Core Engineering Group • Fire • Risk • Emergency Management

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Fire Safety Strategy

Oakdale West Precinct 1

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Report Details

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Lot 1, Oakdale West, Horsley Park NSW 2175
Document: Fire Safety Strategy
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Report Revision History

REV	DATE ISSUED	COMMENT	PREPARED BY	REVIEWED BY	VERIFIED BY
01	31/05/19	Draft Issue for comment	**Dean Watt** *BEng (Chemical Engineering)*	**Sandro Razzi** *BE (Building)* *Grad Dip (Performance Based Building & Fire Codes)*	
02	28/06/19	Updated draft for comment			
03	15/08/19	Final Issue			**Sandro Razzi** *BE (Building)* *Grad Dip (Performance Based Building & Fire Codes)* *Accredited Fire Engineer* *BPB 0501* *FIEAust* *CPEng 2180287* 

EXECUTIVE SUMMARY

CORE Engineering Group have been engaged by Goodman to develop a Fire Safety Strategy (FSS) for the proposed Precinct 1 site at Oakdale West Industrial Estate in Eastern Creek. This FSS provides an overview of the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building.

Due to the complexity of the building design, a fully prescriptive approach of complying with the Building Code of Australia 2019 (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 to satisfy the Performance Requirements of the BCA have been proposed to account for the following issues which have been identified from a review of the preliminary design documentation and the BCA report to not comply with the DtS Provisions:

- C1.1 – Omission of FRLs to Skybridge walkover.
- C1.1 – Rationalised Type C construction to Warehouse 1A.
- C1.1 – Omission of FRLs to mezzanine structure and supporting elements within Warehouse 1A.
- C2.4 – Vehicular perimeter access with minor non-conformances.
- D1.3 – Stairs serving the Warehouse 1A mezzanine levels are not fire-isolated stairways.
- D1.4 – Extended travel distances to the nearest exit within the warehouses.
- D1.5 – Extended travel distances between alternative exits within the warehouses.
- D1.9 – Extended travel distances to a final exit via a non-fire-isolated stair.
- E1.3 – External hydrants positioned beneath awnings.
- E2.2 – Rationalised automatic smoke exhaust system (within Warehouse 1A).

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 complete fire engineering analysis will be included within the Fire Engineering Report (FER), undertaken in accordance with the International Fire Engineering Guidelines (IFEG), and as such is not documented herein.

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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 2016 (BCA) [10] 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.

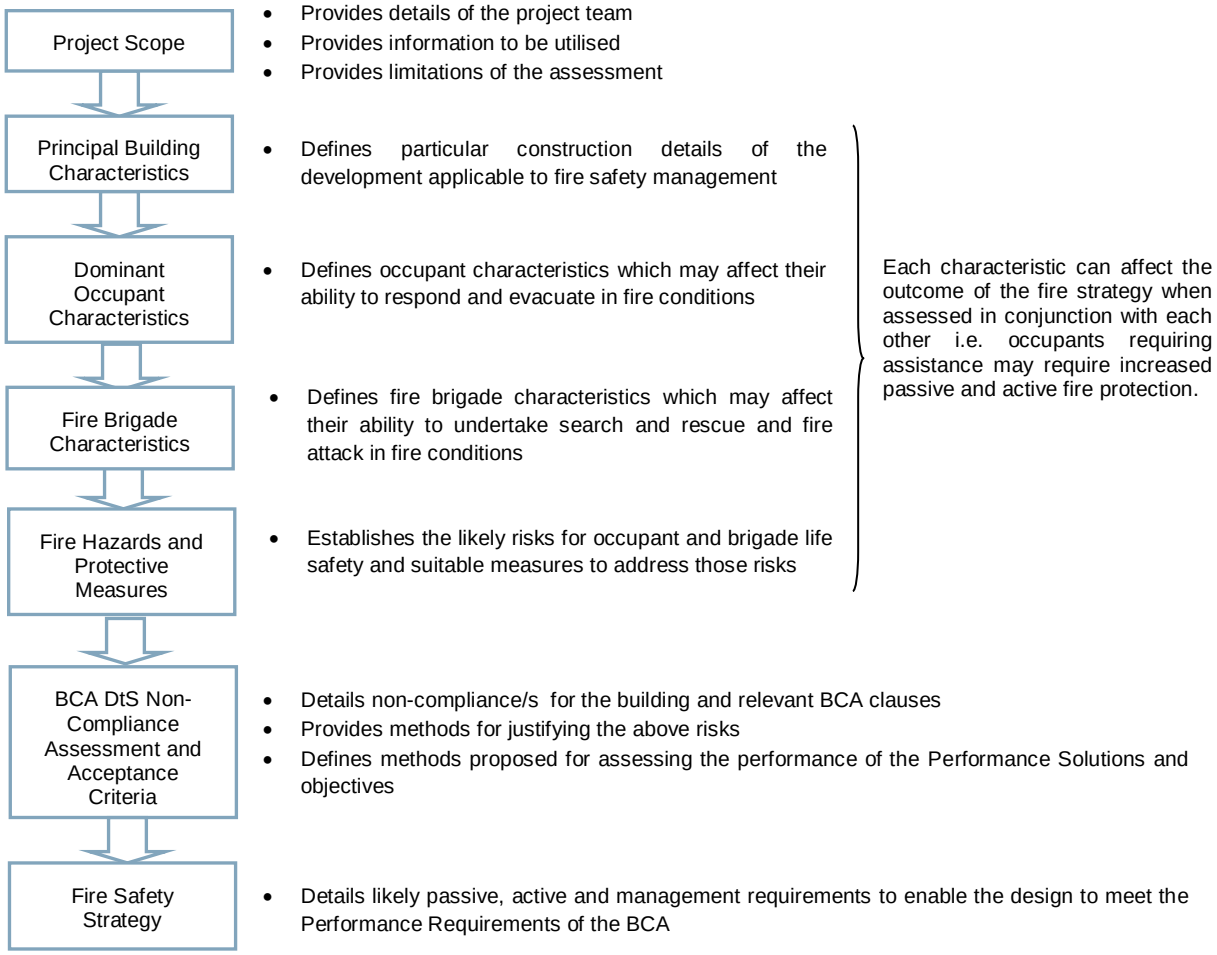


Figure 1-1: Fire Safety Strategy Process

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.

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 to develop a FSS for the construction of Oakdale West Precinct 1 at Lot 1, Oakdale West, Horsley Park NSW 2175. The purpose of this FSS is to outline the fire engineering principles that will be utilised in ensuring that the prescriptive DtS non-compliances identified in the BCA report are resolved in order to conform to the building regulations and permit 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	Richard Mawer Stephanie Partridge	Goodman
Principal Certifying Authority/BCA Consultant	Dean Goldsmith	Blackett Maguire + Goldsmith
Fire Safety Engineer	Dean Watt	CORE Engineering Group
C10 Accredited Fire Engineer	Sandro Razzi	

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:

- BCA report provided by Blackett Maguire + Goldsmith, Report #190119 Revision 1, dated 2 August 2019.
- Architectural plans provided by SBA Architects, as indicated in Table 2-2.
- FRAGTC Project Requirements Brief provided by TM Insight, Revision 2.2 (AFL Issue), dated 16 January 2019.

Table 2-2: Drawings

DRAWING NO.	DESCRIPTION	ISSUE	DATE
15117_OAK MP 02	SSDA Oakdale West Estate Masterplan	BD	27/06/19
15117_OAK MP 05	Precinct 1 Plan	AM	27/06/19
OAK_1A_DA10	Site Plan	K	31/05/19
OAK_1A_DA11	Roof Plan	E	31/05/19
OAK_1A_DA12	Office Plan Ground	E	31/05/19

DRAWING NO.	DESCRIPTION	ISSUE	DATE
OAK_1A_DA13	Office Plan First	E	31/05/19
OAK_1A_DA14	Office Elevations	E	31/05/19
OAK_1A_DA15	Elevations	E	31/05/19
OAK_1A_DA16	Warehouse Sections – 1	F	31/05/19
OAK_1A_DA17	Warehouse Sections – 2	A	31/05/19
OAK_1A_DA18	Warehouse Plan	A	31/05/19
OAK_1A_DA18a	Mezzanine Plan – 1	A	31/05/19
OAK_1A_DA18b	Mezzanine Plan – 2	A	31/05/19
OAK_1A_DA18c	Mezzanine Plan – 3	A	31/05/19
OAK_1A_DA18d	Mezzanine Plan – 4	A	31/05/19
OAK_1A_DA18e	Mezzanine Plan – 5	A	31/05/19
OAK_1A_DA18f	Mezzanine Plan – 6	A	31/05/19
OAK_1A_DA19	Skybridge Sections & Elevations	A	31/05/19
OAK_1C_DA30	Site Plan / Floor Plan	K	31/05/19
OAK_1C_DA31	Roof Plan	E	31/05/19
OAK_1C_DA32	Office Plan Ground	D	31/05/19
OAK_1C_DA33	Office Plan First	D	31/05/19
OAK_1C_DA34	Office Elevations	D	31/05/19
OAK_1C_DA35	Elevations Sheet 1	E	31/05/19
OAK_1C_DA36	Elevations Sheet 2	E	31/05/19

2.4 LIMITATIONS AND ASSUMPTIONS

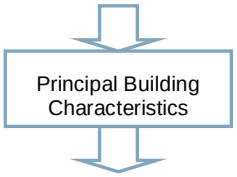
In this instance the FSS is developed based on applicable limitations and assumptions for the development which are listed as follows:

- 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 firefighting 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 Horsley Park, approximately 42 km west of Sydney's central business district. The Oakdale West industrial estate consists of 22 warehouses located within 5 precincts, accessed from a future southern link road. This report specifically addresses Precinct 1.

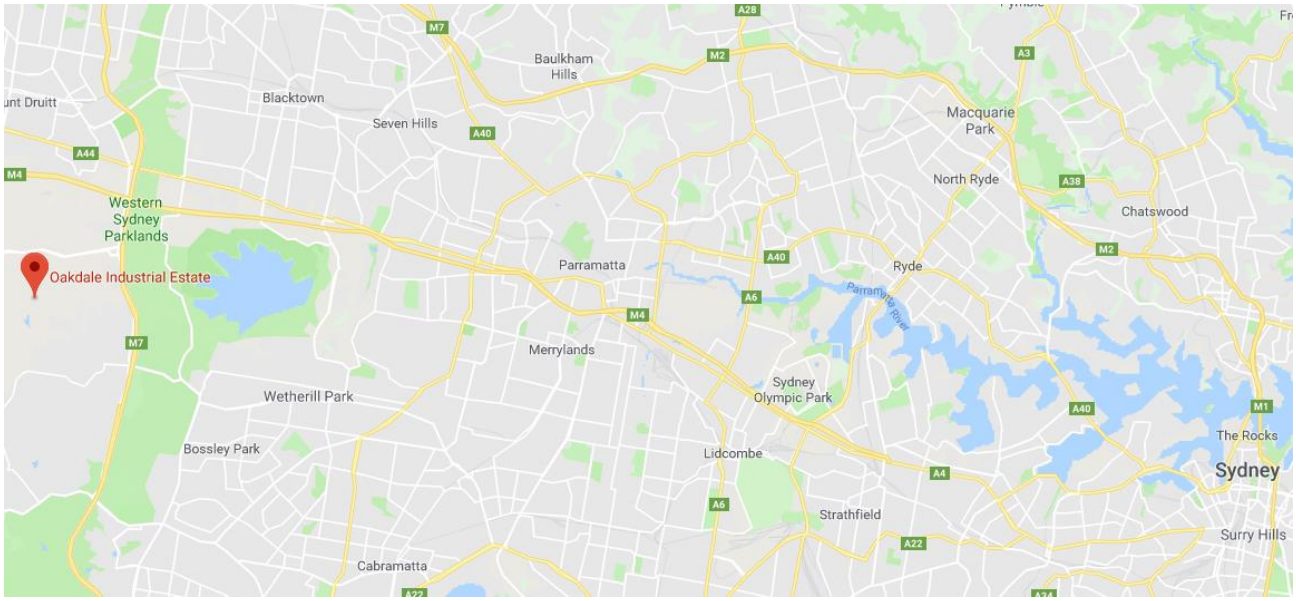


Figure 3-1: Oakdale West Site Location & Context **Source: www.googlemaps.com.au**

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 located in Huntingwood and Bonnyrigg Heights, which are approximately 8.5 km and 14 km from the site, respectively, when considering actual driving directions.

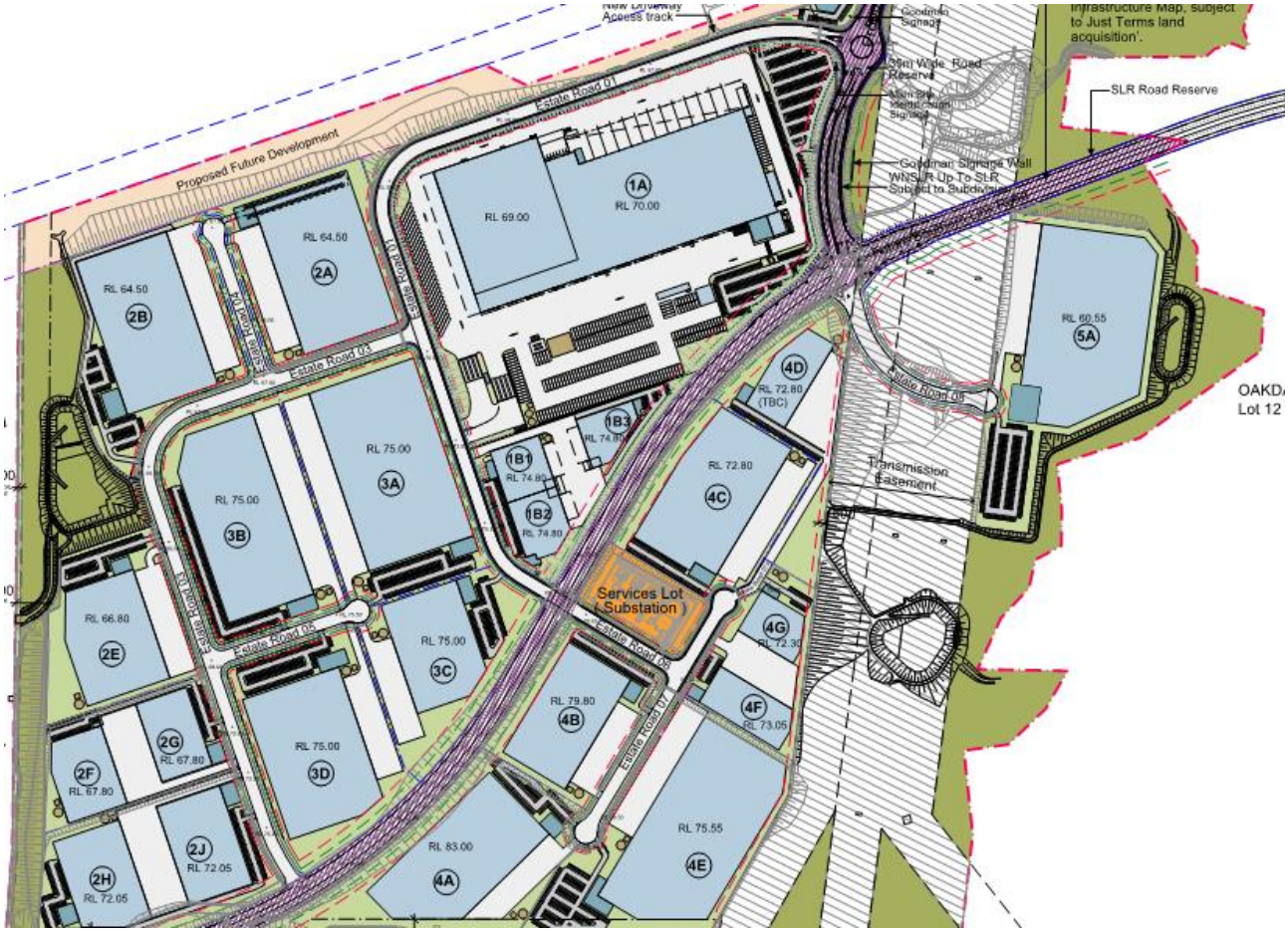


Figure 3-2: Oakdale West Estate Plan

3.3 SITE LAYOUT

The total area of the Precinct 1 development site is approximately 219,000 m², split into 187,000 m² for Lot 1A and 32,000 for Lot 1B.

Lot 1A:

As depicted within Figure 3-3, Lot 1A consists of a single warehouse building with a floor area of approximately 61,700 m². Warehouse 1A has ridge heights of 27.3 m (Zone A) and 35.8 m (Zone B) to accommodate high-bay and automated racking. Mezzanine platforms with multiple levels are present within this facility, up to a floor area of approximately 30,750 m², and are located throughout the building.

Additional facilities include:

- A 3-storey office building which is to be fire-separated from the warehouse portion (2,520 m² approx.).
- Multiple outbuildings totalling a floor area of 3,006 m², including a separate Dangerous Goods enclosure.

Onsite external carparking is available around the development, predominantly along the southern and eastern perimeters of the site. Loading docks and associated hardstands for Warehouse 1A are located on the north-western and south-eastern sides of the building.

Lot 1B:

Two buildings are located on Site B, forming three warehouse tenancies. Each of these warehouse tenancies has a ridge height of 13.7 m, and is provided with an associated 2-storey office (each with a floor area of approximately 500 m²).

Onsite external carparking is available around the development, predominantly along the north-eastern and south-western perimeters of the site. Loading docks and associated hardstands for Warehouse 1B tenancies are central and shared between the two buildings.

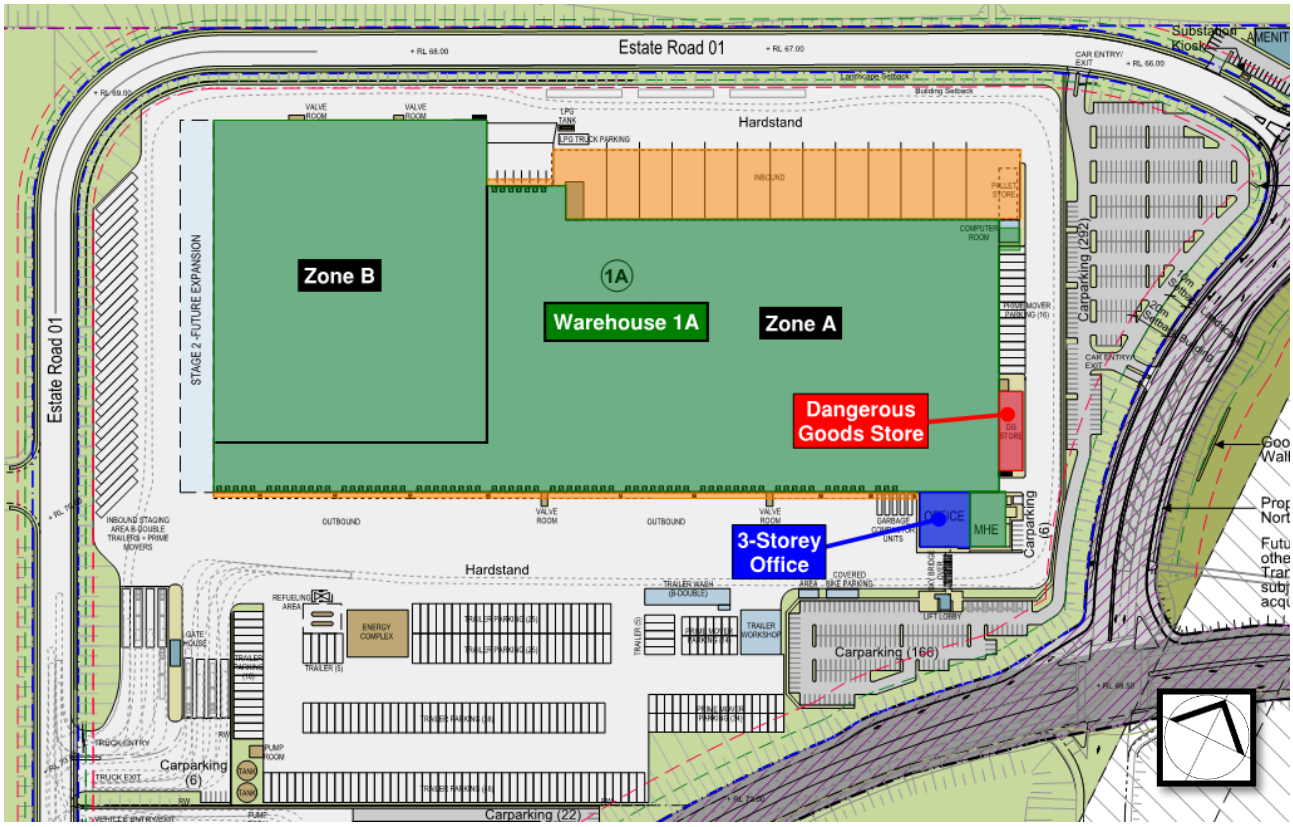


Figure 3-3: Oakdale West Precinct 1 Site Plan – Lot 1A

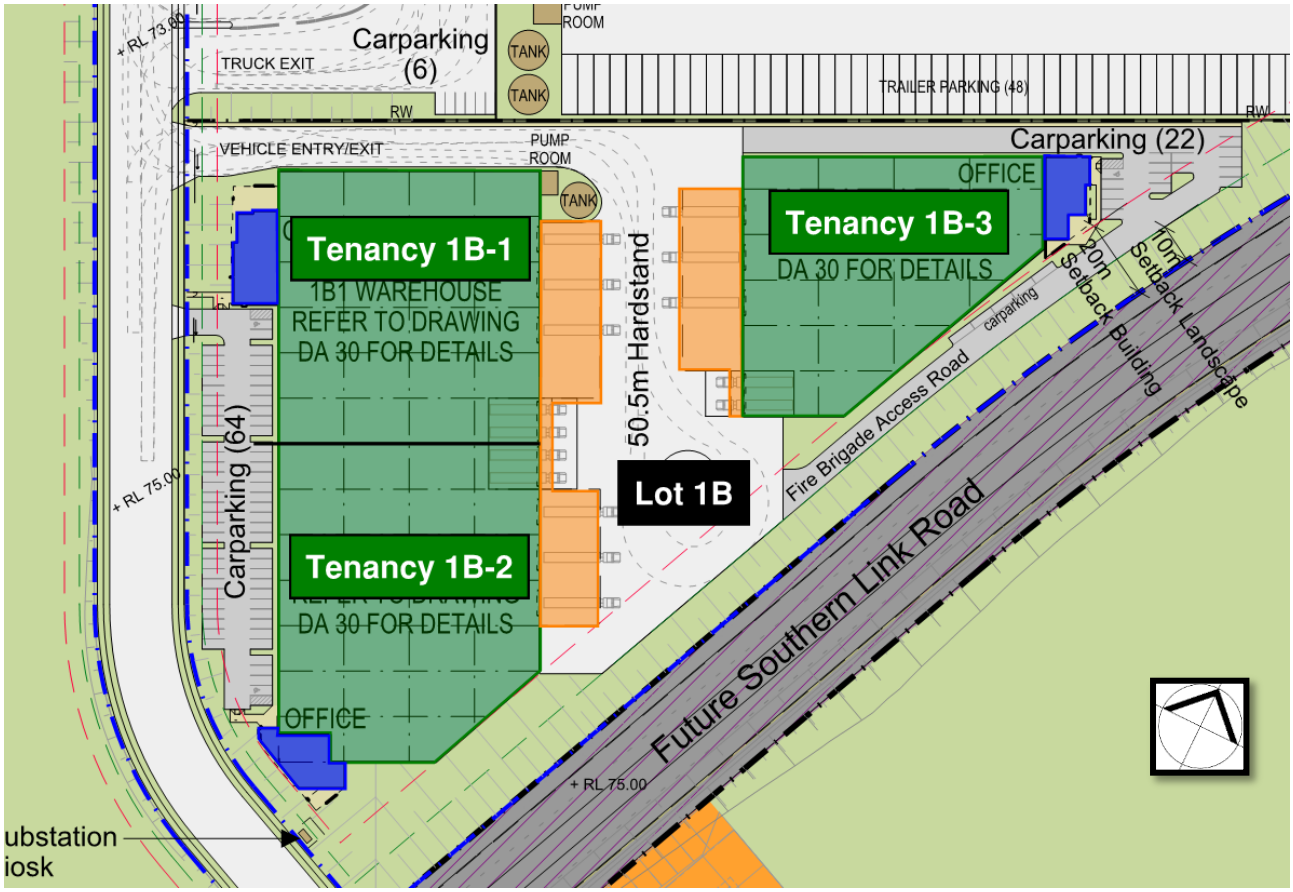


Figure 3-4: Oakdale West Precinct 1 Site Plan – Lot 1B

Whilst not directly applicable to this development, the following sections are expected to be indicative of that expected within the facility.

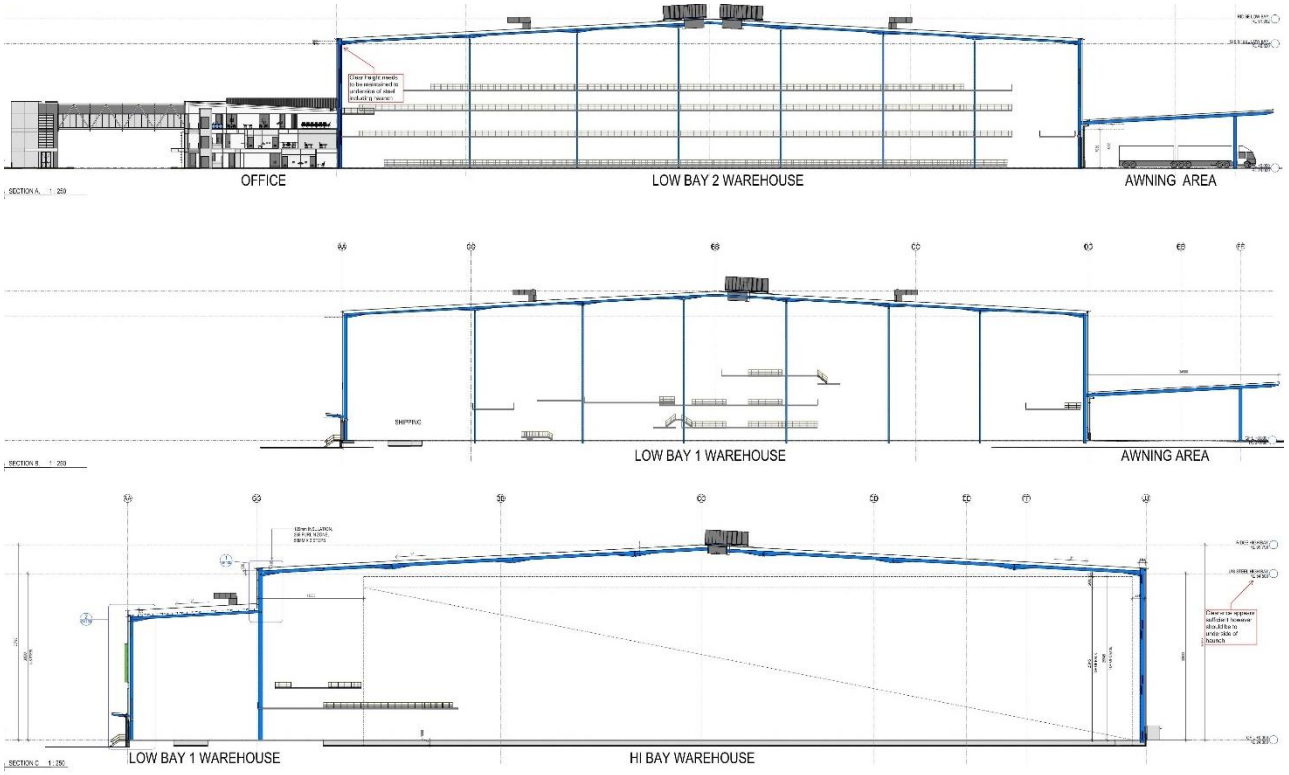


Figure 3-5: South and West Elevations

3.4 BUILDING STRUCTURE

Lot 1A

The 3-storey office shall be fire-separated from the warehouse facility. Due to the number of mezzanine levels, the warehouse is prescriptively subject to the requirements of Type A construction. However, the mezzanine platforms, access stairs and supporting elements are proposed to be addressed by a Performance Solution. Via this Performance Solution, the external walls of the warehouse are also permitted to be in accordance with Type C construction.

The building shall be constructed as a steel portal frame structure, with ridge heights of 27.3 m (Zone A)and 35.8 m (Zone B), dado panel walls and a metal sheet roof. The use of insulated sandwich panels is proposed around the perimeter of the building, and are expected to be present within any potential cool rooms.

Lot 1B

The warehouse buildings will be of steel portal frame construction with additional internal steel columns, under Type C construction. The external wall will be of dado construction having concrete to a height of approximately 3 m with steel sheeting above.

General

Materials and finishes shall generally be in accordance with the DtS requirements for the respective Type of Construction for each building and shall conform with the testing methodology outlined in the DtS Provisions so as to avoid the spread of smoke and fire and minimise the risk to occupants and firefighters.

3.5 BCA ASSESSMENT SUMMARY

Table 3-1: BCA Building Characteristics – Warehouse 1A

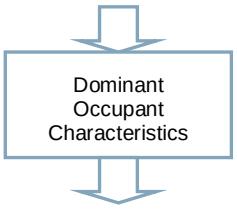
CHARACTERISTIC	DESCRIPTION	
Classification	Class 7b (Warehouse); Class 5 (Office, access bridge & gatehouse); Class 8 (Energy complex, trailer wash & workshop); Class 10b (Pump rooms & tanks)	
Construction Type	Warehouse – Type A Construction (Large-isolated building, permitted to be assessed as Type C via Performance Solution) Office – Type B (Sky Bridge permitted to have nil FRL via Performance Solution).	
Rise in Storeys	Five (5)	
Floor Area	**Total:**	**101,659 m²**
	Warehouse 1A	64,842 m²
	Warehouse 1A Mezzanines	30,766 m²
	Warehouse 1A Main Office	2,646 m²
	Warehouse 1A Outbuildings	3,405 m²

Table 3-2: BCA Building Characteristics – Warehouse 1B

CHARACTERISTIC	DESCRIPTION	
Classification	Class 7b (Warehouse); Class 5 (Office) for each tenancy	
Construction Type	Type C Construction (Large-isolated building) for each tenancy	
Rise in Storeys	Two (2) for each building	
Effective Height	Less than 12 m for each building	
Floor Area	**Total:**	**14,870 m²**
	Warehouse 1B-1	4,625 m²
	Warehouse 1B-1 Office	500 m²
	Warehouse 1B-2	4,998 m²
	Warehouse 1B-2 Office	415 m²
	Warehouse 1B-3	3,990 m²
	Warehouse 1B-3 Office	342 m²

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

Warehouse 1A

Regarding Warehouse 1A, the following indicative population numbers have been provided by the tenant, totalling 645 occupants across all shifts. It should be noted that Warehouse 1A will accommodate 24-hour per day operation, incorporating two 10-hour shifts and a 5-hour maintenance period each day.

- Warehouse – 431 occupants:
- Office spaces – 64 occupants
- Transport Office – 25 occupants
- Drivers – 125 occupants

Warehouse 1B

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

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

As per the BCA report, these values result in the following estimated populations based on the floor areas provided in Section 3.5, by considering discounted floor areas for racking and circulation spaces.

- Building 1B-1:
  - Warehouse: 75 occupants
  - Office: 49 occupants
- Building 1B-2:
  - Warehouse: 78 occupants
  - Office: 49 occupants
- Building 1B-C:
  - Warehouse: 64 occupants
  - Office: 35 occupants

In the absence of specific occupant numbers for Warehouse 1B tenancies being provided, these population estimates 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 are only listed at this stage to 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 generally 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 expected nature of the work conducted the majority of occupants are assumed to be able bodied people with a small number of less mobile occupants requiring assistance during an evacuation.

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.

- ***Staff and Security*** are expected to be mobile with normal hearing and visual abilities, and occupants in this group are considered to take and implement decisions independently, and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the building; and
- ***Clients / Visitors*** are expected to be mobile with normal hearing and visual abilities, this occupant group are expected to be capable of making and implementing decisions independently however may require assistance in locating the nearest and safest egress path in an emergency; and
- ***External Maintenance Contractors*** are expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. The contractors are expected to be awake and aware of their surroundings at all times when inside the building; and
- ***FRNSW*** are expected to be equipped with safety equipment and will be educated in firefighting activities and the dangers associated with fire incidents. This occupant group would be expected to be in a position to assist other occupants requiring assistance to evacuate. It is not expected that this occupant group would be present in the building at the time of fire ignition; however, they are expected to enter the building at a later stage to assist with the evacuation of occupants, if required, and to undertake fire suppression activities.

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 and /or 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*** this occupant group is 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. Notwithstanding this they will be equipped with breathing apparatus and specialist equipment to prevent them from being adversely affected by fire hazards.

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 (AS 3745:2010). Clear escape routes should be maintained with doors unlocked, and no obstructions or rubbish to hinder evacuation.

Staff that are assigned to the automated racking system are to undergo training in the emergency operation procedures for the system, including measures for the shutdown and power isolation of the racking system, as well as facilitating brigade access and operations.

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 and Figure 5-2 illustrate the site plan with fire services provided on Precinct 1, with dedicated systems for each of Lot 1A and Lot 1B. These include the Main Fire Indicator Panels (FIP), Fire Control Centre, fire hydrant boosters, sprinkler boosters, sprinkler tanks, pump rooms, and perimeter vehicular access path around the precinct. It is noted that some of these locations (such as the hydrant boosters and automation control room) are yet to be shown on the architectural drawings and therefore are to be confirmed.

Dedicated parking bays are to be provided to allow brigade appliances to connect with the sprinkler services, without detracting from the ability of other vehicles to utilise the perimeter access path around the facility.

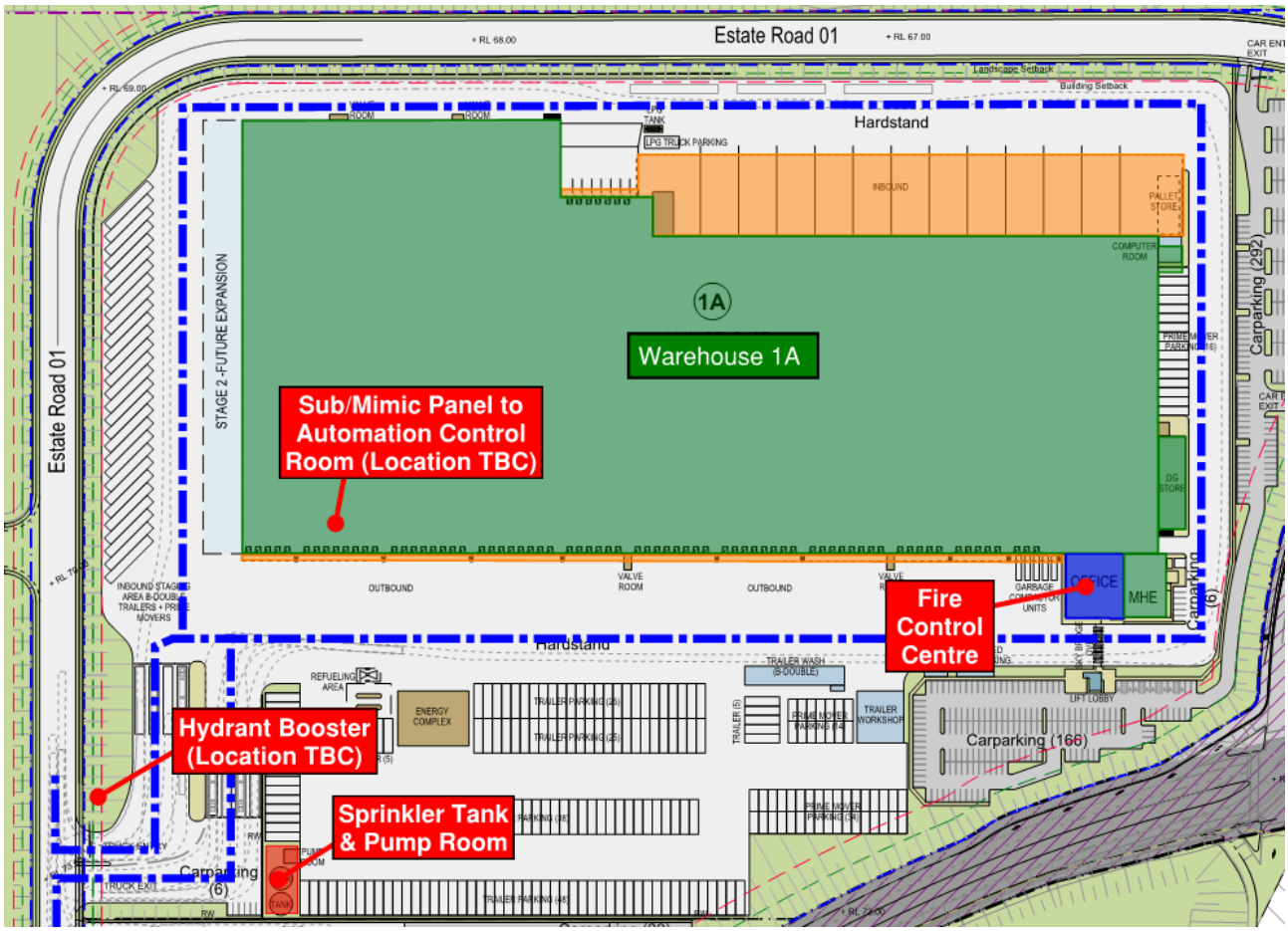


Figure 5-1: Fire Brigade Access and Site Facilities – Lot 1A

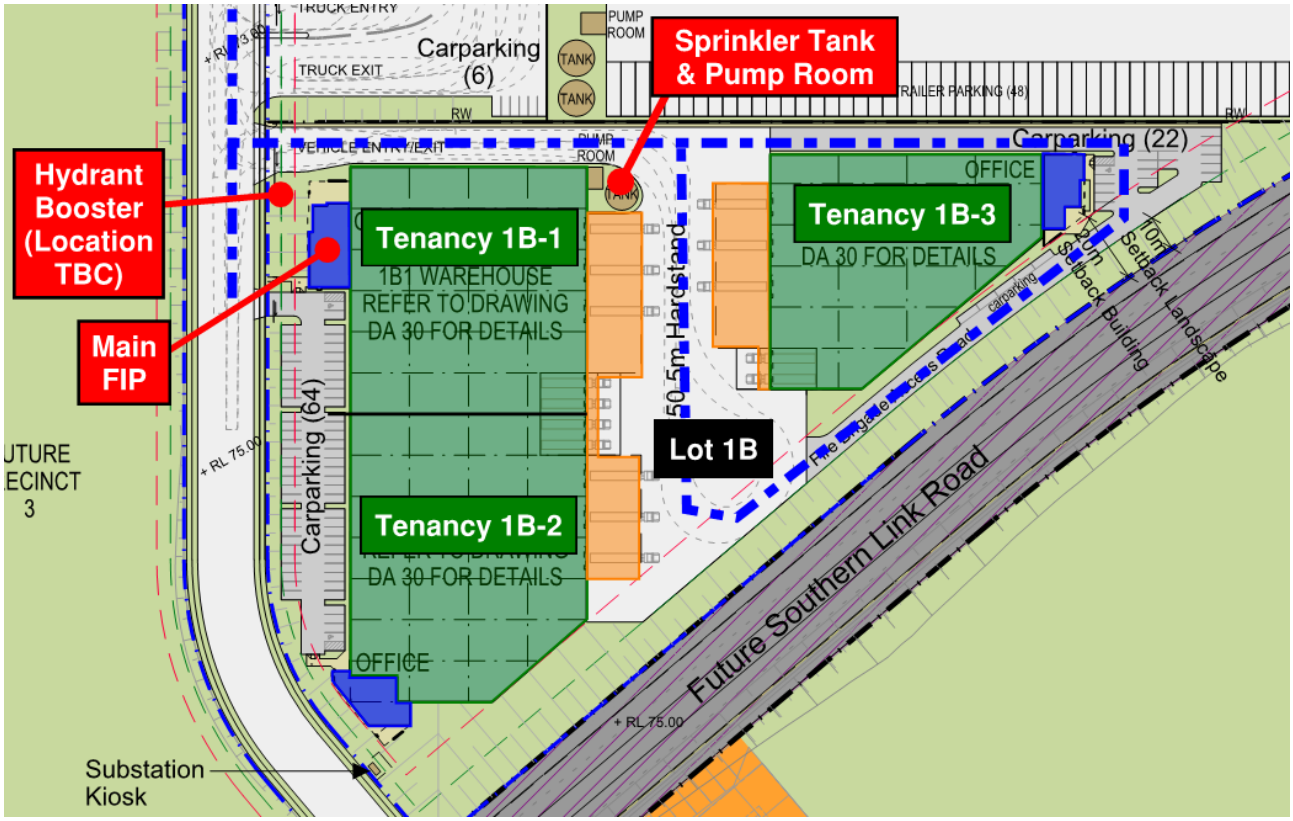


Figure 5-2: Fire Brigade Access and Site Facilities – Lot 1B

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 Huntingwood and Bonnyrigg Heights, which are approximately 8.5 km and 14 km from the site, respectively.

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 fire statistics [5,6] and hazards, the fire hazards specific to this building are summarised below.

6.2.1 General Layout

Exits are provided around the perimeter of each building to allow for multiple alternative egress opportunities. Due to the open nature of the warehouses, there are limited dead end travel routes to exits, however due to the building's large area, especially for the extensive racking and mezzanine systems within Warehouse 1A, extended travel distances to the nearest exit and between alternative exits are present.

No hazards to adjoining buildings have been identified and internal hazards are minimal. Due to the open space and multiple egress opportunities, as well as the early detection systems provided within Warehouse 1A, internal fire exposures are also expected to be minimal as occupants in the area of fire origin are likely to promptly become aware of fire and are likely to commence evacuation.

6.2.2 Activities

Generally it is not expected that regular hot work processes, use of highly flammable materials, manufacturing processes or operation of high friction or high temperature machinery will be performed within the building. An exception to this is the welding bay present within Warehouse 1A. Precinct 1 accommodates multiple storage facilities that are likely to contain a large number of combustibles within racking.

6.2.3 Ignition Sources

Ignition sources relevant to this site, in order of occurrence are as follows:

Warehouse

- Intentional
- Electrical distribution / lighting
- Heating equipment
- Shop tools / industrial equipment

Office

- Intentional
- Electrical distribution / lighting
- Heating equipment

6.2.4 Fuel Sources

Quantity of Materials

- Warehouse - The racked storage areas are likely to have the densest fire load, with between 200 MJ/m² – 1,700 MJ/m² expected depending on the type of items stored. Racking containing combustibles such as rubber and paper products can be higher than this expected range and is dependent on how high the products are stacked, noting the presence of high-bay racking within Warehouse 1A.
- Office – 420 MJ/m² with isolated peak values reaching 760 MJ/m².

Dangerous Goods

Dangerous goods cannot be discounted from being present in the building. However the quantity will be limited by the space available and relevant workplace health and safety regulations will apply governing storage allowances (quantity) and requirements.

Should the storage of Dangerous Goods above these thresholds be anticipated, the facility shall be subject to a review via a Fire Safety Study along with additional requirements to manage these heightened risks.

Note: Upon confirmation of the nature, quantities and storage location of Dangerous Goods within Warehouse 1A, a more detailed summary of the associated hazards for this facility can be incorporated.

Location of Materials

Significant fuel loads will be limited to the warehouse tenancies, specifically the Warehouse 1A high-bay racking, and the Dangerous Goods store. Products will be distributed through high rack storage, storerooms, and waste and rubbish containers, but are anticipated to be the densest within the racking aisles of the warehouse spaces. The lobbies and stairways are to be maintained clear of furniture, stored items and the like and constructed with materials and assemblies in accordance with C1.10 to reduce fire spread and smoke production in the event of fire in common areas.

Fire Behaviour

Fire growth rates will vary with fuel type and conditions of ventilation and compartmentation. The most likely outcome of any fire outbreak within any of the buildings is a sprinkler-controlled fire. This would be expected to grow at an ultra-fast time-squared fire growth rate until sprinkler activation in the warehouse areas, at which point the sprinklers are expected to suppress or control the fire. A medium t^2 fire growth rate is expected in the office areas.

6.3 PREVENTATIVE AND PROTECTIVE MEASURES

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.

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. Tenancies of Warehouse 1B are not prescriptively required to be fitted with automatic smoke exhaust systems.

- An automatic smoke exhaust system within each zone of Warehouse 1A.
- The volume of the buildings will act as a large smoke reservoir to increase the available evacuation time for occupants.

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.

- Type C construction to Warehouse 1A, where permitted by a Performance Solution (i.e. omission of FRLs to mezzanine structure and supporting elements, and external walls).
- Type C construction to Warehouse 1B tenancies.
- Bounding construction that achieves an FRL of 4 hours to the Dangerous Goods store that is adjacent to Warehouse 1A.
- Fire separation achieving an FRL of 4 hours between Warehouse 1A and its 3-storey main office.
- Sprinkler systems documented in Sub System D.

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.
- Aspirating smoke detection system where automated racking areas are present (Warehouse 1A).
- Smoke detection system within all Warehouse 1A spaces and under mezzanine platforms.
- Storage mode sprinkler system at the roof level of warehouses.
- In-rack sprinkler protection provided where high-bay racking is present and where Dangerous Goods are expected to be handled.
- Sprinkler system to offices and beneath awnings.
- 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.
- Emergency management plan.

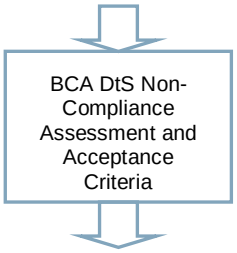
6.3.6 Fire Services Intervention (Sub-System F)

The buildings are to be provided with the following systems to assist in fire brigade intervention:

- Dedicated fire hydrant system with a hydrant booster valve for each of the Warehouses.
- External hydrant coverage, with additional internal hydrant coverage within Warehouse 1A.
- Automatic link to fire brigade.
- Control & Indicating Equipment.
- Vehicular perimeter access in a forward motion, with minor non-conformances around Warehouse 1B.
- Sprinkler booster valves.
- Automatic shutdown of automated racking systems within Warehouse 1A upon fire trip.

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 perimeter vehicular access with no part of the roadway less than 6 m in width and no more than 18 m from the building. The pathway must also permit the passage and operations of fire brigade appliances. **DtS Variation** The following non-conformances are present regarding the perimeter access pathway around Warehouse 1A and the Warehouse 1B tenancies. Warehouse 1A • The pedestrian Skybridge is present over the perimeter access path in the south-eastern corner of the site. • The perimeter access path is greater than 18 m from the northern perimeter of Warehouse 1A where a 35 m wide awning is present. Warehouse 1B • Perimeter access is not available along the south-eastern side of Warehouses 1B-1&2. • The perimeter access path is greater than 18 m from the south-western side of Warehouses 1B-1&2. **Performance Solution** For Warehouse 1A, the Performance Solution relies upon the fact that staging is available both before and after the Skybridge walkover, thereby permitting the brigade to still stage within this vicinity. Where awnings are present, the perimeter access path permits staging for brigade appliances. For Warehouse 1B, the Performance Solution relies upon the fact that the south-western carpark to Warehouse 1B can be utilised as an alternative pathway to facilitate the access of personnel and emergency vehicles. Staging locations are also provided on the central hardstand which serves each of the three Warehouse 1B tenancies, and carparks facilitate the turning circles of FRNSW appliances as necessary.
Omission of FRLs to Skybridge Structure	**Relevant BCA DtS Provisions** Provision C1.1: A building must be provided with fire-resisting construction as per that specified within Specification C1.1. Specification C1.1: A Class 5 building of Type B construction must be provided with loadbearing internal walls and columns that achieve an FRL of 120 minutes.

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
	DtS Variation It is proposed for the Skybridge adjoining the Main Office to not achieve an FRL. **Performance Solution** The Performance Solution shall rely upon the smoke separation provided between the Skybridge and the Main Office. Additionally, the Skybridge is to be structurally independent from the Main Office.
Rationalisation to Type C construction	**Relevant BCA DtS Provisions** Provision C1.1: A building must be provided with fire-resisting construction as per that specified within Specification C1.1. Specification C1.1: A Class 7b building of Type A construction must be provided with loadbearing internal columns that achieve an FRL of 240/--/-- and floors that achieve an FRL of 240/240/240 **DtS Variation** It is proposed to rationalise the type of construction for the Warehouse 1A building from Type A to Type C construction. **Performance Solution** The Performance shall rely upon the fact that the prescriptive requirement for Type A construction for Warehouse 1A is driven by the number of mezzanine platforms. However, the intended use, daily operations and occupation upon these mezzanine platforms is less comparable to a typical storey and more comparable to a maintenance area and plant support system.
Reduced FRLS to Mezzanine Structure **BCA DtS Provisions** Specification C1.1: Fire-resisting construction Provision D1.3: When fire-isolated stairways & ramps are required **Performance Requirements** CP1	**Relevant BCA DtS Provisions** Provision C1.1: A building must be provided with fire-resisting construction as per that specified within Specification C1.1. Specification C1.1: A Class 7b building of Type A construction must be provided with loadbearing internal columns that achieve an FRL of 240/--/-- and floors that achieve an FRL of 240/240/240. Provision D1.3: A stair serving greater than 3 storeys in a sprinkler-protected building must be fire-isolated. **DtS Variation** The mezzanine platforms within Warehouse 1A shall not achieve an FRL, on the basis that the design should mitigate the risk of disproportionate collapse. Additionally, supporting columns shall achieve an ESA/m ratio no greater than 26 m²/tonne, in lieu of achieving an FRL. Stairs serving these mezzanine platforms are permitted to be non-fire-isolated. **Performance Solution** In addition to the rationale of justifying that Type C construction is appropriate for the Warehouse 1A building, the Performance Solution shall utilise an ASET/RSET comparison and a lumped thermal capacity approach to justify the above reductions in fire resistance levels. The managed nature of the Warehouse 1A facility and the detection and active suppression measures that are afforded assist in justifying the Performance Solution.
Extended Travel Distances & Smoke Hazard Management	**Relevant BCA DtS Provisions** Provision D1.4: travel distance to the nearest exit must not exceed 40 metres. Provision D1.5: travel distance between alternative exits must not exceed 60 metres. Provision D1.9: The distance from any point on a floor to a point of egress to a road or open space by way of a required non-fire-isolated stairway must not exceed 80 m. Additionally, a required non-fire-isolated stairway must discharge at a point not more than 40 m from one of 2 such doorways if travel to each of them from the non-fire-isolated stairways is in approximately opposite directions.

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
BCA DtS Provisions Provision D1.4: Distance to the nearest exit. Provision D1.5: Distance between alternative exits Provision D1.9: Travel by non-fire-isolated stairways or ramps Provision E2.2: Smoke hazard management **Performance Requirements** DP4 & EP2.2	Provision E2.2 (Table E2.2a): requires a large isolated building be provided with an automatic smoke exhaust system with extraction rates as detailed in BCA Specification E2.2b and smoke zones no greater than 2,000 m². **DtS Variation** The following non-conformances have been identified within Precinct 1: Warehouse 1A • Travel distances on the ground floor may extend up to 30 m to a point of choice. • Travel distances extend up to a maximum of 80 m to the nearest exit and 160 m between alternative exits. • Travel distances upon mezzanine platforms extend up to a maximum of 60 m to the nearest exit and 100 m between alternative exits. • Total travel distances off the mezzanine platforms to a final exit via non-fire-isolated stairs is up to 120 m. Warehouse 1B: • Travel distances within these each of these tenancies extend up to a maximum of 60 m to the nearest exit and 120 m between alternative exits, in lieu of 40 m and 60 m, respectively. **Performance Solution** The Performance Solution will rely upon the sprinkler protection, the active detection measures present within Warehouse 1A, and the volume of the warehouse enclosures to act as a smoke reservoir for hot combustion products with significant reserve so as to provide the population with adequate time to safely evacuate each building prior to the onset of untenable conditions.
Hydrants Under Awnings **BCA DtS Provisions** Provision E1.3: Fire hydrants **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. **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. Should a fire be located under an awning itself, fall-back hydrants are provided on the respective hardstands to provide coverage to the hydrants under the awnings.

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

All 3 buildings on Precinct 1 shall be designed as large-isolated buildings.

Warehouse 1A:

Due to the number of mezzanine platforms, Warehouses 1A is prescriptively required to be built in accordance with the BCA DtS Provisions for Type A fire-resisting construction.

- However, a Performance Solution is proposed to rationalise the construction of Warehouse 1A to Type C construction in lieu of Type A, based on the use and occupation of the facility.
- Fire separation is to be provided between the main office and the warehouse via a fire wall. As such, the office portion is therefore permitted to achieve a 2-hour FRL as per the DtS Provisions.
- Via a Performance Solution, the Skybridge adjoining the Main Office may achieve no fire-resistance level. This is on the basis of:
  - Smoke separation being provided between the Skybridge and the Main Office; and
  - The design of the Skybridge being structurally independent from the Main Office.
- Via a Performance Solution, the mezzanine platforms may achieve no fire-resistance level, and any supporting elements to the mezzanine structures are to be designed to achieve an ESA-to-mass ratio no greater than 26 m²/tonne, as appropriate. This is subject to further confirmation regarding the arrangement of fire (suppression) systems provided upon, under and around the mezzanine platforms.
  - Further, stairs serving the mezzanine platforms are permitted to be open non-fire-isolated stairways.
  - The mezzanine structures are to be designed with consideration of preventing disproportionate collapse in the event of the failure of a supporting element.
- Bounding construction achieving an FRL of 4 hours is anticipated to be provided to the adjacent Dangerous Goods store.
  - Aerosols are to be stored within a separate caged enclosure.

Warehouses 1B:

Warehouses 1B tenancies shall be built in accordance with the BCA DtS provisions for Type C fire-resisting construction.

8.2.2 Insulated Sandwich Panelling

Where insulated sandwich panelling is utilised within the buildings (such as for cool rooms), it is to be installed in accordance with the requirements of the IPCA Code of Practice. At this stage it is understood that such panelling is proposed around the perimeter of the Warehouse 1A building.

- Any insulated sandwich panelling must have a Group 1 Certificate when tested to AS ISO 9705-2003, or an FM Class 1 Certificate when tested to FM 4881.
- The insulated sandwich panelling is to be listed on the Fire Safety Schedule for the building.
- The location of any insulated sandwich panelling is to be nominated on an architectural plan or similar, mounted at the FIP.
- In accordance with the Annexure B of the Code of Practice, labels must be placed on all doors leading into the building, compartments and rooms that have utilised insulated sandwich panel systems.

8.2.3 Combustibility of External Walls

Warehouse 1A prescriptively requires Type A construction, however a Performance Solution is proposed to rationalise Warehouse 1A under Type C construction instead. Under Type C construction, combustible materials may be used as an attachment on the façade on this building.

For Warehouse 1B tenancies which only require Type C construction, limitations are not specified regarding the presence of combustible materials in the external wall.

However, consideration should be given to the specification of a non-combustible cladding system to minimise the risks associated with fire spread, noting the current risk approval in the industry for the instances where combustible cladding is specified.

8.3 EGRESS PROVISIONS

8.3.1 Evacuation Strategy

Activation of any sprinkler heads or detectors should initiate the evacuation of all areas of the building on that specific site, i.e. fire detection in a Warehouse 1B tenancy initiates evacuation across all Warehouse 1B tenancies.

Dedicated fire wardens from the warehouse and office areas should ensure that all clients, visitors, and staff are promptly evacuated.

8.3.2 Travel Distances

In the warehouse buildings, the travel distances to a point of choice, to the nearest exit and between alternative exits must be compliant with the BCA DtS requirements with the following exceptions.

- Warehouse 1A – Travel distances on the general ground level may extend up to a maximum of 100 m to the nearest exit and 200 m between alternative exits, in lieu of 40 m and 60 m, respectively.
  - From within the manual picking area (at +460 mm AFFL), travel distances may extend up to 85 m to the nearest exit and 165 m between alternative exits.
  - From within the central conveyor OPM areas, confirmation of expected occupant locations and available egress routes is required to determine the extent of travel distances.
  - From within the high-bay area of Warehouse 1A (Zone B), travel distances may extend up to 110 m to the nearest exit and 215 m between alternative exits (*noting that this presents an approval risk with FRNSW due to travel exceeding 100 m to an exit*).
- Warehouse 1A Mezzanines – Regarding the mezzanine levels, the following maximum travel distances are permitted:
  - [+2,370 mm; +2,450 mm; +3,900 mm AFFL] – Travel distances are understood to be compliant upon these mezzanines.
  - [+5,850 mm; +6,500 mm AFFL] – Up to 30 m to a single exit, and 75 m between alternative exits.
    - It is noted that additional access stairs may be required as the design progresses to achieve these travel distances.
  - [+7,000 mm; +7,400 mm AFFL] – Up to 55 m to the nearest exit.
  - [+8,400 mm; 9,600 mm – 11,500 mm AFFL] – Up to 30 m to a single exit, 45 m to the nearest exit, and 75 m between alternative exits.
    - To achieve these travel distances, it is noted that an existing stair may be required to be extended upwards to serve the 10,000 mm AFFL mezzanine.

- [+14,350 mm AFFL] – Up to 70 m to the nearest exit, and 140 mm between alternative exits.
- Total travel distances off the mezzanine platforms to a final exit via non-fire-isolated stairs should not exceed 120 m.

  These distances are subject to revision pending the final mezzanine configurations and the confirmation of the available egress pathways upon the various mezzanine platforms.

- Warehouse 1B tenancies – Travel distances may extend up to a maximum of 60 m to the nearest exit and 120 m between alternative exits, in lieu of 40 m and 60 m, respectively.

These non-conformances shall be addressed through a Performance Solution that demonstrates that occupants have sufficient time to evacuate from the warehouse tenancies and the various Warehouse 1A mezzanine levels due to the volume of the compartment and the available smoke hazard management systems.

Where instances of reduces egress width are present, the PCA is to make the determination as to whether these areas are considered to be "maintenance-only". A Performance Solution is anticipated to be possible for those instances that are considered otherwise, and would be reliant upon the regular use and familiarity by personnel.

8.3.3 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 sliding doors.

8.3.4 Signage and Lighting

Emergency lighting is to be provided throughout the buildings in accordance with DtS Provisions E4.2 and E4.4 of the BCA and AS2293.1:2005.

- Emergency lightning within automated racking access aisles should be considered, for the benefit of brigade intervention. This is subject to the final layout and extent of the automated racking system.

Exit signage is to be provided throughout the building in accordance with the DtS Provisions E4.5, E4.6, E4.8 of the BCA and AS2293.1:2005. Directional signage in racking aisles and above block storage areas may be installed at a height greater than 2.7 m AFFL at the discretion of the Authority Having Jurisdiction, as per Clause 6.8.1 of AS2293.1:2005, or through a Performance Solution.

8.4 ACTIVE FIRE PROTECTION SYSTEMS

8.4.1 Building Occupant Warning System

A building occupant warning system should be provided throughout all parts of the buildings. The system should be in accordance with the prescriptive requirements of Specification E1.5 and Clause 6 of Specification E2.2a of the BCA and AS1670.1:2015.

- The occupant warning alarm should be sounded throughout all areas of the respective building upon activation of the smoke detection or sprinkler systems.
- Following fire detection, the automated racking systems must conduct return to base functions and shut down automatically.

8.4.2 Smoke Detection System

An automatic smoke detection system must be provided within Warehouse 1A to activate automatic smoke exhaust within the respective zone and occupant warning for the building. The following design requirements are expected, and should be reviewed and confirmed through detailed fire engineering analysis.

- Where automated racking is present, a multi-point aspirating detection system may be necessary, as per precedent set by FRNSW for extensive applications of automated racking, to assist in addressing the risk of smouldering fires. Should this be deemed necessary via consultation with FRNSW, the extent of this aspirating detection system is to be confirmed pending the final mezzanine configuration.
- At roof level and below mezzanine platforms, detectors shall be spaced in accordance with DtS Specification E2.2b Clause 8 and Specification E2.2a Clause 5, i.e. no greater than 20 m apart and no greater than 10 m from a wall or bulkhead.
- Within the adjacent Dangerous Goods Store, detectors shall be located on 10 m maximum spacings (5 m from walls or baffles).
- The detector obscuration threshold installed must not exceed 8% smoke obscuration per metre.

- Throughout the warehouse areas, detection shall activate the smoke exhaust as per Specification E2.2b (Clause 8) in the area of activation (i.e. Zone A or Zone B).
- Any detector activation shall sound the occupant warning system throughout the respective building.
- Any smoke detector activation shall initiate direct brigade notification.

A smoke detection system for occupant warning is unlikely to be required throughout the tenancies of Warehouse 1B due to their large volumes and simplistic layouts for egress. This can be verified through detailed fire engineering analysis and modelling.

- Note: if extended travel distances are present within the warehouse offices, detection must be provided in accordance with AS1670.1:2015.

8.4.3 Fire Sprinkler System

A fire sprinkler system shall be provided throughout the buildings in accordance with the relevant regulatory requirements. Each site (Warehouse 1A, and Warehouses 1B tenancies) 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 spaces a ceiling-level storage mode system shall be provided in accordance with BCA Specification E1.5 and AS2118.1:2017. Sprinkler activation temperature must be no greater than 101°C and have a Response Time Index (RTI) of less than 50 $m^{1/2}s^{1/2}$ (i.e. fast response type).
- Additionally, in-rack sprinkler protection shall be provided throughout the facility where ceiling heights exceed 13.7 m and high-bay storage or automated racking is provided.
- Where Dangerous Goods are expected to be handled, additional suppression measures may be necessary, such as foam suppression. The extent of areas where Dangerous Goods may be present and their quantities are to be confirmed. Currently it is understood that Dangerous Goods will be transient throughout the Warehouse 1A building, in addition to being present within the dedicated store that is located adjacent to the warehouse building.

  The above and any additional suppression measures are to be confirmed by a suitably qualified Fire Services Engineer.

Upon sprinkler activation the building occupant warning alarm shall be initiated throughout the building in question, and the direct brigade notification activated.

- Regarding Warehouse 1A, sprinkler activation within a zone (Zone A or B) shall activate only the exhaust within that respective zone.

8.4.4 Automatic Smoke Exhaust System

<u>Warehouse 1A</u>

Warehouse 1A shall be provided with an automatic smoke exhaust system, and shall be designed to achieve the following minimum requirements.

- Operation of this exhaust system for a certain zone of Warehouse 1A (Zone A or B) is to be initiated by smoke detection or sprinkler operation within this respective zone.
- System capacity must be capable of an exhaust rate equal to one enclosure air change per hour. This is to be confirmed through detailed fire engineering analysis and modelling.
- The exhaust capacity within the Dangerous Goods store is to be confirmed by detailed fire engineering modelling.
- Adequate make-up air should be provided at low level to facilitate the clearance 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 FCC.
- Signs and a mechanical block plan alerting the fire brigade to the operation of the smoke exhaust 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.
- It is recommended that multiple fans be provided and be evenly distributed to otherwise comply with the requirements of Specification E2.2b Clause 5 of the BCA.
- The system shall be connected to an essential power supply.

Warehouse 1B

The floor areas and volumes within Warehouse 1B tenancies do not trigger the requirement to provide automatic smoke exhaust systems.

8.5 FIRST AID FIRE FIGHTING

8.5.1 Fire Hose Reels

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

Locations should be signposted and readily accessible to occupants. Facilities should be monitored for abuse, mistreatment, and servicing. Where necessary, the use of internal fire hydrants necessitates the installation of hose reels adjacent to the hydrants in accordance with AS2441:2005 and Provision E1.4(e) of the BCA. 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 Portable Fire Fighting Equipment

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.

8.6 FIRE BRIGADE INTERVENTION

8.6.1 Control and Indicating Equipment

Warehouse 1A

Warehouse 1A exceeds a floor area of 18,000 m² and as per Provision E1.8, a compliant Fire Control Centre (FCC) is required to be provided and should be located within the main entry of the Warehouse 1A main office.

- A Sub-FIP or Mimic-FIP is proposed to be located within the Automation Control Room that serves the automated racking within Warehouse 1A.
- The Warehouse 1A FIP must be capable of isolating, resetting, and determining the fire location within the building.
- Smoke exhaust fan controls should be provided at the FIP serving Warehouse 1A. If a separate fire fan control panel is provided, it should include a display to indicate the operation or otherwise of the fans.

Warehouse 1B

A Main FIP is to be provided within the office of Warehouse 1B-1, serving all Warehouses 1B tenancies.

- The Main FIP serving the Warehouse 1B tenancies must be capable of isolating, resetting, and determining the fire location within each tenancy of these buildings.
- Pending future discussions and consultation with FRNSW, a Sub-FIP or Mimic Panel may be required within the office serving Warehouse 1B-3; however based on recent precedent, this is not expected.

General

The Main FIPs must be installed in accordance with BCA Specification E2.2a and AS1670.1:2015. Additionally:

- A red strobe should be installed at the entry door to each FIP to alert arriving fire brigade of the fire alarm origin and FIP location.

8.6.2 Fire Hydrants

A dedicated hydrant system with independent booster assembly must be provided for each of Warehouse 1A and the portion of the site that includes the Warehouses 1B tenancies, in accordance with BCA Provision E1.3 and AS2419.1:2005 with the following specifications:

- As far as possible, the hydrant system should consist of external hydrant points. This is expected to be possible for Warehouses 1B tenancies.

- An external hydrant should be provided adjacent to or within close proximity of each external entry/exit point around the building.
- It should be noted that as per precedent set by FRNSW, the maximum distance from external hydrants to any point on a floor is to be no greater than 100 m. The strategy to accommodate this or justify exceptions will rely upon confirmation of the typical routines for access regarding the mezzanine platforms, and an understanding of how brigade access is likely to be facilitated.
- Where the size and design of a building requires the provision of internal fire hydrants (Clause 3.2.3.3 of AS2419:2005) 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.
  - 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, per the request of FRNSW.
  - 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 per the request of FRNSW.

    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.
- Should hydrants be located beneath warehouse awnings, they are to be designed and installed in accordance with the provision for external hydrants, via a Performance Solution.
  - Coverage of the areas beneath awnings must be provided by compliant external hydrants i.e. additional fallback hydrants.
- External hydrant connections should be provided with the heat shields per the requirements of AS2419.1 (i.e. FRL 90/90/90 2 m either side, and 3 m above the hydrant connection point) or be setback more than 10 m from the building. If required, a Performance Solution may be available to omit radiant heat shield protection to external hydrants (inclusive of those under awnings).
- Each system should 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 and FIP.
- The hydrant booster assemblies are proposed to be located at the entrance to the each of the warehouse buildings, along the south-western estate road that serve the precinct, within sight of each main building's entry (see Figure 8-1).
- 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.

Note: The requirement for hydrant coverage within automated racking areas of Warehouse 1A is to be confirmed by the Principal Certifying Authority, noting that these structures may be classified as plant areas.

8.6.3 Vehicular Perimeter Access

The vehicular perimeter access pathway should be provided around the perimeter of all buildings. These should be designed and constructed with an all-weather surface capable of supporting all FRNSW appliances in accordance with BCA Provision C2.4 and FRNSW Policy No. 4 '*Guidelines for Emergency Vehicle Access*', available at http://www.fire.nsw.gov.au/gallery/files/pdf/guidelines/vehicle_access.pdf with the following exceptions permitted:

- The pedestrian Skybridge is present over the perimeter access path in the south-eastern corner of the Warehouse 1A site.
- The perimeter access path is greater than 18 m from the northern perimeter of Warehouse 1A where a 35 m wide awning is present.
- Perimeter access is not available along the south-eastern side of Warehouses 1B-1&2.
- The perimeter access path is greater than 18 m from the south-western side of Warehouses 1B-1&2.

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

- Access to the north-eastern face of Warehouse 1B-3 is available through the designated carpark. As such, the designs of this carpark must also consider the manoeuvrability of FRNSW vehicles and thus adhere to Policy No.4 'Guidelines for Emergency Vehicle Access' developed by FRNSW.

  Note: the traffic engineer is to confirm all swept paths for brigade appliances around the perimeter access pathway.
- The hardstand of the Warehouse 1B facility must accommodate the forward motion of brigade vehicles.

- Access to the south-western face of Warehouse 1B-1&2 is available through the designated carpark for pedestrians and smaller emergency vehicles.
- Sprinkler tank suction points must be located for each system such that a connected brigade appliance does not obstruct vehicular access around the building. These dedicated bays shall also be provided with line-marking.
- 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:
  - Fitted with locks that are openable with a 003 key; and/or
  - Fitted with locks / latches that are openable with a master key, swipe, or badge with copies of these keys/swipes/badges provided to the two local fire brigade stations; and/or
  - Mechanical gates and boom gates should open on fire trip and power failure.

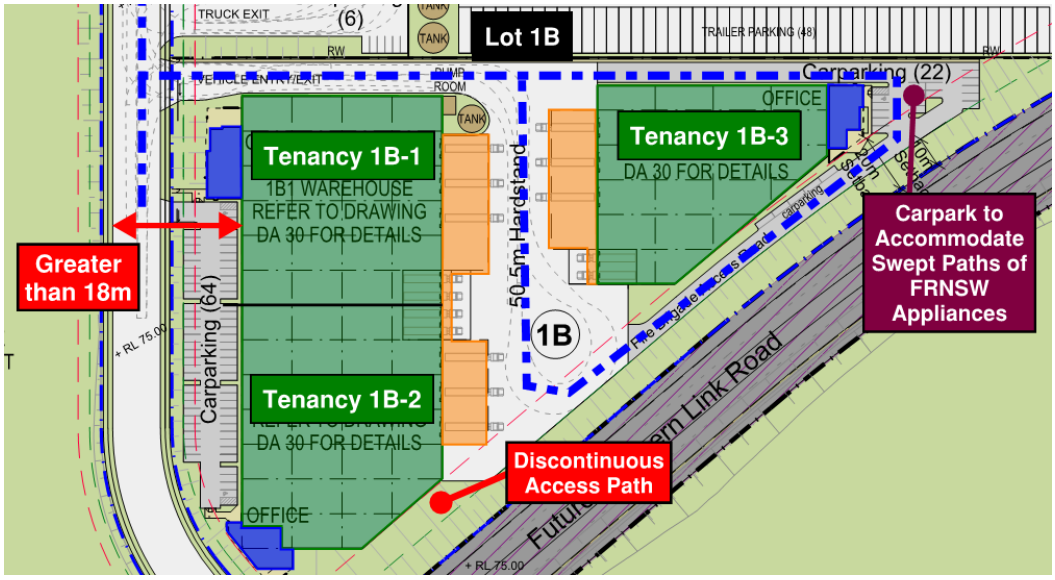


Figure 8-1: Vehicular Perimeter Access Path – Lot 1B

8.7 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.

- Consideration should be given to the development of automated racking procedure manual and associated training of managers for the Warehouse 1A facility, in order to assist and streamline brigade intervention. This should specifically deal with the provisions for fire brigade entry into and around any automated racking systems during and after a fire event, that is, access for brigade personnel, power shutdown, and return to base function for sorting machinery and local command point, as per precedent set by FRNSW.

8.7.1 Maintenance of Fire Safety Equipment

The fire safety systems should be tested and maintained in accordance with Australian Standard AS1851 or other relevant testing regulatory.

The smoke clearance systems should be tested in accordance with the AS1851 requirements for an automatic smoke clearance system as applicable.

8.7.2 Evacuation Plan

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

9 NOMENCLATURE

ACRONYM	EXPANSION
ABCB	Australian Building Codes Board
AFSS	Annual Fire Safety Statement
ASET	Available Safe Evacuation 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 Evacuation Time
RTI	Response Time Index

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