FIRE SAFETY STRATEGY

14 Aquatic Dr, Frenchs Forest NSW

Report Number:

222087_FSS_02

Date:

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REPORT DETAIL

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Report Revision History

Rev	Date	Comment	Prepared By	Reviewed By
01	17/04/2025	Preliminary Issue	**Norman Boustany** *BEng (Civil) (Hons)* *GradDip (Fire Safety)*	**Thomas Newton** *MEng (Fire Safety)* *Certifier Fire Safety – BDC 3149*
02	21/04/2025	Final Issue	**Norman Boustany** *BEng (Civil) (Hons)* *GradDip (Fire Safety)*	**Thomas Newton** *MEng (Fire Safety)* *Certifier Fire Safety – BDC 3149*

EXECUTIVE SUMMARY

This Fire Safety Strategy has been prepared by Affinity Fire Engineering Pt Ltd (AFFINITY) on behalf of Goodman Property Services (Aust.) Pty Ltd (the Applicant) to accompany a Development Application (DA) for self-storage units and warehouse and distribution centre uses at 14 Aquatic Drive, Frenchs Forest.

This site is located on the southern side of Warringah Road and within the broader Frenchs Forest Business Park. It currently hosts an existing four storey commercial building which is proposed for demolition under this application.

The proposed development comprises construction of a three-storey industrial building including:

- 153 self-storage units at ground floor;
- 72 warehouse units on Levels 1 and 2;
- 123 car parking spaces across all levels;
- outdoor breakout spaces for staff at ground floor and Level 2;
- shared lobby across all levels;
- landscaping; and
- associated infrastructure/servicing works.

Approval is sought for 24/7 operation of the proposed self-storage and warehouse and distribution units.

Building Code of Australia Compliance

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.

CONTENTS

1 INTRODUCTION & SCOPE

1.1 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 AFEG [4] and provide a workable and safe Fire Safety Strategy.

1.2 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.

1.2.1 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) [14] 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.

1.2.2 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.

1.2.3 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.

1.3 Regulatory Framework of the Fire Engineering Assessment

1.3.1 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.

1.3.2 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.

1.3.3 Stakeholders

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

Table 1-1: Relevant Stakeholders

Role	Organisation	Name
Developer	Goodman Property Services (Aust) Pty Ltd	Rory Pryor Guy Smith Tom Steinthal

Role	Organisation	Name
Architecture	SBA	Greg Baird William Ly
Civil Engineer	Costin Roe	Mark Wilson
Structural Engineer	Costin Roe	Grant Roe
Traffic	Ason	Ali Rasouli
BCA Consultant	Blackett Maguire + Goldsmith	Dean Goldsmith
Fire Safety Consultant	Affinity Fire Engineering	Thomas Newton Norman Boustany

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.

1.4 Sources of Information

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

- Architectural Plans prepared by SBA Architects as listed below:

DA SHEET LIST		
Sheet Number	Sheet Name	Current Revision
DA000	COVER SHEET	P4
DA001	ARTIST IMPRESSION PERSPECTIVES 01	P2
DA002	ARTIST IMPRESSION PERSPECTIVES 02	P2
DA100	SITE ANALYSIS / DEMOLITION PLAN	P4
DA101	SITE PLAN / ROOF PLAN	P9
DA102	SETBACK PLAN	P5
DA200	GROUND FLOOR	P12
DA201	L1 FLOOR PLAN	P10
DA202	L1 MEZZANINE FLOOR PLAN	P9
DA203	L2 FLOOR PLAN	P10
DA204	L2 MEZZANINE FLOOR PLAN	P8
DA300	EXTERNAL ELEVATIONS	P2
DA301	INTERNAL ELEVATIONS	P3
DA302	INTERNAL ELEVATIONS	P3
DA303	TYPICAL UNIT TYPE 1 - ELEVATIONS	P2
DA304	TYPICAL UNIT TYPE 2 - ELEVATIONS	P2
DA400	SECTIONS	P1

1.5 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 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 1.3.3 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.

2 BUILDING CHARACTERISTICS

2.1 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.

2.2 Site Description

The site is located in the suburb of Frenches Forst approximately 13 kilometres north of the Sydney central business district in the local government area of Northern Beaches Council. The allotment is a battleaxe lot, with a long driveway access from Aquatic Drive.

A location plan including the site's existing developments is provided in Figure 2-1 where an aerial image outlines the site's allotment boundaries.

In regard to Fire and Rescue operations, the 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.

Figure 2-1: Allotment Location within the Local Settings

2.3 Building Description

The development entails the construction of 3 levels of industrial strata units with mezzanines for a combined gross floor area of 11,798 m^2. The building is accessed via a driveway entered into from Aquatic Drive. The driveway is lined with carparking and leads to the front entrance lobby of the building and the main vehicle access ramps to the upper levels.

Ground Floor

The ground floor is partly recessed underground as a result of the slopping site, however it is still counted in the building rise-in-storey. The ground floor has a simple design consisting of small storage units organised around a vehicle driveway. The building entrance lobby is located in the south-western corner and houses a non-fire-isolated stair providing pedestrian access to the upper levels, and the FDCIE.

Level 1

Level 1 features industrial strata units surrounding a common driveway. The driveway is accessed via a ramp adjacent the ground floor entrance. The industrial units feature a loading bay, storage space, kitchen and bathroom amenities with a mezzanine floor located above. As a result of the combined size of the mezzanines being over 200 m^2, the mezzanine level is considered a storey. Further to this, occupant carparking is also provided outside each tenancy with some located beneath mezzanine

overhangs. Occupant egress is facilitated via non-fire-isolated stairs located on the southern perimeter and two fire-isolated stairs located on the northwest and northeast corner respectively.

Level 2

Level 2 features a very similar design to level 1 and is accessed via a driveway ramp from level 1. As a result of the combined size of the mezzanines being over 200 m^2, the mezzanine level on level 2 is also considered a storey. Therefore, although indicated as having three (3) main levels, the building has a rise-in-storey of 5. Occupant egress is facilitated by a single non-fire-isolated stairs located on the southwest corner and two fire-isolated stairs located on the northwest and northeast corner respectively.

2.4 Building Structure

Generally, materials used in construction will 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 fire fighters. The main building structure will consist of concrete and steel construction with large degrees of fire rating to meet the BCA required Fire Resistance Levels.

From a BCA compliance perspective, the building is deemed to have a Rise-in-Storeys of five (5) and an effective height of 13.2m. As a majority Class 7b structure, this results in the building being to Type A construction methodologies (unless otherwise rationalised by Fire Engineering).

2.5 Building Characteristic Assessment

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

Table 2-1: Building Characteristics Assessment for BCA Compliance

CHARACTERISTIC	SITE 1
NCC Classification	Class 5 – Office Class 7b – (Self Storage and Warehouse Units) Class 10a – (Pump room, Sprinkler Tank)
Rise in Storeys	Five (5)
Effective Height	13.2m
Type of Construction	Type A

3 OCCUPANT CHARACTERISTICS

3.1 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.

3.2 Dominant Occupant Characteristics Assessment

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 be responsive 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 assistance in locating or accessing the nearest and safest egress path in an

Characteristic	Description
	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 [9] and CIBSE Guide E [12] 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. [15], Nelson and Mowrer [16], 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 [12] such as in the breezeway and carpark areas; and ▸ 1.0m/s is assumed for an able-bodied adult where congestion is likely [12] 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 [16] such as in the administration and office areas.

4 HAZARDS AND PROTECTIVE MEASURES

4.1 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.

4.2 Fire hazards

4.2.1 Building layout and egress

Occupants are afforded exits located at building corners (except the southeastern corner). The southwestern exit is a non-fire-isolated exit, with the remaining exits being fire-isolated. As a result of the slopping nature of the site, the exit located on the southern perimeter discharges on the ground floor, whereas the exits on the northern perimeter discharge on Level 1.

4.2.2 General activities

The building will be used for general goods storage 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.

4.3 Fuel Loads

Quantity of Materials

Due to the nature of the facility, the fire loads within the storage units 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.

4.4 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.

Management of the site must incorporate a strict control measure son the tenants and owners to mandate that Dangerous Goods materials are not stored or processed within the building.

4.5 Rooftop Solar Panels

Solar photovoltaic systems contribute to an increased probability of a fire event, primarily due to electrical risks [8]. 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"
- As per the requirements of AS5033:2021 Clause 5.4, green 'PV' signage is to also be provided adjacent to isolation switches in the MSB and Inverter boards.
- As per the requirements of AS5033:2021 Clause 5.7, a shutdown procedure must also be detailed at the PV equipment that is to be operated in the event of a shutdown.

4.6 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, 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;
  - Internal fire hydrants are to be positioned within all fire-isolated stair serving a car parking level; and
  - External hydrants are to be located around the building perimeter to provide coverage to all external and undercroft carparking spaces. Note that external hydrants must not be located within 10m of an electric vehicle charging bay.
- 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 or internal 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 electric vehicle charging carparking areas are located exclusively externally in the driveway carpark that is separated from the building.

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

4.7 Review of relevant fire statistics

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

4.7.1 Warehouse

From the National Fire Protection Association (NFPA) report on 'Structure Fires in U.S. Warehouses' [31], 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 4-1 illustrates the leading cause of structure fires in warehouses, while Figure 4-2 indicates the leading areas of origin.

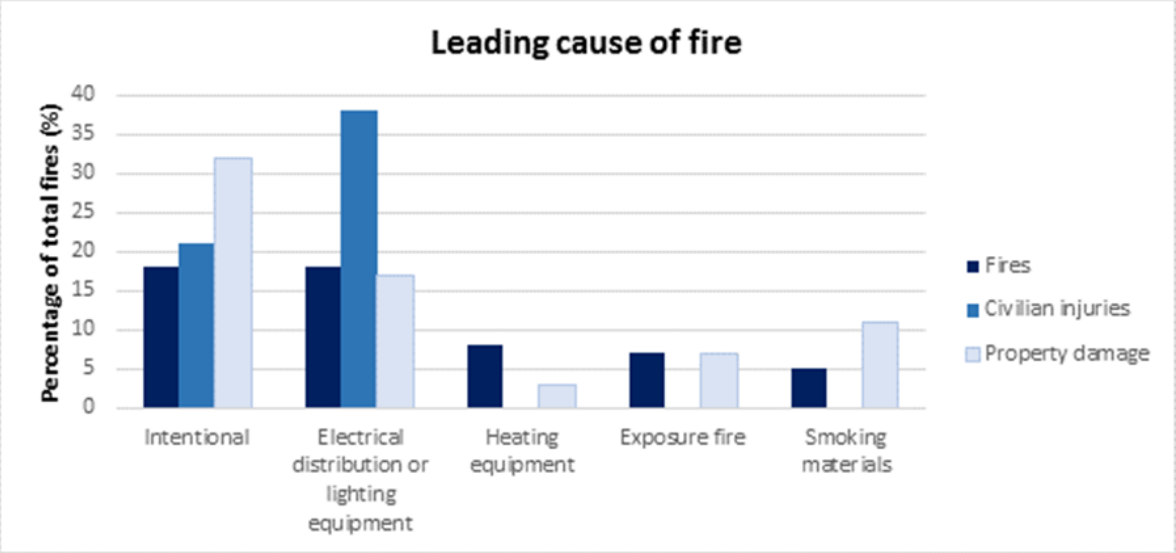


Figure 4-1: Leading Causes of Structure Fires in Warehouses

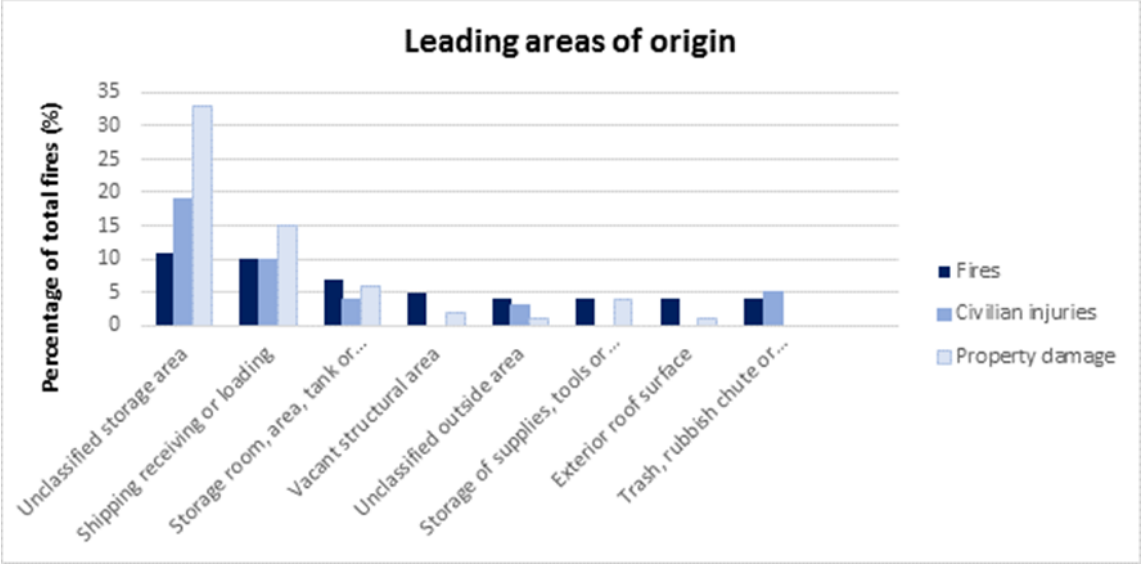


Figure 4-2: Structure fires in warehouses by area of origin

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%)

4.7.2 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.

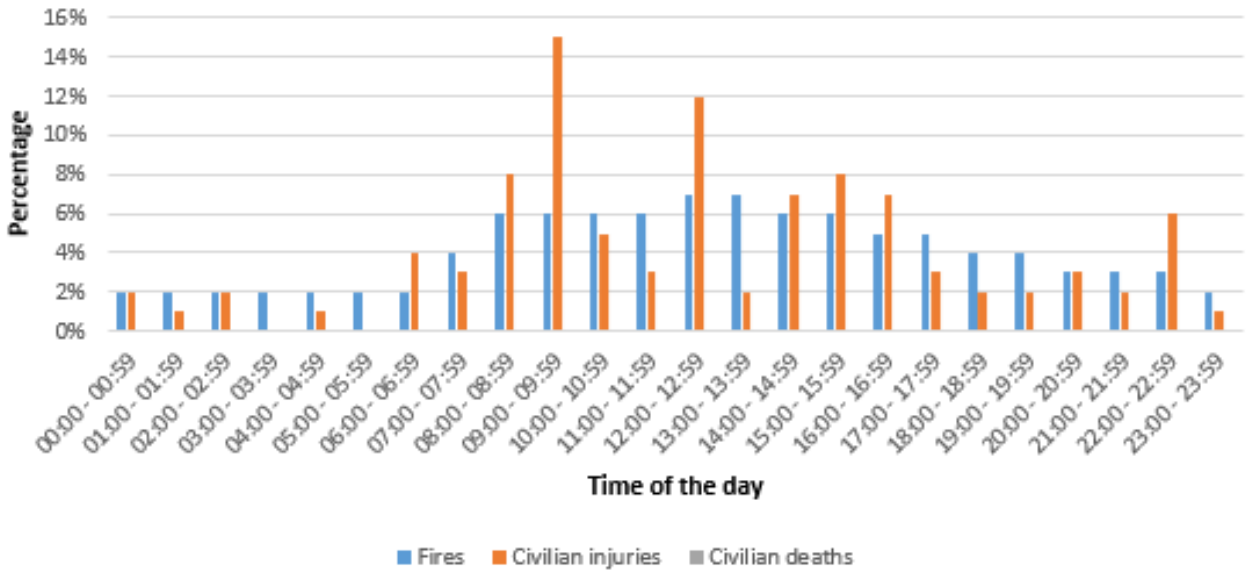


Figure 4-3: Percentage of fires, civilian injuries and deaths at different times of the day (offices)

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.

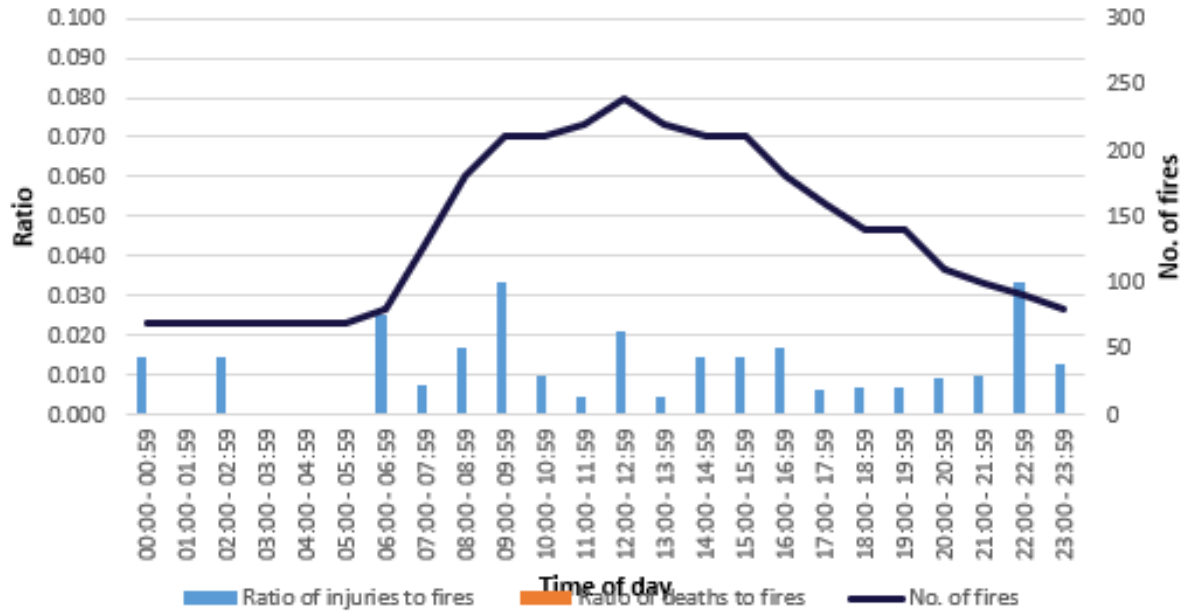


Figure 4-4: Number of fires, ratio of injuries/fires and deaths/fires for different times of the day (offices)

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%)

5 BCA DTS NON-COMPLIANCE REVIEW

5.1 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.

5.2 BCA DTS Non-Compliance Assessment and Acceptance Criteria

Table 5-1: Summary of Performance Solutions

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA
Rationalising Fire-Rating to Level 2 Structure
Relevant Regulatory Requirement: BCA Clause C2D2 requires the building be constructed in accordance with the requirements of Type A Construction as outlined in Specification 5. Specifically: ▸ Columns in the external walls are required to achieve a 240/180/90 FRL. ▸ Internal columns located directly below the roof are required to achieve a 60/60/60 FRL. **Performance Requirement:** The relevant Performance Requirements are C1P1 **Non-compliance with DTS provisions:** <u>Warehouse Unit Mezzanines</u> ▸ The mezzanine structures within the Warehouse Units shall consist of non-fire rated steel construction (in lieu of applying 24o/240/240 FRLs). <u>Level 2 Structure</u> ▸ The Level 2 structure (except for external walls adjacent the site boundary and entry driveways) are permitted to be in accordance with Type C construction methodologies.
Combustible Attachments to the External Walls

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Relevant Regulatory Requirement:

BCA Clause C2D14 requires attachments to an external wall to be non-combustible or have a permitted concession under this BCA Clause.

Performance Requirement:

The relevant Performance Requirement is C1P2

Non-compliance with DTS provisions:

There will be illuminated tenant and wayfinding signage fitted to the external walls of the building that contain combustible elements.

Vehicle Ramp Exposure to Site Boundary

Relevant Regulatory Requirement:

BCA Clause C4D3 states that external walls 3m from a side boundary must have openings protected in accordance with BCA Clause C4D5, and if wall-wetting sprinklers are used they must be located externally. BCA Clause C4D3 also states that openings in external walls required to have an FRL must not occupy more than 1/3 of the area of the external wall of the storey in which it is located.

BCA Clause C4D5 states that openings in external walls must be protected by either wall wetting sprinklers, fire shutters or fire windows.

Performance Requirement:

The relevant Performance Requirement is C1P2

Non-compliance with DTS provisions:

The vehicle entrance ramp to each level of the building features an open design at the building edge. As this opening is within 3m of the boundary, this opening must be afforded a means of protection in accordance with BCA Clause C4D5, however this is not provided in the design.

Omission of Insulation Criterion to Fire Shutters

Relevant Regulatory Requirement:

BCA Clause C4D6 states that an opening within a fire wall must not exceed ½ of the length of the fire wall and must be protected by a single fire door or fire shutter which has an FRL of not less than that required by specification for the fire wall except that each door or shutter must have an insulation level of at least 30.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

BCA Specification 5 nominates the FRL for firewalls of a Class 7b building to achieve a 240/240/240 FRL and furthermore BCA Clause C4D6 specifies that doors, including roller shutters within a firewall, must achieve the FRL required by the firewall with the exception of an insulation not less than 30.

Performance Requirement:

The relevant Performance Requirement is C1P2

Non-compliance with DTS provisions:

Fire shutters installed on Ground floor and Level 1 fire walls achieve a --/240/-- FRL in lieu of --/240/30 FRL.

Rationalised Service Penetration FRLs

Relevant Regulatory Requirement:

BCA Clause C4D15 requires that services which penetrate a building element that is required to have an FRL with respect to integrity or insulation must comply with a tested system in accordance with AS1530.4:2014 to maintain the FRL of the building element.

Performance Requirement:

The relevant Performance Requirements are C1P2 and C1P8

Non-compliance with DTS provisions:

Various penetrations crossing between the Class 5 office space and the Class 7b storage area have a rationalised protection rating of --/120/120 FRL in lieu of --/240/240 FRL where no such systems exist on the marketplace.

Rationalised Non-Fire-Isolated Stair

Relevant Regulatory Requirement:

BCA Clause D2D4 states that every stairway or ramp serving as a required exit must be fire-isolated unless it connects, passes through or passes by not more than 2 consecutive stories and on extra storey of any classification if the building is protected by a sprinkler system or the extra storey does not provide access to the exit and is fire separated from it.

Performance Requirement:

The relevant Performance Requirements are D1P4 and D1P5

Non-compliance with DTS provisions:

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

As the mezzanines on level 1 and 2 are considered storeys within the building, the non-fire-isolated stairs technically passes by a total of 5 stories inclusive of ground, level 1 and level 2. As such, the stair is required to be a fire-isolated exit, however it is designed as a non-fire-isolated stair.

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 various areas of the building, with the following maximum distances to be rationalised through fire engineering:

Ground Floor

- Up to 30m to a point-of-choice in lieu of 20m.
- Up to 118m between alternative exits in lieu of 60m.

Level 1

- Up to 28m to a point-of-choice in lieu of 20m.
- Up to 90m between alternative exits in lieu of 60m.

Level 2

- Up to 30m to a point-of-choice in lieu of 20m.
- Up to 152m between alternative exits in lieu of 60m.

Discharge Point of Non-Fire-Isolated Stair

Relevant Regulatory Requirement:

BCA Clause D2D14 states that in a Class 7b building, a required non-fire-isolated stairway must discharge at a point not more than –

- 20m from a doorway providing egress to a road or open space or leading to a road or open space.
- 40m from one of 2 such doorways if travel to each of them from the non-fire-isolated stairway is in opposite or approximately opposite directions.

Performance Requirement:

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

The relevant Performance Requirement is D1P4

Non-compliance with DTS provisions:

The discharge point of the mezzanine non-fire isolated stairs on level 1 and level 2 are not within 40m of an exit to open space.

Enclosure of Space Under Lobby Stairs

Relevant Regulatory Requirement:

BCA Clause D3D9 states that the space below a required non-fire-isolated stairway must be enclosed to form a cupboard or other enclosed space unless –

- The enclosing walls and ceilings have an FRL of not less than 60/60/60; and
- Any access doorway to the enclosed space is fitted with a self-closing --/60/30 fire door.

Performance Requirement:

The relevant Performance Requirement is C1P2

Non-compliance with DTS provisions:

The space below the non-fire-isolated stairway within the entrance lobby houses the fire-indicator panel for the site and is not enclosed in fire-rated construction as is required by the BCA DTS provisions.

Roof as Open Space

Relevant Regulatory Requirement:

BCA Clause D3D13 requires a roof acting as roof as open space to have direct access to a public road.

Performance Requirement:

The relevant Performance Requirements are D1P4 and E2P2

Non-compliance with DTS provisions:

The roof as Open Space (Level 2 Hardstand) serving as an exit from the Level 2 units discharges to the Ground via a non-fire isolated stair, which requires re-entry into the building rather than a continuous discharge via open space. Furthermore, the fire isolated stairs in the North-Eastern corner which discharges within 3m of openings in the external wall on Ground floor.

VARIATIONS, ASSOCIATED METHODOLOGY AND ACCEPTANCE CRITERIA

Fire Hose Reel Design

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 area.

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 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:

Fire Sprinkler Booster Assembly: The booster location is on the eastern side of the site, however non-compliant with Clause 7.3.1(c)(ii) due to it being more than 20m from the main pedestrian entrance.

6 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.

6.1 Passive Fire Construction

6.1.1 Fire Resisting Construction

The building structure including floors, walls, columns and shafts shall be constructed in accordance with the requirements of Specification 5 for Type A Construction throughout with the following exceptions:

Warehouse Unit Mezzanines (Level 1 and Level 2)

- The mezzanine structures within the Warehouse Units shall consist of non-fire rated steel construction (in lieu of applying 24o/240/240 FRLs).

Level 2 Structure

- The Level 2 structure (except for external walls adjacent the site boundary and entry driveways) are permitted to be in accordance with Type C construction methodologies.

The fire-rating requirements for Level 2 are summarised in the figure below.

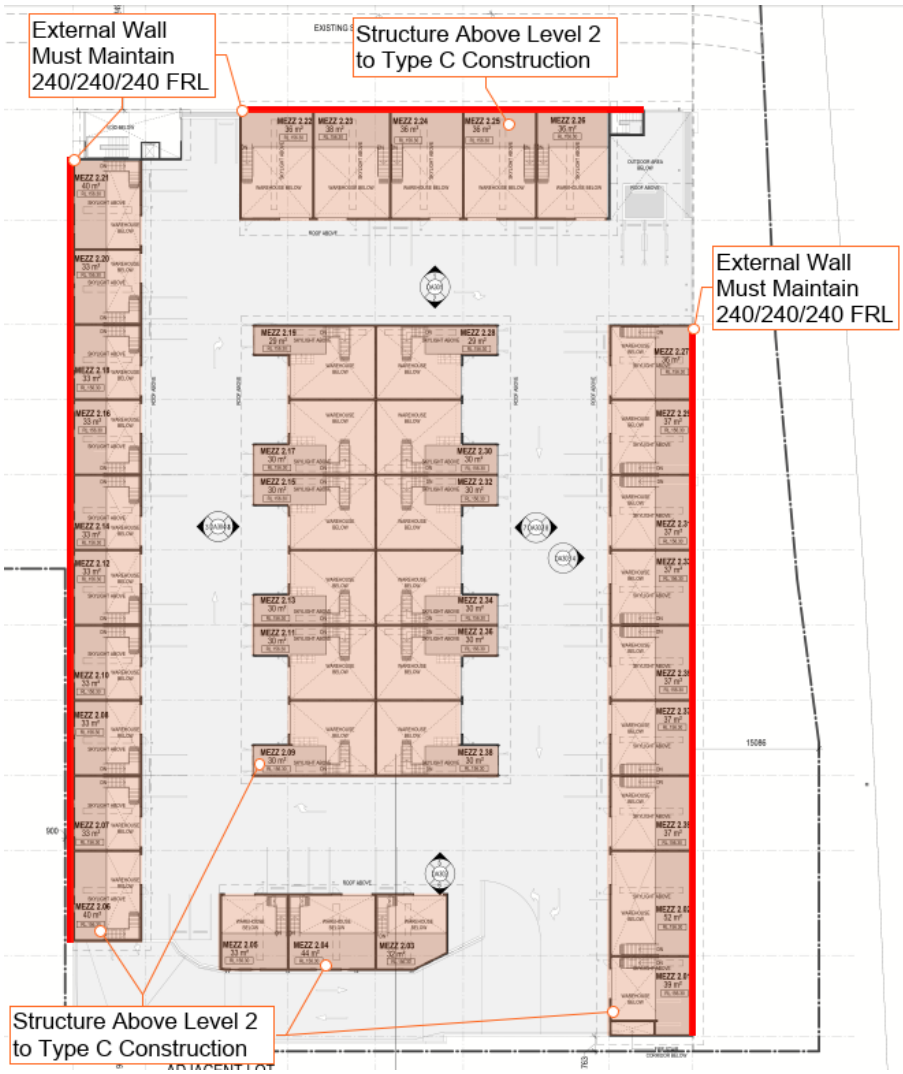


Figure 6-1: Level 2 Rationalised Fire Rating to Structure

6.1.2 Fire Rating to Service Penetrations

All service penetrations are to be sealed in accordance with BCA Clause C3D15 and Specification 13 to ensure that the fire resisting performance of the floor through which it passes is maintained with the following exceptions:

- Due to the limited availability of tested fire collars and sealing available on the market, several service penetrations through 240min FRL structure will only achieve a --/120/120 FRL.
  - The exact location and specifics of these penetrations shall be determined through the detailed design phase of the project. The intent is to provide compliant fire sealing to the penetrations wherever practicable, and thus this Performance Solution allowing a reduced to --/120/120 FRL is only incorporated where there are no available systems on the market.

As part of the above Performance Solution, the following fire safety measures shall be incorporated into the building design;

- A full penetration register is to be prepared for the development in accordance with the Schedule in Appendix B of AS4072.1:2005.

6.1.3 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.

6.1.4 Construction of Exits

Exits along the northern perimeter of the site shall be fire-isolated exits. This includes the stairs from the upper levels as well up from the ground floor to level 1.

As part of the fire engineered solution, the stair within the entrance lobby that proceeds to level 2 shall be constructed as a non-fire-isolated stair.

- The lobby stair serving Ground, Level 1 and Level 2 shall be constructed as a non-fire-isolated stair in lieu of being within a fire isolated shaft.

As part of the above Performance Solution, the following fire safety measures shall be incorporated into the building design:

- The ground floor lobby must be bound by fire rated construction achieving a 240/240/240 FRL.
- No access is permitted to the lobby from within the ground floor compartment. (Access only from outside through the entrance door is permitted)

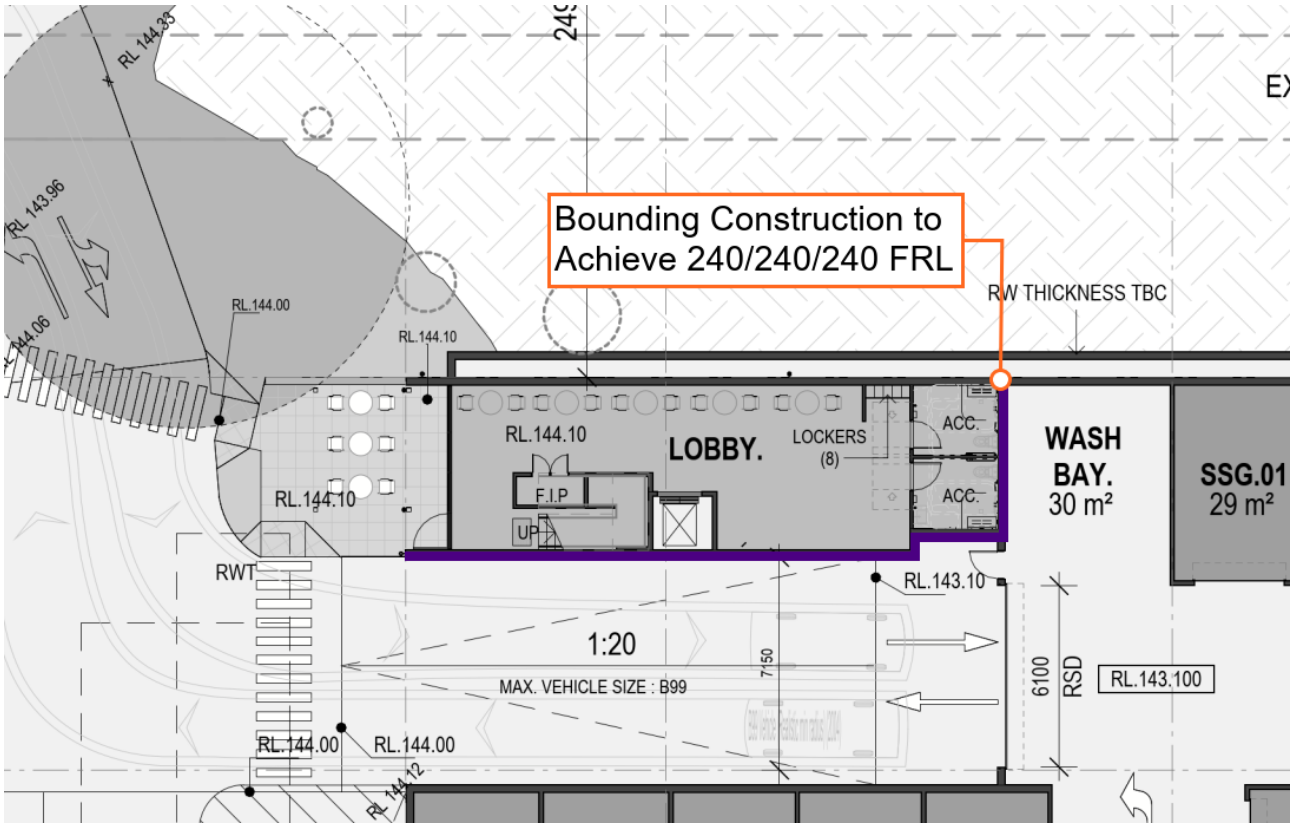


Figure 6-2: Fire Rated Bounding Construction to the Entrance Lobby at Ground Floor Level

6.1.5 Non-Combustible Materials

Where non-combustible materials and their supporting members are required by the BCA, these must be fully DtS compliant.

As part of the requirements for Type A Construction, external walls including their components and any attachments, both internal and external, are to be non-combustible and/or compliant with BCA Clause C2D10 and C2D14 with the following exceptions:

- There will be illuminated tenant and wayfinding signage fitted to the external walls of the building that contain combustible elements.
  - These signs shall be constructed of a polycarbonate material that has not been tested to achieve a Group 1 or 2 rating under AS5637.1:2015.

6.1.6 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.

6.2 Egress Provisions

6.2.1 Evacuation Strategy

Activation of any smoke detector, 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 6.3.3).

6.2.2 Egress Provisions

With exception of the following items being addressed through a fire-engineered Performance Solution, travel distances to a point of choice or single exit are to be not more than 20m and the distance to the nearest of two or more alternative exits must not exceed 40m and the distance between alternative exits must be no closer than 9m and no further apart than 60m.

Egress Travel Distances

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

Ground Floor

- Up to 30m to a point-of-choice in lieu of 20m.
- Up to 118m between alternative exits in lieu of 60m.

Level 1

- Up to 28m to a point-of-choice in lieu of 20m.
- Up to 90m between alternative exits in lieu of 60m.

Level 2

- Up to 30m to a point-of-choice in lieu of 20m.
- Up to 152m between alternative exits in lieu of 60m.

Roof As Open Space

Level 2 is acting as Roof-as-Open-Space, however to reach a public road occupants are required to travel back through the building and through to a non-fire-isolated stair; and hence the egress route is not entirely through 'open space'.

The following figures highlight the worst-case travel distance on each floor.

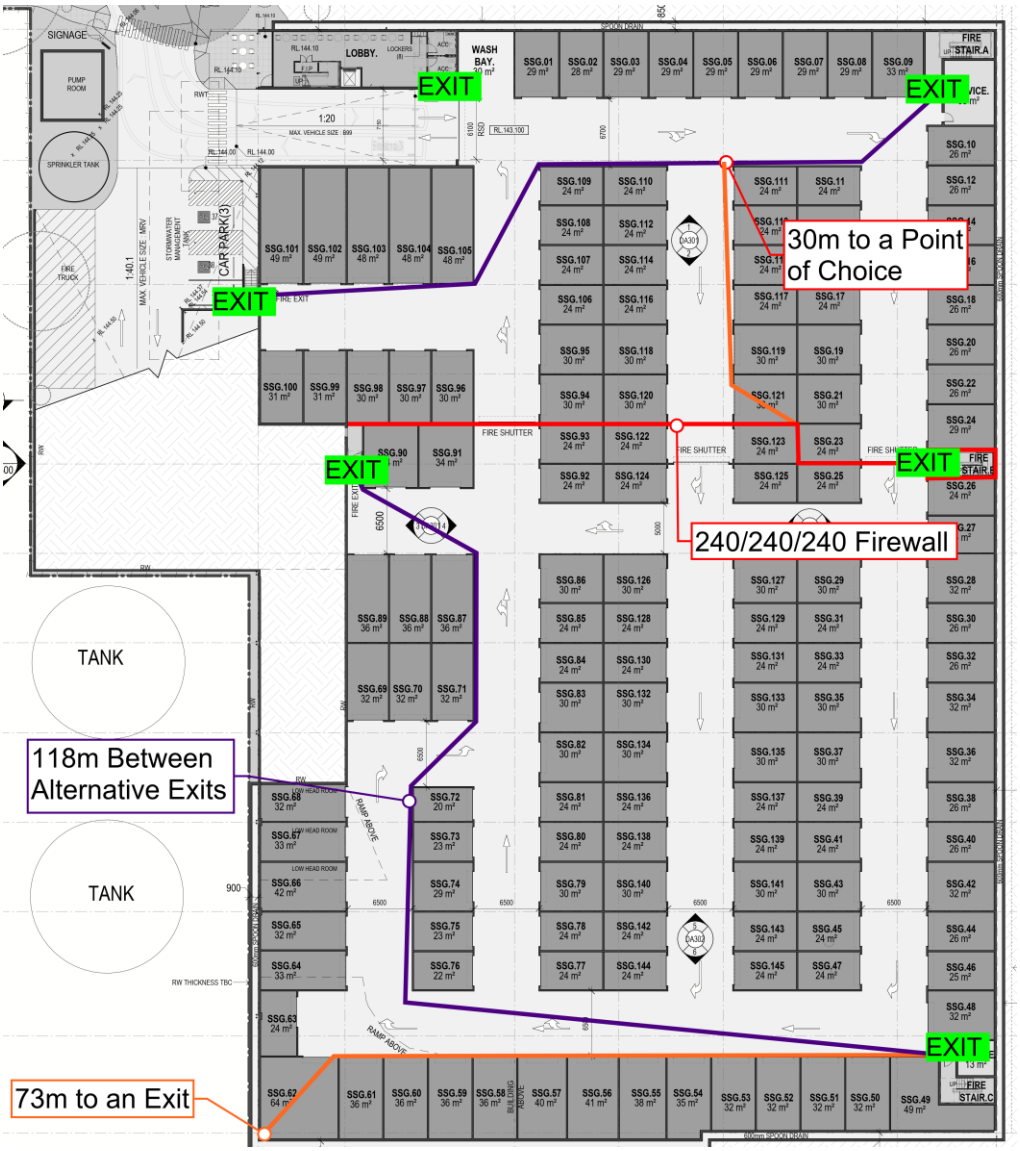


Figure 6-3: Ground Floor Extended Travel Distances

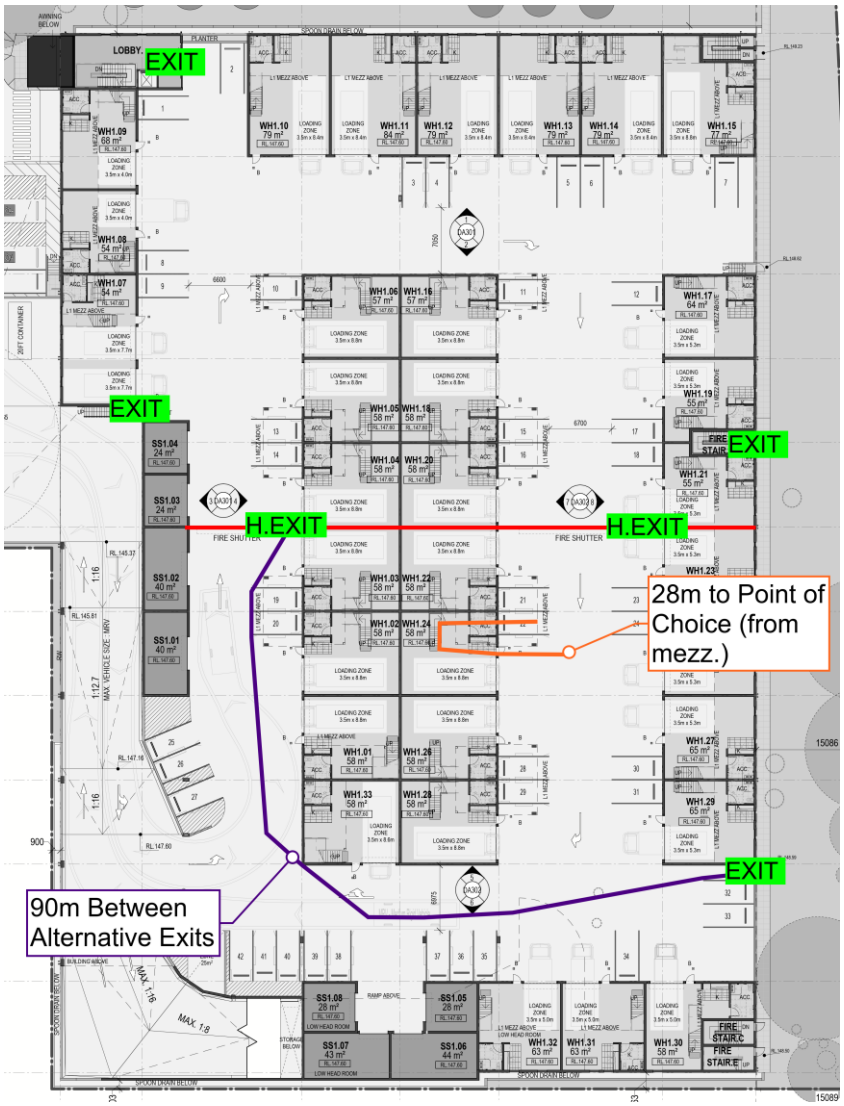


Figure 6-4: Level 1 Extended Travel Distances

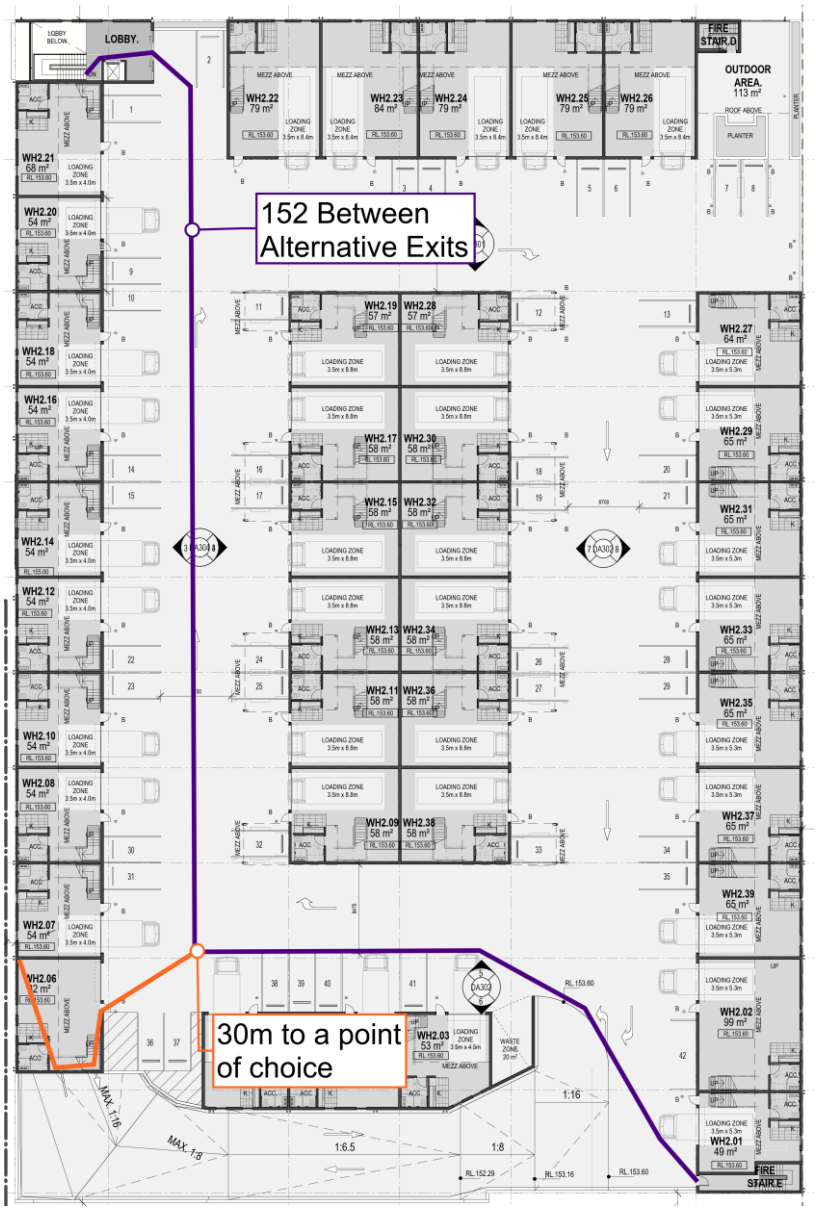


Figure 6-5: Level 2 Extended Travel Distances

6.2.3 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.

6.2.4 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.

6.3 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.

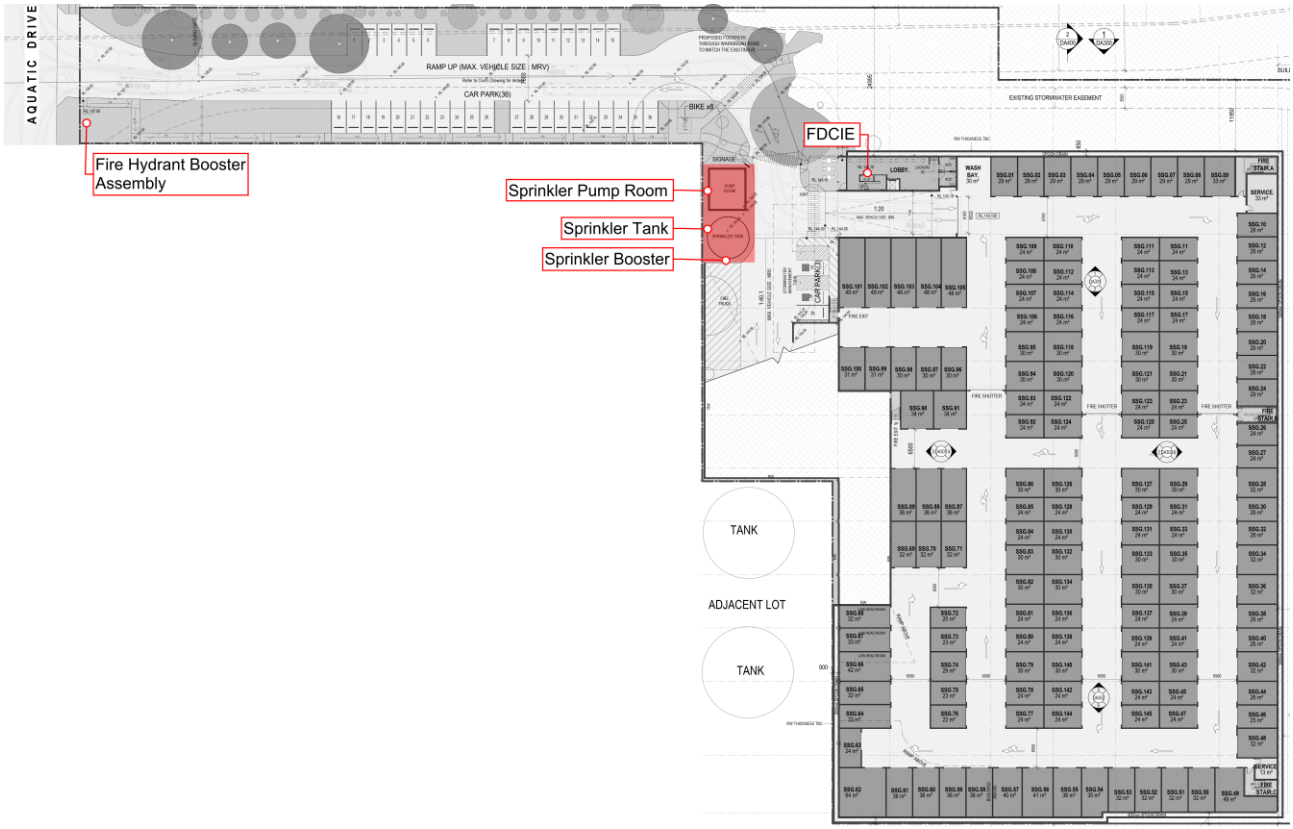


Figure 6-6: Site Fire Services Overview

6.3.1 Fire Control & Indicating Equipment

The building fire safety systems shall be connected to the Fire Control & Indicating Equipment (FDCIE) located within a dedicated cabinet within the ground floor entrance lobby. This shall also form the Fire Control Centre for the Building.

- The FDCIE must incorporate;
  - The ability to enable, disable & reset ALL zones/alarms across the network/precinct.
  - Contain the site ASE and brigade monitoring system.

6.3.2 Fire Brigade Alarm Signalling Equipment

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

6.3.3 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, smoke detector or manual call point shall initiate the building alarm tones throughout the building.

6.3.4 Automatic Smoke Detection System

An automatic smoke detection system be installed to the below listed areas as per the nominated design standard.

Lobby and Amenities

- No smoke detection is required to be installed in the entrance lobby and associated amenities.

Ground Floor and Level 1

- An automatic smoke detection system shall be installed throughout the circulation space with the detector spacing compliant with AS1670.1:2018 Section 7, with the following taking precedence:
  - Detector spacing shall be to 7.5m interval spacing in lieu of 15m.
  - At least one detector must be placed in each of the storage units.

Level 2

- An automatic smoke detection system shall be installed within the storage units on Level 2 compliant with AS1670.1:2018 Section 7, with the following taking precedence:
  - At least one detector must be placed in each of the units.

6.3.5 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:

- The fire sprinkler booster location is on the eastern side of the site, this is however non-compliant with Clause 7.3.1(c)(ii) due it being more than 20m from the main pedestrian entrance.

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).

6.4 Occupant Fire Fighting Facilities

6.4.1 Fire Hose Reel

Fire hose reels are to be provided throughout 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.

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 (i.e. Fire Wardens/Security Staff).

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.

6.4.2 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

6.5 Fire Brigade Intervention

6.5.1 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.

6.6 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.

6.6.1 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.

6.6.2 No Smoking Policy

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

6.6.3 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.

6.6.4 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.

6.6.5 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.

6.6.6 Rooftop Solar Panels

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

- 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, 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"

Where battery storage devices are incorporated for the solar array, the batteries shall be contained within a dedicated enclosure incorporating the following minimum fire safety measures;

- The room shall be separated from other areas of the building by a minimum of 120/120/120 FRL. Doors within a fire-rated wall to be a fire door achieving a --/120/30 FRL per AS1905.1:2015.
- The enclosure shall have direct access to the outside.
- The room shall be protected with an automatic fire sprinkler system in accordance with AS2118.1:2017.
- An external fire hydrant, located no closer than 10m from the room, shall be located outside to provide coverage of the enclosure.

6.6.7 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.

6.6.8 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.

7 REFERENCES

1. Australian Building Codes Board, "NCC - Building Code of Australia – Volume One, 2022", Canberra ACT 2023."
2. Australian Building Codes Board, "NCC - Guide to Volume One", Canberra ACT 2019.
3. Australian Building Codes Board, "International Fire Engineering Guidelines", Canberra ACT 2005.
4. Australian Building Codes Board, "Australian Fire Engineering Guidelines", Canberra, 2021.
5. Brzezinska. D & Bryant. P., Performance-Based Analysis in Evaluation of Safety in Carparks under Electric Vehicle Fire Conditions, Energies 2022, 15, 659.
6. Society of Fire Protection Engineers, "The SFPE Handbook of Fire Protection Engineering", 4th edition, 2008.
7. Drysdale D, "An Introduction to Fire Dynamics", 3rd edition, John Wyley & Sons, UK, 2011.
8. Davis R. (2014), "Fire Concerns With Roof-Mounted Solar Panels", SFPE Fire Protection Engineering Emerging Trends Newsletter, Issue 92, 2014.
9. PD7974-6:2004, "The application of fire safety engineering principles to fire safety design of buildings – Part 6: Human factors", BSI British Standards.
10. PD7974.7:2003, "Application of fire safety engineering principles to the design of buildings – Part 7: Probabilistic risk assessment", BSI British Standards.
11. Spearpoint, M., "Fire Engineering Design Guide", 3rd edition, New Zealand Centre for Advanced Engineering, May 2008.
12. The Chartered Institute of Building Services Engineers, "Fire Safety Engineering CIBSE Guide E", 3rd Edition, May 2010.
13. Drysdale D, "An Introduction to Fire Dynamics", 3rd edition, John Wiley & Sons, UK, 2011.
14. "Fire Brigade Intervention Model V3-0", Australasian Fire Authorities Council, June 2020.
15. Boyce, K., Shields, T., and Silcock, G., "Toward the Characterization of Building Occupancies for Fire Safety Engineering: Capabilities of Disabled People Moving Horizontally and on an Incline", Fire Technology, Vol. 35, No. 1, February 1999, pp. 51-67.
16. Nelson, H.E. "BUD" and Mowrer, F.W., "Emergency Movement", The SFPE Handbook of Fire Protection Engineering (3rd Edition), National Fire Protection Association, Quincy, MA 02269, 2002 pp. 3/367-380.
17. Pauls, J. L. "Movement of People in Building Evacuations", Human Response to Tall Buildings, Chap 21. Dowden, Hutchinson and Ross, Stroudsburg, PA, 1977.
18. Pelecheno N, Malkawi A, "Evacuation simulation models: Challenges in modelling high rise building evacuation with cellular autometa approaches", Automation in Construction Journal 2008 (Vol. 17), pp.377-385.

19. Predtechenskii, V.V. and Milinskii, A.I., Planning for foot traffic in buildings (translated from Russian). Stroizdat publishers, Moscow, 1969. English translation published for National Bureau of Standards and the National Science Foundation, Washington, by Amerind Publishing Co. Pvt. Ltd, New Delhi, India, 1978.
20. Shi, L, Xie, Q, Cheng, X, Chen, L, Zhou, Y, Zhang, R, "Developing a database for emergency evacuation model", pp. 1724-1729 Building and Environment, 2009.
21. Hall, J.R. "U.S. Experience with Sprinklers", National Fire Protection Association, June 2013.
22. Turner, M. "Fire Brigade's Fight for Sprinklers in New Underground Car Park." Fire, 79 (972): 32-34, 1986.
23. Thomas, IR., "Fires in Carparks", Fire Australia February 2004, Eastside Printing, 2004.
24. BHP Steel: Structural steel Development Group, Report No MRL/Ps69/89/006. "Fire Safety in Car Parks".
25. Li, Y and Spearpoint, M. Analysis of vehicle fire statistics in New Zealand parking buildings. Fire Technology, Vol. 43, No. 2, 2007, pp.93-106.
26. BS EN 1991-1-2:2002, 'Eurocode 1: Actions on structures – Part 1-2: General actions – Actions on structures exposed to fire', British Standards, March 2009.
27. AS 1530.4, "Methods for fire tests on building materials, components and structures, Part 4: Fire resistance tests of elements of construction", Standards Australia, 2005.
28. Bushfire CRC, "Window and Glazing Exposure to Laboratory-Simulated Bushfires", Doc: 2006-205, May 2006.
29. Rakic J, "The Performance of Unit Entry Doors when Exposed to Simulated Sprinkler Controlled Fires", Lorient International, Lindfield, NSW, Australia.
30. England JP, Chow V, Yunlong Liu, (2007) Modelling Smoke Spread through Barrier Systems Retrieved from http://www.yunlong.com.au/pdf/PEngland.pdf
31. Campbell, R., 'Structure Fires in Warehouse Properties', NFPA Research, January 2016.
32. Sun, P., Bisschop, R., Niu, H. et al. "A Review of Battery Fires in Electric Vehicles". Fire Technology, 56, 1361–1410 (2020)

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 7-1 [10]; the applicable occupancy type is highlighted.

Table 7-1: 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 [10] is presented in the following table.

Table 7-2: 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

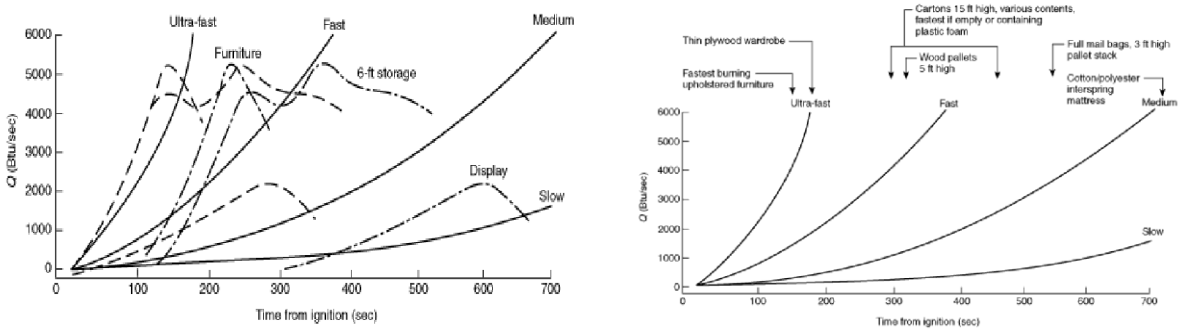
The rate of fire growth is generally expressed in terms of an energy release rate. The most commonly used relationship is what is commonly referred to as a quadratic t-squared fire. In such a fire, the rate of heat release is given by the expression:

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

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 7-1.



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

Figure 7-1: 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 [12] 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 7-3: Fuel load densities for different occupancy groups

Densities in mega-joules per square metre				
Occupancy	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 7-4: 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 7-5: 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 7-6: 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%)