** • Distances up to 70 m to the nearest exit and 140 m between alternative exit are anticipated typically. • Due to the size of Lot 1, distances up to 85 m to the nearest exit and 170 m between alternative exits are anticipated (noting up to an additional 45m is required to traverse beneath the awnings to open space).

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
Provision E2.2: Smoke hazard management – General requirements **Performance Requirements** DP4, EP2.2	• A rationalised automatic smoke exhaust system is proposed with a capacity of 1 volume air change per hour **Performance Solution** The Performance Solution relies upon: • The volume of the warehouse enclosures providing a large smoke reservoir hence longer time is available for occupant egress before the smoke descends. • The automatic smoke exhaust system is initiated upon sprinkler activation. • The population density inside the warehouse is expected to be low where the occupants are likely to be awake and able-bodied to evacuate while the tenability within the warehouse is maintained.
Egress Paths on Adjacent Lots **BCA DtS Provisions** Provision D1.10: Discharge from exits **Performance Requirements** DP4	**Relevant BCA DtS Provisions** Provision D1.10: If a required exit leads to an open space, the path of travel to the road must have an unobstructed width throughout of not less than the minimum width of the required exit or 1 m, whichever is greater. **DtS Variation** Egress from some buildings will necessitate passing through adjacent lots. **Performance Solution** The Performance Solution shall rely upon the access path over the affected adjoining lot being maintained clear and unobstructed, primarily via a restriction on use easement registered with the Department for Lands and Property Information.
Fire Hydrants **BCA DtS Provisions** Provision E1.3: Fire hydrant **Performance Requirements** EP1.3	**Relevant BCA DtS Provisions** Provision E1.3: requires that a fire hydrant system is provided and installed in accordance with AS2419.1, which in turn requires internal hydrant to achieve coverage from a single hose length. **DtS Variation** Hydrants located beneath warehouse awnings shall be treated as external hydrants, thereby allowing two hose lengths for coverage. External hydrants shall not be afforded the protection of a 90/90/90 FRL radiant heat shield 3 m above and 2 m either side of hydrant connection points. **Performance Solution** The hydrants located beneath the awnings are to have all the requirements of an external hydrant per AS2419.1:2005, except that they are located under the building footprint and are not provided with 90/90/90 FRL heat shields. Fall-back hydrants are to be provided on the respective hardstands to provide coverage under the awnings.
Sprinkler Booster Locations **BCA DtS Provisions** Provision E1.5: Sprinklers	**Relevant BCA DtS Provisions** Specification E1.5: An automatic fire sprinkler system must comply with AS 2118.1 for all building classifications, which specifies that the fire brigade booster assembly shall conform to requirements of AS 2419.1. This requires fire brigade assemblies to be located within sight of the main entrance to the building. **DtS Variation** The location of the sprinkler booster of each Lot are not within sight of the main entrance of each Lot therefore does not comply with the provisions above.

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
Performance Requirements EP1.4	**Performance Solution** Sprinkler boosters shall be positioned such that they are accessible directly via the perimeter access path and have a dedicated hardstand in accordance with FRNSW guidelines.

8 PROPOSED FIRE SAFETY STRATEGY

8.1 OVERVIEW

The FSS outlined below has been proposed to satisfy the fire and life safety objectives specified for this project by the relevant stakeholders. In addition, the FSS is required to adequately address the specific fire and life safety hazards identified for the proposed development, and as such have been generally derived from the preventative and protective measures outlined within the BCA, and fire engineering literature and research. Where items of non-compliance have not been identified by the design team in the concept design phase, it is expected that those items will be DtS solutions.

This section provides guidance for the design and application of fire safety measures. It highlights specific design considerations for a range of fire safety measures that will undergo analysis as part of the FER to ascertain whether the relevant Performance Requirements of the BCA are satisfied. Design guidance (general informative details and specific requirements) for a range of specific fire safety measures is provided. This list is not exhaustive and the use of other fire safety measures including new technologies will require additional review.

8.2 PASSIVE FIRE PROTECTION

Type of Construction Required

8.2.1 Each building shall be built in accordance with the BCA DtS provisions for Type C fire-resisting construction, as a large-isolated building.

In practice, this means external wall that is less than 1.5 m from any fire-source feature shall achieve an FRL 90/90/90. External wall that are 1.5 m to less than 3 m from a fire-source feature shall achieve an FRL of 60/60/60. Fire walls in Type C construction shall achieve an FRL of 90/90/90.

From review of the masterplan, it does not appear that any external walls are prescriptively required to achieve an FRL.

8.2.2

Combustibility of External Wall

As the buildings require Type C construction, there is no prescriptive requirement for materials in the external wall build-up to be non-combustible. However, given the global scrutiny on combustible façade materials, it is recommended to specify non-combustible cladding materials.

8.3 VEHICULAR PERIMETER ACCESS

The vehicular perimeter access pathway should be provided around the whole of the building. These should be designed and constructed with an all-weather surface capable of supporting all FRNSW appliances in accordance with BCA Clause C2.4 and the FRNSW Fire Safety Guideline '*Access for Emergency Vehicles And Emergency Service Personnel*', available at http://www.fire.nsw.gov.au, with the following exceptions permitted:

- Perimeter access on the eastern side of Lot 2 is over the adjoining Lot 3.
- Perimeter access on the southern corner of Lot 7 is discontinuous.
- Parts of the perimeter vehicular access around the warehouses is in excess of 18 m from the external wall of the buildings.

To facilitate the perimeter access non-conformances, the following measures should be provided as part of the Performance Solution:

- A restriction on use easement (Section 88B instrument) should be registered with the Department for Lands and Property Information to maintain the access path clear of stored goods and accessible by the fire brigade at all times.
- Gates in the security line between lots should be provided enabling access to the egress doors and fire hydrants from the hardstand.[1]

1 Egress to the road is expected to be provided solely within the lease boundary, however should egress be required over the adjoining hardstand (as for the perimeter access), a Performance Solution is also possible for this.

- All gates, security fencing, and boom gates should be readily openable by the fire authorities. This can be achieved through one, or a combination of, the following [7]:
  - Any vehicle access gate that is required to be locked should be secured with a non-hardened metal chain and lock.
  - All locks fitted to vehicle access gates and security devices are to be keyed alike, and a copy of the key deposited with the two nearest FRNSW fire brigade stations or kept with the site security if 24/7 security is provided for the site.
  - Any electrically operated vehicle access gate or security device should incorporate either mechanical override, fail-safe open mode, or activated by site security so that fire appliances can access the site in the event of fire.
- The load-bearing capacity and vehicle swept path of the vehicular access paths and carparks must be compatible with fire brigade vehicle requirements.

8.4 EGRESS PROVISIONS

Evacuation Strategy

8.4.1 Activation of any sprinkler heads or detectors should initiate the evacuation of all areas of the building. Dedicated fire wardens from the warehouse and office areas should ensure that all clients, visitors, and staff are promptly evacuated.

Travel Distances

8.4.2 In the warehouse, the travel distances to the nearest exit and between alternative exits must be compliant with the BCA DtS requirements with the following exceptions identified.

- Travel distances within warehouse areas are likely to extend up to 70 m to the nearest exit and the 140 m between exits in lieu of 40 m and 60 m respectively. These maximum distances also typically enable hydrant coverage to be achieved via external hydrants only.
- These distances may be extended by the additional distance under the awnings (~15 m) prior to reaching open space.
- Due to the size of Lot 1, distances up to 85 m to the nearest exit and 170 m between alternative exits are anticipated (noting up to an additional 45m is required to traverse beneath the awnings to open space).
- Due to the side of Lot 9, distances up to 90 m to the nearest exit and 180 m between alternative exits are anticipated (noting up to an additional 20m is required to traverse beneath the awnings to open space, which shall be demonstrated as a place of safe refuge).

It is anticipated that these distances can be addressed through a Performance Solution involving detailed computational smoke modelling and evacuation analysis.

8.4.3 Exits from some buildings involve travel over adjoining lots. Although non-compliant, this can be assessed via a Performance Solution reliant on the Section 88B instrument as for the perimeter access. The width of the egress path must be no less than 1 m wide.

Door Hardware, Operation and Mechanisms

8.5.1 All exit doors and doors in a path of travel to an exit are required to be DtS compliant throughout the building. This includes the swing of doors, the applied latching and locking mechanisms and the force required on mechanism used to open doors.

8.5 FIRE FIGHTING EQUIPMENT

Fire Hydrants

A dedicated fire hydrant system is proposed for each lot, in accordance with BCA Clause E1.3 and AS2419.1:2005. The following additional guidance is provided:

- As far as possible, the hydrant system should consist of external hydrants.
- Where the size and design of a building requires the provision of internal fire hydrants to achieve floor coverage in accordance with the requirements of AS2419.1, such hydrants should be located to allow progressive movement of firefighters towards the central parts of the building, per the request of FRNSW.
  - When working from an external hydrant, the next additional hydrant should be located into the building not more than 50 m from the external hydrant.

  - When working from an internal hydrant (either from within a fire isolated exit or passageway, within 4 m of an exit or another additional hydrant), the next additional hydrant should be located not more than 25 m from that hydrant.[2]
  - An external hydrant should be provided adjacent to or within close proximity of each external entry/exit point around the building.
- All points on the floor shall be within 100 m of an external hydrant, as per FRNSW recommendation (refer next item, whereby hydrants located beneath warehouse awnings can be considered external – subject to demonstrating that the awning is a 'safe place').
- Hydrants located beneath the warehouse can be considered external for coverage purposes, by way of a Performance Solution.
  - The hydrants under the awning must be designed with all requirements of external hydrants, other than that heat shields are not required.
- However, hydrant coverage of the area beneath the awnings shall be based on additional external hydrants (i.e. fallback hydrants) located within 10m either side of the awing. Where complete coverage from external hydrants is not possible for the super awning, coverage is to be supplemented by:
  - The hydrants located below the awning being treated as internal hydrants (i.e. 40m of coverage); and
  - External hydrants located outside of the awning must be within 50 m of the nearest hydrant below the awning. For progressive movement, the next internal hydrant required for coverage must be within 25m of this hydrant.
- The system must incorporate a ring main with isolation valves that are external to the building and numbered with the corresponding numbers indicated on the block plan at the booster assembly.
- All hose connections in the system are to be fitted in accordance with FRNSW Technical information sheet – FRNSW compatible hose connections (available at firesafety.fire.nsw.gov.au). These couplings should be tested as part of the system when the commissioning tests are undertaken.
- The hydrant booster assembly is proposed to be located at the entrance to the lot within sight of the main building entry.

Note: AS2419.1:2021 has been gazetted in NCC 2022 (preview) which shall be applicable as of 1 September 2022. As such, for any CC subsequent to that date, AS2419.1:2021 will be the DtS compliant standard of performance.

Further, specific to industrial facilities, the scope of AS2419.1:2021 is limited to:

- *"Class 7b or 8 building having a total volume not more than 108,000 m³".*
- *"Buildings that do not include automatic racked storage systems"*.
- *"Buildings and associated areas that do not include special hazards"*.

However, guidance is provided in Appendices C & E of AS2419.1:2021 for the holistic design of buildings, with these building being subject to a Performance Solution at the discretion of FRNSW. As a result, anticipated design items for review include but are not limited to:

- Increased water supply to the building (may be based on 4 or 5 hydrants operating, instead of 3) – "*A first principles analysis should be undertaken to determine the number of fire hydrants required to flow*".
- The location of the hydrant booster and other (sprinkler) infrastructure is subject to FRNSW approval – "*When operating at a LIB fire, exclusion zones of not less than 1.5 times the height of the building are established to mitigate the risk to the attending fire brigade from building collapse*".
- ASRS advice is provided in Appendix C.3 regarding:
  - Facilitating brigade access.
  - Providing hydrant coverage.
  - Power isolation, return to base functions, and manual operation of cranes.
  - Increasing water supply capabilities for the sprinkler and hydrant systems for up to 4 hours.
- All points on the floor within a Class 7b or Class 8 LIB shall be within 90 m of an exit (in lieu of 100 m as per above) – "*Where this distance is exceeded, additional exits around and from within the building should be provided*".

2 25 m and 50 m distances have been recommended to make allowance for shorter-than-standard hoses (repairs etc.) and unknown variables in the building layout and fixtures etc.

Whilst it is understood that FRNSW were involved in the preparation of AS2419.1:2021 and have provided a formal position statement regarding its adoption in building design, there is currently no precedence on brigade support for the above Performance Solutions relating to buildings that are outside the scope of the standard of this document.

Fire Hose Reels

Fire hose reel shall be provided throughout the building in accordance with Provision E1.4 of the BCA and AS2441:2005.

All points on the floor should be within reach of a 4 m hose stream issuing from a nozzle at the end of the hose laid on the floor with a hose length not exceeding 36 m (i.e. a maximum of 40 m from the hydrant location).

8.5.2 However, should it be desired, it is possible to present a Performance Solution to enable the installation of 50 m fire hose reels – generally to enable hose reels located around the building perimeter only, or to limit the installation of hose reels in cold stores. Additional requirements to permit the use of 50m hose reels are as follows:

- 50 m fire hose reels must be tested and certified to AS/NZS1221.
- The pressure and flow at the nozzle of the 50 m hose reel is to achieve compliance with the pressure and flow requirements of AS2441.1-2005.
- Coverage is to be achieved with no more than two bends in the hose.
- Staff training in the use of the 50 m length fire hose reels is to occur at least every 12 months to maintain occupant familiarity with the increased weight and length of the extended hose reels

Fire Sprinkler System

8.5.3 A fire sprinkler system shall be provided throughout the building in accordance with the relevant regulatory requirements. Each lot should have an independent system with dedicated fire pump, water supply tanks and booster assemblies.

- In the offices and beneath the warehouse awnings the system shall comply with BCA Specification E1.5 and AS2118.1:2017.
- In the warehouse a storage mode system shall be provided in accordance with BCA Specification E1.5 and AS2118.1:2017 with the sprinkler head location, spacing and design capacity in accordance with Factory Mutual Guidelines 2-0 and 8-9 (or NFPA regulations). Sprinkler activation temperature must be no greater than 101°C and have a Response Time Index (RTI) of less than $50m^{1/2}s^{1/2}$ (i.e. fast response type).

Upon sprinkler activation the automatic smoke exhaust system and building occupant warning alarm shall be initiated, as well as the direct brigade notification.

8.5.4 At the fire sprinkler booster, a dedicated hardstand for fire brigade appliances is required. As per FRNSW Guideline For Emergency Vehicle Access [7] this hardstand should be designed to be 18 m long by 6 m wide, whilst allowing other fire brigade appliances to pass.

8.5.5 Portable Fire Extinguishers

Portable fire extinguishers are to be provided throughout the building in accordance with Table E1.6 of the BCA and selected, located, and distributed in accordance with AS2444:2001.

Fire Control Centre

Each building shall be provided with a within a compliant Fire Control Centre (FCC) at the main entry.

- Lot 5 does not prescriptively require a FCC, however the design is likely to be similar in providing the Fire Indicator Panel (FIP) to the main office.
- The FCC serving Warehouse 8 is proposed to be provided within an acoustically separated enclosure, adjacent to the pump room.

In each instance, the Main FIP must be installed in accordance with BCA Specification E2.2a and AS1670.1:2018 and have the following capabilities.

- The FIP panel must be capable of isolating, resetting, and determining the fire location within the building.
- A red strobe shall be installed at the entry door to the FIP to alert arriving fire brigade of the fire alarm origin and FIP location.
- Smoke exhaust fan controls shall be provided at the FIP which shall include clear signalling of the operational status of the fans.

- Where two tenancies are proposed in the same building , a mimic panel or sub-FIP may be required . This is subject to consultation with FRNSW and can also facilitate specific functional requirements of tenants (i.e. should an alarm occur during operational hours of 1 tenancy and not the other. It may also be possible to house the FCC centrally at the pump room in an acoustically sealed enclosure.

8.6 SMOKE HAZARD MANAGEMENT

Smoke Detection System

A smoke detection system for occupant warning is unlikely to be required throughout the warehouses due to their large volume.

- In the event of future subdivisions of warehouse buildings into smaller tenancies, there might arise a need for smoke detection due to the reduced smoke reservoir volumes.

8.6.1
- In the event of travel distances in excess of the DtS Provisions being present in the building offices, detection will likely be required throughout each affected office in accordance with AS1670.1:2018

Smoke Hazard Management System

A rationalised smoke hazard management system shall be provided, designed to achieve the following minimum requirements.

8.6.2
- System capacity must be capable of an exhaust rate equal to one enclosure air change per hour, and initiated upon activation of the sprinkler system.
- Adequate make-up air should be provided at low level to facilitate the exhaust system's designed operational capacity, whilst ensuring the inlet velocity does not exceed 2.5 m/s. The make-up air should be provided at a low level by:
  - Permanently open natural ventilation louvers; and/or
  - Perforated roller shutters; and/or
  - Mechanically operated louvers that open upon activation of the fans. All motors and cables to automatic louvers, vents or supply fans must be fire rated to operate at 200°C for a period of 60 minutes.
- On/Auto/Off switches should be located at the FIP.
- Signs and a mechanical block plan alerting the fire brigade to the operation of the system must be provided.
- Fire rated fans and fire rated cabling should be designed to operate at 200°C for a period no less than 60 minutes.
- The fans shall be served by essential power and the mechanical services board serving the fans be located in a fire-rated enclosure (120/120/120) if located within the building.

8.6.3
- Multiple fans be provided and be evenly distributed to otherwise comply with the requirements of Specification E2.2b Clause 5 of the BCA.

Building Occupant Warning System

A building occupant warning system should be provided throughout all parts of each building. The system should be in accordance with the prescriptive requirements of Specification E1.5 and Clause 7 of Specification E2.2a and AS1670.1:2018.

- The occupant warning alarm should be sounded throughout all areas of the building upon activation of the smoke detection (where provided) and/or sprinkler systems.

8.7 VISIBILITY IN AN EMERGENCY

Emergency lighting and exit signage is to be provided throughout in accordance with BCA DtS Part E4 and AS2293.1:2018.

Whether through adjudication by the authority having jurisdiction (AHJ) or via a Performance Solution, it is anticipated that the directional signage at the end of the racking aisles and above block storage areas can be installed at a height greater than 2.7 m. Should a Performance Solution be desired, it shall consider the following:

- Exit signs and directional signs shall be "Jumbo size" to increase the visibility to occupants.
- The final height and location of the directional exit signs shall be determined through the fire engineering analysis.

8.8 BUILDING MANAGEMENT PROCEDURES

The ongoing management of the building is as important in maintaining a high level of life safety as the provisions recommended during the design phase of the building.

Maintenance of Fire Safety Equipment

The fire safety systems should be tested and maintained in accordance with Australian Standard AS1851 or suitable alternative testing and maintenance regime.

Evacuation Plan

An emergency management plan should be developed for the site in accordance with AS3745:2010.

8.8.1

8.8.2

9 ACRONYMS

ACRONYM	EXPANSION
ABCB	Australian Building Codes Board
AFSS	Annual Fire Safety Statement
ASET	Available Safe Egress Time
BCA	Building Code of Australia
CFD	Computational Fluid Dynamics
DtS	Deemed-to-Satisfy
EPA	Environmental Protection Authority
FCC	Fire Control Centre
FER	Fire Engineering Report
FIP	Fire Indicator Panel
FRL	Fire Resistance Level
FRNSW	Fire Rescue NSW
FSS	Fire Safety Strategy
GFA	Gross Floor Area
IFEG	International Fire Engineering Guidelines
NCC	National Construction Code
NFPA	National Fire Protection Association
OHS	Occupational Health and Safety
RSET	Required Safe Egress Time
RTI	Response Time Index

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Fire Safety Strategy

WH9

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Report Revision History

REV	DATE ISSUED	COMMENT	PREPARED BY	REVIEWED BY
01	11/03/2022	Draft Issue for comment	**Christie Tran** *BEng (Mechanical)* *MEng (Fire Protection)*	**Graham Morris** *MEng (Structural and Fire Safety)* *MIEAust, CPEng, NER (Fire Safety)*
02	27/05/2022	Revised for updated plan (Mod 2)	**Dean Watt** *BEng (Chemical)(Hons)* *MEng (Fire Safety)*	
03	17/06/2022	Revised for updated plan (Mod 2)		
04	03/08/2022	Revised for updated plans & renaming convention to Mod 3.		

EXECUTIVE SUMMARY

CORE Engineering Group has been engaged by Mirvac to develop a Fire Safety Strategy (FSS) for the construction of a warehouse facility (WH9) at Lots 54-58 DP1285305 Mamre Road, Kemps Creek.

This FSS provides an overview of the design, construction and management requirements considered necessary to achieve an acceptable level of life safety within the building.

A fully prescriptive approach of complying with the Building Code of Australia 2019 Amendment 1 (BCA) [1] Deemed-to-Satisfy (DtS) provisions for occupant egress, fire resisting construction, fire services, and fire brigade intervention is unlikely to satisfy the desired architectural and client aspirations.

As such, Performance Solutions have been proposed to account for the following items which can satisfy the Performance Requirements of the BCA rather than the DtS Provisions:

- C2.4 – Vehicular Perimeter Access
- D1.4 – Extended travel distances to the nearest exit within warehouse building
- D1.5 – Distances between alternative exits within warehouse building
- E1.3 – External hydrants positioned beneath awnings
- E1.5 – Sprinkler system design
- E2.2 – Rationalised automatic smoke exhaust system

This FSS provides a holistic summary of the fire and life safety measures anticipated to be necessary in developing the above listed Performance Solutions. These measures include passive and active fire protection systems, egress provisions, occupant first aid firefighting, fire brigade intervention, and future building management provisions.

The fire strategy presented herein shows that the built form proposed is capable of meeting the Performance Requirements of the BCA.

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1 INTRODUCTION

1.1 OVERVIEW

This Fire Safety Strategy has been undertaken to nominate proposed Performance Solutions for assessing compliance with the nominated Performance Requirements of the BCA [1] in accordance with the methodologies defined in the International Fire Engineering Guideline IFEG [3].

In order to develop and assess the nominated non-compliances the following flowchart process is to be adopted.

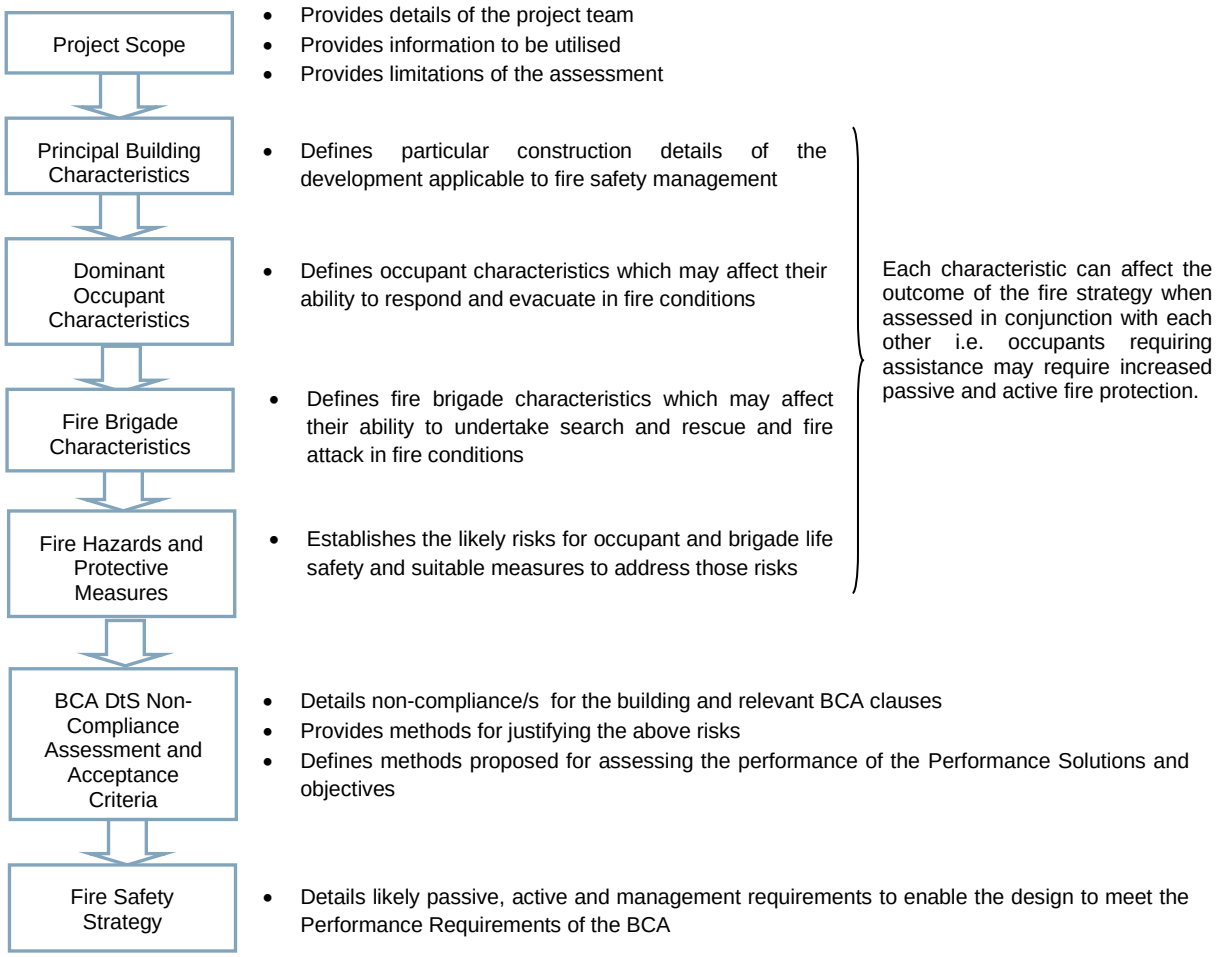


Figure 1-1: Fire Safety Strategy Process

The scope of the FSS is to detail the nominated departures that do not prescriptively meet the Deemed-to-Satisfy (DtS) Provisions of the BCA, assess these in regard to the appropriate Performance Requirements, and provide methodologies for establishing a workable and safe FSS to be verified further through the Performance Based Design Brief Process.

1.2 FIRE SAFETY OBJECTIVES

This FSS highlights the proposed Performance Solutions to be considered in the fire engineering assessment, for the development of a Fire Engineering Report (FER). This fire engineering assessment is one which will satisfy the performance requirements of the BCA whilst maintaining an acceptable level of life safety, protection of adjacent property, and provide adequate provisions for fire brigade intervention. At a community level, fire safety objectives are met if the relevant legislation and regulations (such as the BCA) are complied with. As stated in the BCA, "*A Building Solution will comply with the BCA if it satisfies the Performance Requirements*". In addition to this, certain non-regulatory objectives exist as detailed below.

1.2.1 Building regulatory objectives

The following items are a summary of the fire and life safety objectives of the BCA:

- **Life safety of occupants -** the occupants must be able to leave the building (or remain in a safe refuge) without being subject to hazardous or untenable conditions. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of exposing building occupants to hazardous or untenable conditions in an event of a fire.
- **Life safety of fire fighters -** firefighters must be given a reasonable time to rescue any remaining occupants before the onset of hazardous conditions or building collapse occurs. The objective of the fire engineering assessment is to demonstrate that the proposed building design and fire safety systems would facilitate fire brigade intervention and minimise the risk of exposing firefighters to hazardous or untenable conditions in an event of a fire.
- **Protection of adjoining buildings** - structures must not collapse onto adjacent property and fire spread by radiation should not occur. The objective of the fire engineering assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of fire spreading from one building to another.

1.2.2 Fire Brigade objectives

The overall philosophical Fire Brigade objectives throughout Australia are to protect life, property and the environment from fire according to the Fire Brigade Intervention Model (FBIM) [5] as per the Fire Services State and Territory Acts and Regulations.

Over and above the requirements of the BCA, the Fire Brigade has functions with regard to property and environmental protection and considerations regarding occupational health and safety for its employees.

1.2.3 Non-prescribed objectives

Fire Engineering has an overarching benefit to many facets of the built environment where non-prescribed objectives can have an influence on the FSS adopted. Although not assessed within, the following can be considered if requested.

- **Business continuity -** will the loss of a particular facility due to fire / smoke damage result in excessive financial impact on the client? For example, is the facility critical to business continuity?
- **Public perception -** should a fire occur within the facility is there likely to be questionable public perception about the safety and operation of the facility?
- **Environmental protection -** fires of excessive sizes can have significant effects on the environment which may require a detailed risk assessment to minimise such outcomes.
- **Heritage salvation -** buildings can have a heritage value for both cultural and educational purposes which can be destroyed by insufficient fire protection.
- **Risk mitigation / insurance limitations -** are there specific limitations on insurance with respect to risk mitigation and fire safety design? i.e. Does the relevant insurer have concerns with respect to open voids through the building?
- **Future proofing (isolation of systems) -** what flexibility is required in the overall design to allow for future development or changes in building layout?
- **Occupational Health and Safety (OHS) requirements -** buildings may have specific fire safety requirements pertaining to OHS requirements.

1.3 REGULATORY FRAMEWORK OF THE FIRE ENGINEERING ASSESSMENT

1.3.1 Building Code of Australia

One of the goals of the BCA is the achievement and maintenance of acceptable standards of safety from fire for the benefit of the community. This goal extends no further than is necessary in the public interest and is considered to be cost effective and not needlessly onerous in its application.

Section A2.1 of the BCA [1] outlines how compliance with the Performance Requirements can be achieved, being satisfied by one of the following:

(a) A Performance Solution which demonstrates–

  (i) Compliance with all relevant Performance Requirements; or

  (ii) The solution is at least equivalent to the Deemed-to-Satisfy Provisions; or

(b) A Deemed-to-Satisfy Solution; or

(c) a combination of (1) and (2).

Section A2.2 of the BCA provides several different methods for assessing that a Performance Solution complies with the Performance Requirements, through one or a combination of the following Assessment Methods:

(a) Evidence of suitability that shows the use of a material, product, form of construction or design meets the relevant Performance Requirements.

(b) A Verification Method including the following:

  (i) the Verifications Methods in the NCC; or

  (ii) other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements.

(c) Expert Judgement.

(d) Comparison with the Deemed-to-Satisfy Provisions.

Where a Performance Requirement is satisfied entirely by a Performance Solution, the following method must be used to determine the Performance Requirements relevant to the Performance Solution:

(a) Identify the relevant Performance Requirement from the Sections or Part to which the Performance Solution applies.

(b) Identify Performance Requirements from other Sections of Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Performance Solution.

Under Section A2.4, the following method must be used to determine the relevant Performance Requirements when using a Performance Solution in combination with a Deemed-to-Satisfy Solution: These methods are summarised as follows:

(a) Identify the relevant Deemed-to-Satisfy Provisions of each Section or Part that are to be the subject of the Performance Solution.

(b) Identify the Performance Requirements from the same Section or Part that are relevant to the identified Deemed-to-Satisfy Provisions.

  (i) Identify Performance Requirements from the other Sections and Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Deemed-to-Satisfy Provisions that are the subject of the Performance Solution.

1.3.2 International Fire Engineering Guidelines

The IFEG [3] document has been developed for use in fire safety design and assessment of buildings, and reflects international best practice. The document is intended to provide guidance for fire engineers as they work to develop and assess strategies that provide acceptable levels of safety.

The document is particularly useful in providing guidance in the design and assessment of Performance Solutions against the Performance Requirements of the BCA. The prescribed methodology set out in the IFEG will be generally adopted in the FER.

2 PROJECT SCOPE

2.1 OVERVIEW

CORE Engineering Group has been engaged by Mirvac to develop a Fire Safety Strategy (FSS) for the construction of a warehouse facility (WH9) at Lots 54-58 DP1285305 Mamre Road, Kemps Creek.

The purpose of this FSS is to outline the fire engineering principles to be considered in ensuring that the built form proposed is capable of meeting the Performance Requirements of the BCA and thus permitting development approval.

The complete fire engineering analysis will be included within the FER, and as such is not documented herein. This document does however outline the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building as a result of the Performance Solution and to satisfy the Performance Requirements of the BCA.

2.2 RELEVANT STAKEHOLDERS

This Performance Solution has been developed collaboratively with the relevant stakeholders as identified below:

Table 2-1: Relevant Stakeholders

ROLE	NAME	ORGANISATION
Development Manager	Daniel Brook Stephen Foster	Mirvac
Principal Certifying Authority	Dean Goldsmith	Blackett Maguire + Goldsmith
Architect	Richard Prince	SBA Architects
Fire Engineer	Dean Watt	CORE Engineering Group
Register Certifier – Fire Safety	Graham Morris	

It should be noted that at times some parties may have a vested interest in the outcome of the Fire Engineering assessment. Such parties can include local fire brigades, insurers, Environmental Protection Authority (EPA), project control groups, end users and community representatives. Although not always a legislative requirement, the design team should give due consideration to their inclusion in the Fire Engineering process. Where not required by legislation it is the client's decision to involve such parties, especially local fire brigade, to ensure a transparent and adequate fire safety solution for all. Where we are not notified of the inclusion of such parties it is assumed the client / representative has given due consideration to the above.

2.3 SOURCES OF INFORMATION

The following sources of information have been provided by the design team:

- Architectural plans by SBA Architects:
  - SSDA-Mod 3 Estate Masterplan – MP3-02 (Rev A), dated 28 July 2022.
  - Lot 9 Site & Warehouse Floor Plan – DA910 (Rev K), dated 25 May 2022.

2.4 LIMITATIONS AND ASSUMPTIONS

In this instance the FSS is developed based on applicable limitations and assumptions for the development which are listed as follows:

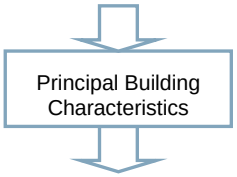
- The report is specifically limited to the project described in Section 3.
- The report is based on the information provided by the team as listed above in Section 2.3.
- Building and occupant characteristics are as per Section 3 and 4 respectively of this report. Variations to these assumptions may affect the FSS and FER, and therefore should be reviewed by a suitably qualified Fire Engineer should they differ.
- As per any building design, DtS or otherwise, the report is limited to the fire hazards and fuel loads as prescribed in the IFEG [3]. The report does not provide guidance in respect to areas which are used for

Dangerous Goods (DG) storage, processing of flammable liquids, explosive materials, multiple fire ignitions, or sabotage of fire safety systems.

- The development complies with the fire safety DtS provisions of the BCA [10] with all aspects in regards to fire and life safety unless otherwise stated in this report. Where not specifically mentioned, the design is expected to meet the BCA DtS requirements of all relevant codes and legislation at the time of construction and/or at the time of issue of this report.
- The assessment is limited to the objectives of the BCA and does not consider property damage such as building and contents damage caused by fire, potential increased insurance liability, and loss of business continuity.
- Malicious acts or arson with respect to fire ignition and safety systems are limited in nature and are outside the objectives of the BCA. Such acts can potentially overwhelm fire safety systems and therefore further strategies such as security, housekeeping, and management procedures may better mitigate such risks.
- This report is prepared in good faith and with due care for information purposes only, and should not be relied upon as providing any warranty or guarantee that ignition or a fire will not occur.
- The FSS and FER is only applicable to the completed building. This report is not suitable, unless approved otherwise, to the building in a staged handover.
- Where parties nominated in Section 2.2 have not been consulted or legislatively are not required to be, this report does not take into account, nor warrant, that fire safety requirements specific to their needs have been complied with.

3 PRINCIPAL BUILDING CHARACTERISTICS

3.1 OVERVIEW



Building characteristics are assessed as part of the fire engineering assessment due to the following:

1. The location can affect the time for fire brigade intervention and potential external fire exposure issues.
2. The structure will impact on the ability to resist a developing fire and support condition to allow occupants to escape the building and the fire brigade to undertake fire fighting to the degree necessary.
3. The floor area determines the potential fire size and area required to be evacuated in the event of a fire.
4. BCA details such as Type of Construction, Class and Height will dictate passive and active fire safety systems.

3.2 SITE LOCATION

The development site is located in Kemps Creek, approximately 40 km west of Sydney's central business district. The Kemps Creek site consists of eleven lots located on Mamre Road Lots 54-58 on DP 259135. The internal roads within the estate are yet to be named.

Figure 3-1: Site Location

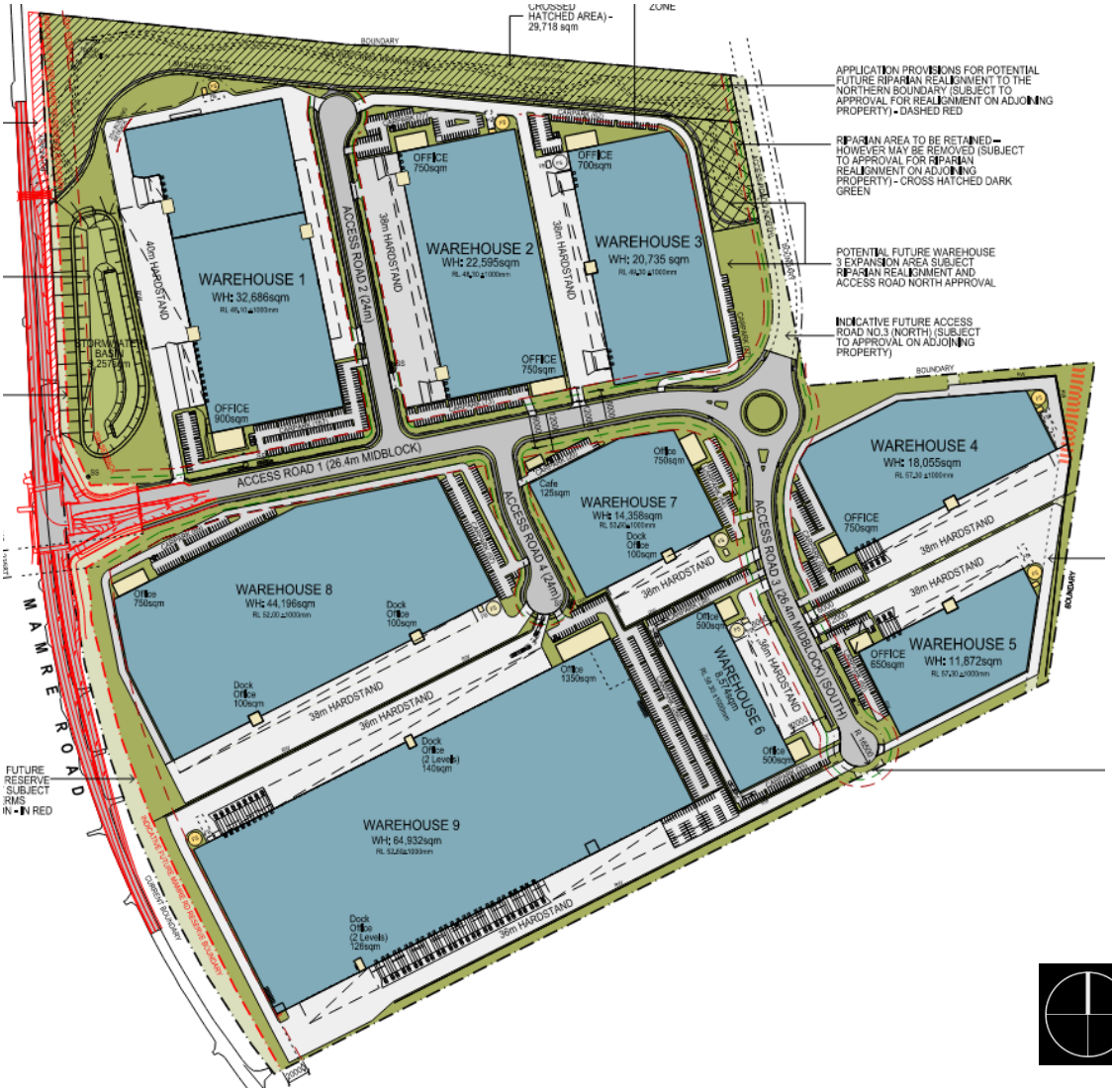


Figure 3-2: Lot 9 location with respect to master plan

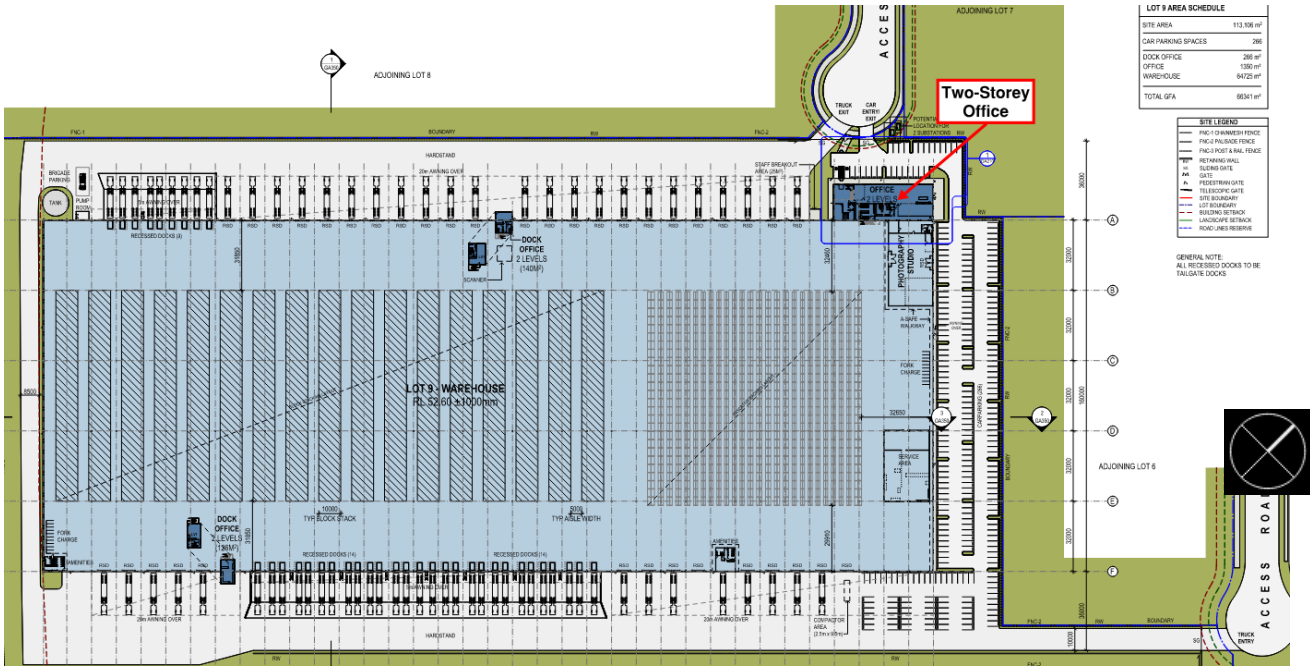


Figure 3-3: Lot 9 Development Plan

The building site influences the likely fire brigade intervention times and given the close proximity to the nearest fire station is expected to facilitate a relatively convenient and expedient fire brigade response. Furthermore, being located in an outer suburb of a major city, the development is provided with the services and facilities expected in an urban setting. The two nearest fire brigade stations provided with permanent staff are St Marys and Bonnyrigg Heights approximately 10 km and 11 km from the site respectively when considering actual driving distances.

3.3 SITE LAYOUT

Lot 9 of the development plan consists of Warehouse 9 as illustrated in Figure 3-3. This report addresses fire safety strategy for Lot 9 (Warehouse 9).

Lot 9 is located at the south-western corner of the site. The total area of Warehouse 9 is ~66,548 m². The facility also includes a two (2) storey office and multiple dock offices.

3.4 BUILDING STRUCTURE

The warehouse shall be constructed as a steel portal frame structure with dado panel walls and a metal sheet roof.

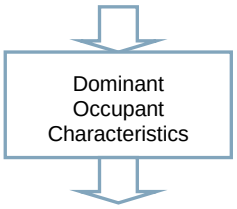
3.5 BCA ASSESSMENT SUMMARY

Table 3-1: BCA Building Characteristics

CHARACTERISTIC	DESCRIPTION (Relevant to both buildings)
Classification	Class 7b (Warehouse) and Class 5 (Office)
Construction Type	Type C (Large-Isolated Building)
Rise in Storeys	Two (2)
Effective Height	Less than 12 m
Floor Area and Volume	~66,341 m² (Greater than 18,000 m² and 108,000 m³)

4 DOMINANT OCCUPANT CHARACTERISTICS

4.1 OVERVIEW



The occupant characteristics are assessed within the Fire Safety Strategy due to the following:

1. Population numbers can dictate the time required to evacuate the building and the required life safety systems to be provided due to evacuation times.
2. Physical and mental attributes affect the occupants' capacity to respond to various fire cues and react accordingly.
3. Familiarity of occupants can affect the time taken to evacuate the building and subsequent active / passive requirements.

4.2 OCCUPANT NUMBERS AND DISTRIBUTION

The BCA assumes the following occupant densities per an area's function and use according to Table D1.13 [10]:

- Warehouse: 30m² per person
- Office: 10m² per person

In the absence of specific occupant numbers provided by the tenant, the population estimated from Table D1.13 of the BCA DtS Provisions will be utilised in the analysis, therefore providing a conservative population in the warehouse parts.

It is noted that these numbers provide conservative inputs to the fire engineering analysis and do not form the requirements for amenities and the like.

4.3 OCCUPANT ATTRIBUTES

Occupants in the building may be of mixed age, although the elderly and children are not expected to be present. The population is therefore expected to be that of the general working public and be adults between the ages of 16 to 70. Due to the nature of the work conducted the majority of occupants are assumed to be able bodied people, however there may be a small number of less mobile or visually impaired occupants in the office portion of the building.

All occupants are expected to be awake and alert adults or in the direct company of an adult, capable of entering the leaving the building under their own volition. Occupants in all of these areas are not expected to be adversely impaired by drugs, alcohol, fatigue or other adverse conditions to degrees greater than in other warehouse and office buildings.

4.4 OCCUPANT FAMILIARITY

The majority of occupants within the building are expected to be staff and therefore the population in general are likely to react favourably in an emergency situation.

- Staff, Maintenance and Security can be expected to have a good familiarity with the building and the fire safety systems provided and may be trained in emergency procedures; and
- Clients / Visitors may or may not be familiar with the layout of the building and may require assistance in locating the exits; and
- External Maintenance Contractors are expected to have a reasonable familiarity with the building as they would have to undergo site specific induction prior to commencement of work on site; and
- FRNSW are not expected to have any familiarity of the building layout, however are assumed to obtain the required information from the site block plans and tactical fire plans available prior to entering the building.

4.5 EMERGENCY TRAINING

Occupants should be familiar with escape procedures through fire drills and designated fire wardens being appointed to mitigate risks under Workplace Health and Safety legislation (AS3745:2010). Clear escape routes should be maintained with doors unlocked, and no obstructions or rubbish to hinder evacuation.

Staff and visitors are not expected to have fire suppression training and such training is not relied upon for this building population; however staff are expected to possibly attempt to extinguish a fire or limit fire spread by removing objects in the vicinity of the fire in order to defend their belongings.

5 FIRE BRIGADE CHARACTERISTICS

5.1 OVERVIEW

Fire brigade characteristics are assessed within the FSS as brigade characteristics can dictate the time required for fire brigade intervention including search and rescue, and fire attack.

5.2 FIRE BRIGADE ASSESSMENT

Figure 5-1 illustrates the site plan with respect to the fire services provided on the site. These include:

- Perimeter access provided around Lot 9 (noting there are associated non-compliances)
- Fire sprinkler tank and booster, pump room and dedicated appliance bay for Lot 9
- Proposed location of Fire Control Centre (FCC)
- Proposed location of fire hydrant booster (TBC) – noting it must be located more than 10 m from substations

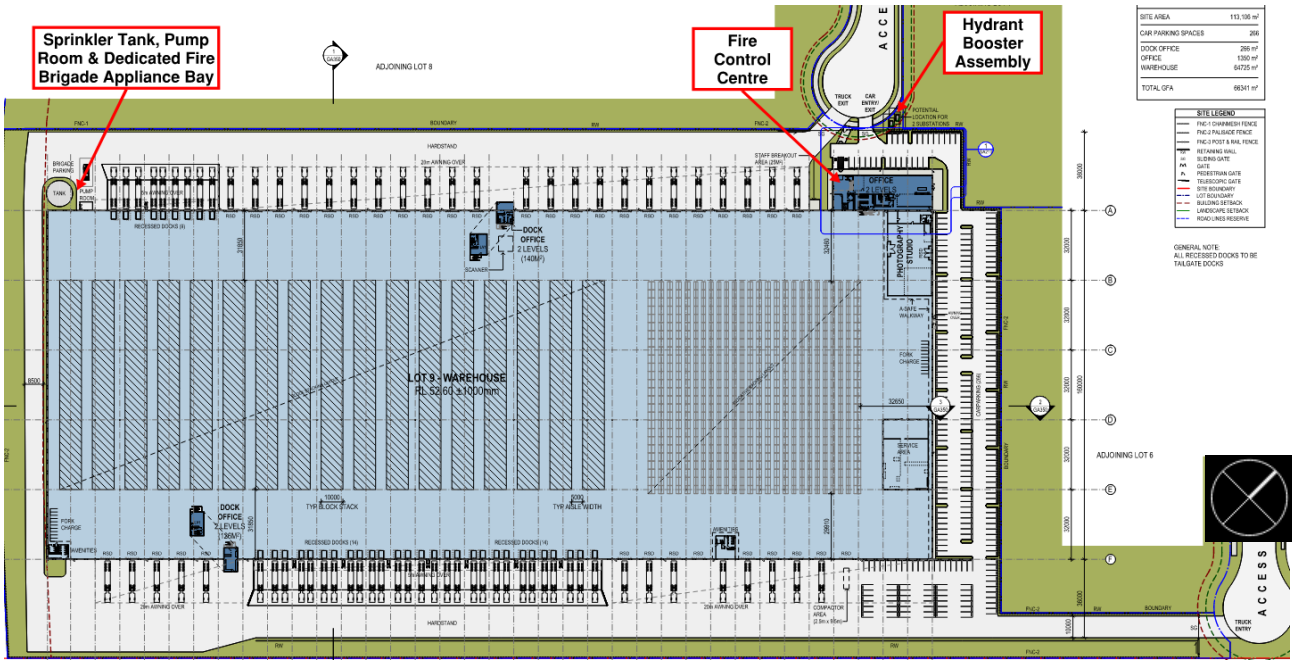


Figure 5-1: Fire Brigade Access and Site Facilities

The building is located within the Fire and Rescue New South Wales (FRNSW) jurisdictional turnout area. The closest two fire stations to the site that are provided with permanent staff are located in St Marys and Bonnyrigg Heights approximately 10 km and 11 km.

6 FIRE HAZARDS AND PROTECTIVE MEASURES

6.1 OVERVIEW

The fire hazard analysis forms the basis for the review of non-compliances within the building. In assessing expected and statistically validated hazards, preventative and protective measures are developed commensurate with those expected risks. The following section reviews applicable hazards and recommends possible measures to address those risks. Furthermore, the hazards identified can form a justified basis for selected scenarios.

6.2 FIRE HAZARDS

Subsequent to a review of the relevant documentation, the identified fire hazards specific to Lot 9 of this site are summarised below.

6.2.1 Combustible External Cladding

As the buildings require Type C construction, there is no restriction on combustible materials within the external walls of the buildings. Regardless, should the design propose any combustible elements, a detailed review and risk assessment is recommended.

6.2.2 Photovoltaic Cells

No PV cells have been identified at this stage; however, it is anticipated that these will be incorporated in the design. The following general design guidance is provided in order to limit any electrical exposure to evacuating occupants or attending fire fighters.

- Warning signs are to be provided on or adjacent to the Fire Indicator Panel which:
  - Shall be of all-weather fade resistant material with lettering on a contrasting coloured background; and
  - Provide notice of the type of alternative electrical generation system and the location of any isolation/shut off switches.

6.2.3 Insulated Sandwich Panels

At this stage of the project, it is understood that no insulated sandwich panels are proposed within WH9.

6.2.4 Dangerous Goods

At this stage of the project, no Dangerous Goods storage requirements have been identified.

6.3 PREVENTATIVE AND PROTECTIVE MEASURES

The following measures are anticipated within the building to limit fire spread and the exposure to occupants and fire brigade. These are categorised in accordance with the sub-systems listed in the IFEG.

6.3.1 Fire Initiation and Development and Control (Sub-System A)

To minimise the risk of fires initiating and growing to a size which may impact on the building occupants, fire safety systems are to be utilised within the building as listed in the following sections. The following general advice may also be provided to limit the likelihood of fire initiation and development.

- Flammable materials should be stored away from ignition sources where possible.
- Scheduled maintenance of all electrical equipment / switchboards
- Adhere to safe operating procedures for ‘hot work’ (e.g. welding).
- No smoking policy

6.3.2 Smoke Development and Spread and Control (Sub-System B)

It is recognised that smoke is one of the most serious threats to life safety in the event of a fire. Whilst the automatic smoke exhaust system for this facility shall be rationalised, the following are anticipated:

- Large smoke reservoir due to volume of building.

- Automatic smoke exhaust system initiated upon sprinkler activation, achieving a capacity of 1 volume air change per hour.

6.3.3 Fire Spread and Impact and Control (Sub-System C)

To limit the extent and impact of fire spread through the buildings, the following are to be implemented in the building.

- Type C construction
- Fire sprinkler system

6.3.4 Fire Detection, Warning and Suppression (Sub-System D)

The following active systems are to be used within the buildings to facilitate occupant warning and suppress a potential fire.

- Occupant warning system
- Storage / suppression mode sprinkler system at warehouse roof level
- Sprinkler system throughout other areas
- Fire hose reels
- Fire extinguishers

6.3.5 Occupant Evacuation and Control (Sub-System E)

The buildings are to be provided with the following systems to assist in the evacuation of occupants:

- Emergency lighting
- Exit signage
- Exits direct to outside
- Multiple exits located on all four sides of building

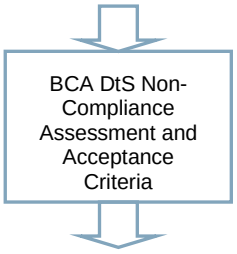
6.3.6 Fire Services Intervention (Sub-System F)

The building is to be provided with the following systems to assist in fire brigade intervention:

- Fire hydrant system, using external hydrants where possible, however it is noted that due to the extent of the facility internal hydrants are required.
- Automatic link to fire brigade
- Perimeter vehicular perimeter access in a forward direction.
- FCC within the main office lobby
- Sprinkler tank, booster and pump
- Local fire brigades in close vicinity supported by full time staff

7 BCA DTS NON-COMPLIANCE ASSESSMENT

7.1 OVERVIEW



In this instance the BCA DtS non-compliances have been formulated based on the anticipated regulatory review to be provided by the principal certifying authority. Where not listed herein the building is required to achieve compliance with relevant DtS provisions or if existing, comply with relevant codes, reports and / or Standards approved at the time of consideration.

The following table lists the departures from the DtS provisions of the BCA for the proposed building and the analysis methodology proposed for the Fire Engineering assessment, which is to be generally in accordance with the IFEG [3].

7.2 BCA DTS NON-COMPLIANCE ASSESSMENT

The non-compliances specific to Lot 9 are listed in Table 7-1 below.

Table 7-1: Summary of Performance Solutions – Lot 9

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
Vehicular Perimeter Access **BCA DtS Provisions** Provision C2.4: Requirements for open spaces and vehicular access **Performance Requirements** CP9	**Relevant BCA DtS Provisions** Provision C2.4: Each building must be provided with continuous vehicular access with a minimum unobstructed width 6 m where the furthest distance from the external wall of the building and the path is not more than 18 m for emergency vehicle access. **DtS Variation** Perimeter vehicular access is greater than 18 m from the building, being approximately 40 m at the northern corner upon approach to the carpark entry / the truck exit from access road 4, due to the configuration of the driveways. **Performance Solution** The Performance Solution shall rely upon the fact that staging locations are available at the corners of the warehouses for firefighting and pedestrian access and smaller emergency vehicles can provide firefighters access to the building in areas of non-conformance.
Extended Travel Distances **BCA DtS Provisions** Provision D1.4: Exit travel distances Provision D1.5: Distance between alternative exits Provision E2.2: Smoke hazard management –	**Relevant BCA DtS Provisions** Provision D1.4: In a Class 7b building, the maximum travel distance must not exceed 40 m when 2 or more exits are available. Provision D1.5: The distances between alternative exits must not exceed 60 m. Provision E2.2: Automatic smoke exhaust must be provided in Class 7b buildings which exceed 18,000 m² in floor area or 108,000 m³ in volume. **DtS Variation** • The overall travel paths in WH9 are likely to be up to 110 m to the nearest exit and 220 m between alternative exits (when including travel underneath the 20 m awnings). • A rationalised automatic smoke exhaust system is proposed with a capacity of 1 volume air change per hour **Performance Solution** The Performance Solution relies upon: • The volume of the warehouse enclosures providing a large smoke reservoir hence longer time is available for occupant egress before the smoke descends. • The automatic smoke exhaust system is initiated upon sprinkler activation.

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
General requirements **Performance Requirements** DP4, EP2.2	• The population density inside the warehouse is expected to be low where the occupants are likely to be awake and able-bodied to evacuate while the tenability within the warehouse is maintained. • The awnings shall be demonstrated to be a place of safe refuge (through CFD modelling and analysis).
Fire Hydrants Under Awnings **BCA DtS Provisions** Provision E1.3: Fire hydrant **Performance Requirements** EP1.3	**Relevant BCA DtS Provisions** Provision E1.3: requires that a fire hydrant system is provided and installed in accordance with AS2419.1, which in turn requires internal hydrant to achieve coverage from a single hose length. **DtS Variation** • Hydrants located beneath warehouse awnings shall be treated as external hydrants, thereby allowing two hose lengths for coverage. • External hydrants shall not be afforded the protection of a 90/90/90 FRL radiant heat shield 3 m above and 2 m either side of hydrant connection points. **Performance Solution** The hydrants located beneath the awnings are to have all the requirements of an external hydrant per AS2419.1:2005, except that they are located under the building footprint and are not provided with 90/90/90 FRL heat shields. Fall-back hydrants are to be provided on the respective hardstands to provide coverage under the awnings.
Fire Hose Reels **BCA DtS Provisions** Provision E1.4: Fire hose reels **Performance Requirements** EP1.1	**Relevant BCA DtS Provisions** Provision E1.4: requires that a fire hose reel system is required to serve any fire compartment greater than 500 m². AS2441:2005 requires that fire hose reels are a maximum 36 m in hose length. **DtS Variation** The use of 50 m fire hose reels is proposed throughout the warehouse. **Performance Solution** The Performance Solution relies upon: • 50 m fire hose reels must be tested and certified to AS/NZS1221. • The pressure and flow at the nozzle of the 50 m hose reel is to achieve compliance with the pressure and flow requirements of AS2441.1-2005. • Coverage is to be achieved with no more than two bends in the hose. • Staff training in the use of the 50 m length fire hose reels is to occur at least every 12 months to maintain occupant familiarity with the increased weight and length of the extended hose reels.
Sprinkler Booster Location **BCA DtS Provisions** Provision E1.5: Sprinklers **Performance Requirements** EP1.4	**Relevant BCA DtS Provisions** Specification E1.5: An automatic fire sprinkler system must comply with AS 2118.1 for all building classifications, which specifies that the fire brigade booster assembly shall conform to requirements of AS 2419.1. This requires fire brigade assemblies to be located within sight of the main entrance to the building. **DtS Variation** The location of the sprinkler booster is not within sight of the main entrance therefore does not comply with the provisions above. **Performance Solution** The sprinkler booster shall be positioned such that they are accessible directly via the perimeter access path and have a dedicated hardstand in accordance with FRNSW guidelines.

8 PROPOSED FIRE SAFETY STRATEGY

8.1 OVERVIEW

The FSS outlined below has been proposed to satisfy the fire and life safety objectives specified for this project by the relevant stakeholders. In addition, the FSS is required to adequately address the specific fire and life safety hazards identified for the proposed development, and as such have been generally derived from the preventative and protective measures outlined within the BCA, and fire engineering literature and research. Where items of non-compliance have not been identified by the design team in the concept design phase, it is expected that those items will be DtS solutions.

This section provides guidance for the design and application of fire safety measures. It highlights specific design considerations for a range of fire safety measures that will undergo analysis as part of the FER to ascertain whether the relevant Performance Requirements of the BCA are satisfied. Design guidance (general informative details and specific requirements) for a range of specific fire safety measures is provided. This list is not exhaustive and the use of other fire safety measures including new technologies will require additional review.

8.2 PASSIVE FIRE PROTECTION

8.2.1 Type of Construction Required

Each building shall be built in accordance with the BCA DtS provisions for Type C fire-resisting construction, as a large-isolated building.

8.2.2 Combustibility of External Wall

As the buildings require Type C construction, there is no prescriptive requirement for materials in the external wall build-up to be non-combustible. However, given the global scrutiny on combustible façade materials, it is recommended to specify non-combustible cladding materials.

8.3 VEHICULAR PERIMETER ACCESS

The vehicular perimeter access pathway should be provided around the whole of the building. This should be designed and constructed with an all-weather surface capable of supporting all FRNSW appliances in accordance with BCA Clause C2.4 and the FRNSW Fire Safety Guideline '*Access for Emergency Vehicles And Emergency Service Personnel*', available at http://www.fire.nsw.gov.au, with the following exceptions permitted:

- Perimeter vehicular access at the northern corner of the Lot 9 warehouse is up to approximately 40 m from the external wall of the building in lieu of 18 m (Figure 8-1).
- The load-bearing capacity and vehicle swept path of the vehicular access paths and carparks must be compatible with fire brigade vehicle requirements.

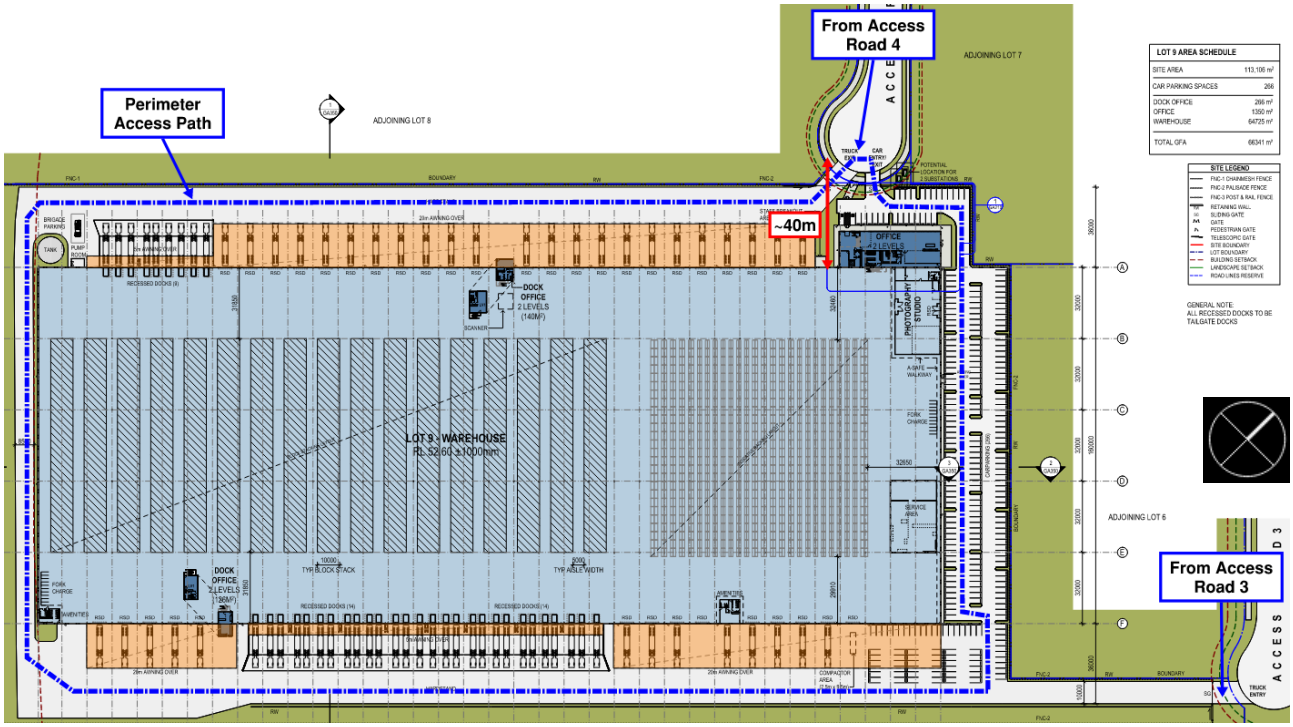


Figure 8-1 Warehouse 9 Perimeter Access

To facilitate the perimeter access non-conformances, the following measures should be provided as part of the Performance Solution:

- All gates, security fencing, and boom gates should be readily openable by the fire authorities. This can be achieved through one, or a combination of, the following [7]:
  - Any vehicle access gate that is required to be locked should be secured with a non-hardened metal chain and lock.
  - All locks fitted to vehicle access gates and security devices are to be keyed alike, and a copy of the key deposited with the two nearest FRNSW fire brigade stations or kept with the site security if 24/7 security is provided for the site.
  - Any electrically operated vehicle access gate or security device should incorporate either mechanical override, fail-safe open mode, or activated by site security so that fire appliances can access the site in the event of fire.

8.4 EGRESS PROVISIONS

8.4.1 Evacuation Strategy

Activation of any sprinkler head should initiate the evacuation of all areas of the building. Dedicated fire wardens from the warehouse and office areas should ensure that all clients, visitors, and staff are promptly evacuated.

8.4.2 Travel Distances

In the warehouse, the following preliminary extended travel distances have been identified.

- The overall travel paths in WH9 are likely to be up to 110 m to the nearest exit and 220 m between alternative exits, when including travel underneath the 20 m awnings.
- However, the awnings shall be demonstrated as being equivalent to open space through CFD modelling, due to the free venting capacity afforded. Ergo, travel distances within WH9 are anticipated as being assessed as up to 90 m to the nearest exit and 180 m between alternative exits.

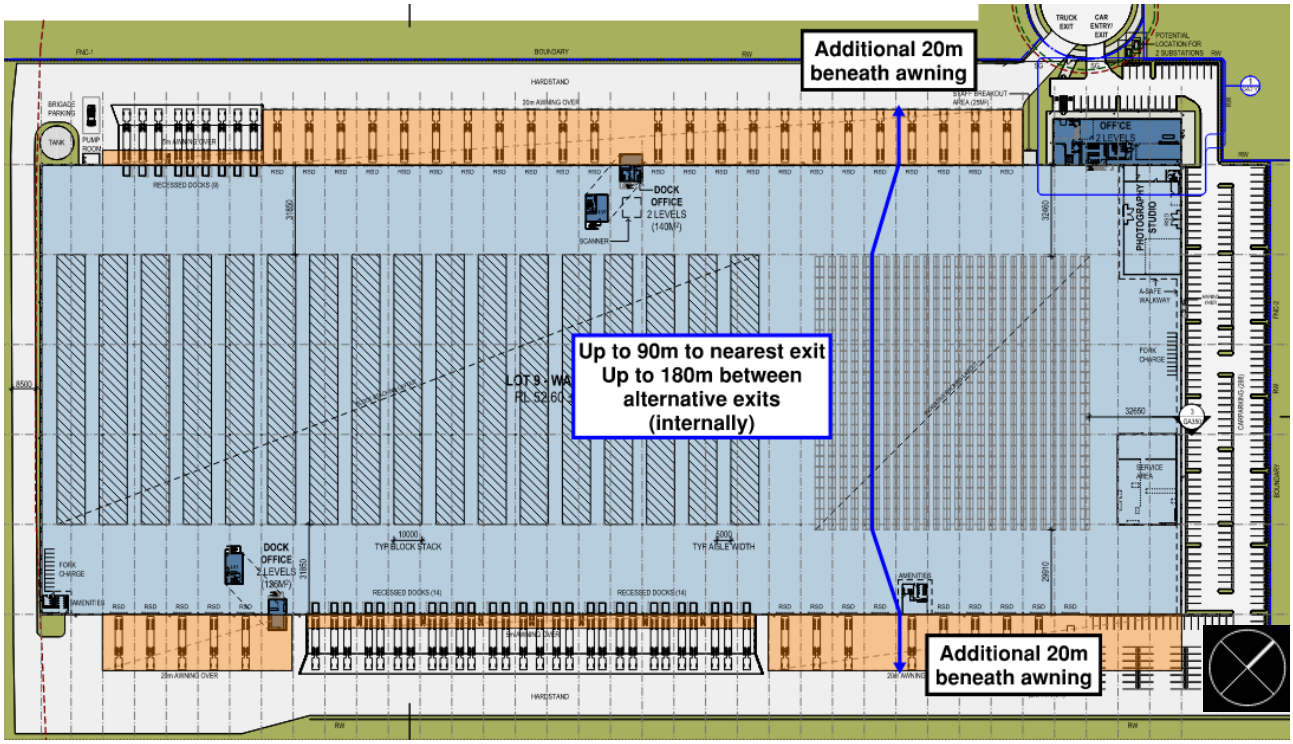


Figure 8-2 Extended Travel Distances – Lot 9

It is anticipated that these distances can be addressed through a Performance Solution involving detailed computational smoke modelling and evacuation analysis.

8.4.3 Door Hardware, Operation and Mechanisms

All exit doors and doors in a path of travel to an exit are required to be DtS compliant throughout the building. This includes the swing of doors, the applied latching and locking mechanisms and the force required on mechanism used to open doors.

8.5 FIRE FIGHTING EQUIPMENT

8.5.1 Fire Hydrants

A dedicated fire hydrant system is proposed in accordance with BCA Provision E1.3 and AS2419.1:2005. The following additional guidance is provided:

- As far as possible, the hydrant system should consist of external hydrants.
  - Due to the proposed extent of this facility the provision of internal fire hydrants to achieve floor coverage in accordance with the requirements of AS2419.1 is required, and therefore such hydrants should be located to allow progressive movement of firefighters towards the central parts of the building, per the request of FRNSW, i.e. when working from an external hydrant, the next additional hydrant should be located into the building not more than 50 m from the external hydrant.
  - When working from an internal hydrant (either from within a fire isolated exit or passageway, within 4 m of an exit or another additional hydrant), the next additional hydrant should be located not more than 25 m from that hydrant.[1]
  - An external hydrant should be provided adjacent to or within close proximity of each external entry/exit point around the building.
- All points on the floor shall be within 100 m of an external hydrant, as per FRNSW recommendation (refer next item, whereby hydrants located beneath warehouse awnings can be considered external).
- Hydrants located beneath the warehouse awnings can be considered as external for coverage of the internal warehouse parts, by way of a Performance Solution.

1 25 m and 50 m distances have been recommended to make allowance for shorter-than-standard hoses (repairs etc.) and unknown variables in the building layout and fixtures etc.

- The hydrants under the awning must be designed with all requirements of external hydrants, other than that heat shields which are not required.
- Fall-back hydrants are to be provided to serve these hydrants located beneath awnings, as per Figure 8-3.

The system for each building must incorporate a ring main with isolation valves that are external to the building and numbered with the corresponding numbers indicated on the block plan at the booster assembly.

- All hose connections in the system are to be fitted in accordance with FRNSW Technical information sheet – FRNSW compatible hose connections (available at firesafety.fire.nsw.gov.au). These couplings should be tested as part of the system when the commissioning tests are undertaken.
- The hydrant booster assembly for each building is proposed to be located at the entrance to the lot within sight of the main building entry.

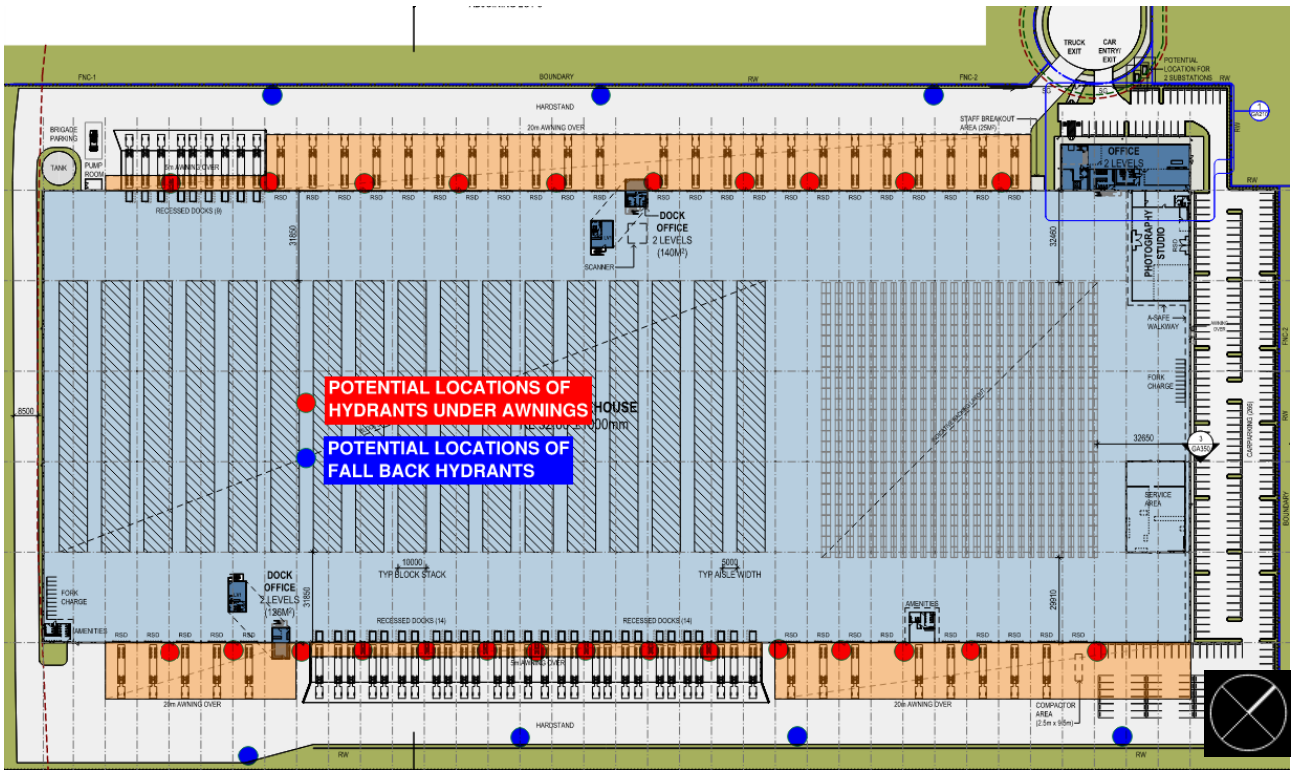


Figure 8-3 Potential locations of external hydrants and fall back hydrants

Note: AS2419.1:2021 has been gazetted in NCC 2022 (preview) which shall be applicable as of 1 September 2022. As such, for any CC subsequent to that date, AS2419.1:2021 will be the DtS compliant standard of performance.

Further, specific to industrial facilities, the scope of AS2419.1:2021 is limited to:

- *"Class 7b or 8 building having a total volume not more than 108,000 m³".*
- *"Buildings that do not include automatic racked storage systems"*.
- *"Buildings and associated areas that do not include special hazards"*.

However, guidance is provided in Appendices C & E of AS2419.1:2021 for the holistic design of buildings, with these building being subject to a Performance Solution at the discretion of FRNSW. As a result, anticipated design items for review include but are not limited to:

- Increased water supply to the building (may be based on 4 or 5 hydrants operating, instead of 3) – "*A first principles analysis should be undertaken to determine the number of fire hydrants required to flow*".
- The location of the hydrant booster and other (sprinkler) infrastructure is subject to FRNSW approval – "*When operating at a LIB fire, exclusion zones of not less than 1.5 times the height of the building are established to mitigate the risk to the attending fire brigade from building collapse*".
- ASRS advice is provided in Appendix C.3 regarding:
  - Facilitating brigade access.
  - Providing hydrant coverage.

- Power isolation, return to base functions, and manual operation of cranes.
- Increasing water supply capabilities for the sprinkler and hydrant systems for up to 4 hours.

- All points on the floor within a Class 7b or Class 8 LIB shall be within 90 m of an exit (in lieu of 100 m as per above) – "*Where this distance is exceeded, additional exits around and from within the building should be provided*".

Whilst it is understood that FRNSW were involved in the preparation of AS2419.1:2021 and have provided a formal position statement regarding its adoption in building design, there is currently no precedence on brigade support for the above Performance Solutions relating to buildings that are outside the scope of the standard of this document.

8.5.2 Fire Hose Reels

Fire hose reel shall be provided throughout the building in accordance with Provision E1.4 of the BCA and AS2441:2005.

All points on the floor should be within reach of a 4 m hose stream issuing from a nozzle at the end of the hose laid on the floor with a hose length not exceeding 36 m (i.e. a maximum of 40 m from the hydrant location).

However, it is possible to present a Performance Solution to enable the installation of 50 m fire hose reels – generally to enable hose reels located around the building perimeter only, or to limit the installation of hose reels in cold stores. Additional requirements to permit the use of 50 m hose reels are as follows:

- 50 m fire hose reels must be tested and certified to AS/NZS1221.
- The pressure and flow at the nozzle of the 50 m hose reel is to achieve compliance with the pressure and flow requirements of AS2441.1-2005.
- Coverage is to be achieved with no more than two bends in the hose.
- Staff training in the use of the 50 m length fire hose reels is to occur at least every 12 months to maintain occupant familiarity with the increased weight and length of the extended hose reels

8.5.3 Fire Sprinkler System

A fire sprinkler system shall be provided throughout the building in accordance with the relevant regulatory requirements.

- In the offices and beneath the warehouse awnings the system shall comply with BCA Specification E1.5 and AS2118.1:2017.
- In the warehouse a storage mode system shall be provided in accordance with BCA Specification E1.5 and AS2118.1:2017 with the sprinkler head location, spacing and design capacity in accordance with Factory Mutual Guidelines 2-0 and 8-9 (or NFPA regulations). Sprinkler activation temperature must be no greater than 101°C and have a Response Time Index (RTI) of less than $50m^{1/2}s^{1/2}$ (i.e. fast response type).

Upon sprinkler activation the automatic smoke exhaust system and building occupant warning alarm shall be initiated, as well as the direct brigade notification.

At the fire sprinkler booster, a dedicated hardstand for fire brigade appliances is required. As per FRNSW Guideline For Emergency Vehicle Access [7] this hardstand should be designed to be 18 m long by 6 m wide, whilst allowing other fire brigade appliances to pass. The hardstand area serving a suction-connection outlet is to be positioned at an angle not greater than 45° from the outlet's longitudinal direction.

8.5.4 Portable Fire Extinguishers

Portable fire extinguishers are to be provided throughout the building in accordance with Table E1.6 of the BCA and selected, located, and distributed in accordance with AS2444:2001.

8.5.5 Fire Control Centre

WH9 shall be provided with a compliant Fire Control Centre (FCC) at the main entry. The Main FIP must be installed in accordance with BCA Specification E2.2a and AS1670.1:2018 and have the following capabilities.

- Capable of isolating, resetting, and determining the fire location within the building.
- A red strobe shall be installed at the entry door to the FIP to alert arriving fire brigade of the fire alarm origin and FIP location.
- Smoke exhaust fan controls shall be provided at the FIP which shall include clear signalling of the operational status of the fans.

8.6 SMOKE HAZARD MANAGEMENT

8.6.1 Smoke Detection System

A smoke detection system for occupant warning is unlikely to be required throughout the warehouse due to the large enclosure volumes.

- In the event of future subdivisions of warehouse buildings into smaller tenancies, there might arise a need for smoke detection due to the reduced smoke reservoir volumes.
- In the event of travel distances in excess of the DtS Provisions being present in the building offices, detection will likely be required throughout each affected office in accordance with AS1670.1:2018.

8.6.2 Smoke Hazard Management System

A rationalised smoke hazard management system shall be provided, designed to achieve the following minimum requirements.

- System capacity must be capable of an exhaust rate equal to one enclosure air change per hour, and initiated upon activation of the sprinkler system.
- Adequate make-up air should be provided at low level to facilitate the exhaust system's designed operational capacity, whilst ensuring the inlet velocity does not exceed 2.5 m/s. The make-up air should be provided at a low level by:
  - Permanently open natural ventilation louvers; and/or
  - Perforated roller shutters; and/or
  - Mechanically operated louvers that open upon activation of the fans. All motors and cables to automatic louvers, vents or supply fans must be fire rated to operate at 200°C for a period of 60 minutes.
- On/Auto/Off switches should be located at the FIP.
- Signs and a mechanical block plan alerting the fire brigade to the operation of the system must be provided.
- Fire rated fans and fire rated cabling should be designed to operate at 200°C for a period no less than 60 minutes.
- The fans shall be served by essential power and the mechanical services board serving the fans be located in a fire-rated enclosure (120/120/120) if located within the building.
- Multiple fans be provided and be evenly distributed to otherwise comply with the requirements of Specification E2.2b Clause 5 of the BCA.

8.6.3 Building Occupant Warning System

A building occupant warning system should be provided throughout all parts of each building. The system should be in accordance with the prescriptive requirements of Specification E1.5 and Clause 7 of Specification E2.2a and AS1670.1:2018.

- The occupant warning alarm should be sounded throughout all areas of the building upon activation of the sprinkler systems.

8.7 VISIBILITY IN AN EMERGENCY

Emergency lighting and exit signage is to be provided throughout in accordance with BCA DtS Part E4 and AS2293.1:2018.

Whether through adjudication by the authority having jurisdiction (AHJ) or via a Performance Solution, it is anticipated that the directional signage at the end of the racking aisles and above block storage areas can be installed at a height greater than 2.7 m. Should a Performance Solution be desired, it shall consider the following:

- Exit signs and directional signs shall be "Jumbo size" to increase the visibility to occupants.
- The final height and location of the directional exit signs shall be determined through the fire engineering analysis.

8.8 BUILDING MANAGEMENT PROCEDURES

The ongoing management of the building is as important in maintaining a high level of life safety as the provisions recommended during the design phase of the building.

8.8.1 Maintenance of Fire Safety Equipment

The fire safety systems should be tested and maintained in accordance with Australian Standard AS1851 or suitable alternative testing and maintenance regime.

8.8.2 Evacuation Plan

An emergency management plan should be developed for the site in accordance with AS3745:2010.

9 ACRONYMS

ACRONYM	EXPANSION
ABCB	Australian Building Codes Board
AFSS	Annual Fire Safety Statement
ASET	Available Safe Egress Time
BCA	Building Code of Australia
CFD	Computational Fluid Dynamics
DtS	Deemed-to-Satisfy
EPA	Environmental Protection Authority
FCC	Fire Control Centre
FER	Fire Engineering Report
FIP	Fire Indicator Panel
FRL	Fire Resistance Level
FRNSW	Fire Rescue NSW
FSS	Fire Safety Strategy
IFEG	International Fire Engineering Guidelines
NCC	National Construction Code
NFPA	National Fire Protection Association
OHS	Occupational Health and Safety
RSET	Required Safe Egress Time
RTI	Response Time Index

10 REFERENCES

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