Appendix GG
Fire safety strategy

EMM
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FIRE SAFETY STRATEGY

Lot K at Kemps Creek Industrial (SSD-10479)

200 Aldington Road, Kemps Creek

Report Number:

252028_FSS_02

Date:

09/05/2025

Stockland Fife Kemps Creek Pty Ltd

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Report Revision History

Rev	Date	Comment	Prepared By	Reviewed By
01	11/04/2025	Draft Issue	**Thomas Newton** *MEng (Fire Safety)*	**Norman Boustany** *BEng (Civil)(Hons)* *GradDip (Fire Safety)*
02	09/05/2025	Final Issue	**Thomas Newton** *MEng (Fire Safety)*	**Norman Boustany** *BEng (Civil)(Hons)* *GradDip (Fire Safety)*

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EXECUTIVE SUMMARY

An Environmental Impact Statement (EIS) has been prepared in response to Secretary's Environmental Assessment Requirements (SEARs) issued for SSD-80264236 on 18 March 2025.

There are two components to the proposed development:

- The construction of a warehouse and distribution centre on Lot K at Kemps Creek Industrial Estate, 200 Aldington Road, Kemps Creek
- The modification (in part) of the approved Concept Master Plan for Kemps Creek Industrial Estate (SSD-10479) in order to accommodate the proposed warehouse and distribution centre on Lot K.

Both components are classified as State significant development (SSD).

The applicant, Stockland Fife Kemps Creek Pty Ltd (SFKC) is a joint venture between Stockland and Fife Capital.

Lot K development

The proposed Lot K development is a bespoke warehouse and distribution centre which represents a contemporary and innovative response to the site operational needs and the logistical requirements for a major national business. The development is comprised of one main warehouse and distribution building with two main dock faces, ancillary offices, carparking, hardstand vehicle parking, a weighbridge and freestanding gate house, surrounded by perimeter landscaping and visual treatments to achieve pleasant micro-climates and desirable streetscapes.

The site is zoned IN1 General Industrial under the Chapter 2 of the State Environmental Planning Policy (Industry and Employment) 2021 (I&E SEPP). Industries (other than offensive or hazardous industries) are permitted with development consent within land zoned IN1. Development for the purpose of a warehouse or distribution centre is defined as a type of 'general industry' and therefore falls within the permissible development of 'industries'.

The vision for Lot K, and other lots within the Kemps Creek Industrial Estate, is to create a world class facility for industrial businesses with an emphasis on design quality, sustainability, innovation and a complementary mix of estate occupants.

The warehouse and distribution centre is classified as SSD due to the estimated development cost which is greater than $50 million, as prescribed under Section 12 of Schedule 1 to the State Environmental Planning Policy (Planning Systems) 2021.

Staged development of the Estate

The Kemps Creek Industrial Estate is being developed in stages.

Condition A4 of SSD-10479 requires that each subsequent stage of the development is to be subject to further development applications.

SSD-10479 is known as Stage 1 and included earthworks, subdivision and a warehouse on Lot F

SDD-61212208 is Stage 2 and has proposed a warehousing and distribution centre on Lot J.

This SSD application is Stage 3.

If approved, Stage 3 will commence contemporaneously with Stage 1 and Stage 2 building works.

Modification of SSD-10479

The proposed modifications to the Concept Master Plan under SSD-10479 are:

- A boundary adjustment between Lot K and Lot G by moving the boundary 10m to the north (increasing the area of Lot K and reducing the area of Lot G)
- Changes to the site ingress and egress for Lot K under the Concept Master Plan
- Changes to the building footprint and general arrangement for Lot K under the Concept Master Plan

These changes are required in order to deliver the specific operational needs of the warehouse and distribution centre for Lot K and to achieve the best possible performance of the facility in terms of local amenity, safety and acoustics.

Building Code of Australia Compliance

This Fire Safety Strategy has been prepared by Affinity Fire Engineering Pt Ltd (AFFINITY) on behalf of Stockland Fife Kemps Creek Pty Ltd (the Applicant). This Fire Safety Strategy (FSS) outlines the fire engineering principles that will be utilised in ensuring that the prescriptive non-compliances with the Deemed-to-Satisfy (DtS) provisions of the Building Code of Australia 2022 (BCA) [1], as noted herein, are resolved through a fire engineered Performance Solution to conform to the building regulations.

The complete fire-engineered analysis will be completed within the Fire Engineering Report and form part of the development Construction Certificate submission, and as such detailed engineering analysis is not documented herein. This Fire Safety Strategy does however outline the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building and satisfy the Performance Requirements of the BCA.

Fire & Rescue NSW Compliance

A specific review has been conducted relative to the emergency vehicular access roads around the site in relation to the Building Code of Australia [1] and also Fire + Rescue NSW Guidelines [5] and requirements. Based on our review in Section 3.4 of this report, and recent experience on similar projects, Affinity Fire Engineering confirms that the design is in compliance with the FRNSW Fire Safety Guideline “Access for fire brigade vehicles and firefighters v5.01” [5].

CONTENTS

2 INTRODUCTION & SCOPE

2.1 Overview

This Fire Safety Strategy has been undertaken and nominates Performance Solutions for assessing compliance with the nominated Performance Requirements of the BCA [1] in accordance with the methodologies defined in the IFEG [3] and provide a workable and safe Fire Safety Strategy.

The Fire Safety Strategy has been developed to provide confidence in the design from a fire safety aspect. The document should be read in conjunction with the developments BCA Compliance Report, as the fire safety strategy and measures detailed herein are provided to address areas of non-compliance as detailed within the subject BCA Compliance report, as deemed suitable by Affinity.

2.2 Fire Safety Objectives

The objective of the Fire Engineering Assessment is to develop a Fire Safety System, which satisfied the Performance Requirements of the NCC whilst maintaining an acceptable level of life safety, protection of adjacent property and adequate provisions for Fire Brigade intervention. At a community level, fire safety objectives are met if the relevant legislation and regulations are complied with. As stated in the NCC, *"Compliance with the NCC is achieved by satisfying the Performance Requirements"*. In addition to this, certain non-regulatory objectives exist as detailed below.

2.2.1 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) [15] as per the Fire Services State and Territory Acts and Regulations.

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

2.2.2 Building Regulatory Objectives

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

- **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 -** fire fighters must be given a reasonable time to rescue any remaining occupants before 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 fire fighters 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.

2.2.3 Non-Prescribed Objectives

Fire Engineering has an overarching benefit to many facets of the built environment where non-prescribed objectives can influence the Fire Safety Strategy adopted. The client and stakeholders for the design have not requested any additional nonprescribed objectives required to be met through the preparation of the FER.

2.3 Regulatory Framework of the Fire Engineering Assessment

2.3.1 National Construction Code Series - Building Code of Australia

One of the goals of the BCA [1] 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 for the public interest and is considered to be cost-effective and not needlessly onerous in its application.

Section A2G1 of the BCA [1] outlines how compliance with the Performance Requirements can be satisfied. These are as follows:

1. Performance Solution; or
2. Deemed-to-Satisfy Solution; or
3. Combination of (1) and (2).

Section A2G2 of the BCA provides several different methods for determining that a Performance Solution complies with the Performance Requirements. These methods are summarised as follows:

1) A Performance Solution is achieved by demonstrating-

   (a) Compliance with all relevant Performance Requirements; or

   (b) The solution is at least equivalent to the Deemed-to-Satisfy Provisions.

2) A Performance Solution must be shown to comply with the relevant Performance Requirements through one or a combination of the following Assessment Methods:

(a) Evidence of suitability in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets the relevant Performance Requirements.
(b) Verification Methods including the following:
    (i) The Verifications Methods in the NCC
    (ii) Other Verification Methods accepted by the appropriate authority that show compliance with the relevant Performance Requirements.
(c) Expert Judgment.
(d) Comparison with the Deemed-to-Satisfy Provisions.

3) Where a Performance Requirement is satisfied entirely by a Performance Solution, in order to comply with (1) the following method must be used to determine the Performance Requirement or Performance Requirements relevant to the Performance Solution:
    (a) Identify the relevant Performance Requirements from the Section or Part to which the Performance Solution applies.
    (b) Identify Performance Requirements from the other Section or Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Performance Solution.
4) Where a Performance Requirement is proposed to be satisfied with a Performance Solution, the following steps must be undertaken:
    (a) Prepare a performance-based design brief in consultation with relevant stakeholders.
    (b) Carry out analysis, using one or more of the Assessment Methods listed in (2), as proposed by the performance-based design brief.
    (c) Evaluate results from (b) against the acceptance criteria in the performance-based design brief.
    (d) Prepare the final report that includes-
        (i) All Performance Requirements and/or Deemed-to-Satisfy Provisions identified through A2G2(3) or A2G4(3) as applicable: and
        (ii) Identification of all Assessment Methods used; and
        (iii) Details of steps (a) and (c); and
        (iv) Confirmation that the Performance Requirement is met; and
        (v) Details of conditions or limitations, if any exist, regarding the Performance Solution.

Section A2G3 of the BCA states that a solution that complies with the Deemed-to-Satisfy Provisions is deemed to have met the Performance Requirements. A Deemed-to-Satisfy Provision can be shown compliance with the Deemed-to-Satisfy Provisions through one or more of the following Assessment Methods:

(a) Evidence of suitability in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets the relevant Performance Requirements.
(b) Expert Judgement.

As described in Section A2G4 a combination of Performance Solutions and Deemed-to-Satisfy Solutions may be used to satisfy the Performance Requirements. When using a combination of solutions, compliance can be shown through the following, as appropriate:

(a) Section A2G2 for assessment against the relevant Performance Requirements.
(b) Section A2G3 for assessment against the relevant Deemed-to-Satisfy Provisions.

Where a Performance Requirement is satisfied by a Performance Solution in combination with a Deemed-to-Satisfy Solution, in order to comply with (1), the following method must be used to determine the Performance Requirement or Performance Requirements relevant to the Performance Solution:

(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 Sections or Parts that are relevant to the identified Deemed-to-Satisfy Provisions.

(c) Identify Performance Requirements from other Sections or 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 subject to the Performance Solution.

2.3.2 Australian Fire Engineering Guidelines (AFEG)

The AFEG [4] document has been developed for use in fire safety design and assessment of buildings and reflects Australia's best practices. 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 AFEG has been generally adopted in this Fire Engineering Report (FER) for the assessment of each individual deviation from the prescriptive provisions as identified by the Principal Certifier. The design of each deviation was developed with a holistic understanding of the impact of the requirements and deviations assessed on the overall risk of fire spread, and occupant and fire fighter life safety.

There are professionals employed in the building process that determine the level of compliance with the building code Deemed-to-Satisfy (DtS) provisions. Conformation of compliance with the applicable BCA DtS provisions is the role of the BCA consultant / Principal Certifier and not the project fire safety engineer. Where not commented on within this report it is the expectation that the design complies with the BCA.

2.3.3 Stakeholders

The Performance Solution has been developed collaboratively with the relevant stakeholders as identified in Table 2-1.

Table 2-1: Relevant Stakeholders

Role	Organisation	Name
Developer	Stockland Fife Kemps Creek Pty Ltd	Sophia Leung (Stockland) Meghan Redfern (Fife Capital)
Architecture	Reid Campbell	Sam Berry-Smith Vanessa Elias
BCA Consultant	McKenzie Group	Geoff Pearce
Traffic Consultant	Ason Group	Mack Brinums Alan Tan
Fire Safety Consultant	Affinity Fire Engineering	Thomas Newton Lazar Youkhanna

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 the 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.

2.4 Sources of Information

The following sources of information have been relied upon in the preparation of this document:

- Architectural Plans prepared by Reid Campbell Architects as listed below:
  - 1230001_ A004 SITE & SETOUT PLAN_M

2.5 Limitations and assumptions

In this instance, this Fire Safety Strategy has been developed based on applicable limitations and assumptions for the development which are listed as follows:

- This report is specifically limited to the project described in Section 2.
- This report is based on the information provided by the team as listed in Section 1.4.
- Building and occupant characteristics are as per Sections 2 and 3 of this document. Variations to these assumptions may affect the Fire Engineering Strategy and therefore they should be reviewed by Affinity Fire Engineering 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 Section 5. The report does not provide guidance in respect of areas, which are used for Dangerous Good storage, processing of flammable liquids, explosive materials, multiple fire ignitions or sabotage of fire safety systems.
- The report is prepared on the basis that the development complies with the DtS provisions of the NCC [1] with all aspects relating to fire and life safety unless otherwise specifically stated in this report. Where not specifically mentioned, the design is expected to meet the NCC 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 NCC 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 NCC. 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 fire will not occur.
- This Fire Safety Strategy (FSS) 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 2.3.3 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 BUILDING CHARACTERISTICS

3.1 Overview

Building characteristics are assessed as part of the Fire Safety Strategy 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 the ability to resist a developing fire and support conditions 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, classification and height will dictate passive and active fire safety systems.

3.2 Site Description

The development site is located within the Stockland Fife Kemps Creek Industrial Estate in the NSW Suburb of Kemps Creek.

Lot K is located centrally in the south-eastern corner of the estate. With access to the site provided through the estate roads, Lot K is bound by Estate Road 01 and Estate Road 02 to the south and west respectively, and neighbouring industrial sites to the north and east. The Industrial Estate is shown in Figure 3-1 with Lot K highlighted for context.

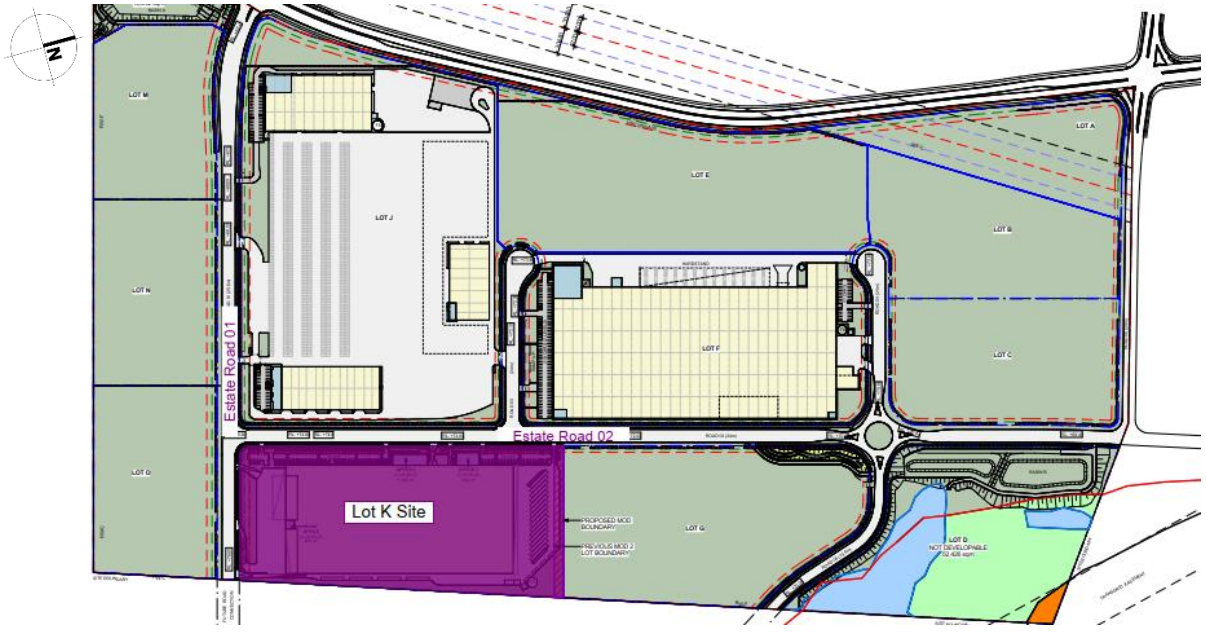

Figure 3-1: Lot K Location within the Estate Masterplan

Regarding Fire and Rescue operations, the site influences the likely fire brigade intervention times, and given the close proximity to the nearest fire station it is expected to facilitate a relatively convenient and expedient fire brigade response. Furthermore, being in an outer suburb of a major city, the development is provided with the services and facilities expected in an urban setting.

3.3 Building Description

The project entails the construction of a warehouse facility comprising of a single large-isolated building with ancillary offices, 2-storey staff carparking deck and an extensive dispatch hardstand and external yard storage areas.

A descriptive mark-up of the site plan is provided in Figure 3-2 with further overview of the site provided in the following text.

Warehouse and Distribution Areas

The site contains Class 7b warehouse space which includes a combination of storage areas and stock sortation feeding into the dispatch docks. The building is of a typical structural steel portal frame design with a roof ridge height of 14.6m. The warehouse roof sheeting incorporates sections of translucent sheeting to provide natural light into the facility and provision for solar panels also distributed across the roof.

An internal wall separates the southern and northern halves of the warehouse to provide delineation of the storage area.

Offices and Ancillary Areas

Three (3) offices exist, each consisting of two (2) levels and are attached to the southern and western sides of the warehouse. These offices provide access to each of the warehouse floor plates and allow dedicated staff monitoring of the southern dispatch docks.

Car Parking

Staff carparking is located along the western side of the building in two locations. The northern-most parking is typical on-grade external carparking, with the southern parking designed as a two (2) deck carpark.

Dispatch Hardstand, Dispatch Docks and Vehicular Access

Dispatch hardstands are located on the southern and norther sides of the building, each provided weather protection by awnings extending 20m and 5m from the building respectively.

The dispatch hardstand extends around the eastern side of the building which also acts as the perimeter vehicular access road for emergency services.

Along the eastern side of the building there are dedicated parking areas for 4 x B-Double Trucks and 3 x Medium Rigid Vehicles.

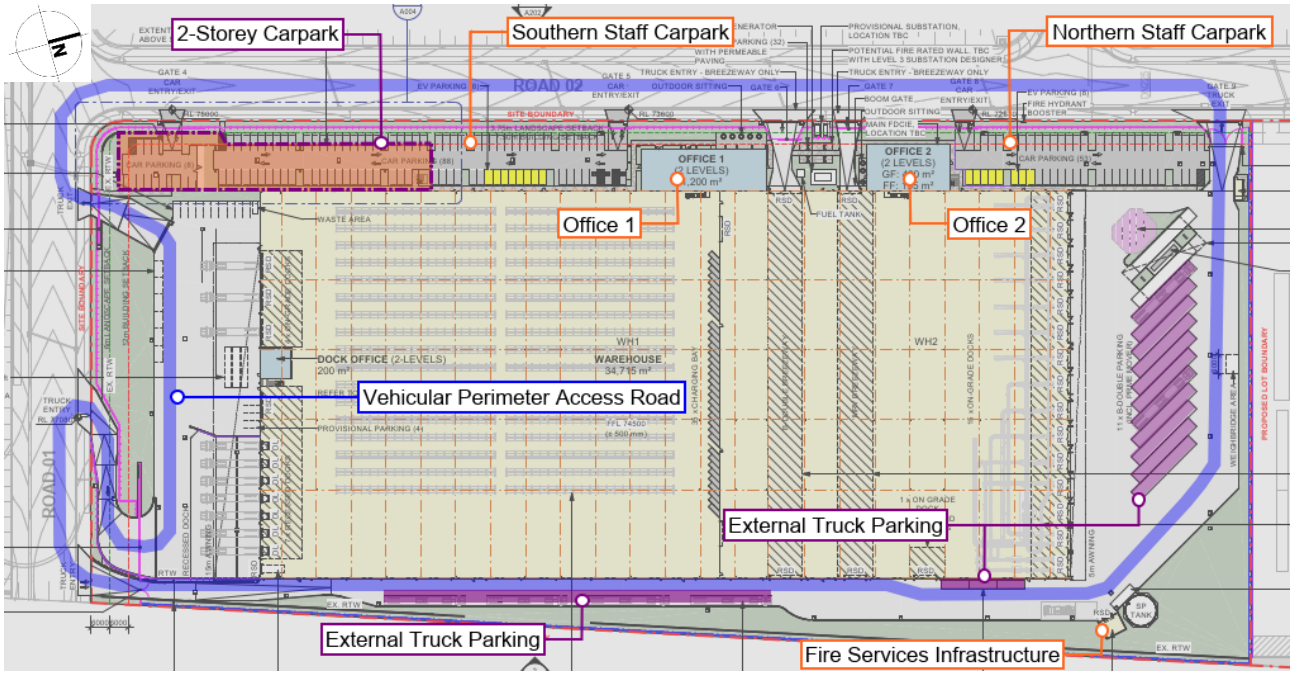

Figure 3-2: Lot K Site Plan - Key Building Features

3.4 Secretary's Environmental Assessment Requirements (SEARs)

Additional to the above objectives and scope of assessment, this report addresses the following items from the project SEARs.

Table 3-1: Secretary's Environmental Assessment Requirements

Item/Topic	SEARs Description/Requirement	Outcome
Fire Brigade Perimeter Vehicular Access	The EIS should address how access for fire brigade vehicles is maintained around the eastern edges of the proposed development for lot K, particularly given that the proposal now shows this area to be used for B-Double parking	Section 3.4.1

3.4.1 Vehicular Perimeter Access for Emergency Services

The vehicular perimeter access for emergency services is illustrated in the figure above in blue, and as detailed herein, there are sections of this roadway that are not conformant with the prescriptive Deemed-to-Satisfy (DtS) provisions of the BCA. In this instance a fire engineered Performance Solution will be developed ahead of the relevant construction certificate and subject to FRNSW approval through the Fire Authority referral pathway detailed within the Environmental Planning and Assessment (Development Certification and Fire Safety) Regulation 2021. The Performance Solution will specifically address variations from the prescriptive DtS provisions of the BCA; noting that a Performance Solution is permitted within Section 10.2.6 of the FRNSW Fire Safety Guideline "Access for fire brigade vehicles and firefighters [5].

The emergency vehicle perimeter access provisions rely upon the Estate Roads on the southern and western sides of the site, with the remaining sides of the vehicular access road utilising internal roads within the site. This design principle is in accordance with the provisions of the Building Code of Australia and FRNSW Fire Safety Guideline. While utilising these roads results in the vehicular access road exceeding the BCA limitation of 18m from the building where it travels along sections of the Estate Road, and a minor section along the eastern portions that is reduced to a clear width of 4.5m between the parking bays and the warehouse façade, and where there are downpipes and bollards for exit doors the clear width is reduced to a minimum clear width of 3.5m. These elements if the design, however, facilitates fire-fighter operations and enables fire-fighting water to be applied to the structure in the most advantageous locations. Direct building access is afforded through provision of pedestrian pathways linking the Estate Road to staff carparks and ultimately the main building structure and available exit doors and main entry points around the perimeter.

The design for a reduced clear road width between the warehouse and B-Double truck parking spaces on the eastern side of the building is in line with the FRNSW Guidelines as per the following extracts.

- A general clear width of 4.5m will be maintained between the building and the parked trucks as per Clause 7.1.2 of the FRNSW Guideline (shown in Figure 3-3).
- The temporary reductions created by downpipes or bollards outside exit doors, reduces the above 4.5m width by a further 1m; down to a minimum clear width of 3.5m. As this is only a temporary reduction it achieves compliance with Section 7.3.3 of the FRNSW Guideline (shown in Figure 3-4).

7.1.2 Along any straight *carriageway* section, the minimum width is 4.5 m for general *fire appliance* access, or 6 m for specialist *fire appliance* access (see Figure 3).

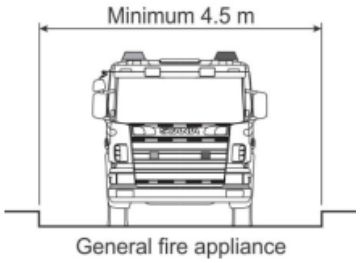

Figure 3-3: Excerpt from FRNSW Guideline Clause 7.1.2

7.3.3 Any constricted access along a straight *carriageway* section is not to be longer than 50 m (see Figure 8).

Note: A 50 m long pinch point allows two lengths of fire hose.

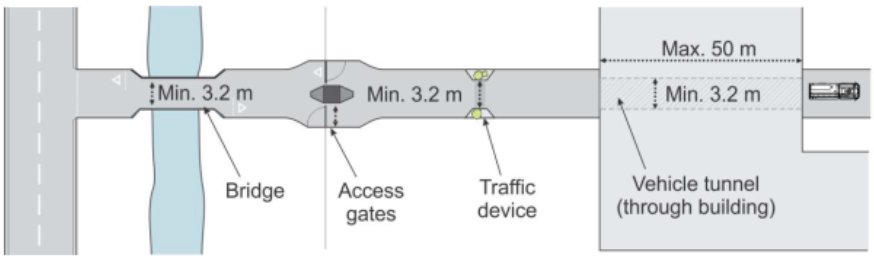

Figure 8 Examples of constricted access (typical pinch points)

Figure 3-4: Excerpt from FRNSW Guideline Clause 7.3.3

Further to the above, the roadway directly adjacent to the north and south of the restricted roadway is 6m in clear width and facilitates deployment of the aerial appliance stabilisers; which is at the building corner and the safety and most suitable location for such staging.

Based on these specific design features Affinity Fire Engineering subsequently confirm that the design is compliant with the FRNSW Fire Safety Guideline "Access for fire brigade vehicles and firefighters" version 5.01" and is capable of compliance with the Performance Requirements of the BCA.

3.5 Building Structure

The building has a rise-in-storey of two (2) and considered a large-isolated building requiring Type C Construction.

As the warehouse development is deemed a large-isolated building, it shall be provided with the relevant BCA DtS provisions requiring an automatic fire suppression system throughout, vehicular perimeter access and an automatic smoke exhaust system (unless otherwise omitted through a Performance Solution as outlined in this strategy).

All materials used in the construction will generally conform with the testing methodology outlined in the DtS provisions so to mitigate the spread of fire and smoke, in turn minimising the fire related risks to occupants and firefighters.

3.6 Building Characteristic Assessment

The following table summarises the characteristics of the subject building, relevant to fire and life safety.

Table 3-2: Building Characteristics Review

CHARACTERISTIC	Lot K Building	Gate House
NCC Classification	Class 5 (Office) Class 7b (Warehouse)	Class 5 (Office)
Rise in Storeys	Two (2)	One (1)
Type of Construction	Type C *Large-Isolated Building*	Type C
Effective Height	Approx. 4m	N/A
Floor Area	34,695 m^2	20 m^2
Volume	500,500 m^3	60 m^2

4 OCCUPANT CHARACTERISTICS

4.1 Overview

The occupant characteristics are assessed as part of the Fire Engineering Review 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 affects 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 Dominant Occupant Characteristics Assessment

Table 4-1: Occupant Characteristics Review

Characteristic	Description
Population numbers	Generally, the occupant numbers in the building is expected to equivalent to the occupant densities (m^2/person) listed in the NCC Table D2D218 for the various areas and the building layout which are listed as follows: ▸ 1 person per 30m^2 in the warehouse storage, plant and carpark areas ▸ 1 person per 10m^2 in the office areas.
Physical and mental attributes	**Staff and Security** Staff in the building are expected to be awake and alert at all times. Staff are expected to have a level of understanding where they can recognise an emergency situation and have the ability to take and implement decisions independently. In addition, staff are expected to respond at all times, and to be unaffected by physical or sensory disabilities. Staff are not expected to be mentally impaired by drugs, alcohol, fatigue or other adverse conditions to degrees greater than in other business places. **Clients and Visitors** This occupant group is expected to be awake and alert. This group may also exhibit physical and mental disabilities to the degree and frequency of the general public. While this occupant group are expected to be capable of making and implementing decisions independently, they may require

Characteristic	Description
	assistance in locating or accessing the nearest and safest egress path in an emergency. The occupant group are expected to be accompanied by a staff member who will be capable of assisting visitors in determining the appropriate response to fire alarm signals and direct them to the most suitable exit in an emergency. **Fire and Rescue NSW** Are expected to be equipped with safety equipment and will be educated in fire-fighting activities and the dangers associated with fire incidents. It is not expected that this occupant group would be present in the building at the time of fire ignition, they are however expected to enter the building at a later stage to undertake fire suppression activities. **Maintenance Personnel** Are expected to be mobile with normal hearing and visual abilities where occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. This group expected to be fully awake and aware of their surroundings at all times when inside the building.
Familiarity with the building	**Staff and Security** Staff are expected to have a complete knowledge of the building layout and be able to coordinate evacuation of other occupant groups in an emergency. **Clients and Visitors** May or may not be familiar with the layout of the building and may require assistance in locating the exits. While these occupants may not have a good familiarity of the egress paths, they will be accompanied by a staff member who will direct them to the most suitable exit in an emergency. **Fire and Rescue NSW** Are not expected to have any familiarity of the building layout, however, are assumed to obtain the required site-specific information from fire service block plans available prior to entering the building. **Maintenance personnel** 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.

Characteristic	Description
Pre-movement time	Pre-movement times can vary and is highly dependent on a combination of a variety of factors [4] such as: ▸ Familiarity with building ▸ Commitment to activity being undertaken at the time of fire ignition ▸ Mental capabilities (ability to assess risks and make appropriate decisions, alertness) ▸ Physical capabilities ▸ Group dynamics ▸ Occupant relationships / social affiliations ▸ Frequency of false alarms Documents such as PD7974-6:2004 [10] and CIBSE Guide E [13] provide guidance on estimating pre-movement times for various occupancies.
Travel speed	Travel speeds for individuals can vary depending on factors such as: ▸ Age and sex, ▸ Physical capabilities (ambulant, semi-ambulant, bed-ridden) ▸ Occupant density / crowding ▸ Perceived danger Based on a literature review of work carried out by Boyce et al. [16], Nelson and Mowrer [17], Pauls [15], Milinskii, Pelecheno [16], Pretechskii [17] and Shi et al. [18], the following travel speeds are adopted for an average horizontal travel speed: ▸ 1.2m/s is assumed for an able-bodied adult where congestion is unlikely [13] such as in the breezeway and carpark areas; and ▸ 1.0m/s is assumed for an able-bodied adult where congestion is likely [13] such as in the warehouse and gymnasium areas; and ▸ 0.8m/s for semi-ambulant occupants requiring assistance to evacuate, walking aid or wheelchair users [17] such as in the administration and office areas.

5 HAZARDS AND PROTECTIVE MEASURES

5.1 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, hazards identified can form a justified basis for selected scenarios in fire engineering assessments.

5.2 Fire hazards

5.2.1 Building layout and egress

Occupants are afforded exits around the perimeter of the building to allow for multiple alternative opportunities in an emergency. Due to the open nature of the warehouse, there are limited dead end travel routes to exits. Many of the exits discharge onto the perimeter access road around the building to facilitate fire fighter access into the building for fire suppression and search and rescue operations.

5.2.2 General activities

The building will be used for general goods storage and distribution and thus 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.

The offices will all contain general office activities with a variety of dedicated office suites, open work areas and meeting rooms.

5.3 Fuel Loads

Quantity of Materials

Due to the nature of the facility, the fire loads within the warehouse will change over time as the tenant changes or the business structure of the same tenant evolves. As such, it is not suitable to provide specific fire load densities for the product and materials being stored within the facility.

The fire load densities with the office areas should however remain consistent and as such the following fire load densities in those parts shall be utilised in the fire engineering analysis where suitable.

The office areas may exhibit mean fire load densities of approximately 800MJ/m^2 with isolated peak values reaching up to 1600MJ/m^2.

5.4 Dangerous Goods

Dangerous goods are not expected to be stored on the site in significant quantities. It is however noted that all commercial buildings will contain a degree of flammable materials for maintenance purposes (i.e. paints, oil, aerosols etc.) and where DGs are stored, they shall be stored in accordance with the Regulatory requirements.

This Fire Safety Strategy has been developed based on there being limited Dangerous Goods stored on site additional to those required for daily maintenance purposes. Any storage of Dangerous Goods will require review and assessment by a suitably qualified Risk Consultant to determine the associated hazards and required preventive measures to meet BCA Clause E1D17 and E2D21.

5.5 Rooftop Solar Panels

Solar photovoltaic systems contribute to an increased probability of a fire event, primarily due to electrical risks [9]. Additionally, should the solar panels be subjected to a fire event, the attending fire brigade can be exposed to hazardous toxins from the combustion of the panel materials.

Where the design incorporates provisions for rooftop solar panels to offset the building's energy requirements, the following design measures shall be included to mitigate the risk to the attending fire fighters in the event of a fire as per FRNSW requirements:

- An A4 notice on fade resistant material must be displayed at the main FDCIE notifying attending fire fighters as to the existence of the Photovoltaic Solar Panel Array on the roof of the building. The notice must include:
  - A figure detailing the location of the panels.
  - A floor plan detailing the location of all associated isolation switches and AC and DC isolators for the shut-off of generated electricity.
  - Notification that the PV do not automatically isolate on fire trip.
  - A statement in 25mm font stating (or similar wording):

    "Photovoltaic (PV) Panels Present — PV panels are mechanically fixed to the roof as shown below"

5.6 Electric Vehicles and Associated Charging Bays

Electric vehicles are becoming increasingly popular however compared to conventionally Internal Combustion Engine (ICE) vehicles, Electric Vehicles (EV) raise doubts regarding fire safety due to the Lithium-Ion batteries which are contained within the EVs to power them. Research [5] has found that many electric vehicle fires are a result of the battery with particular consistency relative to battery abuse, damage due to weather exposure and collisions respectively and in recorded occasions, during charging.

Following thermal runaway, the lithium-ion batteries are known for containing their heat and also continuing heat generations such that reignition is a credible risk to fire fighters. As such a fire hydrant system that is accessible during a fire, and also provides an ongoing supply of water is critical to containing a lithium-ion battery fire.

Due to the increased risk of the electric vehicle presence in the building, noting that this is the same for all projects and not atypical for this development, the fire engineering explicitly includes provisions with the interest of FRNSW fire intervention as an acknowledgement of the challenges faced in suppressing and extinguishing lithium-ion battery fires.

Power Isolation

- All electric vehicle charging equipment must automatically shut down and be isolated from the mains power on general fire alarm anywhere within the building.
- Signage must be displayed at the main FDCIE to indicate the properties of the electric car charging bays to include:
  - The location of the charging bays.
  - The location of manual isolation switches/boards with way finding from the FDCIE and operating instructions.
  - The power rating (kW capacity) of the chargers.
  - Notification that the electric car charging systems automatically ceases operation and are isolated from power supply on general fire alarm.

Fire Hydrant Design

- To enable attending fire fighters to attach to a hydrant and apply water suppression to the potential fire source external hydrants are to be located around the building perimeter to provide coverage to all external carparking spaces. Note that external hydrants must not be located within 10m of an electric vehicle charging bays per the requirements of AS2419.1:2021.
- The hydrant system is to be connected to a pressurised town mains water supply to ensure a continuous water supply for firefighting.

Ventilation

Ventilation of the car parking is a critical measure in any carpark scenario given the type and quantity of combustion products being released from a vehicle fire; this in only enhanced where the fire originates from a lithium-ion battery failure.

Typically for a basement carpark, there is risk of smoke venting up through the lift and stair shafts into the levels above. Where that is the case, a degree of smoke separation could be incorporated to prevent the upper level of the building becoming smoke logged from a basement level fire. In this instance however the carparking areas are external and open sided to facilitate smoke venting directly to atmosphere.

- As a result of the open nature, the carparking areas are not required to be provided with any additional smoke extraction measures.

5.7 Review of relevant fire statistics

The following discussion is based on the fire statistics attached in APPENDIX A.

5.7.1 Warehouse

From the National Fire Protection Association (NFPA) report on 'Structure Fires in U.S. Warehouses' [32], statistics specific to warehouses can be analysed.

A total of 1,270 structure fires were reported in warehouses between 2007 and 2011. The fires recorded resulted in 4 occupant fatalities, 23 occupant injuries and $188 million in direct property damage per year. Overall, 19% of fires were intentionally set. However, no civilian injuries were reported from these fires. Shop tools and industrial equipment caused 8% of fires; however, these fires resulted in 27% of the civilian injuries recorded annually. The leading area of fire origin in warehouses comes from unclassified storage areas, resulting in 13% of fires and 18% of civilian injuries.

Figure 5-1 illustrates the leading cause of structure fires in warehouses, while Figure 5-2 indicates the leading areas of origin.

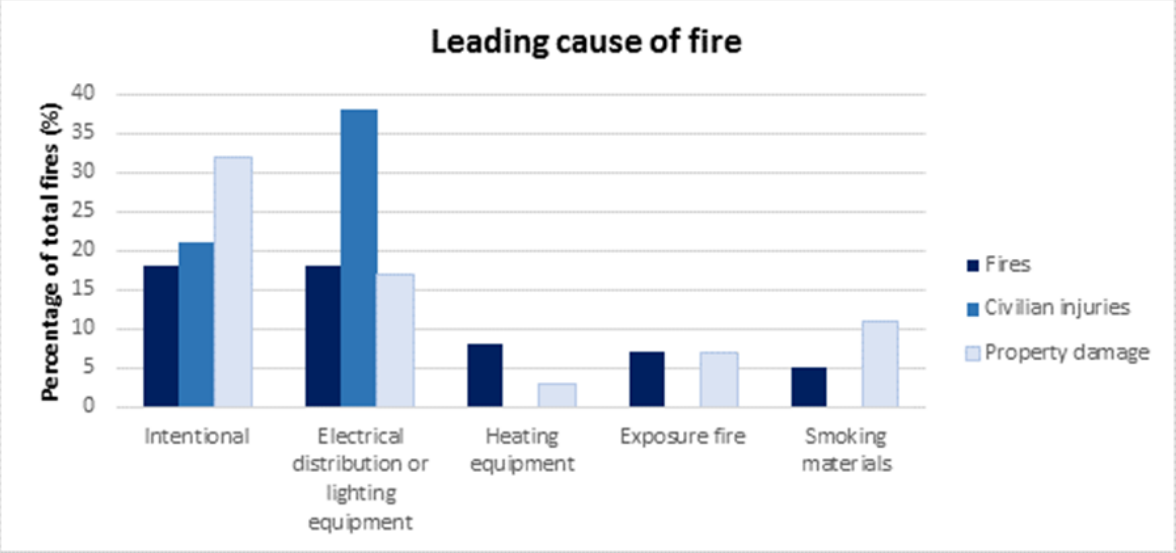

Figure 5-1: Leading Causes of Structure Fires in Warehouses

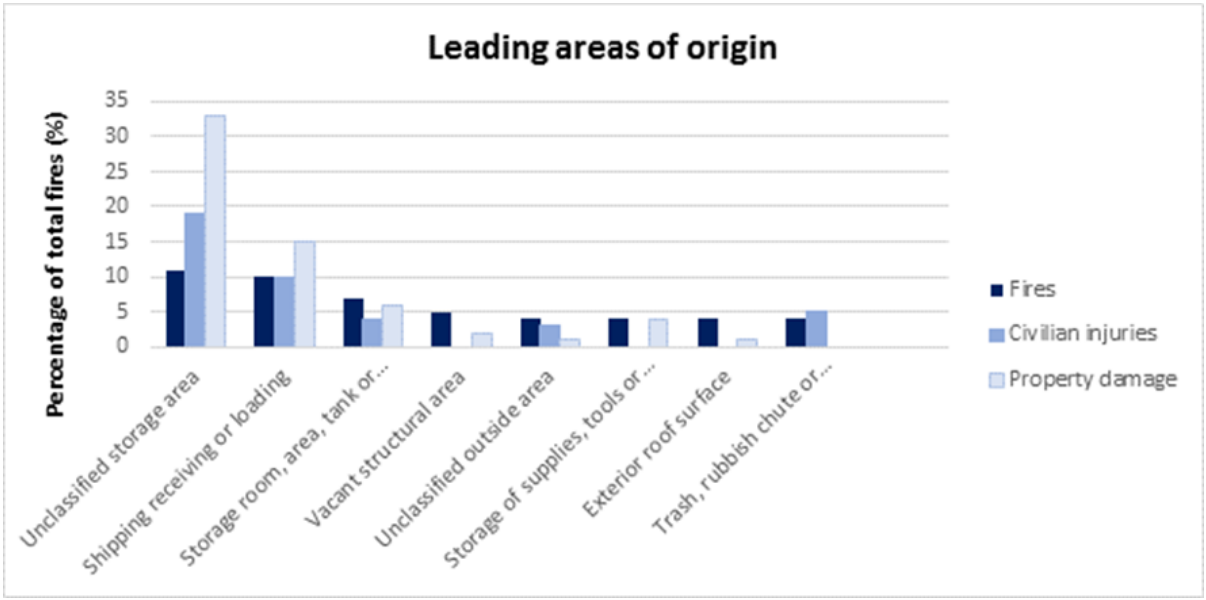

Figure 5-2: Structure fires in warehouses by area of origin

The most common ignition sources in order of likelihood in warehouse structure fires are:

- Intentional (18%)
- Electrical distribution or lighting equipment (18%)
- Heating equipment (8%)
- Exposure fire (7%)
- Smoking materials (5%)

The most common fire origins in order of likelihood in warehouse structure fires are:

- Unclassified storage area (11%)
- Shipping receiving or loading (10%)
- Storage room, area, tank or bin (7%)
- Vacant structural area (5%)
- Unclassified outside area (4%)
- Storage of supplies, tools or dead storage (4%)
- Exterior roof surface (4%)
- Trash, rubbish chute or container (4%)

5.7.2 Office

NFPA statistics published for the years 2007-2011 estimates an average of 3,340 structure fires in office properties per year. Fires in office properties accounted for less than one in every 100 (0.7%) reported structure fires from 2007-2011. These fires caused annual averages of 4 civilian deaths and 44 civilian injuries. One in every four fires was caused by cooking. Electrical distribution and lighting equipment was the second leading major cause. The percentage of fires, civilian injuries and deaths that occurred in 2007-2011 at different times of the day are presented in the figure below.

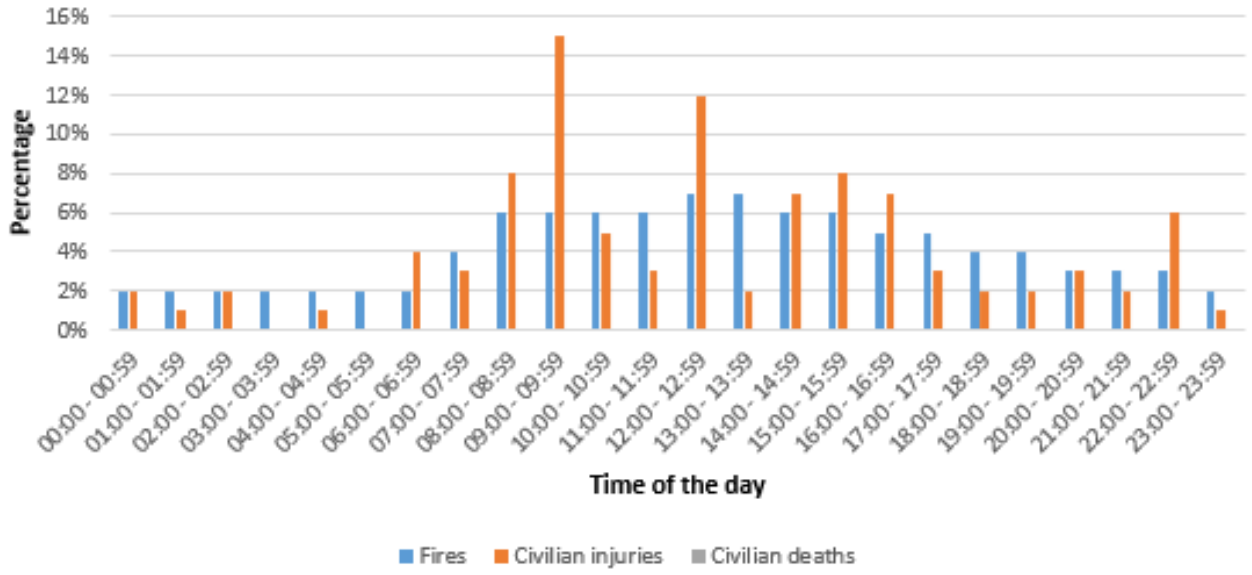

Figure 5-3: Percentage of fires, civilian injuries and deaths at different times of the day (offices)

The following graph that shows the ratio of injuries and deaths to total number of fires has been developed from the data presented in the previous figure. It can be noted that the number of fires during the day is almost four times as many as those during the night. The number of fires peak at midday and are the lowest in the night. This is likely due to the fact that office tenancies are generally unoccupied during the night.

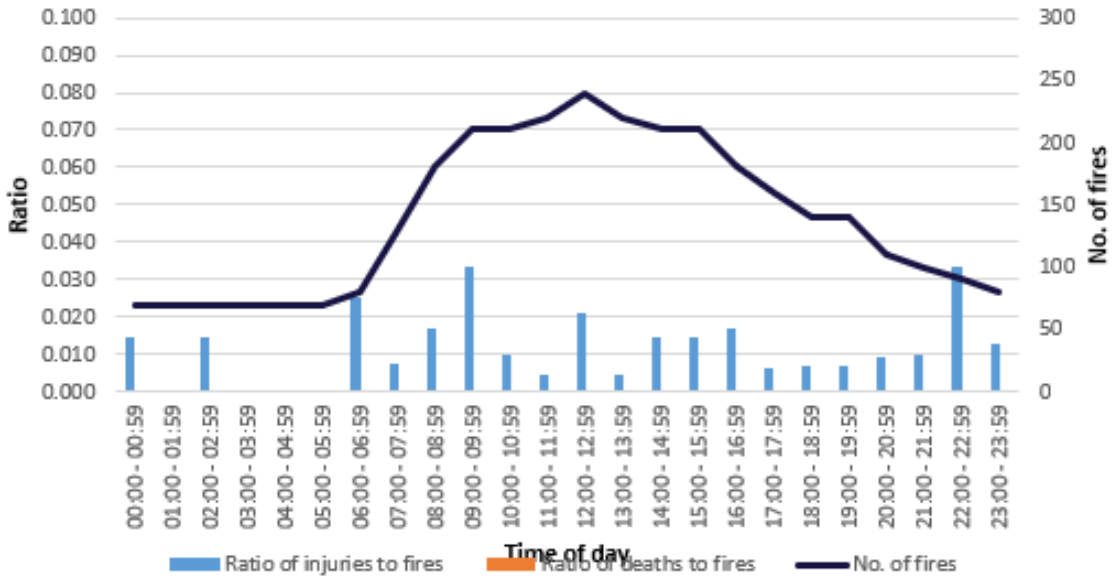

Figure 5-4: Number of fires, ratio of injuries/fires and deaths/fires for different times of the day (offices)

The most common ignition sources in order of likelihood in office structure fires are:

- Cooking equipment (29%)
- Electrical distribution and lighting equipment (12%)
- Heating equipment (11%)
- Intentional (10%)
- Smoking materials (9%)

The most common fire origins in order of likelihood in office structure fires are:

- Kitchen or cooking area (22%)
- Unclassified outside area (4%)
- Lavatory, bathroom, locker room (4%)
- Lobby or entrance way (3%)
- Attic or ceiling/roof assembly or concealed space (2%)
- Duct for HVCA, cable, exhaust, heating or AC (2%)
- Machinery room or elevator machinery (2%)
- Unclassified storage area (2%)

6 BCA DTS NON-COMPLIANCE REVIEW

6.1 Overview

In this instance, the BCA DtS non-compliances have been formulated based on a regulatory review undertaken by the project building surveyor and/or design team and through Affinity Fire Engineering's experience of similar buildings of the size and nature of the subject development. Where not listed herein the building is required to achieve compliance with relevant DtS provisions and relevant codes, reports and Standards.

The following table lists the proposed departures from the DtS provisions of the BCA for the development and the relevant Performance Requirements.

6.2 BCA DtS Non-Compliance Assessment and Acceptance Criteria

Table 6-1: Summary of Performance Solutions

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA
Perimeter Vehicular Access
Relevant Regulatory Requirement: BCA Clause C3D5 requires vehicular access as a continuous means of passage for emergency vehicles in a forward direction around the entire building. Further to this, the roadway is required to have a width of no less than 6m, be located within 18m of the building and have nothing constructed on the pathway that obstructs passage. **Performance Requirement:** The relevant Performance Requirement is C1P9 **Non-compliance with DtS provisions:** ▸ The vehicular access road is greater than 18m from the building as it travels onto the Estate Roads on the southern and western sides of the site. ▸ The vehicular access road is greater than 18m from the building as it travels around the B-Double Parking spaces on the northern side of the site. ▸ Roadway is reduced in clear width to less than 6m along the eastern side of the building as follows: ○ 4.5m clear width between the B-Double parking spaces and building facade. ○ 3.5m clear width between the B-Double parking spaces and temporary obstructions (bollards/downpipes).

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Egress Provisions

Relevant Regulatory Requirement:

BCA Clause D2D5 states that in a Class 5 to 7 building the travel distance to the point of choice must not exceed 20m and to the nearest exit must not exceed 40m where more than one exit is available.

BCA Clause D2D6 states that the travel distance between alternative exits must not exceed 60m.

Performance Requirement:

The relevant Performance Requirements are D1P4 and E2P2

Non-compliance with DtS provisions:

Travel distances exceed the DtS limitations throughout the warehouse areas of the building, with the following maximum distances to be rationalised through fire engineering:

Warehouse Areas

- Travel distances are up to 90m to the nearest exit & 180m between alternative exits through the warehouse parts.

South-Western Carpark

- Travel distances are up to 72m between alternative exits through the ground floor level of the carpark.

50m Fire Hose Reels

Relevant Regulatory Requirement:

BCA Clause E1D3 requires that fire hose reels are installed in accordance with AS2441 within a building having a fire compartment greater than 500m^2. This requires that all points on the floor are to be within reach of a 4m hose stream issuing from a nozzle at the end of the hose, with the hose length not exceeding 36m.

Performance Requirement:

The relevant Performance Requirement is E1P1.

Non-compliance with DtS provisions:

Due to the expansive footprint of the building, fire hose reels with a hose length of 50m in lieu of 36m are proposed to be used to achieve coverage within the warehouse areas.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Fire Hydrants System Design

Relevant Regulatory Requirement:

BCA Clause E1D2 requires that the fire hydrant system must be installed in accordance with AS2419.1 given that Schedule 4 of the BCA lists AS2419.1:2021 as the required document to meet BCA DtS provisions.

Within AS2419.1:2021, the following specific clauses are relative to this design:

- AS2419.1:2021 Clause 2.2.2 requires hydrants beneath awnings with a depth exceeding 3m are to be considered internal hydrants and thus permitted only 40m coverage.
- AS2419.1:2021 clause 3.6.2 (b) requires:
  - Where required non-fire-isolated exits are provided, internal fire hydrants shall be located not more than 4m from a required exit, except that internal fire hydrants need not be located adjacent to each required non-fire-isolated exit, provided fire hydrant coverage to all parts of the floor is achieved.
- AS2419.1:2021 Clause 11.5 (e) requires that where a booster assembly is installed, hydrant block plans shall be sized not less than A3 and have a maximum scale of 1 to 250.

Performance Requirement:

The relevant Performance Requirement is E1P3.

Non-compliance with DtS provisions:

The fire hydrant system shall be compliant with AS2419.1:2021 with the following exceptions permitted through the Performance Solution:

- Hydrants under Awnings: External hydrants are located beneath the loading dock dispatch awning (which has a depth >3m) and shall retain their classification as external hydrants in lieu of being internal hydrants; hence for the purposes of system coverage they will maintain 70m coverage.
- Internal Hydrants Locations: Internal hydrant that are not within 4m of an exit where additional intermediate internal hydrants are required to achieve full coverage of the building.
- Hydrant Block Plan: Hydrant block plans at the booster assembly to be a maximum A1 sized, in lieu of the maximum scale of 1:250. All other blockplans across the site are to be A3.

Fire Sprinkler System Design

Relevant Regulatory Requirement:

BCA Clause E1D4 requires that the fire sprinkler system is to be installed in accordance with AS2118.1:2017 of which under Clause 4.14.1 and 4.14.2, the fire sprinkler booster assembly and

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

suction connection respectively must be in accordance with the requirements of the fire hydrant standard AS2419.1:2021.

AS2419.1:2021 clause 7.3.1 requires a fire booster assembly located remote of the building to be within sight of the principal pedestrian entrance and:

- Adjacent to the site boundary and the principal vehicular access for the fire brigade pumping appliances to the building or site; or
- Not more than 20m from the façade of the building containing the principal pedestrian entrance and not more than 20m from the main pedestrian entrance.

Performance Requirement

The relevant Performance Requirement is E1P4.

Non-compliance with DtS provisions:

The sprinkler booster assembly location is non-compliant with Clause 7.3.1(c)(i) due to the following:

- Not adjacent to the site boundary and the principal vehicular access for the brigade pumping appliances to the building or site.

Adoption of FM Guidelines

Relevant Regulatory Requirement:

BCA Clause E1D4 requires that the fire sprinkler system to be installed in accordance with AS2118.1:2017.

Performance Requirement

The relevant Performance Requirements is E1P4.

Non-compliance with DtS provisions:

AS2118.1:2017 will be adopted in whole except that FM Global Datasheet 2-0 and 8-9 will be adopted in lieu of AS2118.1:2017 for the following items within the warehouse:

- Sprinkler head type based on the storage arrangement, racking equipment, and storage commodity.
- Sprinkler head spacing inclusive of obstruction avoidance.
- Design pressure and flow at each sprinkler head.
- Duration of water supply and tank sizing.

The remaining fire infrastructure will be fully compliant with Australian Standards, inclusive of two (2) AS2941:2013 compliant pump sets and shall be sized to accommodate the above noted FM Guideline pressure and flow requirements.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Smoke Hazard Management

Relevant Regulatory Requirement:

BCA Clause E2D10 requires in a Class 5, 6, 7, 8 or 9 building, which exceeds 18,000m^2 in floor area or 108,000m^3 in volume, with a ceiling height more than 12m, to be provided with an automatic smoke exhaust system in accordance with Specification 21 throughout.

Performance Requirement:

The relevant Performance Requirement is E2P2

Non-compliance with DtS provisions:

The fire engineering strategy for the smoke hazard management system within the building is based on the following design principles:

Main Offices, Dock Offices, Carpark and other Ancillary Areas

- Automatic smoke exhaust is to be omitted from the administration office, dock office, and any warehouse amenity areas.
- No smoke detection shall be provided.

Warehouse Areas

An automatic smoke exhaust system shall be provided to the warehouse areas of the building in accordance with the DtS provisions and AS1668.1:2015 with the following exceptions:

- A smoke extraction rate of 1 air change per hour shall be achieved in lieu of extraction rates defined in BCA Specification 21.
- The warehouse shall form a single smoke reservoir resulting in a zone exceeding 2,000m^2.
- The automatic smoke exhaust system shall activate from sprinkler activation in lieu of smoke detector activation.
- No smoke detection shall be provided.

Exit and Emergency Lighting

Relevant Regulatory Requirement:

BCA Clause E4D2, E4D4, E4D5, E4D6 and E4D8 specifies that exit and emergency lighting is to be installed to specific design parameters and in accordance with AS2293.1:2018.

Performance Requirement:

The relevant Performance Requirement is E2P2

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Non-compliance with DtS provisions:

Directional exit signs within the warehouse shall be installed 5m above the finished floor level in lieu of the AS2293.1:2018 limitation of 2.7m within forklift travel zones.

7 PROPOSED FIRE SAFETY STRATEGY

The fire safety strategy outlined below has been proposed to satisfy the fire and life safety objectives specified for this project by the relevant stakeholders. In addition, the fire safety strategy 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.

The specified fire safety strategy will undergo analysis as part of a Fire Engineering Report to ascertain whether the relevant Performance Requirements of the BCA are satisfied. The information herein is therefore pending completion of the fire engineering analysis and as such, it is possible to change and or make modifications through the detailed design phase of the project.

7.1 Passive Fire Construction

7.1.1 Fire Resisting Construction and Compartmentation

The building structure including floors, walls, columns and shafts shall be constructed in accordance with the requirements of BCA Clause C2D2, Specification 5 for Type C Construction.

7.1.2 Finishes and Linings

Where practicable, internal finishes, internal linings and internal materials used throughout the building should be non-combustible to reduce the spread of fire and the generation of toxic smoke products.

All wall, floor and ceiling, and roof and ceiling assemblies must be tested and rated for their fire hazard properties in accordance with the prescriptive requirements of BCA Clause C2D11 and Specification 7.

7.1.3 Separation of Equipment

Rooms containing equipment listed below must be fire separated from the remainder of the building by construction in accordance with Specification 5 or 120/120/120 FRL construction, whichever is greater, with any door opening into that room consisting of a --/120/30 FRL self-closing fire door.

- Lift motors and lift control panels (unless the lift installation does not have a machine-room); or
- Emergency generators used to sustain emergency equipment operating in emergency mode; or
- Central smoke control plant (other than smoke exhaust systems designed for high temperature operation); or
- Boilers; or
- A battery system installed in the building that have a total voltage of 12 volts or more and a storage capacity of 200kWh or more.

Electricity supply systems inclusive of electricity substations located within a building and main switchboard located within the building which sustains emergency equipment operating in the emergency mode (i.e. the smoke exhaust mechanical board and all switchboards feeding that) must meet the requirements of BCA Clause C3D14. This includes the requirements of being separated from any other part of the building by construction having:

- An FRL of not less than 120/120/120; and
- Any doorway in that construction protected with a self-closing fire door having an FRL of not less than --/120/30.

7.2 Egress Provisions

7.2.1 Evacuation Strategy

Activation of any sprinkler head or manual call point shall initiate the building occupant warning alarm tones throughout the building.

Dedicated fire wardens shall ensure that all clients, visitors, maintenance contractors and staff are promptly evacuated if a fire is identified anywhere in the building (see Section 7.3.3).

7.2.2 Egress Provisions

With exception of the following items being addressed through a fire-engineered Performance Solution, travel distances and egress provisions are to be in accordance with the prescriptive DtS provisions.

The fire engineering assessment shall address travel distances that have been identified as being non-compliant in the following locations:

Warehouse Areas

- Travel distances are up to 90m to the nearest exit & 180m between alternative exits through the warehouse parts.

South-Western Carpark

- Travel distances are up to 72m between alternative exits through the ground floor level of the carpark.

7.2.3 Door Hardware, Operation and Mechanisms

All doors serving as required exits shall have the hardware, door swings, latch operations and signage in accordance with the prescriptive requirements of BCA Clauses D3D24, D3D25, D3D26 and D3D28.

7.2.4 Signage and Lighting

Exit and emergency lighting are to be provided throughout building in accordance with the prescriptive DtS provisions of BCA Clause E4D2, E4D4, E4D5, E4D6, E4D8 and AS2293.1:2018 with the following exceptions:

- Directional exit signs within the warehouse shall be installed up to 5m above the finished floor level in lieu of the AS2293.1:2018 limitation of 2.7m within forklift travel zones.

As part of the exit and emergency lighting design, the following measures must be incorporated:

- Exit signs are to be pictograph 'running man' signs as per the prescriptive requirements of AS2293.1:2018.
- All exit and directional exit signs are to be power-operated illuminated signs.
- Any directional exit signs located above 2.7m are to be 'Jumbo' sized signs.

7.3 Active Fire Protection Systems

The following figure provides an overview of the fire infrastructure on the project to support the design specification for those systems in the subsequent sections.

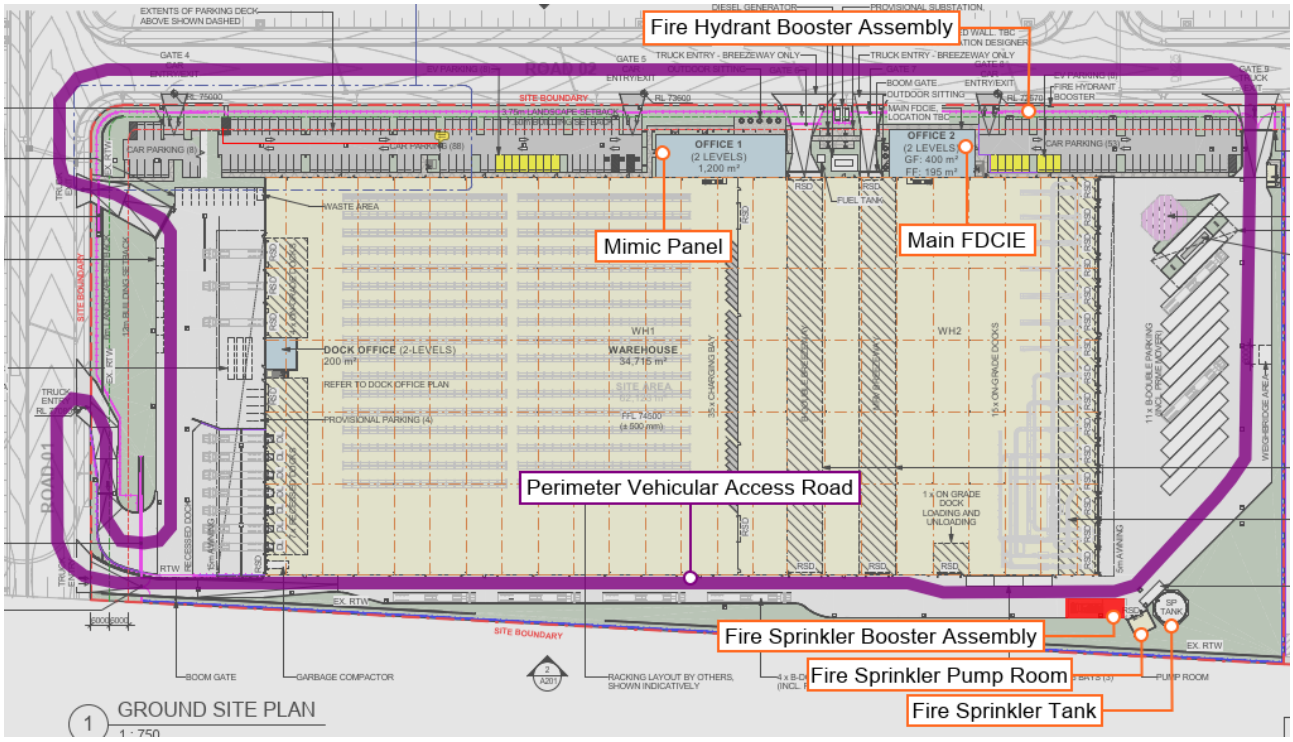

Figure 7-1: Site Fire Services Overview

7.3.1 Fire Control & Indicating Equipment

Main FDCIE

The fire safety systems shall be connected to a Main Fire Control & Indicating Equipment (FDCIE) located within the main entry lobby of Office 2. This shall form the Fire Control Centre for the site and house the Alarm Signalling Equipment (ASE).

- The main-FDCIE must incorporate;
  - The ability to enable, disable & reset ALL zones/alarms across the network/precinct.
  - Contain the site ASE and brigade monitoring system.
  - Contain controls for the automatic smoke exhaust system for that specific building.

Mimic Panel

- The building must also be provided with a Mimic Panel in the main entry lobby of Office 1.

7.3.2 Fire Brigade Alarm Signalling Equipment

An automatic link shall be provided directly to an approved monitoring centre on activation of the fire sprinkler system or manual call points installed in the building in compliance with DtS Provisions and AS1670.3:2018.

7.3.3 Building Occupant Warning System

A building occupant warning system shall be provided throughout the building. The system shall be in accordance with the prescriptive requirements of Specification 17, Specification 20 and AS1670.1:2018.

Activation of any fire sprinkler head or manual call point shall initiate the building alarm tones throughout the building.

7.3.4 Automatic Fire Sprinkler System

A fire sprinkler system shall be provided throughout the building in accordance with the prescriptive requirements of BCA Specification 17 and AS2118.1:2017, with the following exceptions:

Sprinkler Design Standard

- AS2118.1:2017 will be adopted in whole except that FM Global Datasheet 2-0 and 8-9 will be adopted in lieu of AS2118.1:2017 for the following items within the warehouse:
  - Sprinkler head type based on the storage arrangement, racking equipment, and storage commodity.
  - Sprinkler head spacing inclusive of obstruction avoidance.
  - Design pressure and flow at each sprinkler head.
  - Duration of water supply and tank sizing.

  Note: The remaining fire infrastructure will be fully compliant with Australian Standards, inclusive of two (2) AS2941:2013 compliant pump sets and shall be sized to accommodate the above noted FM Guideline pressure and flow requirements.

Fire Sprinkler Booster Assembly:

The sprinkler booster assembly locations are non-compliant with Clause 7.3.1(c)(i) due to the following:

- Not adjacent to the site boundary and the principal vehicular access for the brigade pumping appliances to the building or site.

As part of the fire sprinkler system design, the following design measures must be incorporated:

- The fire sprinkler booster assembly must ensure an adequate staging area for pumping appliances as per FRNSW Fire Guideline requirements *"Access for fire brigade vehicles and firefighters"* available at https://www.fire.nsw.gov.au/ and AS2118.1:2017.
- The design of any fixed suction provided for a fire brigade pumping appliance to draught from a below-ground water supply is to satisfy Clause 4.4 of Australian Standard AS2419.1:2021. The maximum length of the dry pipe between the lowest section water level and the large bore suction connection must not exceed 2.8m (due to the limitations of the primer on the fire brigade pumping appliances).

Fire & Rescue NSW Hardstand Requirements

As detailed in FRNSW Fire Guideline requirements *"Access for fire brigade vehicles and firefighters"*, any hardstand serving a suction-connection outlet is to have a working space that extends a minimum of 18m from the point of connection to allow a semi-rigid suction hose to be connected to the rear of the fire appliance. This is demonstrated in Figure 7-2.

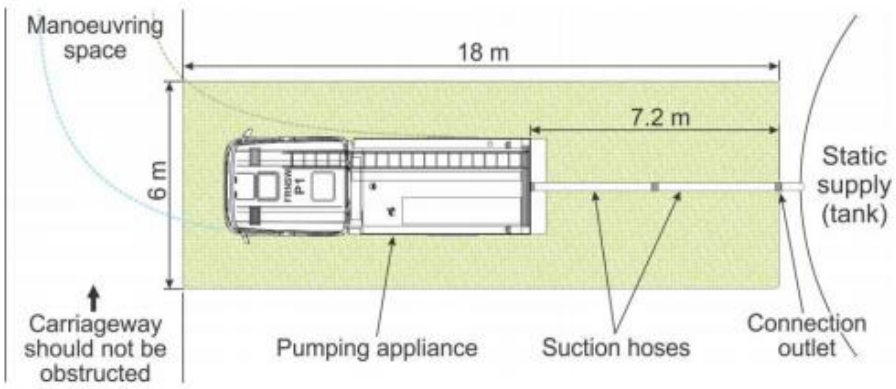

Figure 14 Hardstand area serving a suction-connection outlet

Figure 7-2: FRNSW Access For Fire Brigade Vehicles & Firefighters Excerpt (State Govt NSW 2019)

The preliminary fire engineering assumes that the fire sprinkler suction point is located inward facing to the hardstand and hence necessitate an appliance to back up against it. The orientation of the suction point may be adjusted so long as the design reflects the FRNSW requirements as detailed in FRNSW Fire Guideline requirements *"Access for fire brigade vehicles and firefighters"*. Connection orientations are as per excerpt from the aforementioned FRNSW document per Figure 7-3.

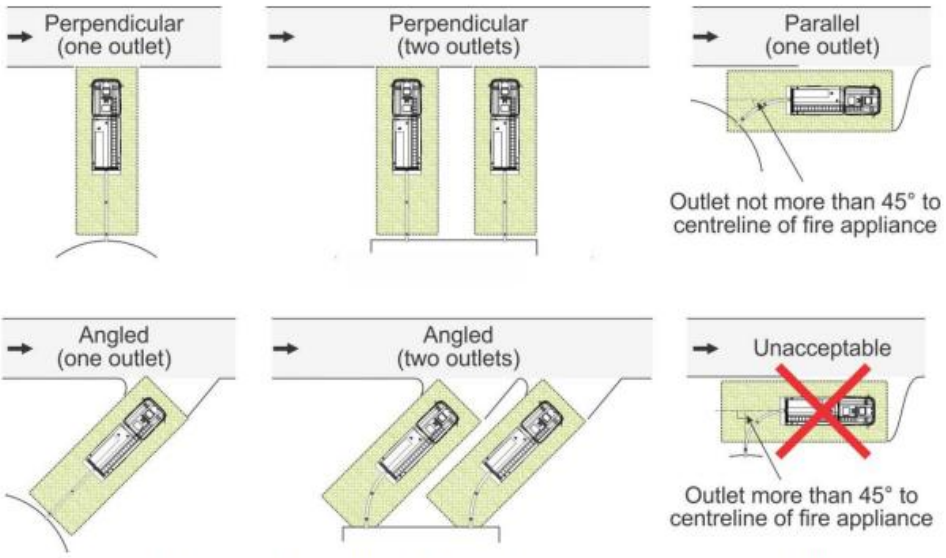

Figure 15 Example of orientation of hardstand area for suction-connection outlets

Figure 7-3: FRNSW Access For Fire Brigade Vehicles & Firefighters Excerpt (State Govt NSW 2019)

Notwithstanding, a detailed design of the fire sprinkler suction connection point and booster assembly respectively must be undertaken by the fire sprinkler design consultant to meet the desired requirements. Note that a minimum 6m clear width has been maintained past the appliance staging area to meet the requirements of BCA Clause C3D5.

7.3.5 Automatic Smoke Exhaust System

Main Offices, Dock Offices, Carpark and other Ancillary Areas

- Automatic smoke exhaust is to be omitted from the administration office, dock office, and any warehouse amenity areas.
- No smoke detection shall be provided.

Warehouse Areas

An automatic smoke exhaust system shall be provided to the warehouse areas of the building in accordance with the DtS provisions and AS1668.1:2015 with the following exceptions:

- A smoke extraction rate of 1 air change per hour shall be achieved in lieu of extraction rates defined in BCA Specification 21.
- The warehouse shall form a single smoke reservoir resulting in a zone exceeding 2,000m^2.
- The automatic smoke exhaust system shall activate from sprinkler activation in lieu of smoke detector activation.
- No smoke detection shall be provided.

As part of the automatic smoke exhaust system design, the following design measures must be incorporated:

- The automatic smoke exhaust system provided to the warehouse areas must be designed in accordance with BCA Specification 21 and AS1668.1:2015 unless noted otherwise herein.

- A mechanical system blockplan shall be provided at the FDCIE in accordance with AS1668.1:2015 and also incorporate the following;
  - Signs alerting the Fire Brigade to the operation of the smoke exhaust system.
  - A schematic of the system detailing fan extraction rates, and make-up air locations and free area requirements.
  - Reference the Fire Engineering Report.
  - Notification that the system is automatically initiated by sprinkler activation.
  - Incorporate the same legend and fan numbering as those used on the FDCIE fan control switches.
- The automatic smoke exhaust system must be connected to the site's essential power (safety service).
  - The electrical board must be fire separated from the remaining building per BCA Clause C3D14 (--/120/120 FRL walls and --/120/30 FRL fire door).

7.4 Occupant Fire Fighting Facilities

7.4.1 Fire Hose Reel

Fire hose reels are to be provided throughout the warehouse areas of the building in accordance with the prescriptive DtS provisions of BCA Clause E1D3 and AS2441:2005 with exception of the following;

- Due to the expansive footprint of the building, hose reels with a length of 50m in lieu of 36m are proposed to be used to achieve coverage within the warehouse areas.

As part of the fire hose reel design, the following design measures must be incorporated:

- Where 50m long hoses are used;
  - They must be tested to meet the requirements of AS1221:1997 other than the specification of a maximum hose length of 36m.
  - Coverage to any part of the warehouse by a 50m long hose line must be achieved with no more than 2 bends.
- To ensure that the provision of 50m hose reels does not impact life safety, on-site training in the use of the hose reels must be undertaken by key staff members (Fire Wardens and Warehouse Supervisors).

The location of all fire hose reels should be readily accessible to occupants. The use of facilities should be monitored for abuse, mistreatment and servicing. The fire hose reels shall be located within 4m of an exit and provide coverage to all areas of the building based on a 50m or 36m hose length with a 4m water stream.

7.4.2 Portable Fire Fighting Equipment

Portable fire extinguishers are to be provided throughout the building in accordance with Table E1D14 of the BCA with the type of extinguisher selected in accordance with AS2444:2001.

General office areas	Dry Powder (ABE type)	2.5Kg
Computer/server rooms	CO_2	3.5 Kg

▸ Plant rooms	Dry Powder (ABE)	2.5 Kg
▸ Designated exits	Dry Powder (ABE)	4.5 Kg
▸ Adjacent each fire hose reel cabinet	Dry Powder (ABE)	4.5 Kg

7.5 Fire Brigade Intervention

7.5.1 Fire Hydrant System

A fire hydrant system shall be provided throughout the site to serve the building in accordance with the prescriptive requirements of Clause E1D2 and AS2419.1:2021 with exception of the following:

- Hydrants under Awnings:
  - External hydrants are located beneath the loading dock dispatch awning (which has a depth >3m) and shall retain their classification as external hydrants in lieu of being internal hydrants; hence for the purposes of system coverage they will maintain 70m coverage.
- Internal Hydrants Locations:
  - Internal hydrant that are not within 4m of an exit where additional intermediate internal hydrants are required to achieve full coverage of the building.
- Hydrant Block Plan:
  - Hydrant block plans at the booster assembly to be a maximum A1 sized, in lieu of the maximum scale of 1:250. All other blockplans across the site are to be A3.

As part of the fire hydrant system design, the following design measures must be incorporated:

- The system shall incorporate a ring main and associated isolated valves as required for a large-isolated building. Isolation valves shall be numbered with those corresponding numbers indicated on the hydrant block plan.
- All connection points must be fitted with Storz hose couplings which comply with FRNSW Technical Information D15/45534 for *"FRNSW compatible Storz hose connections"*. Further information is available from FRNSW available at www.fire.nsw.gov.au.
- Each hydrant under a dispatch awning must be provided with a twin valve connection (as per the requirements of an external hydrant).
  - External fall-back hydrants are to be provided to achieve full coverage of the area beneath the dispatch awning.
- Per the typical FRNSW requirements, as far as possible the hydrant system should consist of external hydrant points, with internal hydrants only provided where there are shortfalls in coverage from external hydrants.
  - Where internal hydrants are required;
    - They must be designed to allow progressive movement through the building such that an internal hydrant is within 50m of an external hydrant and 25m of an internal hydrant.
    - A localised block plan must also be provided at every hydrant relied upon for progressive movement pictorially and numerically illustrating the location of the next available additional hydrant. These localised block plans should be of a size appropriate to their notice and location and be of all-weather fade-resistant construction.

7.5.2 Vehicular Perimeter Access

Vehicular perimeter access roadways are provided around the large-isolated building. This shall be designed and constructed in all-weather surface capable of supporting all FRNSW appliances in accordance with BCA Clause C3D5 and FRNSW Fire Safety Guideline "Access for fire brigade vehicles and firefighters" version 5.01" (available from www.fire.nsw.gov.au).

The following variations from the prescriptive requirements shall be addressed through a fire engineered Performance Solution (as illustrated in Figure 7-4):

- The vehicular access road is greater than 18m from the building as it travels onto the Estate Roads on the southern and western sides of the site.
- The vehicular access road is greater than 18m from the building as it travels around the B-Double Parking spaces on the northern side of the site.
- Roadway is reduced in clear width to less than 6m along the eastern side of the building as follows:
  - 4.5m clear width between the B-Double parking spaces and building facade.
  - 3.5m clear width between the B-Double parking spaces and temporary obstructions (bollards/downpipes).

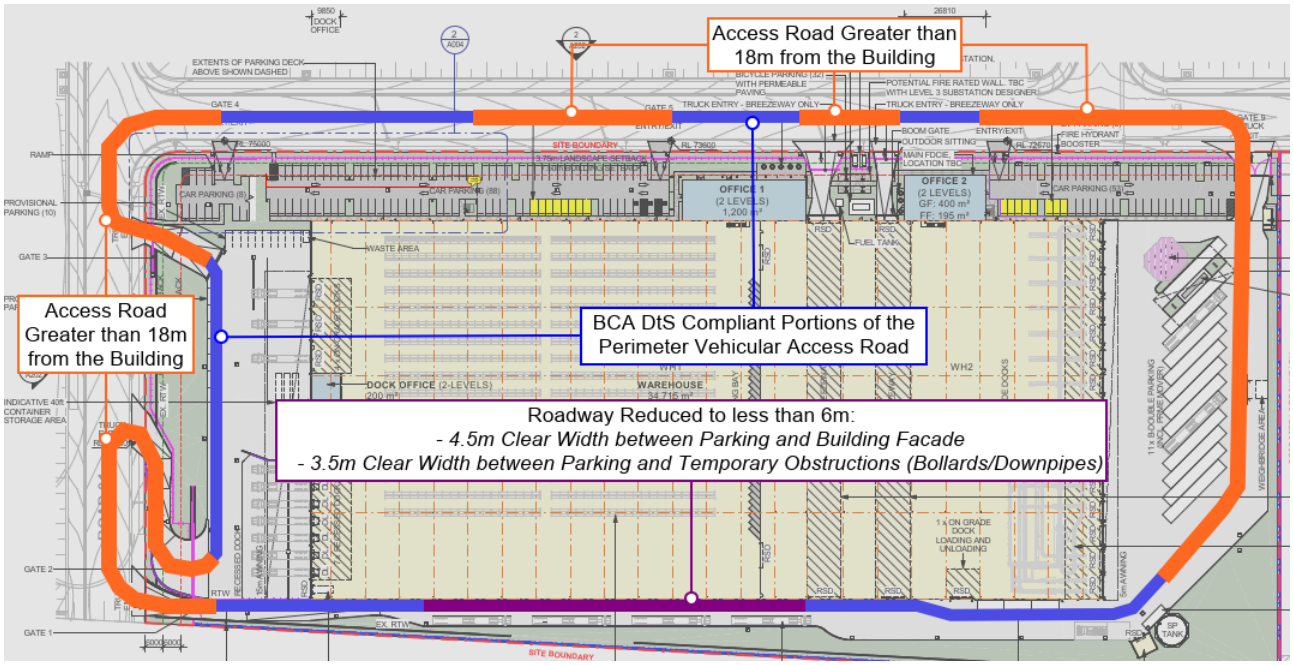

Figure 7-4: Vehicular Perimeter Access Roadway around the Building – Areas of Non-Compliance Highlighted

As part of the fire-engineered Performance Solution for perimeter vehicular access, the following must be incorporated into the design;

Perimeter Access Path Performance

- Gradients upon the access road are suitable for heavy vehicles in accordance with Australian Standards and FRNSW Fire Safety Guidelines;

- The fire appliance access road and surface will be suitable in all weather and are capable of supporting the maximum distributed load over the entire area as per FRNSW Fire Safety Guideline "access for fire brigade vehicles and firefighters v5.01";
- Fire brigade appliances will be provided with adequate room and sweep paths around the building corners to travel in forward direction.

Security Gate Requirements

- Security gates that cross the vehicular access path at the vehicular entries to the carpark and dispatch hardstand must:
  - Manually operated Gates: are to be locked with a loose chain and padlock, or fixed cylinder hardware set.
  - Mechanically driven Gates: are to have a manual overdrive provided at the gate motor to disengage the gearing and allow manual opening of the gate by FRNSW;
    Operational instructions and diagrams illustrating the gate gear override mechanism must be provided at the Main FDCIE.
- Copies of any access keys/fobs etc. are to be provided to the nearest FRNSW station to the site, and also a copy hung at the Main FDCIE.

7.6 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.

7.6.1 Maintenance of Fire Safety Equipment

Any fire detection systems, fire sprinkler systems, emergency warning systems, fire hydrants, hose reels, portable fire extinguishers, emergency lighting and any other fire safety equipment shall be tested and maintained in accordance with Australian Standard AS1851 or another relevant testing regulatory.

7.6.2 No Smoking Policy

A no-smoking policy shall be implemented and enforced throughout all internal areas of the building.

7.6.3 Fire Safety Manual

A fire safety manual shall be developed for the site to provide an overview of all fire safety procedures and systems within the building. The manual should also record false alarms, and outcomes from fire drills and provide details of the ongoing maintenance and inspection procedures. The manuals should be reviewed annually, and lessons-learned exercises undertaken. Any conclusions drawn from this exercise should be implemented into the fire safety procedures.

7.6.4 Emergency Management Plan

An Emergency Management Plan (EMP) must be developed in accordance with AS3745:2010 Amd 2:2018. The EMP must;

- Developed by an emergency planning committee (EPC).
- Implement emergency control organisation (ECO) procedures for the building.
- Specifically address the types of emergencies that may arise from the industry and/or activities associated with the business operations.
- Ongoing training, education and execution of the emergency management procedures are to be regularly conducted with all building occupants.

An evacuation plan should be developed for the site in accordance with AS3745:2010 Amd 2:2018 and standard fire orders should be displayed throughout the building.

7.6.5 Dangerous Goods

Should future use of the facility incorporate the use and/or storage of dangerous goods outside the purpose of frequent maintenance purposes, the site will require review and assessment by a suitably qualified Risk Consultant to determine the associated hazards and required preventative measures to meet BCA Clause E1D17 and E2D21. The fire engineering strategy shall be required the following requirements:

- Storage of dangerous or hazardous goods on this site will require re-assessment of the fire engineering analysis by a registered Certifier- Fire Safety (formerly C10 Fire Safety Engineer).
- Where the storage quantity trigger requirements for a fire safety study, the above re-assessment of fire engineering analysis must also be submitted to Fire and Rescue NSW for the key stakeholder's review and support.

7.6.6 Rooftop Solar Panels

The following measures shall be provided where the design includes the installation of solar panels to the roof of a building.

- An A4 notice on fade resistant material must be displayed at the Main FDCIE of that building to notify attending fire fighters as to the existence of the Photovoltaic Solar Panel Array on the roof of the building. The notice must include:
  - A figure detailing the location of the panels.
  - A floor plan detailing the location of all associated isolation switches, AC and DC isolators for the shut-off of generated electricity.
  - Notification that the PV do not automatically isolate on fire trip.
  - A statement in 25mm font stating (or similar wording):

"Photovoltaic (PV) Panels Present — PV panels are mechanically fixed to the roof as shown below"

7.6.7 Electric Vehicle Charging

- All electric vehicle charging equipment must automatically shut down and be isolated from the mains power on general fire alarm anywhere within the building.
- Signage must be displayed at the Main-FDCIE to indicate the properties of the electric car charging bays to include:
  - The location of the charging bays.
  - The location of manual isolation switches/boards with way finding from the FDCIE and operating instructions.
  - The power rating (kW capacity) of the chargers.
  - Notification that the electric car charging systems automatically ceases operation and are isolated from power supply on general fire alarm.

7.6.8 Hot Works Policy

A hot works policy should be put in place and rigorously enforced to ensure that all hot works, including grinding and welding, are managed to avoid the accidental ignition of fires.

7.6.9 Fire Drills and General Fire Safety Training

All fire wardens are to be trained in first-aid firefighting and emergency response. All staff shall be inducted with a fire safety brief including the actions necessary for the activation of the building emergency warning system and the location of all emergency egress paths and fire exits. In addition, periodic fire drills should be undertaken and any lessons learned included in future fire safety procedures.

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APPENDIX A FIRE STATISTICS

PROBABILITY OF FIRE STARTS

The probability of a fire start in a range of building uses, based on UK data, can be established using the data presented in Table 8-1 [11]; the applicable occupancy type is highlighted.

Table 8-1: Overall probability of fire starts for various occupancies, UK data

Occupancy	Probability Of Fire Starts (% Per Year)
Industrial	4.4
Storage	1.3
Offices	0.6
Assembly entertainment	12.0
Assembly non-residential	2.0
Hospitals	30.0
Schools	4.0
Dwellings	0.3

PROBABILITY OF CIVILIAN INJURY AND FATALITY

The probability of injuries and deaths for various occupancy types based on UK data [11] is presented in the following table.

Table 8-2: Probability of occupant injury and fatality by occupancy type, UK data averages for the years 1995 and 1997-1999

Type Of Occupancy	No Of Fires	Probability Of Occupant Injury Per Fire Event (%)	Probability Of Occupant Death Per Fire Event (%)
Further education	535	3.18	0.00
Schools	1669	3.06	0.00
Licensed premises	3317	7.90	0.08
Public recreational buildings	2581	1.86	0.05
Shops	5671	5.01	0.06
Hotels	1021	11.36	0.24
Hostels	1338	4.48	0.04
Hospitals	3063	3.69	0.11
Care homes	1616	8.04	0.28
Offices	1988	11.02	0.02
Factories	5299	5.40	0.08

APPENDIX B FIRE BEHAVIOUR

FIRE GROWTH RATE

As the fire increases in size, the rate of fire growth accelerates. The growth rate of a fire can result in various hazards for occupants due to the following:

- Protective and preventative measures may not be adequate
- Occupants may have insufficient time to evacuate
- Occupants may perceive a reduced threat from slow growing fires

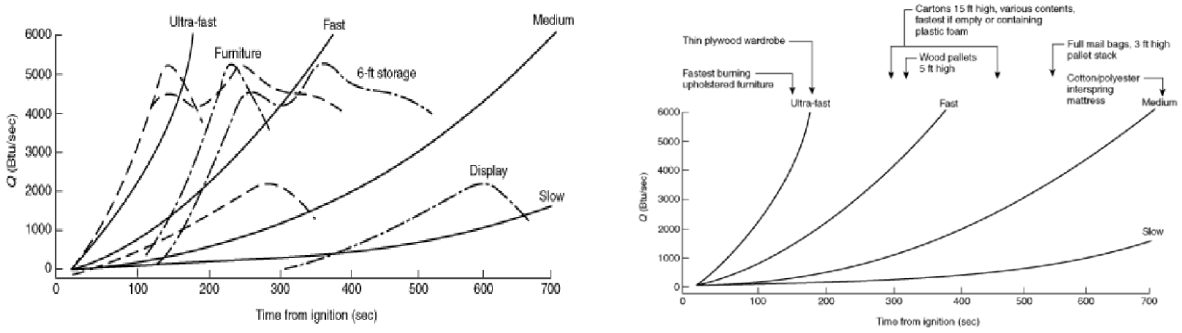
The rate of fire growth is generally expressed in terms of an energy release rate. The most commonly used relationship is what is commonly referred to as a quadratic t-squared fire. In such a fire, the rate of heat release is given by the expression:

$$Q = \left(\frac{t}{k}\right)^2$$

Where; t is time from ignition of the fire (seconds) and k is the growth time (seconds) for the fire to reach a heat output of 1.055 MW.

The continued growth of a fire defined by the above equation relies on both a sufficient source of fuel and air and assumes that flashover has not been reached. The rate of fire growth can be estimated from the results of a number of fire tests that have been performed on various fuel commodities.

National Fire Protection Association Standard NFPA 92B, provides information on the relevance of t-squared approximation to real fire as depicted in Figure 8-1.



(a) t-squared fire, rates of energy release (b) Relation of t-squared fires to some fire tests

Figure 8-1: NFPA 92B design fires and heat release rates

A slow fire growth is not considered to be the most challenging in terms of fire and life safety or fire brigade intervention. The continued growth of a fire defined by the above equation relies on both a sufficient source of fuel and air and assumes that flashover has not been reached. The rate of fire growth can be estimated from data published in CIBSE Guide E [13] and BS9999:2008 are listed below:

- Assembly hall seating : Medium-Fast
- Dwelling : Medium
- Office : Medium
- Hotel bedroom : Medium
- Hotel reception : Medium
- Meeting room : Medium
- Picture Gallery : Slow
- Reception area : Slow
- Restaurant/Canteen : Medium
- Shop : Fast
- Teaching laboratories : Fast
- Warehouse : Medium/Fast/Ultra-fast
- Waiting Room : Slow

From the above list, it can be concluded that the likely fire scenarios in the building may be approximated by the standard Ultra-fast time-squared fire growth rate curve.

APPENDIX C FIRE LOADS

The fire load within a room or compartment will influence the duration and severity of a fire and resultant hazard to occupants. The effective fire load for the building has been estimated by consideration of the typical spaces within the building.

The IFEG has published further fire load densities for broad occupancy groupings (extracted from CIB 1983) as provided in the table below. The CIB compilation emphasises that at least the 95% fractile should be selected for design purposes. The following fire loads have been extracted from the IFEG and are considered applicable to the subject building:

Table 8-3: Fuel load densities for different occupancy groups

Occupancy	Densities in mega-joules per square metre			
	Mean	Percent fractile		
	(MJ/m^2)	80	90	95
Dwelling	780	870	920	970
Hospital	230	350	440	520
Hospital storage	2000	3000	3700	4400
Hotel bedroom	310	400	460	510
Offices	420	570	670	760
Shops	600	900	1100	1300
Manufacturing	300	470	590	720
Manufacturing and storage <150kg/m^2	1180	1800	2240	2690
Libraries	1500	2250	2550	-
Schools	285	360	410	450

WAREHOUSES (U.S.A.)

The following data has been extracted from the fire statistics data published by the NFPA for the years 2009-2013. The sum of each column of data may not equal totals due to rounding errors.

Table 8-4: Leading causes of structure fires in warehouse properties (2009-2013 annual averages)

Cause	Fires	Civilian Injuries
Intentional	220 (18%)	4 (21%)
Electrical distribution and lighting equipment	220 (18%)	8 (38%)
Heating equipment	90 (8%)	0 (0%)
Exposure fire	90 (7%)	0 (0%)

Cause	Fires	Civilian Injuries
Smoking materials	60 (5%)	0 (0%)
Cooking equipment	50 (4%)	0 (0%)
Lightning	20 (2%)	0 (0%)

Based on the table above, it can be noted that the leading cause is generally equipment used by the building occupants. Electrical distribution and lighting equipment is the leading cause of fires and civilian injuries, accounting for over a third of civilian injuries (38%). The following table indicates the majority of deaths and injuries occur in storage and loading bays of warehouse buildings.

Table 8-5: Structure fires in warehouse properties by area of origin (2009-2013 annual averages)

Cause	Fires	Civilian Injuries
Unclassified storage area	140 (11%)	4 (19%)
Shipping receiving or loading area	120 (10%)	2 (10%)
Storage room, area, tank or bin	80 (7%)	1 (4%)
Vacant structural area	60 (5%)	0 (0%)
Unclassified outside area	50 (4%)	1 (3%)
Storage of supplies or tools or dead storage	50 (4%)	0 (0%)
Exterior roof surface	50 (4%)	0 (0%)
Trash or rubbish chute, area or container	40 (4%)	0 (0%)
Unclassified equipment or service area	40 (4%)	0 (2%)
Processing or manufacturing area, or workroom	40 (3%)	1 (5%)
Unclassified area of origin	40 (3%)	1 (5%)
Office	40 (3%)	1 (7%)
Exterior wall surface	40 (3%)	0 (0%)
Maintenance or paint shop area	30 (3%)	1 (5%)

Cause	Fires	Civilian Injuries
Unclassified structural area	30 (2%)	0 (0%)
Garage or vehicle storage area	30 (2%)	1 (6%)
Kitchen or cooking area	20 (2%)	0 (0%)
Wall assembly or concealed space	20 (2%)	0 (0%)
Machinery room or area or elevator machinery room	20 (2%)	0 (0%)
Other known area of origin	280 (23%)	6 (27%)

The following table lists the extent of fire spread in warehouse properties and the corresponding number of civilian injuries.

Table 8-6: Structure fires in warehouse properties by extent of flame (2009-2013 annual averages)

Extent Of Fire Spread	Fires	Civilian Injuries
Confined fire identified by incident type	280 (23%)	0 (0%)
Confined to object of origin	170 (14%)	6 (32%)
Confined to room of origin	260 (21%)	4 (19%)
Confined to floor of origin	70 (6%)	1 (6%)
Confined to building of origin	370 (31%)	7 (38%)
Beyond building of origin	60 (5%)	1 (5%)