Fire Engineering Brief

Galleria Shopping Centre

Redevelopment

284 Collier Road, Morley WA 6062

Client:	Vicinity Centres
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Prepared by:	Amy Chao
Position:	Senior Fire Safety Engineer
Signed:	

Approved by:	Alex Alexandrovski
Position:	Senior Fire Safety Engineer
Signed:	

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BCA Consultants (WA) Pty Ltd
ACN: 165 448 493

Suite 59, City West Centre
102 Railway Parade
WEST PERTH WA 6005

PO Box 1139,
West Perth WA 6872

Telephone: +61 8 9265 1400
Facsimile: +61 8 9321 9755
Internet: www.bcagroup.com.au

Executive Summary

This Fire Engineering Brief (FEB) presents a fire safety engineering strategy proposed to be adopted for the analysis of the identified deviations from the Deemed-to-Satisfy (DtS) provisions of the National Construction Code Volume One, Building Code of Australia 2022 [ABCB, 2022] associated with the redevelopment of the Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062.

The Galleria Shopping Centre (GSC) is being redeveloped in stages. The scope of this stage of redevelopment includes the centre and north part of the Ground Floor and First Floor (Myer Mall).

The works do not comply in full with the BCA DtS provisions; therefore, the design is considered a "performance-based building design". The deviations from the BCA DtS provisions that require assessment, as identified by the building surveyor for the project, are identified in Table 1.

Perf. Sol.	Performance Solutions	DtS Provisions	Performance Requirements
1	The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120	C2D2(2) and Table S5C21e	C1P1, C1P2(1)(a), C1P2(1)(c), C1P2(1)(d)
	The loadbearing columns and walls that support the First Floor slab achieve FRL 120/--/-- in lieu of FRL 180/--/--	C2D2(2) and Table S5C21g	
2	Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant are not fire-stopped	C4D15(2)	C1P2(1)(d)
	Power supply to the AHUs that provide make-up air to the smoke exhaust systems is not fire-rated	Cl. S21C7(7) of Spec. 21, AS 1668	E2P2
3	Travel distances for the non-fire-isolated exits are measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space	D2D5(3)(a)	D1P4; E2P2
4	Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m	D2D5(3)(a)	D1P4; E2P2
	Travel distances from parts of the GF BoH area to a point of choice are extended up to 25 m in lieu of 20 m		
	Travel distances from parts of the GF storage area to a single exit are extended up to 30 m in lieu of 20 m		
	Travel distances from FF amenities to a point of choice are extended up to 27 m in lieu of 20 m		
	Travel distances from the GF BoH area to the nearest of the alterative exits are extended up to 50 m		
5	Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust are extended up to 61 m in lieu of 40 m	D2D5(3)(a)	D1P4, E2P2

Perf. Sol.	Performance Solutions	DtS Provisions	Performance Requirements
	Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, are extended up to 118 m in lieu of 60 m	D2D6(c)(iii)	
	Smoke exhaust rates are determined on a performance basis in lieu of compliance with the BCA DtS provisions	E2D15(2)(a), Cl. S21C2(2) of Spec. 21	E2P2
	Horizontal length of the Myer retail mall smoke reservoir is extended up to 144 m long in lieu of 60 m	E2D15(2)(a), Cl. S21C4(2) of Spec. 21	
	Horizontal length of the Plaza smoke reservoir is extended up to 66 m long in lieu of 60 m		
	Make-up air velocity through vertical openings exceeds 1 m/s	E2D15(2)(a), Cl. S21C6(3) of Spec. 21	
6	The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03)	D2D12(1)	D1P5, E2P2
7	First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) in lieu of to a road or open space	D2D12(2)(a)	D1P5, E2P2
	Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space	D2D12(2)(b)	
8	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m	E1D2(2) and Cl. 3.5.3.3(b) of AS 2419.1-2021	E1P3
	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.5.3.3(c) of AS 2419.1-2021	
	Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.6.1(e) of AS 2419.1-2021	
	Internal fire hydrants are not located in every fire-isolated exit	E1D2(2) and Cl. 3.6.2(a)(ii) of AS 2419.1-2021	

Perf. Sol.	Performance Solutions	DtS Provisions	Performance Requirements
	Internal fire hydrants installed in retail malls are provided more than 4 m from required exits	E1D2(2) and Cl. 3.6.2(b) of AS 2419.1-2021	
9	In the refurbished and extended parts of the GSC, the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, in lieu of fire hose reels	E1D3(2)(a)	E1P1
10	Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy	Cl. 3.1.2 of AS 2118.1, S17C2(a) of BCA Spec. S17 and E1D4(b)	E1P4
11	Walls between the sprinklered and non-sprinklered parts are provided with glazed sections that are not protected against fire spread	S17C3(a) of Spec. 5 and E1D4(b)	C1P2(1)(d), E1P4
12	After-hours, the make-up air velocity through the Timezone and JB Hi-Fi shopfront openings is increased up to 3.5 m/s in lieu of a maximum 2.5 m/s.	S21C6(2) of Spec. 21 and E2D15(2)(a)	E2P2

Table 1: Performance Solutions and relevant BCA provisions

The assessment was carried out in accordance with the process prescribed by BCA Clause A2G2(4) and endorsed by the Government of Western Australia, Department of Mines, Industry Regulations and Safety (DMIRS).

The fire engineering analysis of the performance-based design generally follows the methodology outlined in the Australian Fire Engineering Guidelines [ABCB, 2021], which is produced by the Australian Building Codes Board.

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1. Introduction

This Fire Engineering Brief (FEB) presents a fire safety engineering strategy proposed to be adopted for the analysis of the identified deviations from the Deemed-to-Satisfy (DtS) provisions of the National Construction Code Volume One, Building Code of Australia 2022 [ABCB, 2022] associated with the redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062.

The method of meeting the Performance Requirements of the BCA adopted for this project is in accordance with BCA Clause A2G1(2)(c), i.e. compliance with the Performance Requirements is achieved by a combination of a "*Performance Solution*" and "*Deemed-to-Satisfy Solution*".

The works do not comply in full with the BCA DtS provisions; therefore, the design is considered a "performance-based building design". The deviations from the BCA DtS provisions that require assessment in accordance with BCA Clause A2G2(1), as identified by the building surveyor for the project (BCA Consultants), are detailed in Section 8.

The purpose of this document is to identify the deviations from the BCA DtS provisions; outline the proposed Performance Solutions, acceptance and limiting criteria, design concepts, and fire safety strategy; and generally set down the fire safety engineering philosophy for the approval by the design team. This report is limited to only assessing the deviations from the BCA DtS provisions detailed in Section 8.

BCA Consultants (WA) Pty Ltd (BCA Consultants) developed this report at the request of Vicinity Centres Pty Ltd, who are the owner for the site.

2. Objectives

The fire safety objectives must satisfy the community expectations (legislative objectives) and relevant stakeholders' expectations (design objectives). The fire safety objectives for the project are summarized below.

2.1 Legislative objectives

The following are the fire safety objectives of the BCA:

1. Safeguard people from illness or injury due to a fire in a building.
2. Safeguard occupants from illness or injury while evacuating a building during a fire.
3. Facilitate the activities of emergency services personnel.
4. Avoid the spread of fire between buildings.
5. Protect other property from physical damage caused by structural failure of a building as a result of fire.

2.2 Design objectives

The client requested that a fire safety engineering assessment be provided to support the performance-based building design as outlined in Section 9 of this report.

Objectives such as protection of property; protection of furnishings; protection of reputation and ensuring business continuity; safety other than fire safety; have not been identified as design objectives of this assessment. However, by satisfying the core fire safety objectives some of the above objectives may also be satisfied.

3. Assumptions & Limitations

The following assumptions and limitations apply to this FEB:

a) This FEB outlines the methodology for the assessment of the Performance Solutions for the redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062, and is limited to the deviations from the BCA DtS provisions as identified in Section 8.

b) This FEB is developed on the assumption that all building works, except for the deviations identified in Section 8 of this report, shall comply with the DtS provisions of the BCA at the completion of the works.

c) The Performance Solution outlined in this FEB is developed to demonstrate compliance with the relevant BCA Performance Requirements and may not provide the level of property protection inherent in a BCA DtS compliant design.

d) This FEB relies on third parties, particularly the building surveyor, for the identification and confirmation of the deviations from the BCA DtS provisions and other information. This FEB does not provide a guarantee of the accuracy of the information provided by third parties.

The full list of assumptions and limitations is provided in Appendix A of this report.

4. Principal Building Characteristics

4.1 General

The GSC is an existing regional shopping centre located at 284 Collier Road, the corner of Collier and Walter Roads, Morley, WA 6062, and is proposed to be redeveloped in stages. The location plan is illustrated in Figure 1 below.

Figure 1: Location Plan of Galleria Shopping Centre

The shopping centre consists of major retailers including Woolworths, Coles. Kmart, Aldi, Target, Rebel Sports, Myer, Event Cinemas and facilities including toilets, restrooms, info desk, lost and found, wheelchair hire, payphones, recycling stations, Uber and Taxi bays.

The scope of redevelopment for this stage includes the north part of the Ground Floor and First Floor retail mall areas and the adjacent tenancies, excluding any major tenancies.

In accordance with the DtS provisions of the BCA and based on the advice provided by the building surveyor the building has the following characteristics:

Characteristic	Description
Classification	Class 6 (retail), Class 7a (car park), Class 9b (cinema)
Number of Storeys Contained	3 (Ground Floor, First Floor and Mezzanine)
Effective Height	10 m
Type of Construction Required	Type B
Large Isolated Building	Yes – the tenancies are located in a large isolated building

Table 2: Building Characteristics

4.2 Area of Works

The extent of the proposed refurbishment works is highlighted pink in Figure 2 and Figure 3 below. This report focuses on the areas only. The remaining existing, un-altered parts of the shopping centre will not be assessed.

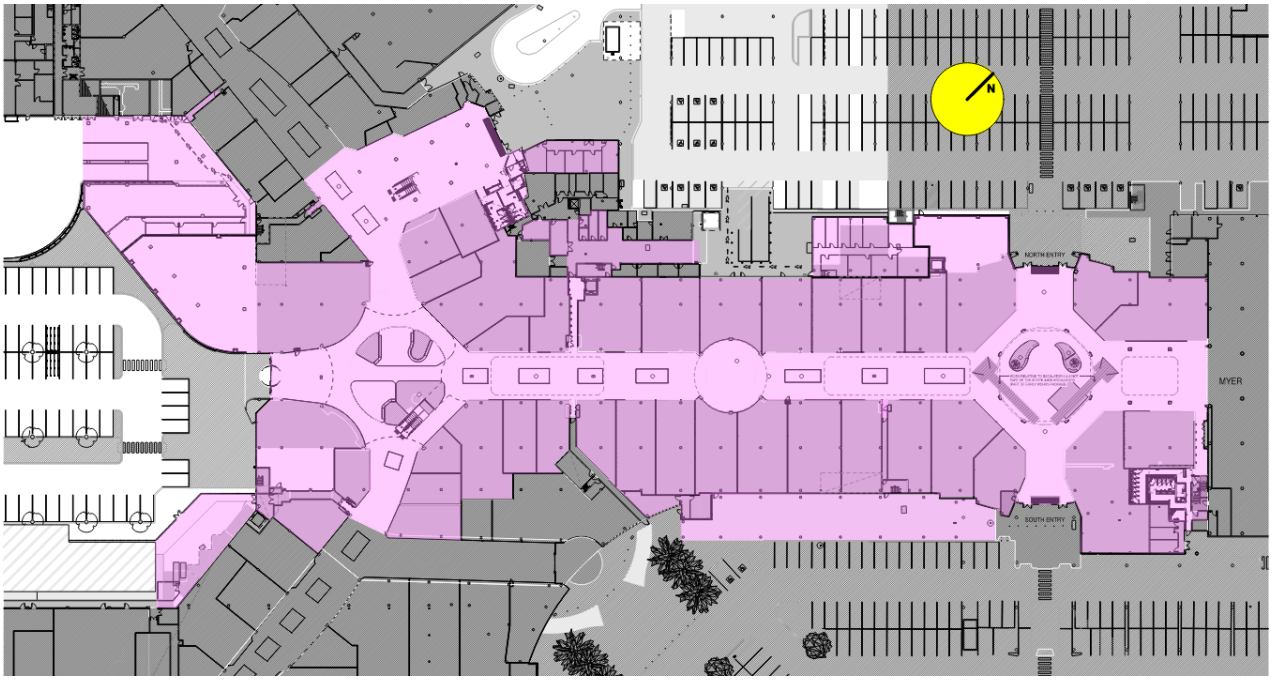


Figure 2: Extend of refurbishment on the Ground Floor of GSC

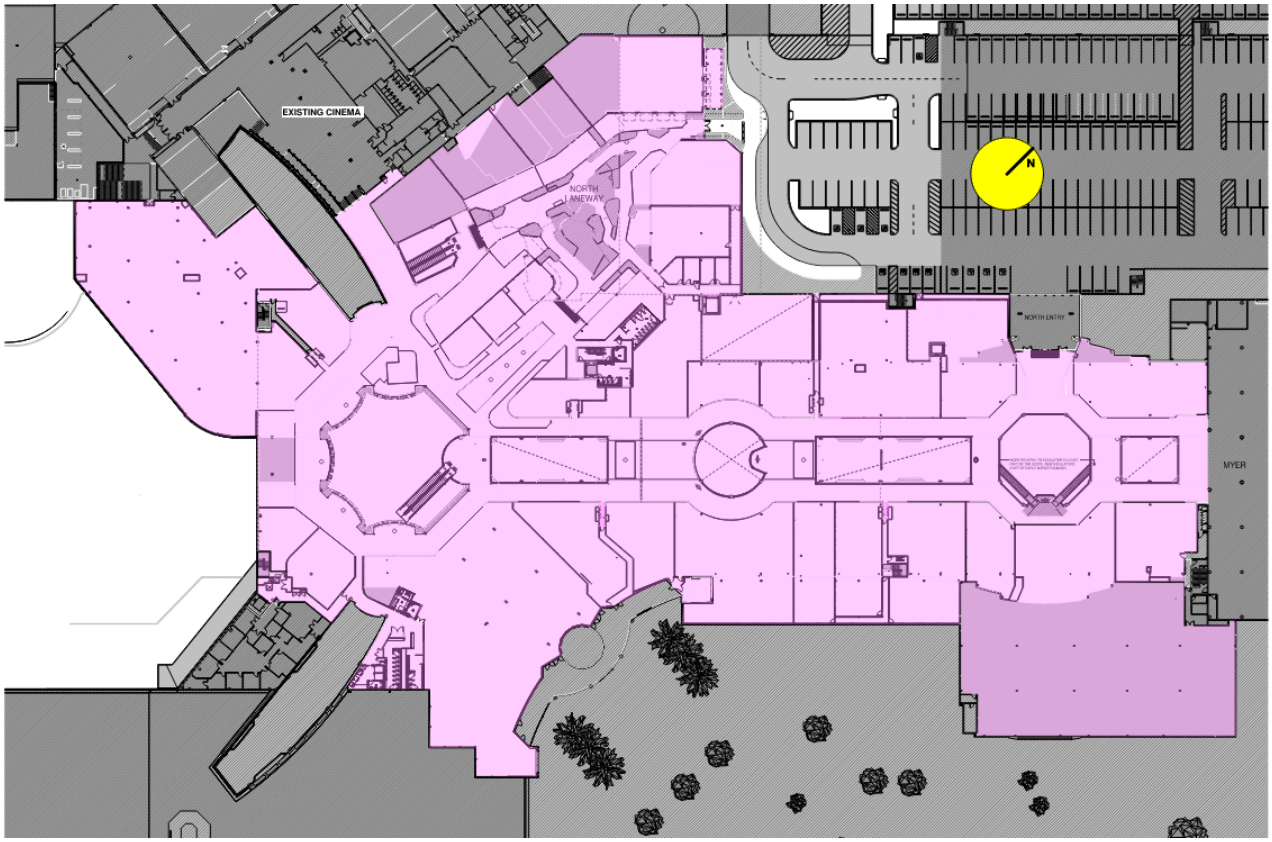


Figure 3: Extend of refurbishment on the First Floor of GSC.

4.3 Fire Compartment

The centre is being treated as a large-isolated building and therefore is to be designed as a single fire compartment, except the following existing conditions that are to be retained:

- Myer is currently fire separated from the main centre by fire walls fitted with sliding fire doors
- Kmart, Coles, Woolworths, Target, and the Cinemas are smoke separated.

Figure 4 and Figure 5 below show the fire-separated Myer tenancy in red, the smoke-separated tenancies in blue, the remaining tenancies in orange, and the retail mall circulation spaces in green.

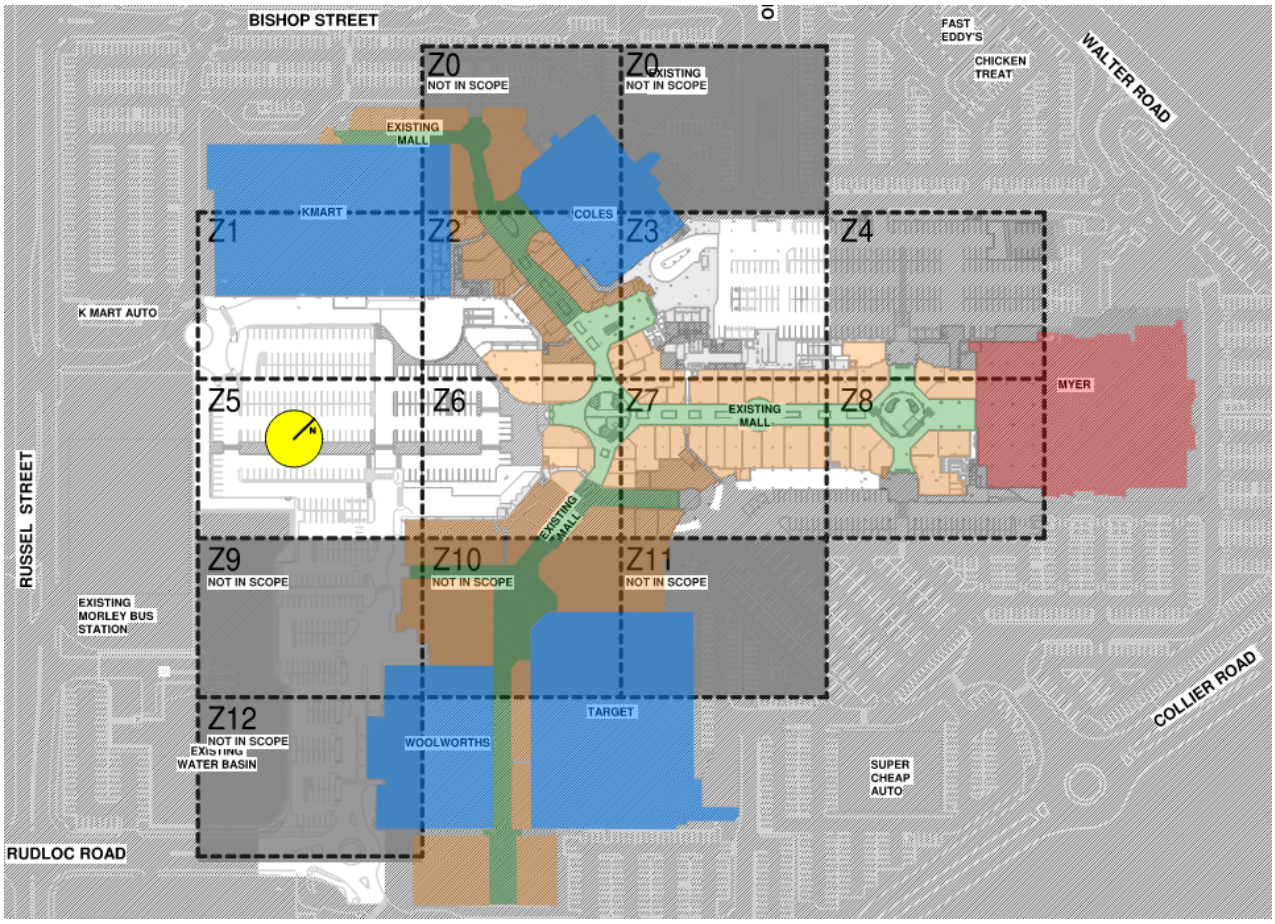


Figure 4: Ground Floor tenancies fire/smoke separated from main shopping centre

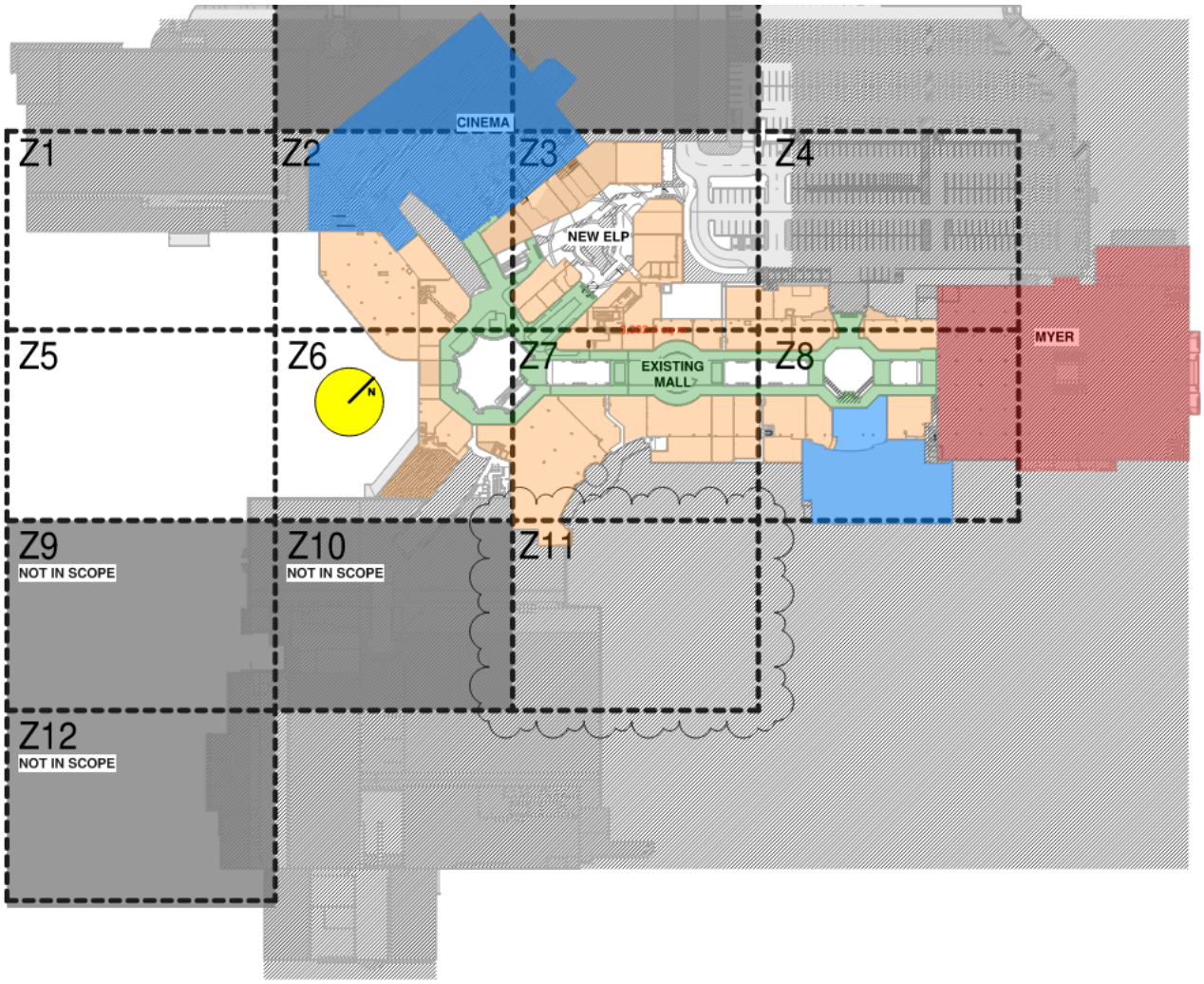


Figure 5: First Floor tenancies fire/smoke separated from main shopping centre

4.4 Smoke Zones

The centre is separated into smoke zones as shown in Figure 6 and Figure 7 below (full size drawings of the smoke zones are provided in Appendix E). Each smoke zone is provided with dedicated smoke exhaust, as outlined in Table 3. Smoke zones SZ-01 and SZ-04 are outside the scope but smoke exhaust fans in these zones may activate during a fire in smoke zone SZ-02.

Smoke zone	Smoke Exhaust Fans	Design SEF capacity, l/s	Actual SEF capacity, l/s
SZ-01	SEF 13.2; SEF 13.3; SEF 13.4; SEF 13.5	64,000	48,352
SZ-02	SEF 13.1; SEF 14.1; SEF 17.6; SEF 21.5	92,000	83,191
SZ-03(A)	SEF 10.1; SEF 10.2; SEF 19.1; SEF 19.2	92,000	102,230
SZ-03(B)	SEF 15.1; SEF 15.2; SEF 16.1; SEF 16.2	92,000	102,535
SZ-03(C)	SEF 12.1; SEF 12.2; SEF 14.2; SEF 14.3	92,000	100,772
SZ-04	SEF 21.1; SEF 21.2; SEF 21.3; SEF 21.4	64,000	31,613

Table 3: Smoke zones and smoke exhaust capacity per each zone

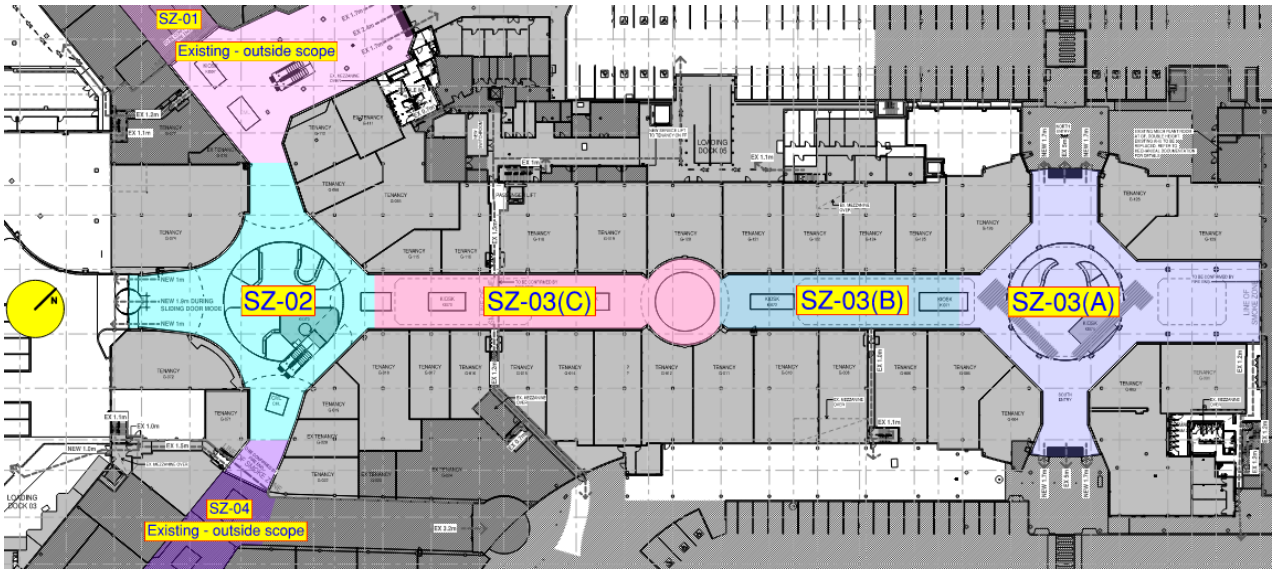


Figure 6: Ground Floor smoke zones

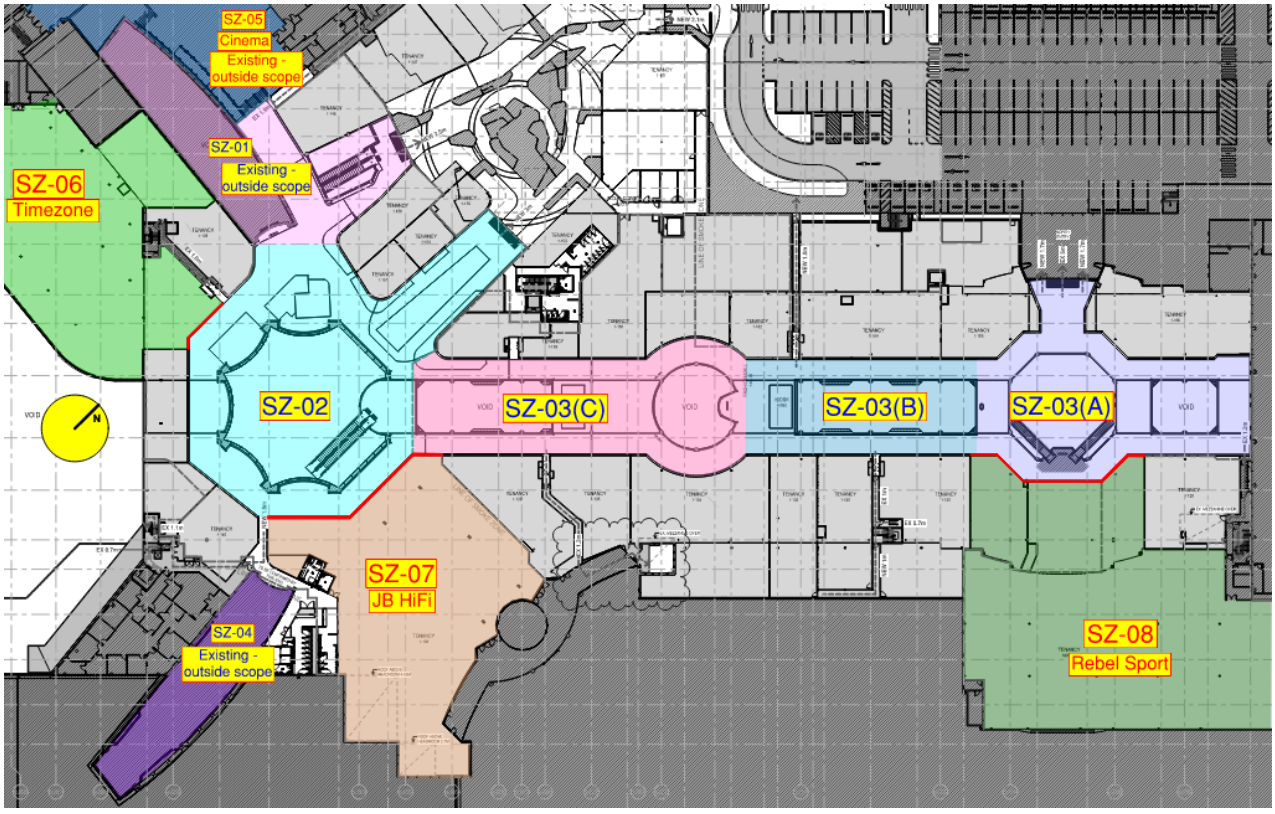


Figure 7: First Floor smoke zones

Make-up air to the smoke exhaust systems shall be provided from AHUs nominated in Table 4 below and via the external retail mall doors that shall automatically open upon fire alarm activation (both during trading hours and after-hours), as nominated in Table 5 below. All AHUs nominated in Table 4 shall operate in supply mode simultaneously independent of the smoke zone in which the fire has been detected and shall provide make-up air to the retail malls at Ground Floor only.

Plant Room	Air Handing Units	Design make-up air capacity, l/s
AP1	AHU 1.1; AHU 1.2	9,000
AP3	AHU 3.1; AHU 3.2; AHU 3.3	7,050
AP4	AHU 4.1; AHU 4.2; AHU 4.3	16,250
AP6	AHU 6.1	4,000
AP7	AHU 7.1; AHU 7.2	7,500
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500
AP11	AHU 11.1	3,500
AP ENT	AHU ENT.3	8,000

Table 4: AHUs that shall provide make-up air to the smoke exhaust systems

Door	Location	Size, m	Net free open area, m²*
D.EX.01	South-east entrance to Woolworths and Target mall	2.55 x 2.91	6.55
D.EX.02	South-west entrance to Target link mall	2.45 x 2.40	5.16
D.EX.03	South-west entrance to Kmart mall	1.74 x 2.35	3.38
D.EX.04	North-west entrance to Coles mall	1.65 x 2.35	3.17
D.EX.05	North-east entrance to ANZ mall	3.29 x 2.41	7.20
D.EX.06	North entrance to Coles mall	2.06 x 2.41	4.24
1.Z6.01	South entrance to Plaza (new)	2.03 x 2.45	4.24
G.Z4.03	North-west entrance to Myer mall	2.86 x 2.63	6.73
G.Z8.02	South-east entrance to Myer mall	2.35 x 2.27	4.65
		Total:	45.32

Table 5: External doors that shall provide make-up air to the smoke exhaust system

Note *: the effective width of the doors is reduced by 300 mm as sliding doors leave a 150 mm overlap each side of the opening.

4.5 Department of Fire & Emergency Services Access

GSC is provided with three (3) access points (crossovers) from Walter Road, two (2) access points from Collier Road, three (3) access points from Russell Street and one (1) access point from Dewar Street, facilitating vehicle and pedestrian access for the Department of Fire & Emergency Services (DFES).

The DFES response to GSC is expected to come from the Kiara Fire Station located approximately 5.0 km to the north-east, and Malaga Fire Station located approximately 5.9 km to the north. Figure 8 shows the location of the site relative to these fire stations.

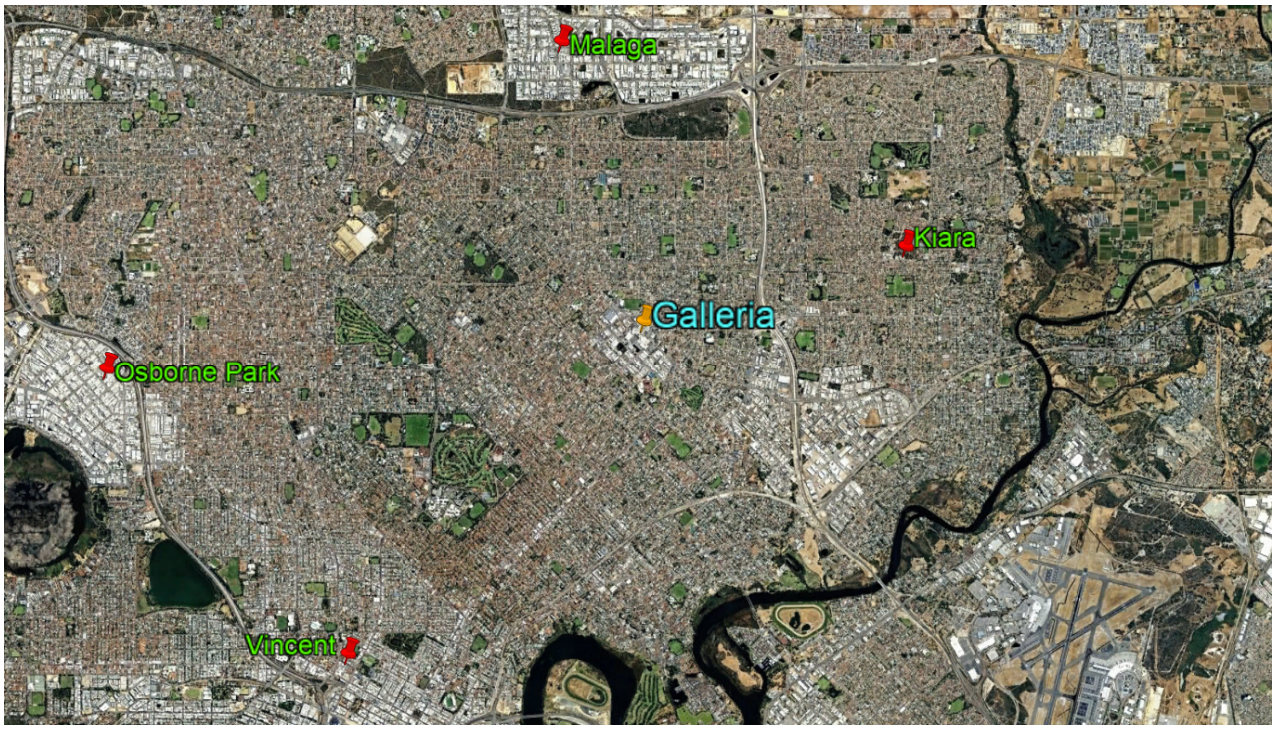


Figure 8: DFES locations relative to the site (image courtesy of Google Earth)

The nearest back-up fire stations are Vincent Fire Station, located approximately 6.9 km to the south-west and Osborne Park fire station located approximately 9.6 km to the west.

The nearest aerial appliance is at Perth Fire Station.

The abovementioned fire stations are manned by DFES personnel on a full-time basis.

4.6 Egress Provisions

The centre is provided with multiple exits around the perimeter of the centre. The number of exits withstanding, the centre is subject to extended travel distances to a single point of choice from the specialty tenancies and extended travel distances to the nearest of the alternative exits from the centre. The performance-based egress provisions are subject of Performance Solutions No. 3, No. 4 and No. 5.

4.7 Preventive and Protective Measures

The fire preventive and protective measures include various passive and active fire protection measures. The Australian Fire Engineering Guidelines (AFEG) indicate that to assist in analysing a fire safety system, it is convenient to consider the system as comprising six ‘sub-systems’ [ABCB, 2021a]. Therefore, preventive and protective measures detailed in Table 6 are grouped in accordance with the different ‘sub-systems’ recommended by the AFEG.

Sub-System	Comment
Sub-System A Fire Initiation and Development and Control	Strict enforcement of a "No-Smoking" policy shall be implemented throughout the building. Strict enforcement of housekeeping measures to ensure rubbish is not accumulated adjacent to potential ignition sources. Regular maintenance and inspection of all electrical equipment and appliances shall be enforced in accordance with the relevant regulations.
Sub-System B Smoke Spread and Control	The GSC is a single fire compartment but is divided into fire- and smoke-separated areas. In the initial stages of fire development smoke spread within smoke-separated areas may be limited by the internal walls. The performance-based smoke exhaust system in the retail mall is expected to control smoke spread in shopping centre. The performance-based smoke exhaust system is subject of Performance Solution No.4.
Sub-System C Fire Spread and Impact and Control	The GSC is a single fire compartment but is divided into fire- and smoke-separated areas. Automatic sprinklers installed throughout the building to AS 2118.1 are expected to control a potential fire. In the unlikely event that the sprinkler system fails to operate as designed, non-fire-rated intertenancy walls should provide temporary barriers in the path of spreading fire.
Sub-System D Fire Detection, Warning and Suppression	An automatic fire sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017 shall be provided throughout the GSC, except sprinklers may be omitted from high ceiling spaces, parking spaces below Rebel Sport tenancy, canopy area in the First Floor North Laneway, and the open deck parking adjacent Coles. The performance-based fire hose coverage is subject of Performance Solution No. 7. A fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018 shall be provided throughout the area of scope. Emergency Warning and Intercommunication System (EWIS) shall be provided in accordance with Clause E4D9(d) of BCA and AS 1670.4-2018 throughout the area of scope. Fire hose reels may be omitted in the area of scope. The performance-based omission of fire hose reels is subject of Performance Solution No. 8. Portable fire extinguishers shall be installed in accordance with BCA Clause E1D14 and AS 2444-2001 (where applicable).
Sub-System E Occupant Evacuation	The building is provided with multiple exits; however, extended travel distances are present. These extended travel distances are subject of Performance Solutions No. 3 and No. 4. Emergency lighting and exit signage shall be provided in accordance with Part E4 of the BCA.
Sub-System F Fire Services Intervention	Professional fire service (DFES) is available on a full-time basis. A fire hydrant system shall be provided in accordance with BCA Clause E1D2 and AS 2419.1-2021, except complete fire hose coverage is achieved with the use of 3 lengths of hose from external attack fire hydrants, in lieu of 2 lengths of hose and internal attack fire hydrants. The performance-based fire hose coverage is subject of Performance Solution No. 7.

Table 6: Preventative and protective measures

4.8 Hazards

Identification of hazards that are expected to affect life safety of building occupants is crucial to undertaking a fire safety engineering assessment. Special attention must be paid to those hazards that are not commonly associated with the type of occupancy.

Hazards associated with the general layout and activities as well as the ignition and fuel sources are identified in Table 7 below:

Type	Comment
General Layout	Multiple alternative exits are provided from the building, although some travel distances to exits and distances between the alternative exits exceed the BCA DtS prescribed maximums. This is mitigated by the provision of a performance-based smoke exhaust system in the retail mall and early warning fire detection and alarm system to AS 1670.1-2018 throughout the shopping centre. The general layout of the building is not considered to present an unusual hazard to occupants and is consistent with the building classification and a regional shopping centre.
Activities	The activities within the building are considered to be of low to medium hazard and are not considered to promote any additional hazards to those typical of this type of occupancy. The above notwithstanding, acts of vandalism that could lead to deliberately lit fires cannot be discarded and shall be address through the implementation of adequate security procedures.
Ignition Sources	The main ignition sources throughout the building are expected to be faulty electrical wiring, lighting, or electrical equipment. In areas where food is being prepared or re-heated the kitchen appliances may become an ignition source. The strict enforcement of the “No-Smoking” policy throughout the building shall reduce the likelihood of discarded smoking materials or use of open flames, such as matches and/or lighters; becoming an ignition source.
Fuel Sources	The main fuel source within the building is expected to consist of retail goods for sale, either in the retail areas or in the back-of-house areas.

Table 7: Hazards and ignition source

4.9 Occupant Characteristics

4.9.1 Occupant Groups

The characteristics of the occupant groups expected to be present in the building when a fire starts, are detailed below:

1. Management, support personnel and security – This occupant group is expected to have good familiarity with the building and the fire safety measures and is expected to be fully trained in emergency procedures. This occupant group is expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the building.

2. Retail Staff – This occupant group is expected to have good familiarity with their respective tenancies and reasonable familiarity with the rest of the centre. Staff should have good familiarity with the fire safety measures. This occupant group is expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the tenancy and is expected to facilitate evacuation in an emergency.

3. Customers – This occupant group may or may not be familiar with the layout of the building. Occupants in this group are expected to have mobility, hearing and visual abilities in line with the general population. This occupant group may require assistance with walking and may have mobility, hearing, and visual impairments in line with the general public.

4. External maintenance contractors – This occupant group is expected to have reasonable familiarity with the building. This occupant group is also expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. Contractors are expected to be awake and aware of their surroundings at all times when inside the tenancy.

In addition to the above, in an emergency DFES are expected to enter the building as part of their fire brigade intervention activities.

4.9.1 Number of Occupants

BCA Clause D2D18 states that the number of persons accommodated in a building must be determined with consideration of the purpose for which it is used and the layout of the floor area. It also states that the number of persons accommodated in a building may be determined using either BCA Clause D2D18(a) and Table D2D18, or by using BCA Clause D2D18(c) which utilises "*any other suitable means of assessing its capacity*".

In determining the population of the GSC relevant to this assessment the following assumptions were made:

1. Occupant numbers for the GSC were based on the "Fire Safety in Shopping Centres" research report, also known as Project 6 [FCRRP, 1998a], i.e. as permitted by BCA Clause D2D18(c), i.e. 6 m²/person for trading floor and specialty shops, and 10 m²/person for the retail mall.

2. Customers can access the trading floors of the Major and Mini-Major Stores, but not the back-of-house (BoH) areas; therefore, only the floor area of the trading floors were used to determine occupant numbers.

3. Occupant numbers for the BoH were based on BCA Table D2D18 provisions for "storage space" (30 m²/person). Occupant numbers for the offices were based on BCA Table D2D18 provisions for "office" (10 m²/person).

4. Customers can access all areas of Specialty Shops, Food Tenancies, or retail mall; therefore, the gross floor area of the shops and retail malls was used to determine the occupant numbers.

5. Occupants from specialty shops that open directly to outside and do not have alternative escape paths via the retail mall are not competing for the same exits with occupants from within the retail mall and specialty shops that open onto the retail mall; hence they are not included in the assessment.

6. Where a specialty shop is provided with an exit directly to outside and an alternative escape path via the mall, the total population of the tenancy was divided by the number of exits and was evacuated accordingly, e.g. if there is one exit directly to outside and one alternative escape path via the retail mall, ½ of the population is evacuated directly to outside and ½ via the retail mall.

For the purposes of this fire engineering analysis, the number of occupants evacuating via the retail malls om the area of scopes was calculated to be 3236 people.

5. Assessment Data

The following data was examined during the production of this FEB:

1. The project architectural drawings listed in Table 8 below prepared by the architect (Buchan; project no.: 19049A).

Drawing No.	Title/Description	Revision	Date
00004	Location Plan	C	23.05.2025
00005	GA Ground Floor – Zones Map 1 of 2	C	23.05.2025
00006	GA First Floor – Zones Map 2 of 2	C	23.05.2025
00007	GA Ground Floor – Scope of Work	C	23.05.2025
00008	GA First Floor – Scope of Work	C	23.05.2025
01000	MLP Ground Floor – With Name	D	23.05.2025
01002	MLP First Floor – With Name	D	23.05.2025
16000	Ground Floor Control Plan	D	23.05.2025
16100	First Floor Control Plan	D	23.05.2025
20001	Ground Floor Plan Z1	D	23.05.2025
20002	Ground Floor Plan Z2	D	23.05.2025
20003	Ground Floor Plan Z3	D	23.05.2025
20004	Ground Floor Plan Z4	D	23.05.2025
20005	Ground Floor Plan Z5	D	23.05.2025
20006	Ground Floor Plan Z6	D	23.05.2025
20007	Ground Floor Plan Z7	D	23.05.2025
20008	Ground Floor Plan Z8	D	23.05.2025
20102	First Floor Plan Z2	D	23.05.2025
20103	First Floor Plan Z3	D	23.05.2025
20104	First Floor Plan Z4	D	23.05.2025
20105	First Floor Plan Z5	D	23.05.2025
20106	First Floor Plan Z6	D	23.05.2025
20107	First Floor Plan Z7	D	23.05.2025
20108	First Floor Plan Z8	D	23.05.2025
20111	First Floor Plan Z11	D	23.05.2025
20202	Roof Plan Z2	D	23.05.2025
20203	Roof Plan Z3	D	23.05.2025
20204	Roof Plan Z4	D	23.05.2025

Drawing No.	Title/Description	Revision	Date
20205	Roof Plan Z5	D	23.05.2025
20206	Roof Plan Z6	D	23.05.2025
20207	Roof Plan Z7	D	23.05.2025
20208	Roof Plan Z8	D	23.05.2025
30002	Ground Floor RCP Z2	D	23.05.2025
30003	Ground Floor RCP Z3	D	23.05.2025
30004	Ground Floor RCP Z4	D	23.05.2025
30005	Ground Floor RCP Z5	D	23.05.2025
30006	Ground Floor RCP Z6	D	23.05.2025
30007	Ground Floor RCP Z7	D	23.05.2025
30008	Ground Floor RCP Z8	D	23.05.2025
30102	First Floor RCP Z2	D	23.05.2025
30103	First Floor RCP Z3	D	23.05.2025
30104	First Floor RCP Z4	D	23.05.2025
30105	First Floor RCP Z5	D	23.05.2025
30106	First Floor RCP Z6	D	23.05.2025
30107	First Floor RCP Z7	D	23.05.2025
30108	First Floor RCP Z8	D	23.05.2025
30111	First Floor RCP Z11	B	23.05.2025
18001	Ground Floor FRL Egress Plan	C	23.05.2025
18002	Ground Floor Mezzanine FRL Egress Plan	C	23.05.2025
18003	First Floor FRL Egress Plan	C	23.05.2025
18004	First Floor Mezzanine FRL Egress Plan	B	23.05.2025
40001	Elevations North & South Entrances 2&3	E	23.05.2025
40002	Elevations Plaza	E	23.05.2025
40003	Elevations Terrace	E	23.05.2025
50001	Sections 1	A	13.03.2025
50002	Sections 2	A	13.03.2025
50003	Sections 3	A	13.03.2025
50004	Sections 4	A	13.03.2025
50005	Sections 5	A	13.03.2025

Table 8: Project architectural drawings schedule

2. The structure drawings listed in Table 9 below prepared by HERA Engineering (project no.: 24077).

Drawing No.	Title/Description	Revision	Date
0L-1-001	Ground Level General Arrangement – Zone 1	A	17.04.2025
0L-2-002	Ground Level General Arrangement – Zone 2	C	17.04.2025
0L-3-003	Ground Level General Arrangement – Zone 3	C	17.04.2025
0L-4-004	Ground Level General Arrangement – Zone 4	C	17.04.2025
0L-6-006	Ground Level General Arrangement – Zone 6	C	17.04.2025
0L-7-007	Ground Level General Arrangement – Zone 7	C	17.04.2025
0L-8-008	Ground Level General Arrangement – Zone 8	C	17.04.2025
1L-1-001	Level 1 General Arrangement – Zone 1	A	17.04.2025
1L-2-002	Level 1 General Arrangement – Zone 2	C	17.04.2025
1L-3-003	Level 1 General Arrangement – Zone 3	C	17.04.2025
1L-4-004	Level 1 General Arrangement – Zone 4	C	17.04.2025
1L-6-006	Level 1 General Arrangement – Zone 6	C	17.04.2025
1L-7-007	Level 1 General Arrangement – Zone 7	C	17.04.2025
1L-8-008	Level 1 General Arrangement – Zone 8	C	17.04.2025
RF-2-002	Roof Awning Level General Arrangement – Zone 2	C	17.04.2025
RF-2-102	Roof Level General Arrangement – Zone 2	C	17.04.2025
RF-2-202	Upper Roof Level General Arrangement – Zone 2	C	17.04.2025
RF-3-003	Roof Awning Level General Arrangement – Zone 3	C	17.04.2025
RF-3-103	Roof Level General Arrangement – Zone 3	C	17.04.2025
RF-4-004	Roof Awning Level General Arrangement – Zone 4	C	17.04.2025
RF-4-104	Roof Level General Arrangement – Zone 4	C	17.04.2025
RF-6-006	Roof Awning Level General Arrangement – Zone 6	C	17.04.2025
RF-6-106	Roof Level General Arrangement – Zone 6	C	17.04.2025
RF-6-206	Upper Roof Level General Arrangement –Zone 6	C	17.04.2025
RF-7-007	Roof Awning Level General Arrangement – Zone 7	C	17.04.2025
RF-7-107	Roof Level General Arrangement – Zone 7	C	17.04.2025
RF-8-008	Roof Awning Level General Arrangement – Zone 8	C	17.04.2025
RF-8-108	Roof Level General Arrangement – Zone 8	C	17.04.2025

Table 9: Structures drawings schedule

3. The fire services drawings listed in Table 9 below prepared by Firesafe Group Pty Ltd (project no.: WCS25009). A copy can be found in Appendix D of this report.

Drawing No.	Title/Description	Revision	Date
0L-0-401	Fire Wet – Main Works Fire Hydrant Coverage Layout – Level 00	B	14.05.2025
1L-0-401	Fire Wet – Main Works Fire Hydrant Coverage Layout – Level 01	B	14.05.2025

Table 10: Fire services drawings schedule

6. Relevant Stakeholders

This FEB was prepared by BCA Consultants in collaboration and consultation with the relevant stakeholders identified in Table 11 below:

Name	Organisation	Role	Email Address
Brendan O'Regan	DFES	Fire Engineer	Brendan.O'Regan@dfes.wa.gov.au
Alexis Wake	DFES	Fire Safety Officer	Alexis.Wake@dfes.wa.gov.au
James Fudge	Vicinity Centres	Client	james.fudge@vicinity.com.au
Nikola Stojanovic	Built Plus	Project manager client	nik.stojanovic@buildplusgroup.com
Chris West	Built Plus	Project manager client	chris.west@buildplusgroup.com
Rebecca Creamer	Multiplex	Design manager	Rebecca.Creamer@multiplex.global
Kylie Judd	Multiplex	Project manager	Kylie.Judd@multiplex.global
Vincent Chi	Buchan	Architect	Vincent.Chi@buchan.au
Chris Bright	Link Engineering	Mechanical engineer	chris@linkengineering.com.au
Rebecca Boston	Firesafe	Fire services engineer	rebecca.boston@firesafegroup.com.au
Mark Viska	BCA Consultants	Building surveyor	mviska@bcagroup.com.au
Chris Meisinger	BCA Consultants	Fire services peer review	cmeisinger@bcagroup.com.au
Amy Chao	BCA Consultants	Fire safety engineer	achao@bcagroup.com.au
Alex Alexandrovski	BCA Consultants	Fire safety engineer	aalexandrovski@bcagroup.com.au

Table 11: Relevant stakeholders

7. Fire Engineering Brief Process

The FEB process to date has consisted of the following stages:

1) Briefing by Buchan with regard to the project details and objectives.

2) E-mail correspondence and telephone conversations with the relevant stakeholders to confirm the extent of the deviations from the BCA DtS provisions and the proposed fire safety strategy.

3) A DRAFT FEB report (Revision A) was issued for stakeholders review on 17 April 2025.

4) An FEB meeting was held with the DFES Built Environment Branch (BEB) to discuss the project on 22 April 2025. A copy of the meeting minutes is provided in Appendix B of this report.

5) The FEB report (Revision B) was submitted to DFES for review and comments on 29 April 2025.

6) Since the submission of FEB Revision B to DFES, the design has changed with new Performance Solutions identified. The FEB was revised accordingly.

7) Revision C of the FEB report was issued for tender on 27 May 2025.

8. Summary of Performance Solutions and Relevant BCA Criteria

Table 12 provides a description of the Performance Solutions, the BCA Performance Requirements and the proposed assessment methods for the Performance Solutions that are addressed in this report.

Perf. Sol.	Description of Performance Solutions	DtS Provisions	Perform. Req's	Assess. Method
1	The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120	C2D2(2) and Table S5C21e	C1P1, C1P2(1)(a), C1P2(1)(c), C1P2(1)(d)	A2G2(2)(b)(ii)
	The loadbearing columns and walls that support the First Floor slab achieve FRL 120/--/-- in lieu of FRL 180/--/--	C2D2(2) and Table S5C21g		
2	Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant are not fire-stopped	C4D15(2)	C1P2(1)(d)	A2G2(2)(b)(ii)
	Power supply to the AHUs that provide make-up air to the smoke exhaust systems is not fire-rated	Cl. S21C7(7) of Spec. 21, AS 1668	E2P2	
3	Travel distances for the non-fire-isolated exits are measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space	D2D5(3)(a)	D1P4; E2P2	A2G2(2)(b)(ii)
4	Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m	D2D5(3)(a)	D1P4, E2P2	A2G2(2)(d)
	Travel distances from parts of the GF BoH area to a point of choice are extended up to 25 m in lieu of 20 m			
	Travel distances from parts of the GF storage area to a single exit are extended up to 30 m in lieu of 20 m			
	Travel distances from FF amenities to a point of choice are extended up to 27 m in lieu of 20 m			
	Travel distances from the GF BoH area to the nearest of the alterative exits are extended up to 50 m			
5	Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust are extended up to 61 m in lieu of 40 m	D2D5(3)(a)	D1P4, E2P2	A2G2(2)(b)(ii)

Perf. Sol.	Description of Performance Solutions	DtS Provisions	Perform. Req's	Assess. Method
	Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, are extended up to 118 m in lieu of 60 m	D2D6(c)(iii)		
	Smoke exhaust rates are determined on a performance basis in lieu of compliance with the BCA DtS provisions	E2D15(2)(a), Cl. S21C2(2) of Spec. 21	E2P2	
	Horizontal length of the Myer retail mall smoke reservoir is extended up to 144 m long in lieu of 60 m	E2D15(2)(a), Cl. S21C4(2) of Spec. 21		
	Horizontal length of the Plaza smoke reservoir is extended up to 66 m long in lieu of 60 m			
	Make-up air velocity through vertical openings exceeds 1 m/s	E2D15(2)(a), Cl. S21C6(3) of Spec. 21		
6	The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03)	D2D12(1)	D1P5, E2P2	A2G2(2)(b)(ii)
7	First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) in lieu of to a road or open space	D2D12(2)(a)	D1P5, E2P2	A2G2(2)(b)(ii)
	Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space	D2D12(2)(b)		
8	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m	E1D2(2) and Cl. 3.5.3.3(b) of AS 2419.1-2021	E1P3	A2G2(2)(b)(ii)
	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.5.3.3(c) of AS 2419.1-2021		

Perf. Sol.	Description of Performance Solutions	DtS Provisions	Perform. Req's	Assess. Method
	Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.6.1(e) of AS 2419.1-2021		
	Internal fire hydrants are not located in every fire-isolated exit	E1D2(2) and Cl. 3.6.2(a)(ii) of AS 2419.1-2021		
	Internal fire hydrants installed in retail malls are provided more than 4 m from required exits	E1D2(2) and Cl. 3.6.2(b) of AS 2419.1-2021		
9	In the refurbished and extended parts of the GSC, the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, in lieu of fire hose reels	E1D3(2)(a)	E1P1	A2G2(2)(b)(ii)
10	Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy	Cl. 3.1.2 of AS 2118.1, S17C2(a) of BCA Spec. S17 and E1D4(b)	E1P4	A2G2(2)(b)(ii)
11	Walls between the sprinklered and non-sprinklered parts are provided with glazed sections that are not protected against fire spread	S17C3(a) of Spec. 5 and E1D4(b)	C1P2(1)(d), E1P4	A2G2(2)(b)(ii)
12	After-hours, the make-up air velocity through the Timezone and JB Hi-Fi shopfront openings is increased up to 3.5 m/s in lieu of a maximum 2.5 m/s.	S21C6(2) of Spec. 21 and E2D15(2)(a)	E2P2	A2G2(2)(b)(ii)

Table 12: Performance Solutions, relevant BCA provisions and the assessment methods

9. Fire Safety Strategy

Please note that this Fire Safety Strategy may be refined and/or modified in parts to reflect the outcomes of smoke modelling. This shall not be considered the final version of the Fire Safety Strategy.

9.1 General

1. The redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062, shall comply with the "Deemed-to-Satisfy" (DtS) Provisions of the National Construction Code Volume One (NCC), Building Code of Australia 2022 (BCA), except for the specific deviations from the BCA DtS identified in Section 8.

2. The fire safety strategy for the GSC outside of the area affected by the redevelopment works shall comply with the provisions of the building codes current at the time of construction of these parts.

3. Should a change in use or building alterations and/or additions occur in the future, a reassessment will be needed to verify consistency with the analysis contained within this report.

4. The requirements listed in this Section are *safety measures* and shall be maintained as per Regulation 48A of the Building Regulations 2012 (with amendments).

9.2 Fire Resistance and Stability, Compartmentation and Separation, Protection of Openings

5. The part of the GSC within the scope of this project has been assessed by the building surveyor as a 2-storey mixed-use development of Type B construction containing Class 6 (retail) and Class 7a (open-deck carpark) parts.

6. Fire resistance and stability, compartmentation and separation, and protection of openings provisions within the scope of this project shall comply with the DtS provisions of BCA Part C2, Part C3 and Part C4, except:

    a. The loadbearing lift shaft in Tenancy 1-165 may achieve FRL 120/120/120 in lieu of FRL 180/120/120.

    b. The loadbearing columns and walls that support the First Floor slab may achieve FRL 120/--/-- in lieu of FRL 180/--/--.

    c. Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant may not be fire-stopped.

7. Areas where the FRL of the loadbearing structure is reduced to nominal 2 hours are highlighted red in Figure 9 and Figure 10 below.

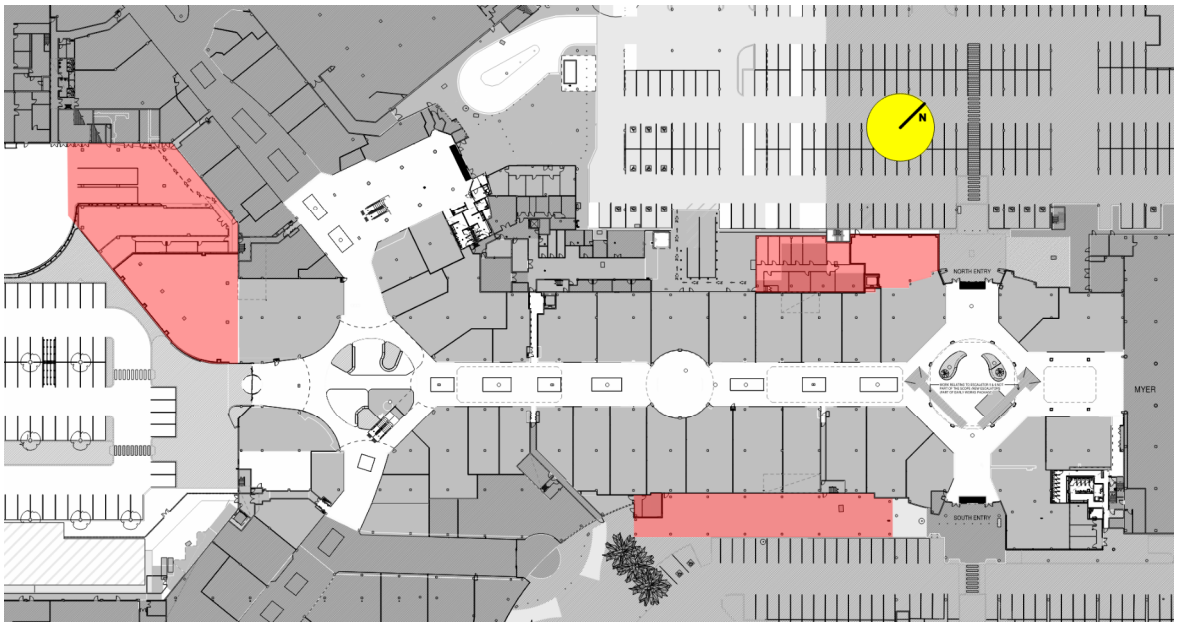


Figure 9: Ground Floor areas where load bearing structure has performance-based reduced FRL

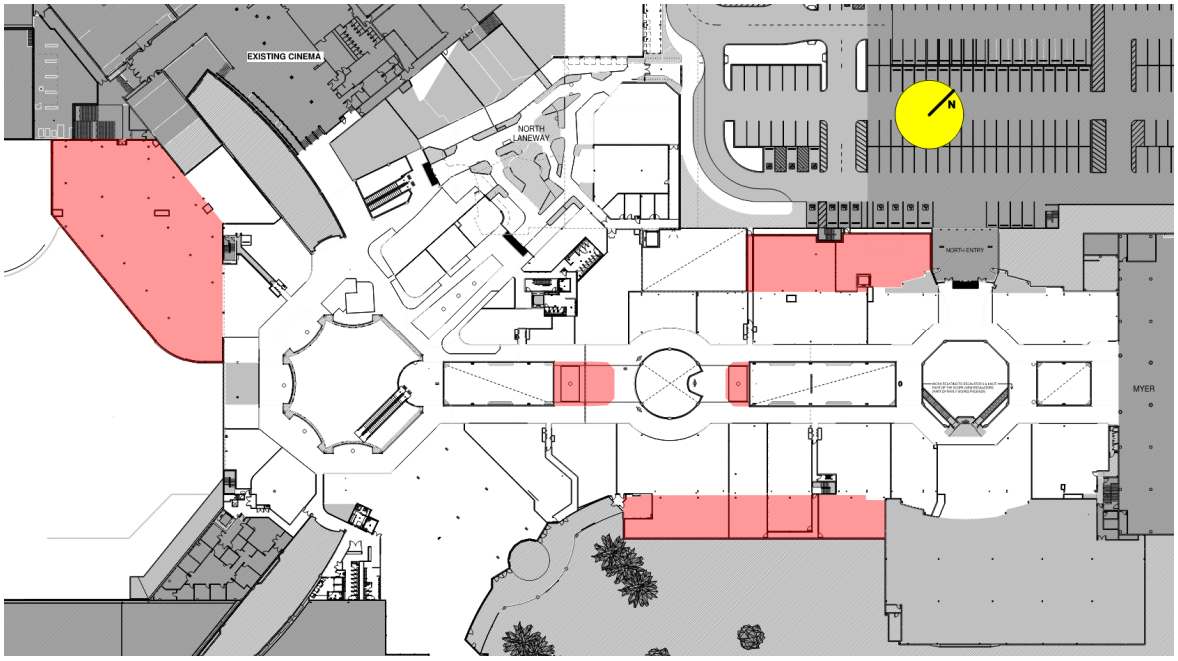


Figure 10: First Floor areas where load bearing structure has performance-based reduced FRL

8. The existing Myer tenancy is fire separated from the rest of the centre with fire walls and the openings to the Myer mall are protected with sliding fire doors. This existing condition is to remain unaltered.

9. The existing Kmart tenancy, Coles tenancy, Woolworths tenancy, Target tenancy and the Cinemas, except for the shopfronts, are smoke separated from the rest of the centre. This existing condition is to remain unaltered.

10. The new Timezone (tenancy 1-141) and JB Hi-Fi (tenancy 1-138) that are provided with automatic smoke exhaust shall be separated from the rest of the centre with walls that shall prevent the free passage of smoke (refer to Figure 11 where the smoke-proof walls are highlighted with solid blue lines). The shopfront openings and external walls of these tenancies do not need to prevent the free passage of smoke.

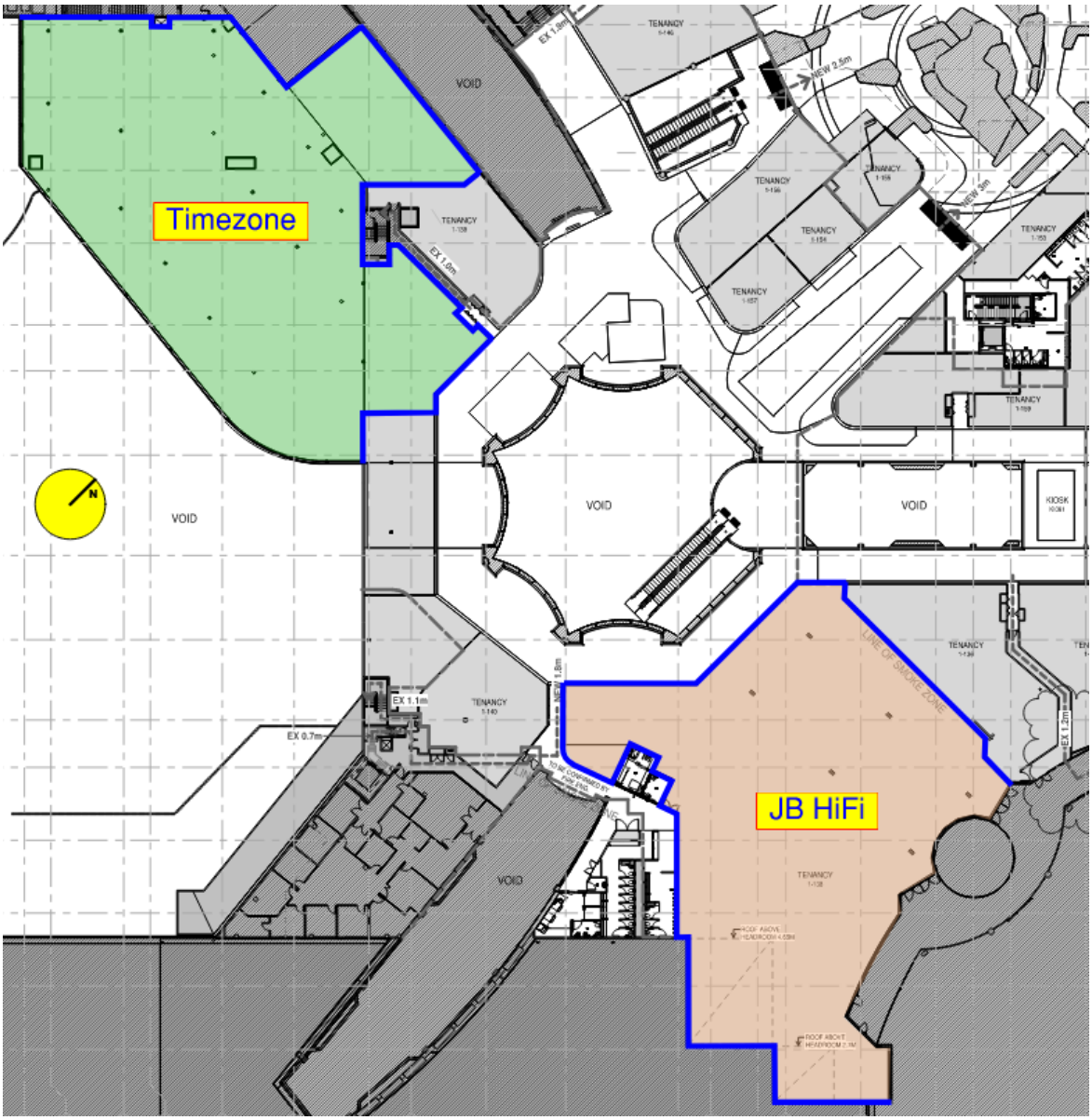


Figure 11: Walls that shall prevent the free passage of smoke around Timezone and JB Hi-Fi

11. The modified Rebel tenancy (MM-004) that is provided with automatic smoke exhaust shall be separated from the rest of the centre with walls that shall prevent the free passage of smoke (refer to Figure 12 below where the smoke-proof walls are highlighted with solid blue lines). The shopfront opening and external walls of this tenancy do not need to prevent the free passage of smoke.

12. The new required non-fire-isolated stairwell adjacent to external balcony 1.BO.03 shall be bound with walls that shall prevent the free passage of smoke (refer to Figure 13 and Figure 14 below where the smoke-proof walls are highlighted with solid blue lines).

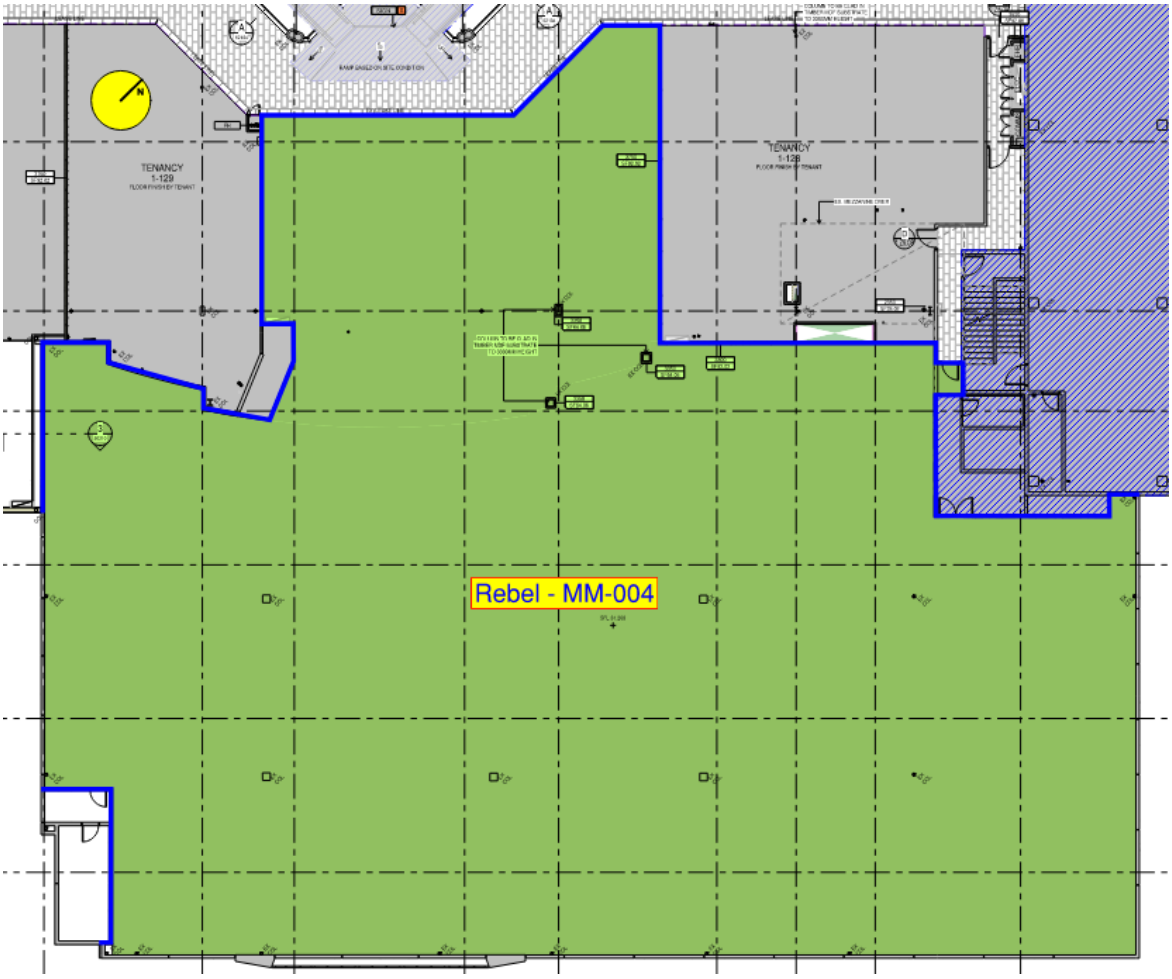


Figure 12: Walls that shall prevent the free passage of smoke around Rebel

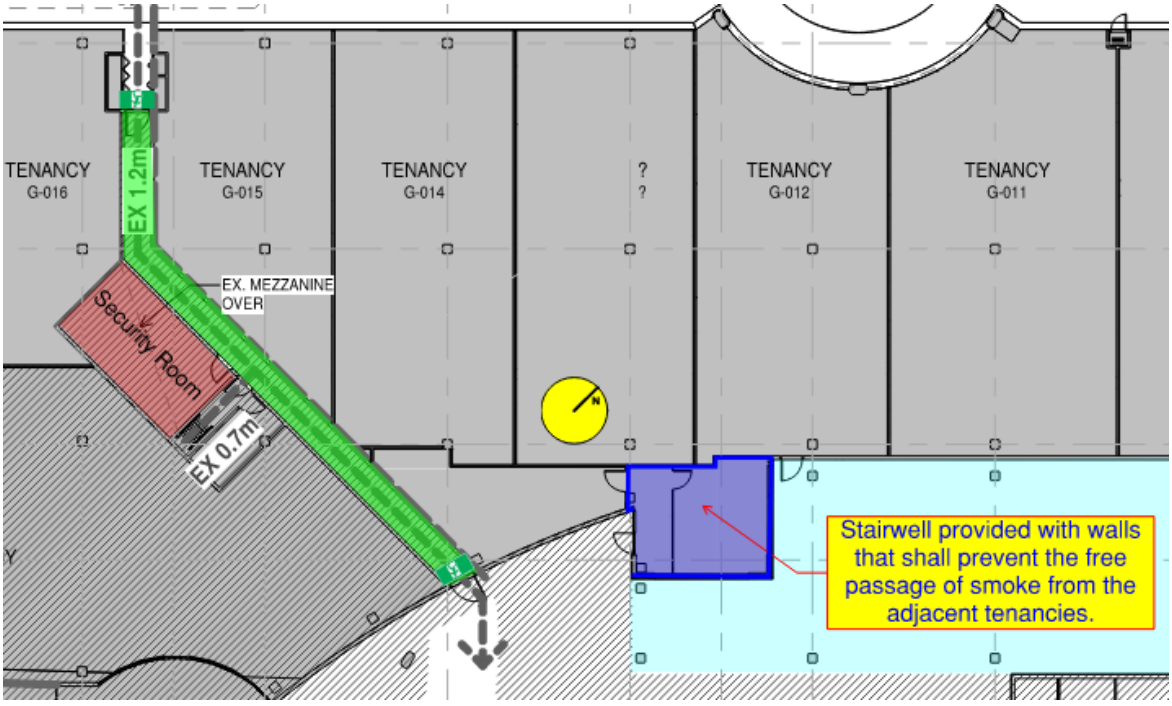


Figure 13: Walls that shall prevent the free passage of smoke on Ground Floor

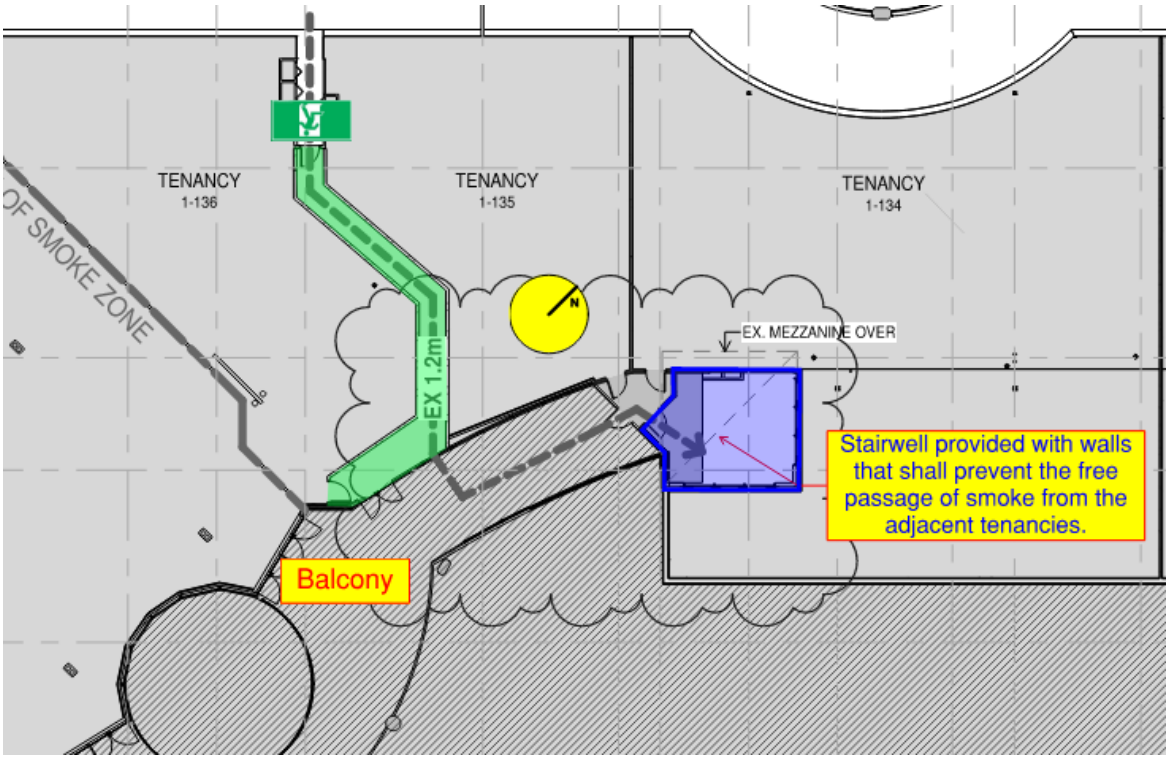


Figure 14: Walls that shall prevent the free passage of smoke on First Floor

13. The walls that shall prevent the free passage of smoke may be penetrated by services and ducts. While the penetrations around the services and ducts shall be smoke-sealed, the ducts need not be provided with smoke dampers.

14. External façades within the scope of this project (including any insulation materials and vapour membranes) shall be non-combustible materials when tested to AS 1530.1-2014.

15. Any plastic skylight materials shall achieve Class B-s2-d0 according to EN 13501-1 or an approved equivalent.

9.3 Provisions for Escape, Construction of Exits

16. Travel distances within the scope of this project shall comply with the DtS provisions of BCA Part D2 and Part D3, except:

    a. Travel distances for the non-fire-isolated exits may be measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space.

    b. Travel distances from some specialty shops to a point of choice may be extended up to 30 m in lieu of 20 m.

    c. Travel distances from parts of the GF BoH area to a point of choice may be extended up to 25 m in lieu of 20 m.

    d. Travel distances from parts of the GF storage area to a single exit may be extended up to 30 m in lieu of 20 m.

e. Travel distances from FF amenities to a point of choice may be extended up to 27 m in lieu of 20 m.

f. Travel distances from the GF BoH area to the nearest of the alterative exits may be extended up to 50 m.

g. Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust may be extended up to 61 m in lieu of 40 m.

h. Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, may be extended up to 118 m in lieu of 60 m.

17. Other egress provisions within the scope of this project shall comply with the DtS provisions of BCA Part D2 and Part D3, except:

    a. The existing security room that does not occupy the whole of a storey may open directly into the Ground Floor fire-isolated corridor 03 (G.BO.03).

    b. First floor fire-isolated corridor 19 (1.BO.19) may discharge to an external balcony (1.BO.03) in lieu of to a road or open space.

    c. Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) may discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space.

18. Tenancies within the scope of this project where travel distances to a point of choice exceed 30 m shall be provided with an alternative exit.

19. Door 1.Z6.01 leading to the Centre Management Office on First Floor, if provided with access control from the retail mall, shall unlock upon fire alarm activation anywhere in the centre to facilitate access to fire-isolated Stair A2 (1.FS.A2).

20. Door 1.Z7.11 leading from external balcony 1.BO.03 on First Floor to the lobby in front of the new required non-fire-isolated stairway shall swing in the direction of egress, i.e. in the direction of travel to door 1.Z7.14.

21. Door G.Z2.07 leading from the Coles mall on Ground Floor to fire-isolated corridor 06 (G.BO.06) upon fire alarm activation shall be provided with re-entry from the corridor side to facilitate the evacuation of occupants who may be working in plantroom AP4 during a potential fire in Loading Dock 04.

22. The existing door leading from lift lobby G.LL.02 on Ground Floor to the western BoH area (refer to Figure 15 below where the door is circled red) upon fire alarm activation shall be provided with re-entry from the BoH side to facilitate the evacuation of occupants who may be working in the existing storerooms and switch rooms during a potential fire in this BoH.

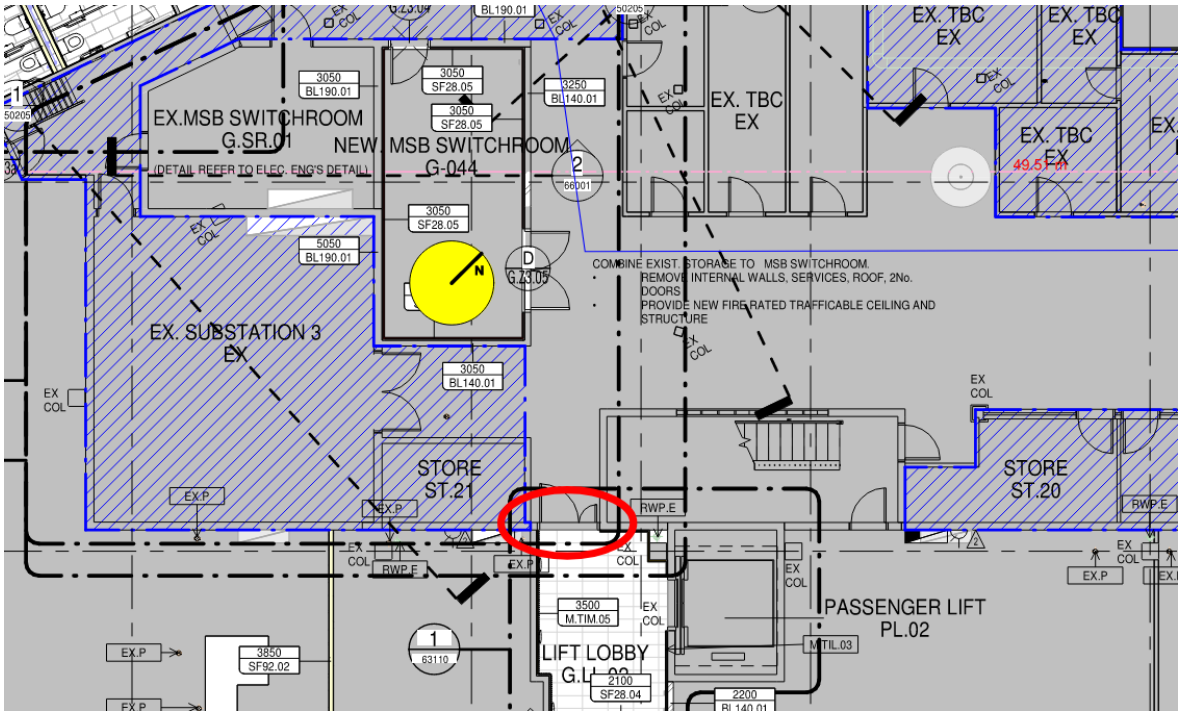


Figure 15: Existing door leading to the western BoH that shall be provided with re-entry

23. Doors opening from the required exits into areas where they can be blocked by parked vehicles or other obstructions (garbage bins, skips, etc.) shall be protected with bollards in accordance with Clause D2D15(1) of the BCA.

24. Egress from the existing fire-isolated Stair A2 (G.EX.FS.A2) directly to the outside at Ground Floor shall be retained.

25. Paths of travel from the point of discharge from the required exits to a road or open space shall be unobstructed and shall comply with Clause D2D15(2) of the BCA. Where paths of travel can be blocked by parked vehicles or other obstructions (garbage bins, skips, etc.) they shall be protected with appropriate barriers all the way to the point of discharge to a road or open space.

9.4 Fire Fighting Equipment

26. The existing fire hydrant system within the scope of this project shall be extended to include new internal fire hydrants. The system shall comply with the DtS provisions of BCA Clause E1D2(2) and AS 2419.1-2021, except:

    a. Fire hose coverage may be achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m.

    b. Fire hose coverage may be achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m.

c. Fire hose coverage may be achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m.

d. Internal fire hydrants need not be located in every fire-isolated exit.

e. Internal fire hydrants installed in retail malls may be provided more than 4 m from required exits.

27. Fire hose reels may be omitted from the refurbished and extended parts of the centre as highlighted pink (refurbished areas) and cyan (extended areas) in Figure 16 and Figure 17 below.

Figure 16: Areas on Ground Floor where hose reels may be omitted

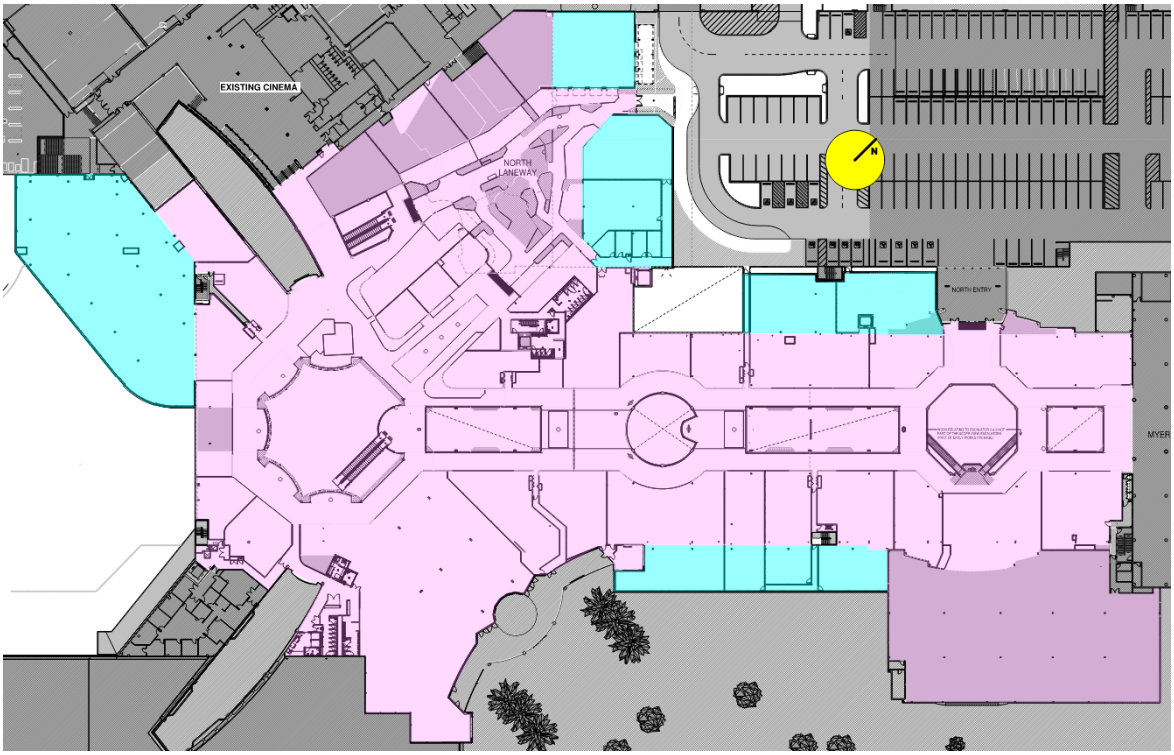


Figure 17: Areas on First Floor where hose reels may be omitted

28. The existing automatic fire sprinkler system within the scope of this project shall be modified and/or expanded where required, and shall comply with the DtS provisions of BCA Clause E1D4, Specification 17 and AS 2118.1-2017, except:

    a. Sprinklers may be omitted from the skylights above the Plaza and Myer retail mall (the areas highlighted red in Figure 18 below).

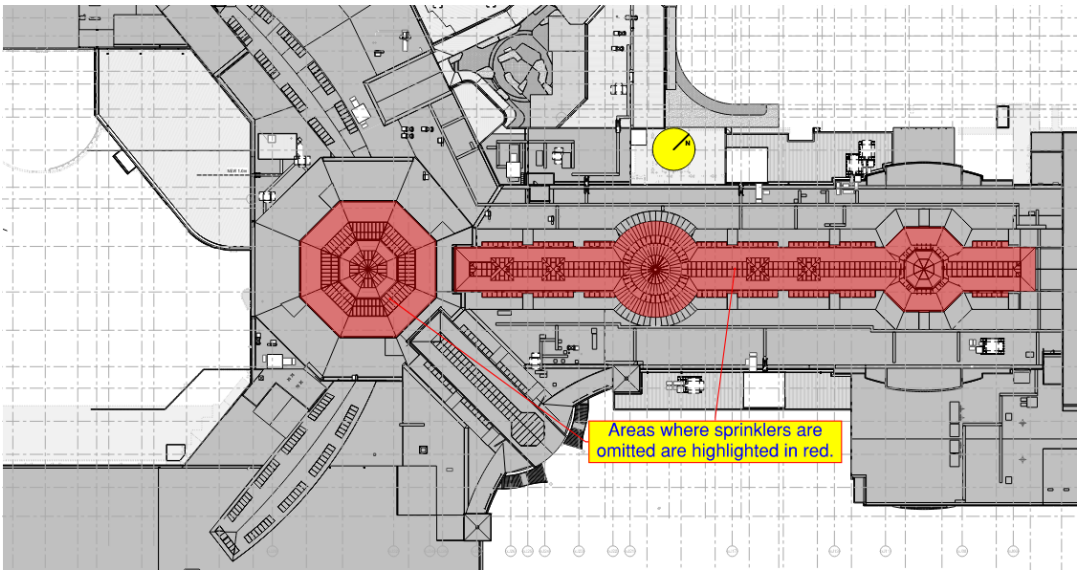


Figure 18: Omission of sprinkler protection from Plaza and Myer mall skylights

    b. Sprinklers may be omitted from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy (the area highlighted red in Figure 19).

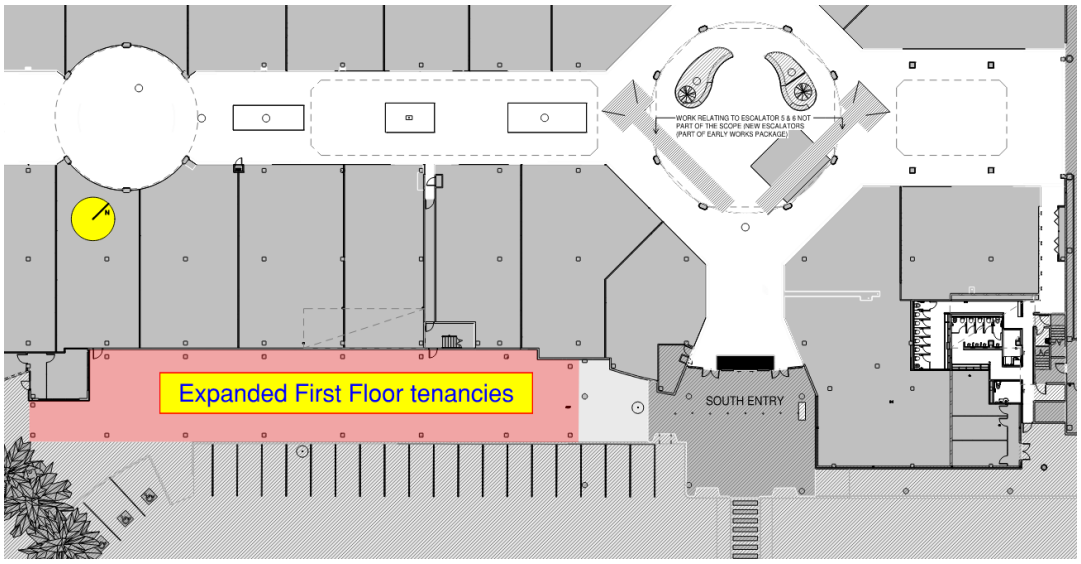


Figure 19: Omission of sprinkler protection below new extended tenancies on First Floor

    c. Walls between the sprinklered and non-sprinklered parts may be provided with glazed sections that are not protected against fire spread (the glazed sections of the walls are clouded red in Figure 20).

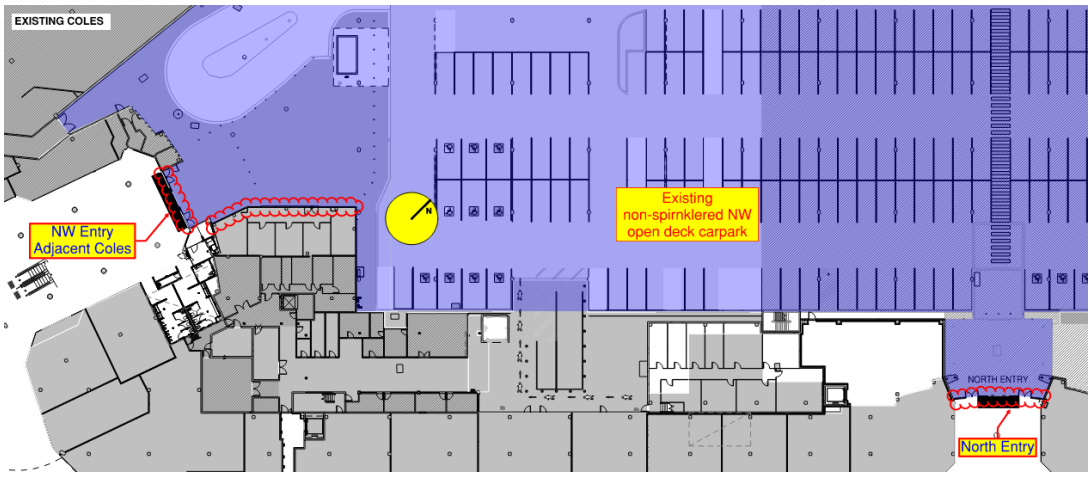


Figure 20: Locations where the walls between the sprinkler protected retail parts of the centre and the open-deck carpark that is not sprinkler protected have glazed sections

29. Additional to item 28, to achieve an appropriate level of fire safety, sprinkler protection shall be extended into the existing Stair M6 (G.ST.M6) located between Rebel (MM-004) and Myer that is no longer considered a fire-isolated stair and into the existing stair located north of passenger lift PL.02. Stair M6 is highlighted cyan in Figure 21 and Figure 22 below. The existing stair is highlighted cyan in Figure 21 and Figure 22 below. The extended sprinkler system shall comply with the DtS provisions of BCA Clause E1D4, Specification 17 and AS 2118.1-2017.

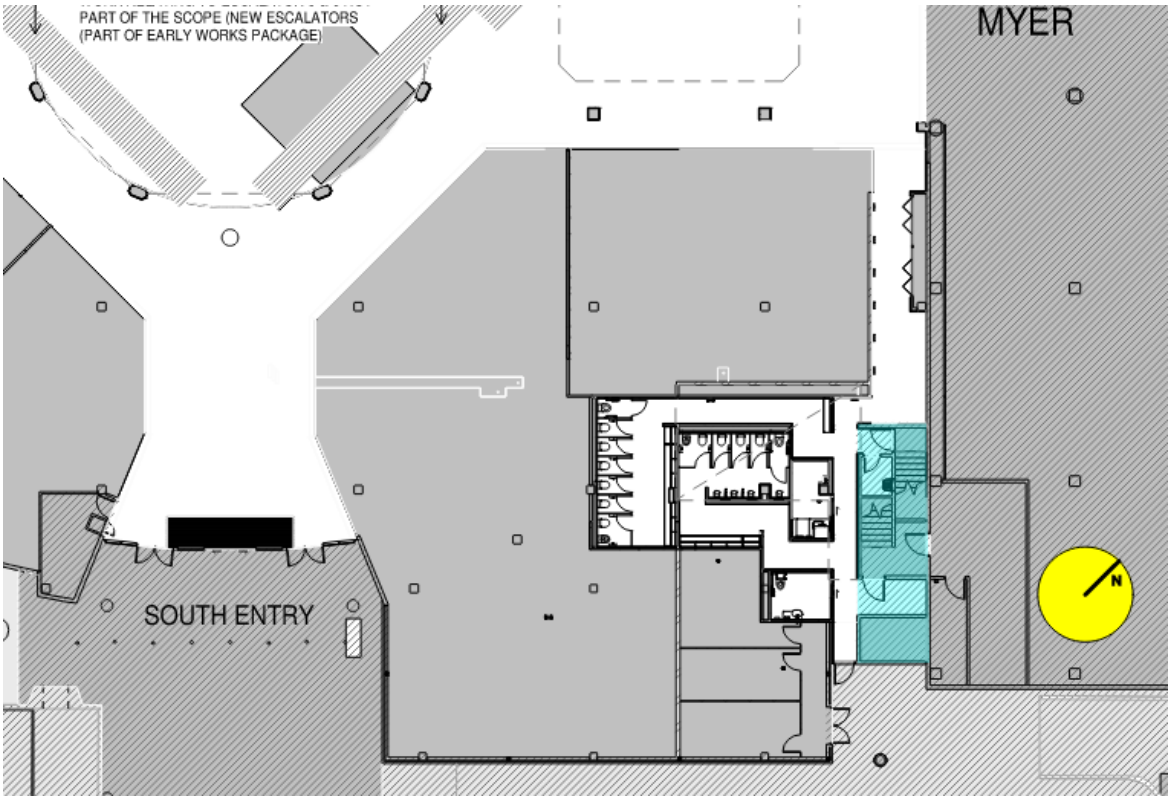


Figure 21: Stair M6 – Ground Floor

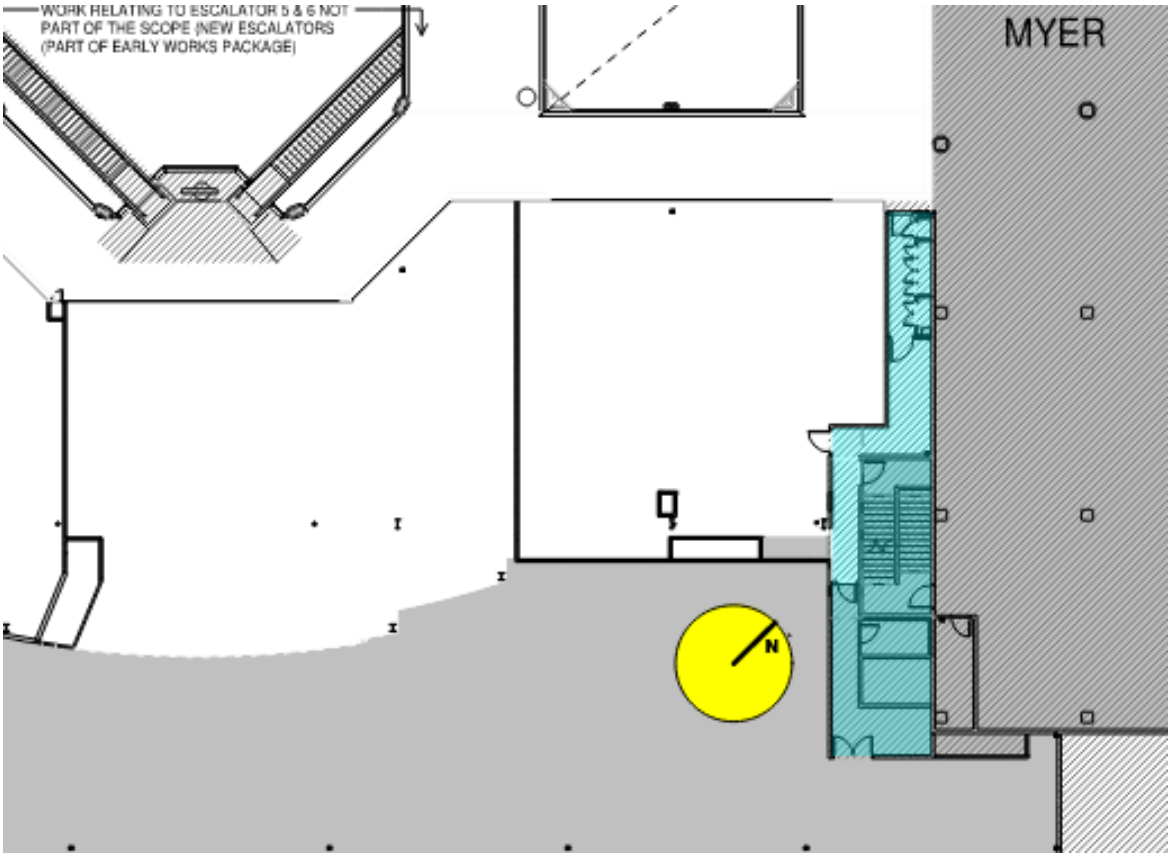


Figure 22: Stair M6 – First Floor

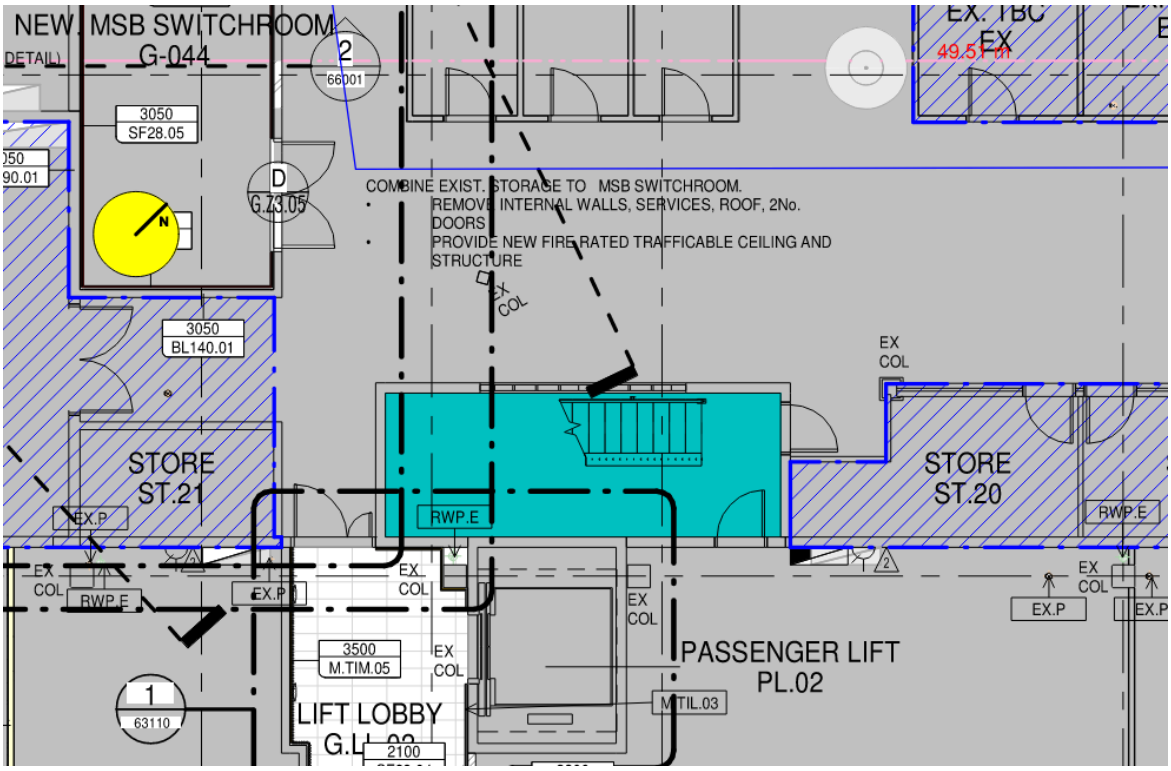


Figure 23: Existing stair north of passenger lift PL.02 – Ground Floor

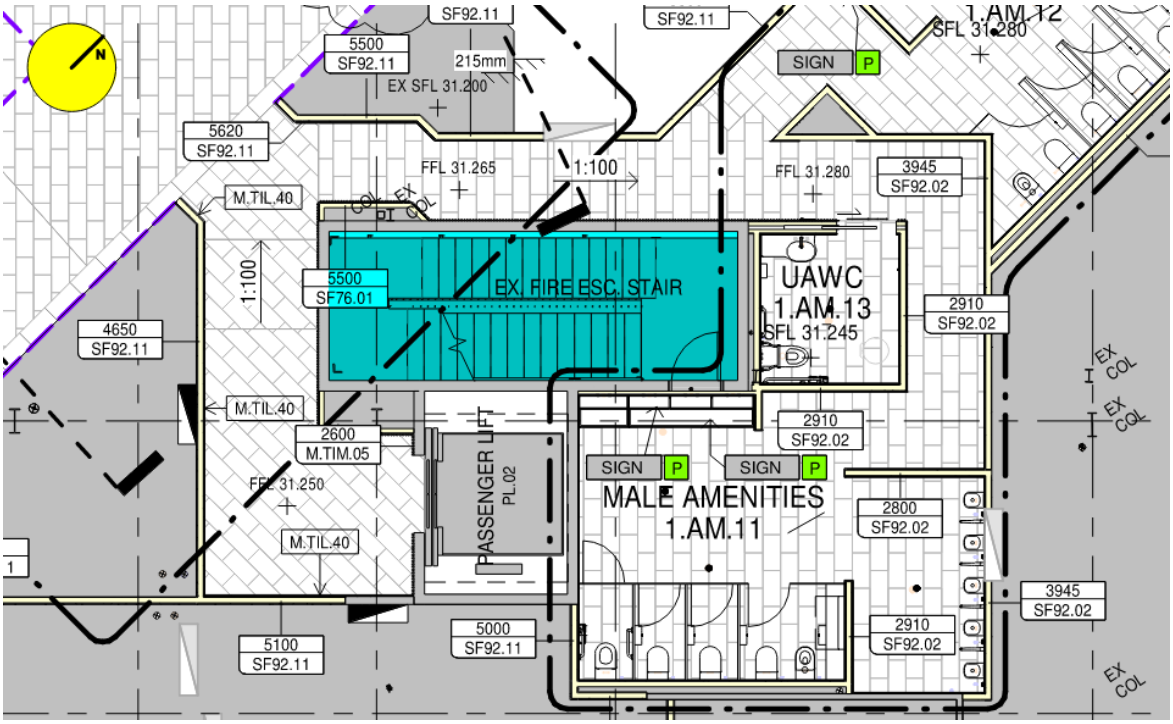


Figure 24: Existing stair north of passenger lift PL.02 – First Floor

30. The fire sprinkler heads within the scope of this project shall:

    a. All below ceiling sprinkler heads shall be fast response, i.e. the sprinkler Response Time Index (RTI) shall not exceed 50 $ms^{-1/2}$ and the conduction factor shall not exceed 0.65 $m/s^{-1/2}$.

    b. The temperature rating of sprinkler heads shall be 68°C for below ceiling sprinklers throughout the retail and BoH areas.

    c. The temperature rating of the sprinkler heads shall be 93°C for sprinkler heads located under uninsulated roofing and in loading docks and BoH areas that are not enclosed with external walls and where temperatures in excess of 40 C could occur in summer.

31. Portable fire extinguishers (PFEs) suitable for Class AB(E) fire risks shall be provided within the scope of this project in accordance with BCA Clause E1D14 and the applicable parts of AS 2444-2001, where required.

32. Additional to Item 31, PFEs shall be provided in lieu of fire hose reels in accordance with Table 4.1 of AS 2444-2001 and the following:

    a. Each PFE shall be 4.5 kg agent capacity ABE PFE (rating 6A) and may protect up to 675 m².

    b. The travel distance from the most remote point on the floor to the nearest PFE shall not exceed 30 m.

    c. Each specialty tenancy shall be provided with at least one PFE.

d. Where combustible kiosks and/or displays (including vehicle displays) are provided under voids in the Plaza and Myer retail mall, at least one 2.5 kg agent capacity ABE PFE (rating 4A) shall be provided in each kiosk or at each display to facilitate the initial attack on the fire.

9.5 Smoke Hazard Management

33. Within the scope of this project, to enhance the detection time and facilitate safe occupant evacuation, a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018 shall be provided in the areas identified below. The below ceiling smoke detectors shall be installed on a 10 m x 10 m nominal grid and smoke detectors in the concealed space shall be installed in accordance with the provisions of AS 1670.1-2018 (except where specifically modified by the provisions of item 35 below). The below ceiling heat detectors shall be installed on a 7 m x 7 m nominal grid in accordance with the provisions of AS 1670.1-2018 where provision of smoke detectors could cause spurious alarms.

    a. Throughout specialty shops and mini-major not provided with automatic smoke exhaust.

    b. Throughout enclosed BoH areas and load docks.

34. Additional to item 33, specific fire alarm zones shall be created to facilitate safe occupant evacuation. The specific alarm zones are summarised in Table 13 and the extent of these zones is shown in Figure 26, Figure 27 and Figure 29 in Section 9.9.

Fire alarm zones associated with dynamic exit signs	Detection mechanism
Fire alarm zone 01 (FAZ-01) – Existing western BoH – areas highlighted orange in Figure 26 in Section 9.9	Smoke detectors
Fire alarm zone 02 (FAZ-02) – Existing western BoH – areas highlighted pink in Figure 26 in Section 9.9	Heat detectors
Fire alarm zone 03 (FAZ-03) – Loading Dock 04 – areas highlighted orange in Figure 27 in Section 9.9	Smoke detectors
Fire alarm zone 04 (FAZ-04) – Loading Dock 04 – areas highlighted pink in Figure 27 in Section 9.9	Heat detectors
Fire alarm zone 05 (FAZ-05) – Tenancies 1-134 and 1-135 – areas highlighted orange in Figure 29 in Section 9.9	Smoke detectors

Table 13: Specific fire alarm zones

35. In fire alarm zones FAZ-01 and FAZ-03 smoke detectors in the BoH areas only need to be installed not more than 1.5 m horizontally from the doorway opening into the external circulation spaces. The approximate locations of smoke detector are marked with ‘S’ symbols in Figure 26 and Figure 27 in Section 9.9.

36. In fire alarm zones FAZ-01 and FAZ-05 smoke detectors in tenancies G-055, G-118, 1-134 and 1-135 shall be installed on a 10 m x 10 m nominal grid in accordance with the provisions of AS 1670.1-2018.

37. In fire alarm zones FAZ-02 and FAZ-04 heat detectors shall be installed on a 7 m x 7 m nominal grid in accordance with the provisions of AS 1670.1-2018.

38. A fire detection and alarm system in accordance with Clause S20C6(3) of BCA Specification 21 shall be provided throughout the following areas:

    a. Rebel tenancy (MM-004).

    b. JB Hi-Fi (tenancy 1-138).

    c. Timezone (tenancy 1-141).

    d. Myer mall & Plaza.

39. The automatic fire sprinkler system and fire detection and alarm systems shall be interfaced with the Fire Brigade Panel (FDCIE) and shall be linked to DFES via the Direct Brigade Alarm (DBA) provided in accordance with Clause S20C8 of BCA Specification 20.

9.6 Smoke Exhaust in Mini-major Tenancies

40. Automatic smoke exhaust systems in accordance with BCA Clause E2D15 and Specification 21 shall be provided in Timezone (SZ-06), JB Hi-Fi (SZ-07) and Rebel (SZ-08), as shown in Figure 25, except:

    a. The make-up air velocity through the Timezone and JB Hi-Fi shopfront openings after-hours may be increased up to 3.5 m/s in lieu of a maximum 2.5 m/s prescribed by Clause S21C6(2).

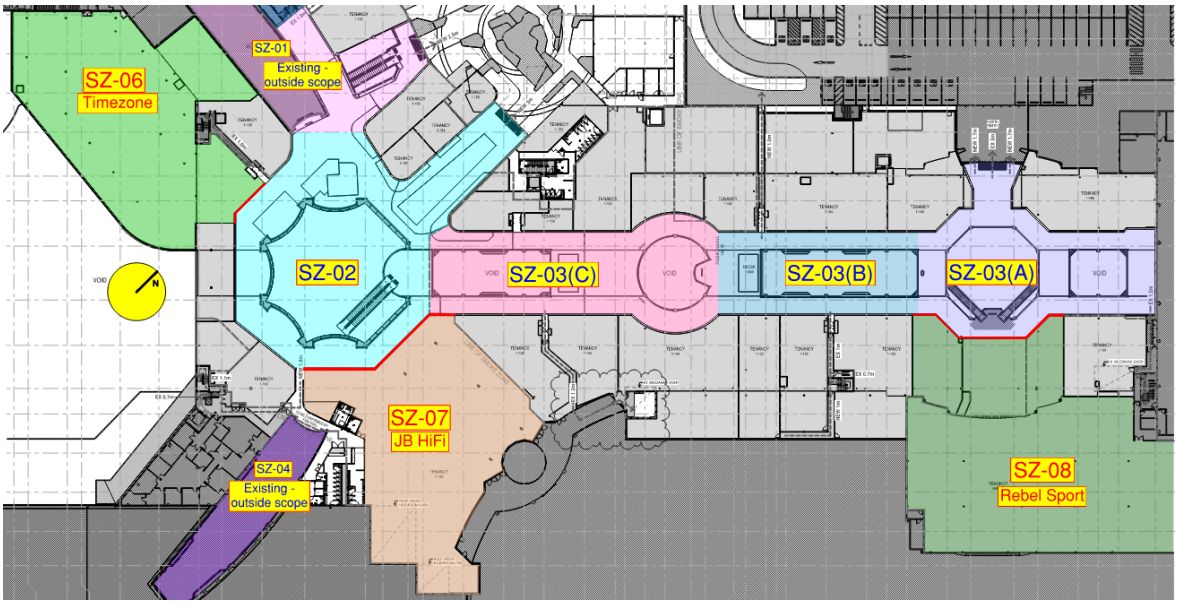


Figure 25: Smoke zones – First Floor

41. The smoke exhaust systems in the tenancies nominated in item 40 above shall activate only if smoke is detected in the tenancy first. The smoke exhaust system in the tenancy shall not activate if smoke is detected in the retail mall first and then spreads and activates smoke detection in the tenancy. Similarly, smoke exhaust in the retail malls shall not activate if smoke is detected in a tenancy nominated in item 40 above and then spreads and activates smoke detection in the retail mall.

42. Make-up air to the smoke exhaust systems nominated in item 40 above shall be provided from the retail malls via the shopfront openings (the characteristics of the make-up air are nominated in Section 9.8 below). The configuration of the shopfront openings shall be as follows:

    a. During trading hours, the roller-shutter(s) in the shopfront shall descend to 2.4 m above floor level upon activation of the smoke detection system installed in the tenancy to create smoke baffles between the tenancy and the retail mall. The bottom section of the roller-shutters (between the bottom of the baffle and the underside of the bulkhead above) shall be solid. The make-up air velocity through the shopfront opening shall not exceed 2.5 m/s.

    b. After-hours, the roller-shutter(s) in the shopfront shall remain closed upon activation of the smoke detection system installed in the tenancy. The roller-shutters shall be provided with openings that shall not extend beyond 2.4 m above floor level. The net free open area of the openings shall be such that the make-up velocity does not exceed 2.5 m/s for the Rebel shopfront and 3.5 m/s for the Timezone and JB-Hi Fi shopfronts.

9.7 Smoke Exhaust in Retail Malls

43. The Plaza (SZ-02) and Myer mall (SZ-03(A), SZ-03(B) and SZ-03(C)) within the scope of this project and the Coles link mall (SZ-01) and the Target link mall (SZ-04) outside the scope of this project are provided with existing smoke exhaust systems. The smoke exhaust fans (SEF) and the design and actual SEF capacities for each smoke zone are summarised in Table 14.

Smoke zone	Smoke Exhaust Fans	Design SEF capacity, l/s	Actual SEF capacity, l/s
SZ-01	SEF 13.2; SEF 13.3; SEF 13.4; SEF 13.5	64,000	48,352
SZ-02	SEF 13.1; SEF 14.1; SEF 17.6; SEF 21.5	92,000	83,191
SZ-03(A)	SEF 10.1; SEF 10.2; SEF 19.1; SEF 19.2	92,000	102,230
SZ-03(B)	SEF 15.1; SEF 15.2; SEF 16.1; SEF 16.2	92,000	102,535
SZ-03(C)	SEF 12.1; SEF 12.2; SEF 14.2; SEF 14.3	92,000	100,772
SZ-04	SEF 21.1; SEF 21.2; SEF 21.3; SEF 21.4	64,000	31,613

Table 14: Smoke zones and smoke exhaust capacity per each zone

44. Even though smoke zones SZ-01 and SZ-04 are outside the scope of this project, they are reference because smoke from SZ-02 may spread to these smoke zones. Without accounting for an adequate volume of make-up air, the effective operation of the smoke exhaust systems in the affected smoke exhaust zones may not be achieved.

45. The configuration of the existing smoke exhaust zones, the number and exhaust capacity generally should remain unchanged; however, the following deviations from the DtS provisions of Clause E2D15(2)(a) and BCA Specification 21 are addressed within the scope of this project:

    a. Smoke exhaust rates in Plaza and Myer mall smoke exhaust zones may be determined on a performance basis in lieu of compliance with the BCA DtS provisions.

    b. The horizontal length of the Myer retail mall smoke reservoir may be extended up to 144 m long in lieu of 60 m.

    c. The horizontal length of the Plaza smoke reservoir may be extended up to 66 m long in lieu of 60 m.

46. The existing smoke baffles throughout the retail malls shall be retained and shall remain unaltered.

9.8 Make-up Air Provisions

47. Make-up air to the smoke exhaust systems in the retail malls and in tenancies nominated in item 40 above shall be provided in accordance with Clause E2D15(2)(a) and BCA Specification 21, and AS 1668.1-2015, except:

    a. Power supply to the AHUs that provide make-up air to the smoke exhaust systems may not be fire-rated.

    b. Make-up air velocity through vertical openings may exceed 1 m/s.

48. Make-up air to the smoke exhaust systems shall be provided from AHUs nominated in Table 15 below and via the external retail mall doors that shall automatically open upon fire alarm activation (both during trading hours and after-hours), as nominated in Table 16 below.

Plant Room	Air Handing Units	Design make-up air capacity, l/s
AP1	AHU 1.1; AHU 1.2	9,000
AP3	AHU 3.1; AHU 3.2; AHU 3.3	7,050
AP4	AHU 4.1; AHU 4.2; AHU 4.3	16,250
AP6	AHU 6.1	4,000
AP7	AHU 7.1; AHU 7.2	7,500
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500
AP11	AHU 11.1	3,500

Plant Room	Air Handing Units	Design make-up air capacity, l/s
AP ENT	AHU ENT.3	8,000

Table 15: AHUs that shall provide make-up air to the smoke exhaust systems

Door	Location	Size, m	Net free open area, m²
D.EX.01	South-east entrance to Woolworths and Target mall	2.55 x 2.91	6.55
D.EX.02	South-west entrance to Target link mall	2.45 x 2.40	5.16
D.EX.03	South-west entrance to Kmart mall	1.74 x 2.35	3.38
D.EX.04	North-west entrance to Coles mall	1.65 x 2.35	3.17
D.EX.05	North-east entrance to ANZ mall	3.29 x 2.41	7.20
D.EX.06	North entrance to Coles mall	2.06 x 2.41	4.24
1.Z6.01	South entrance to Plaza (new)	2.03 x 2.45	4.24
G.Z4.03	North-west entrance to Myer mall	2.86 x 2.63	6.73
G.Z8.02	South-east entrance to Myer mall	2.35 x 2.27	4.65
		Total:	45.32

Table 16: External doors that shall provide make-up air to the smoke exhaust system

49. All AHUs nominated in Table 15 shall operate in supply mode simultaneously independent of the smoke zone in which the fire has been detected and shall provide make-up air to the retail malls at Ground Floor only.

9.9 Emergency Lighting, Exit Signs

50. Emergency lighting within the scope of this project shall be located and installed in accordance with Clauses E4D2, E4D3 and E4D4 of the BCA and AS/NZS 2293.1-2018.

51. Exit signs within the scope of this project shall be located and installed in accordance with Clauses E4D5 and E4D6 of the BCA and AS/NZS 2293.1-2018.

52. Additional to item 51 above, dynamic exit signs shall be installed above the doors nominated in Table 17, as shown in Figure 26 to Figure 29 below.

Doors/openings provided with dynamic exit signs		Fire alarm zones associated with the dynamic exit signs
Level	**Doors/openings**	
Ground Floor	Opening from the Myer retail mall leading to corridor 04 (G.BO.04) and Lift Lobby G.LL.02	Fire alarm zone FAZ-01, Fire alarm zone FAZ-02
	Door leading from Lift Lobby G.LL.02 to the western BoH area	
	Door leading from Tenancy G-055 to the western BoH area	

Doors/openings provided with dynamic exit signs		Fire alarm zones associated with the dynamic exit signs
Level	**Doors/openings**	
	Door leading from Tenancy G-118 to the western BoH area	
Ground Floor	Door leading from the Coles retail mall to fire-isolated corridor 06 (G.BO.06)	Fire alarm zone FAZ-03, Fire alarm zone FAZ-04
	Door leading from fire-isolated corridor 06 (G.BO.06) and Stair A1 (G.EX.FS.A1) to Loading Dock 04	
	Door leading from the Coles retail mall to fire-isolated corridor 20 (G.BO.20)	
First Floor	Door D.3155 leading from Plaza to fire-isolated corridor 15 (1.BO.15)	
	Door D.3957 leading from Tenancy 1-144 to fire-isolated corridor 19 (1.BO.19	
First Floor	Door leading from the Myer retail mall to fire-isolated corridor 19 (1.BO.19)	Fire alarm zone FAZ-05

Table 17: Doors that shall be provided with dynamic exit signs and the associated fire alarm zones

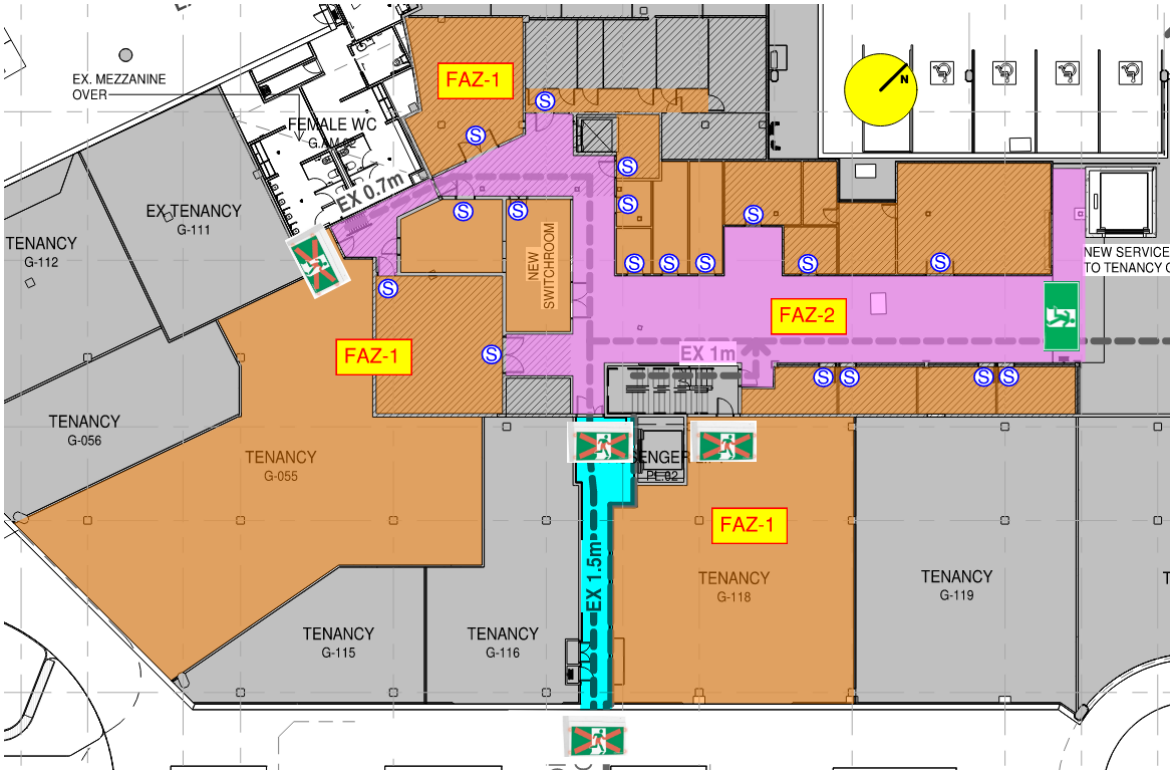


Figure 26: Location of dynamic exit signs interfaced with fire alarm zones FAZ-1 and FAZ-2

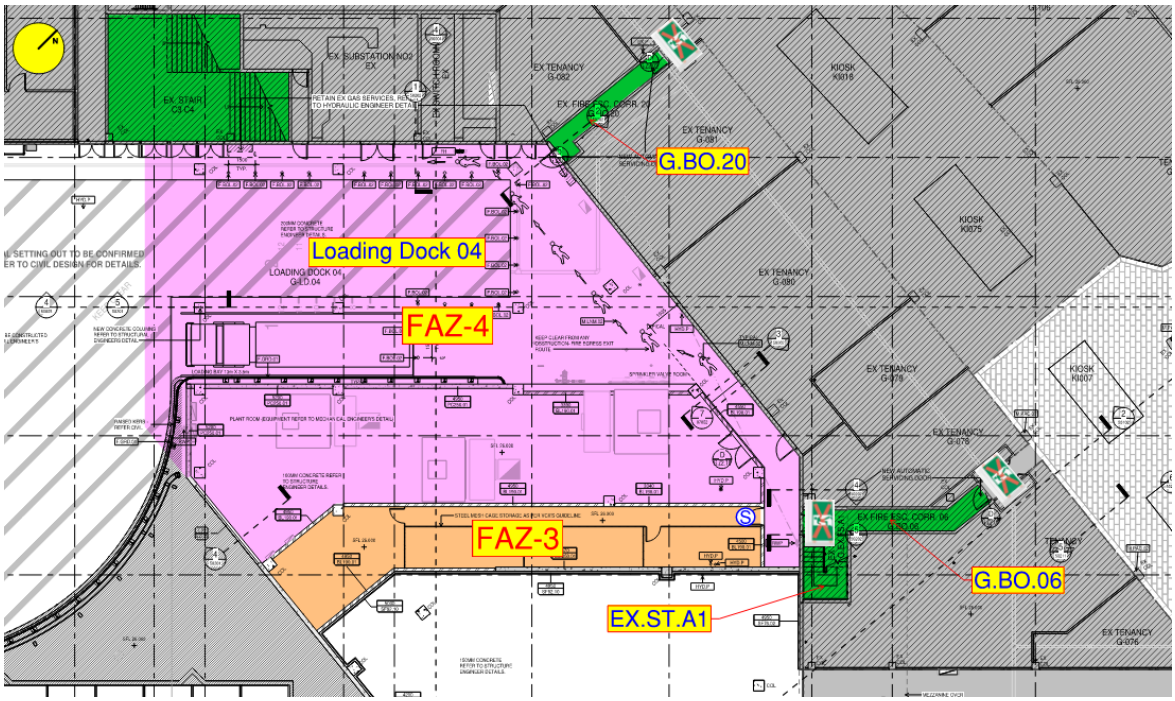


Figure 27: Location of dynamic exit signs interfaced with fire alarm zones FAZ-3 and FAZ-4 – Ground Floor

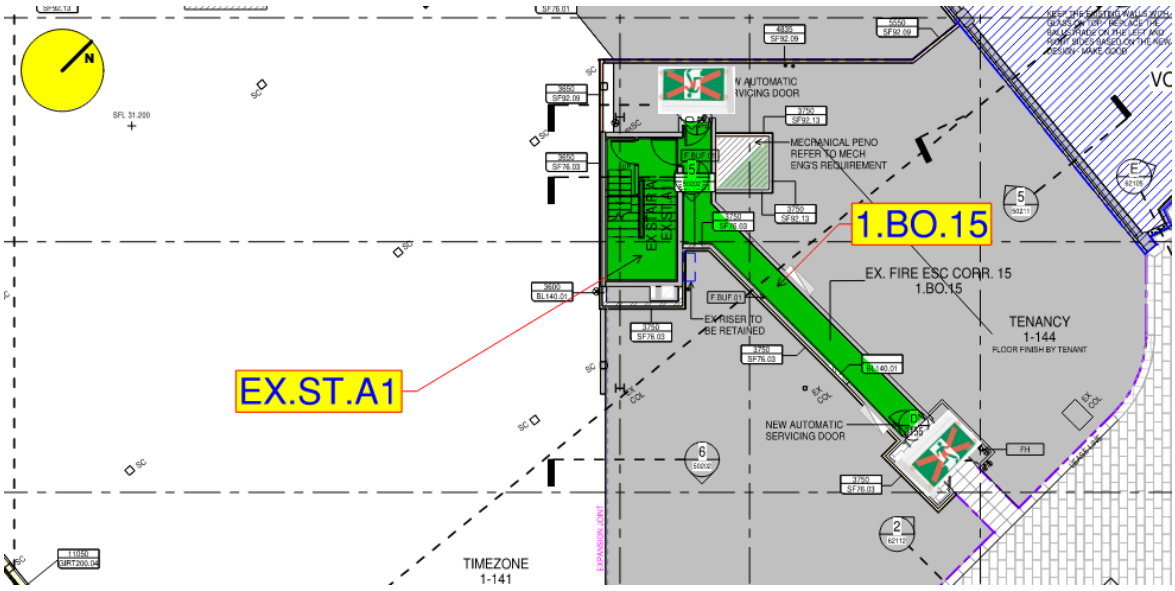


Figure 28: Location of dynamic exit signs interfaced with fire alarm zones FAZ-3 and FAZ-4 – First Floor

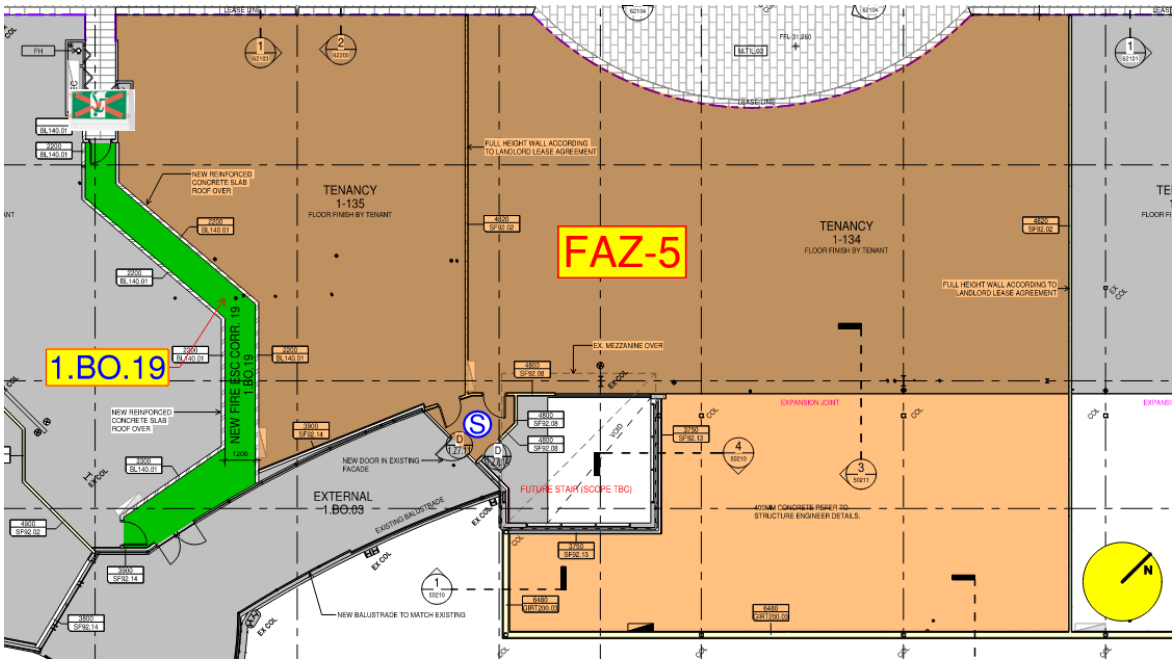


Figure 29: Location of dynamic exit signs interfaced with fire alarm zone FAZ-5

53. The dynamic exit signs shall be as shown in Figure 30 or similar.

Figure 30: Dynamic RED X sign

54. During the normal mode of operation, the dynamic exit signs shall show the running man pictogram. Upon fire alarm activation in a fire alarm zone, as nominated in item 34 above, the dynamic exit signs above the doors associated with the fire-affected fire alarm zone, as nominated in Table 17 above, shall activate and shall display a red cross.

55. Emergency Warning and Intercommunication System (EWIS) shall be provided throughout the areas within the scope of this project (areas highlighted pink in Figure 31 and Figure 32 below) in accordance with Clause E4D9(d) and AS 1670.4-2018. Activation of the automatic fire sprinkler system and of the smoke detection system shall activate the EWIS.

56. Addition to item 55 above, the EWIS shall be extended into the Centre Management Office (the area highlighted cyan in Figure 32 below). The extended EWIS shall be installed in accordance with Clause E4D9(d) and AS 1670.4-2018.

57. The EWIS shall be configured such that compliance with the provisions of Clause AS 1670.4-2018 is achieved in the Plaza and Myer retail malls where the noise levels generated by the existing smoke exhaust fans may be elevated.

Figure 31: Extent of the EWIS system upgrade – Ground Floor.

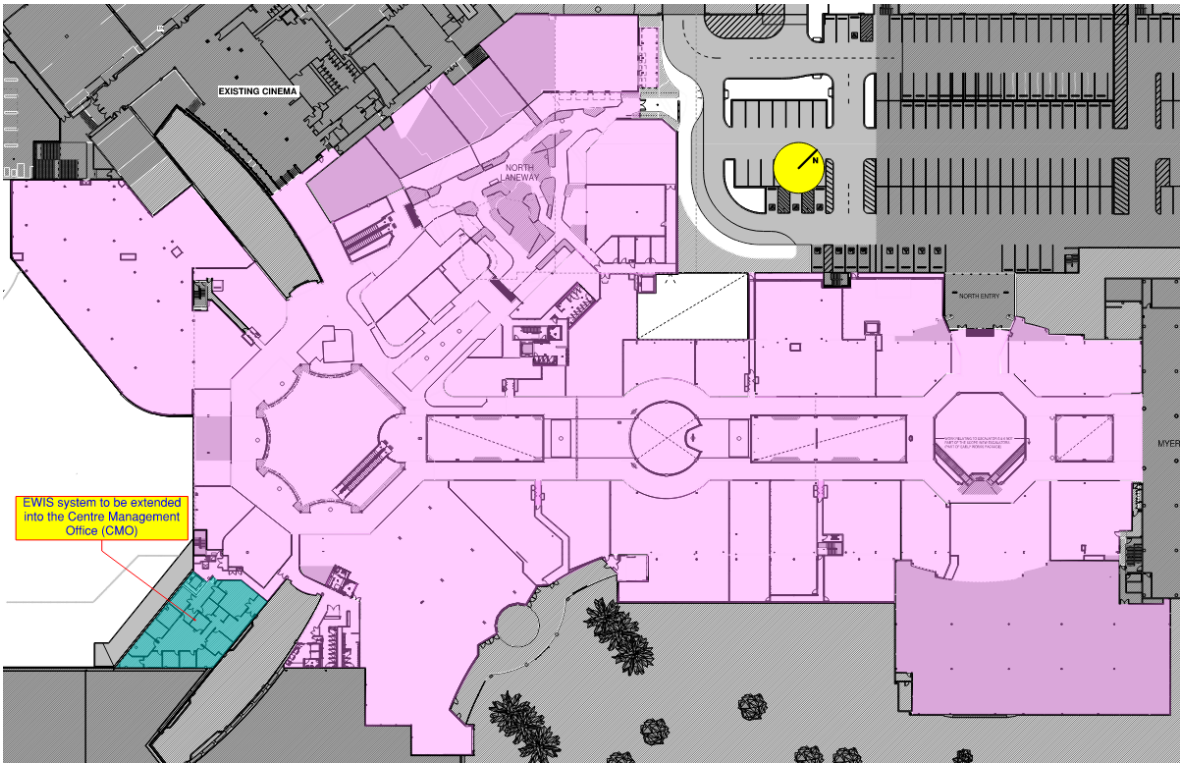


Figure 32: Extent of the EWIS system upgrade – First Floor

9.10 Fire Safety Signage

58. Signage shall be provided at the fire hydrant booster assembly, at the onsite fire hydrants, at the Fire Brigade Panel (FDCIE) and on the fire hydrant system block plans. The signs shall be fade resistant.

    a. The sign shown in Figure 33 below shall be provided at the booster assembly, at the FDCIE and on the fire hydrant system block plans.

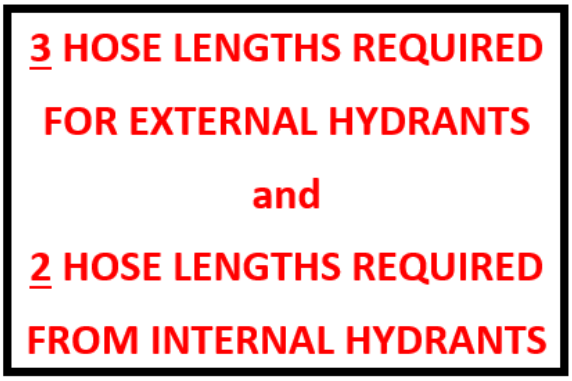


Figure 33: Extra lengths of hose sign at the booster assembly and at the FDCIE

b. The sign at the booster assembly shall be in capital letters not less than 50 mm high in a colour contrasting with the background.

c. The sign at the FDCIE shall be of a minimum A3 size sheet and shall be installed in a prominent location where it is immediately apparent to the responding DFES personnel.

d. The sign on the fire hydrant system block plans shall be appropriate to the size of the block plan and shall be immediately apparent.

e. The sign shown in Figure 34 below shall be provided at the on-site external fire hydrants, including those on the open-deck carpark roof. The sign shall be in capital letters not less than 30 mm high in a colour contrasting with the background in accordance with the provisions of DFES Guideline GL-03.

Figure 34: Sign identifying the requirement for 3 lengths of hose from external hydrants

9.11 Building Subject to FSER Notice

59. A “Building Subject to FSER” notice (a copy of the notice will be provided in the FSER) shall be mounted adjacent to the FDCIE. The notice shall be of a minimum A4 size sheet, mounted within a permanent frame and securely fastened to the wall, and shall be in accordance with the DFES “Direct Brigade Alarm (DBA) Technical Bulletin – July 2014 (Advice 4)” and DFES DBA Connection Code. The notice shall be black lettering on a white background and shall meet the following minimum requirements for size:

    a. BUILDING SUBJECT TO FSER – Times New Roman – 15 mm high capital letters.

    b. Body of the sign – Times New Roman – 12 mm high small letters.

9.12 Maintenance

60. The *safety measures* outlined above shall be maintained and tested in accordance with Regulation 48A of the Building Regulation 2012 (with amendments) and the following:

    a. AS 1851-2012, or the latest edition, if the fire safety system is within the scope of AS 1851.

    b. AS 2293.2-2019, or the latest edition, for emergency lighting and exit signage.

    c. The manufactures' instructions and recommendations for each product.

10. Quantitative Engineering Tools and Parameters

10.1 Required Safe Egress Time versus Available Safe Egress Time Concept

The performance-based travel distances are addressed based on the determination and comparison of the time for occupants to evacuate and the time available for the evacuation to be completed safely. This form of analysis is known as a timeline analysis; or the Required Safe Egress Time (RSET) versus Available Safe Egress Time (ASET) analysis.

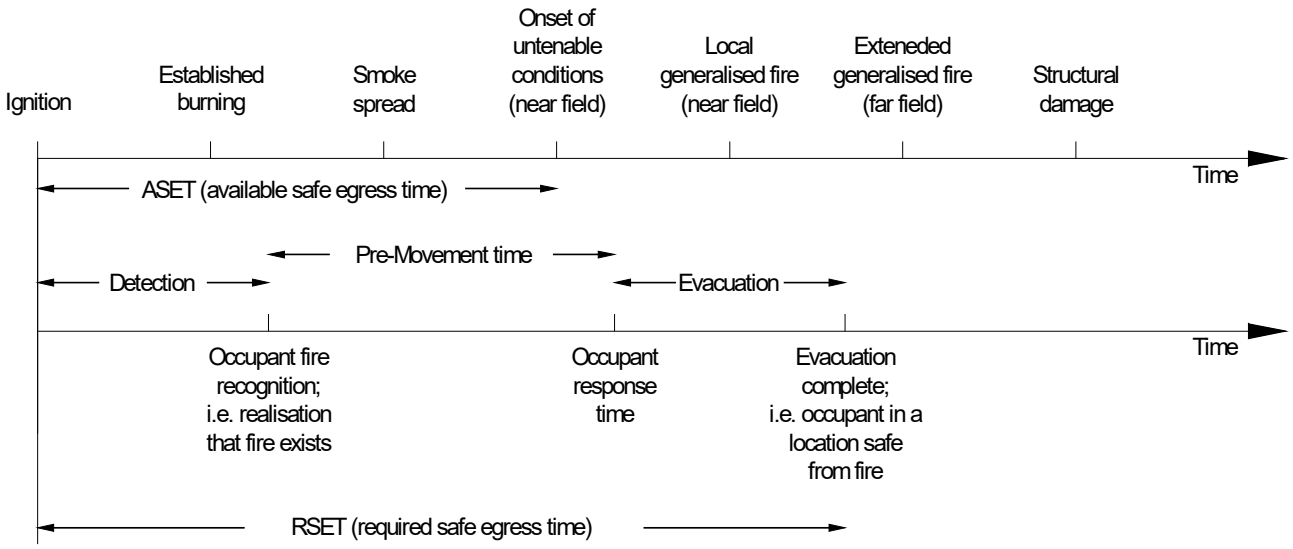


Figure 35: ASET versus RSET timeline diagram

Parameters required to undertake this assessment are defined in the following sections of this report.

10.2 Required Safe Egress Time (RSET) Modelling

The RSET is the sum of times incurred during the following three stages of the evacuation process:

- ***Cue time*** – time taken from effective ignition to the receipt of a cue by the occupants regarding the presence of a fire. In open plan areas occupants can also receive a cue upon development of a visible smoke layer under the ceiling.
- ***Response (pre-movement) time*** – time which extends from the cue to the time when occupants decide to evacuate. The degree of training and familiarity with the surroundings, as well as the general nature of the population, has an impact on the response time, together with the type of cue received. This period covers the time for occupants to assimilate the cue, resolve any ambiguity, undertake pre-evacuation actions and commence evacuation.
- ***Egress time*** – occupant evacuation time, which can be calculated on the basis of movement time to an exit and potential queuing time at the exit before reaching a place of relative safety.

$$T_R = t_d + t_{pm} + t_e$$

where :

T_R is the total time of evacuation to a place of safety.
t_d is the time of occurence for an automatic or intrinsic fire cue.
t_{pm} is the pre - movement t ime.
t_e is the time necessary for occupants to move to a safe place.

Equation 1: Total time for evacuation to a place of safety

10.2.1 Cue Times (t_d)

The cue time in the performance-based design is based on the time it takes smoke of sufficient optical density to cover the distance between the axis of the fire plume and to activate the nearest smoke detector. The cue time in a BCA DtS compliant design is based on the time it takes occupants to become aware of the fire due to exposure to combustion products (see flames, smell smoke, hear fire related noises, such as cracking, popping, things falling downs, etc.) or due to an alarm being raised by others.

When smoke detectors are provided in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018 on a nominal 10 m grid, the maximum radial distance from the axis of the fire plume to the nearest detector should not exceed 7.1 m (refer to Figure 36 below).

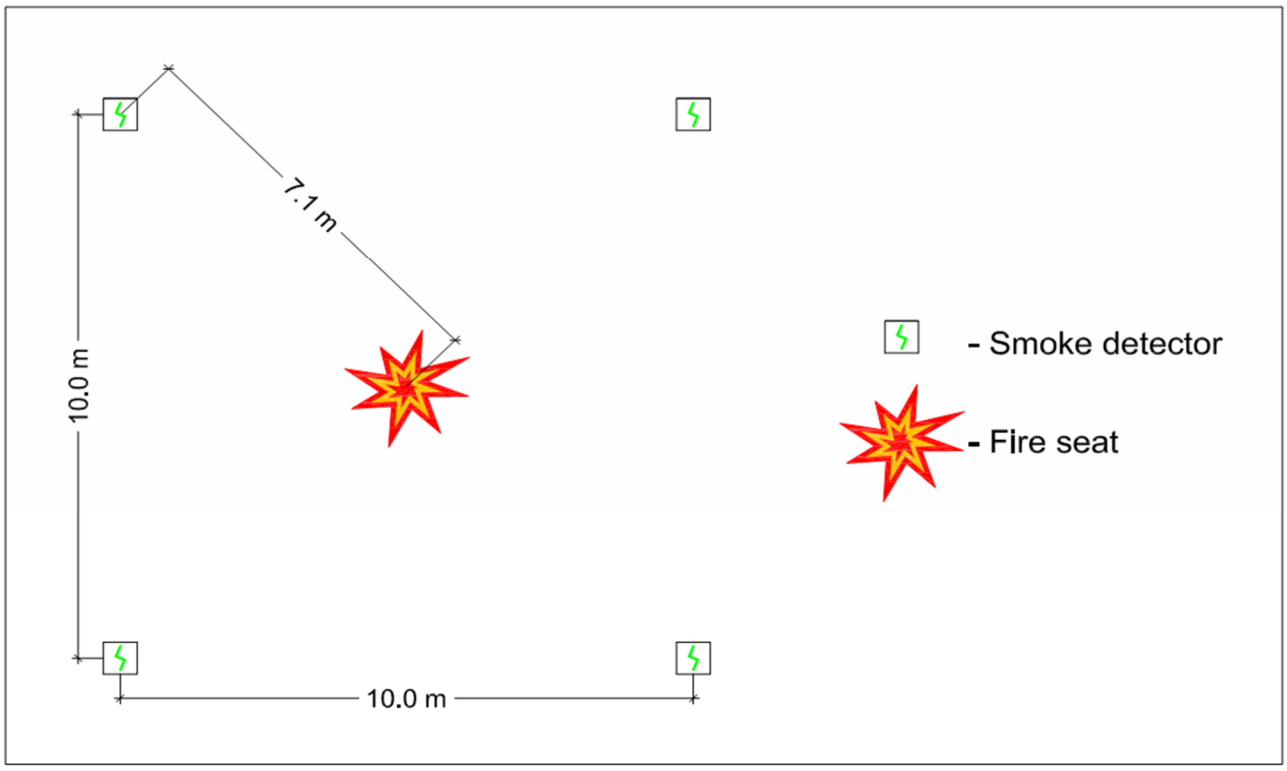


Figure 36: Distance from the axis of a fire plume to the nearest smoke detector installed on a 10 m x 10 m grid to Clause S20C4 of BCA Spec. 20 and AS 1670.1-2018

Where smoke detectors are provided in accordance with Clause S20C6 of BCA Specification 21 and AS 1670.1-2018 a on a nominal 20 m grid, the maximum radial distance from the axis of the fire plume to the nearest detector should not exceed 14.1 m (refer to Figure 37 below).

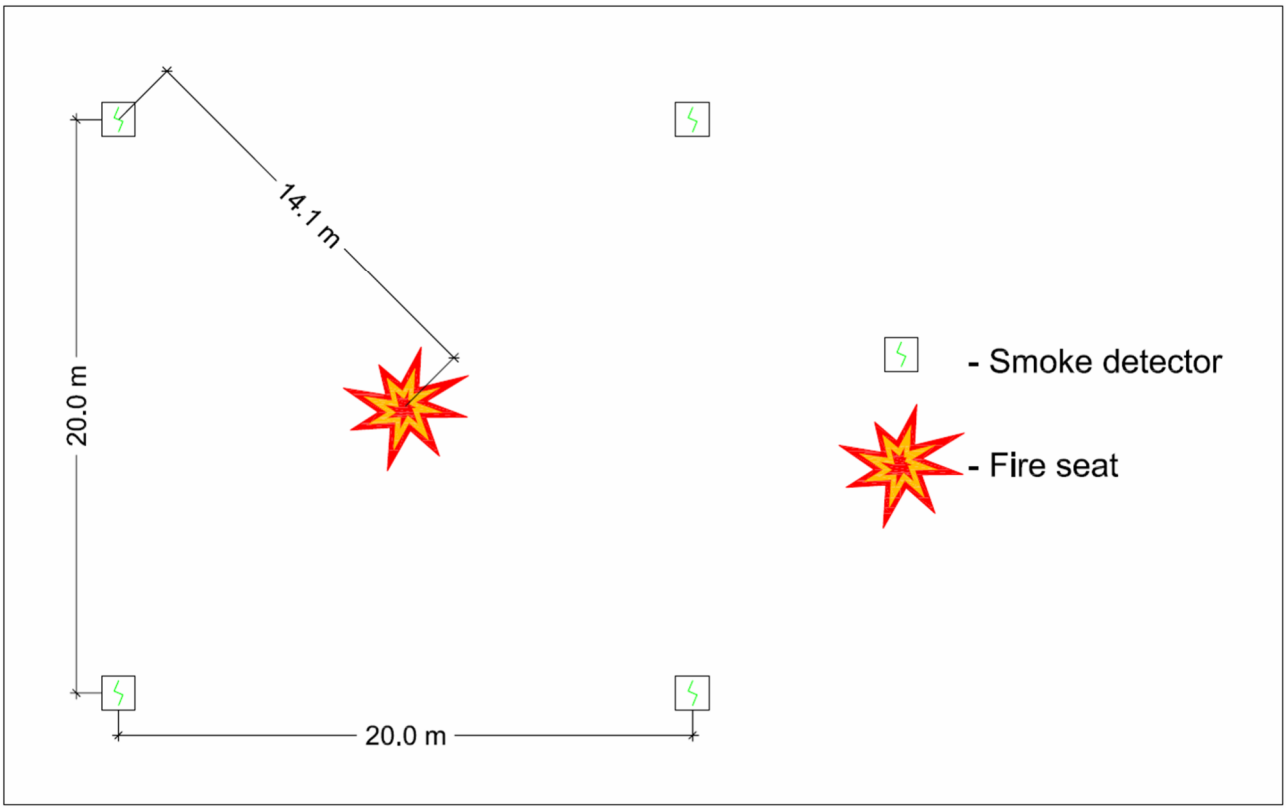


Figure 37: Distance from the axis of a fire plume to the nearest smoke detector installed on a 20 m x 20 m nominal grid

On site, detectors may be located closer than in the nominal grids; however, to provide a conservative estimate, the calculations were carried out using the nominal detector spacing.

One relatively crude method of predicting smoke detector activation times at different spacings and heights is identified in the *International Fire Engineering Guidelines* (IFEG) [ABCB, 2005]. This method was developed by Heskestad [1981] and it suggests that once the temperature at the detector has reached approximately 13°C above ambient the detector is likely to have activated. More recent research however indicates that 13°C is an overly conservative value for most applications, with 4°C to 5°C temperature rise closely replicating experimentally observed smoke detector activation times [Bukowski, 1998].

This report adopts this method in comparative assessments and uses computer model CFAST [Peacock, 2023] to calculate detector activation times.

The smoke detection algorithm from the computer model FDS was used in the absolute assessment of the GSC, as an assessment carried out with the use of computer model CFAST may not provide an adequate estimation of smoke detector activation times under sloping ceilings/roofs.

The FDS algorithm is based on work by William Grosshandler and Tom Cleary from NIST, who developed an enhancement to the smoke detector activation algorithm, originally conceived by Heskestad and Steve Olenick of Combustion Science and Engineering (CSE), and implemented

this model in FDS [McGrattan, 2023]. In FDS the activation of smoke detectors is modelled using simple correlations of transport lag.

The alarm verification time for smoke detectors can be up to 20 seconds (Clause 2.11 of AS4428.1-1998, Amendment No.1 - 2004). This time is added to all calculated activation times of smoke detectors.

Where sprinklers are provided in accordance with AS 2118.1-2017 on a nominal 3 m x 4 m grid, the maximum radial distance from the axis of the fire plume to the nearest sprinkler should not exceed 2.5 m (refer to Figure 38).

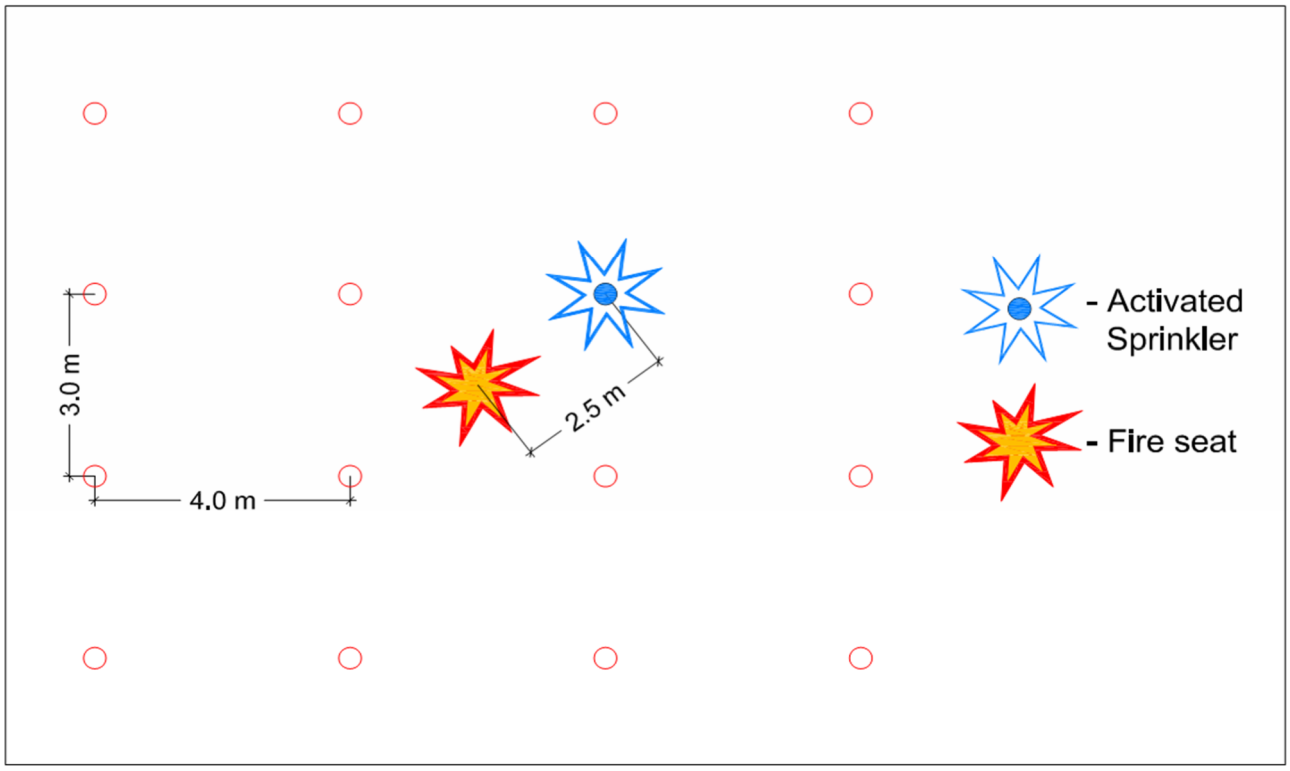


Figure 38: Distance from the axis of a fire plume to the nearest sprinkler installed on a nominal 3 m x 4 m grid in accordance with AS 2118.1-2017

The assessment uses module Sprinkler from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013] to calculate sprinkler activation times in the comparative assessment where sprinklers are the primary detection system.

An additional delay in detection time is created by the depressurisation time of the sprinkler system.

On a small sprinkler system the depressurisation time is considered to be at least 30 seconds; however, on larger systems, the depressurisation time can be as high as 3 minutes [Table 2.4.1.2, Item No. 2.2(b) of AS 1851-2005]. Conservatively, for the purpose of the comparative assessment a 30 second depressurisation time is assumed.

10.2.2 Response Time (t_{pm})

Response time (or pre-movement time) is the time taken between the moment when the cue is first received and the moment when movement to a place of safety begins.

Occupant response time involves the process of interpreting automatic and/or intrinsic cues and identifying them as a cause for evacuation. The response time is dependent upon the type of a cue. For the primary fire/smoke zone the cues may be in the form of:

- Alarm caused by smoke detection system activation.
- Sight or smell of smoke (based on a smoke depth which is 10% of the floor-to-ceiling height).
- Activation of the Building Occupant Warning System (BOWS).
- Notification and evacuation assistance by building management staff.
- Movement of a substantial number of occupants from the primary fire affected zone to an adjacent zone during evacuation.

Occupants close to the fire seat are expected to respond quicker than occupants remote from the fire seat due to the sight of fire and the strong smell of smoke.

Previous investigations in the occupant behaviour reveal that all occupants do not respond to a fire emergency at the same time. It has been observed in emergency evacuations in shopping centres that the staff assistance plays a critical role in the evacuation of occupants, which results in a reduction of the response time and a more efficient evacuation.

Table 3-13.1 of the SFPE Handbook [Proulx, 2002] provides suggested response times for various occupancies based on the type of warning system within the occupancies. These suggested times for retail occupancies range between less than 2 minutes (with live directives from staff) to more than 6 minutes (with fire alarm signal with no staff training). The basis of these estimates is not made clear, i.e. a link to recent experimental data or other justification is not clearly provided.

The above notwithstanding, research carried out in Sweden and the UK [Sandberg, 1997] indicates that pre-movement times less than 60 seconds may be appropriate based on real, unannounced, evacuation drills.

FCRC Project 6 [FCRRP, 1998c] suggests a pre-movement time of 60 seconds from the first sight of dense smoke may be appropriate in shopping centres in a serious fire scenario, and in less serious fire scenarios the pre-movement time may be extended, however there will be more time to evacuate.

Many occupants, especially those in the vicinity or direct line of sight from the fire are expected to respond to a fire cue much quicker and are likely to start movement soon after the cue is received. However, to provide an additional level of conservatism during evacuation scenarios it is assumed that all occupants would start moving at the same time.

A pre-movement time of 120 seconds is therefore considered suitably conservative and is adopted in the analysis.

10.2.3 Occupant Egress Time (t_e)

Occupant egress time is the time taken for the occupants to walk to the exits, queue at the exits and eventually travel to a place of ultimate safety such as an open road.

Egress calculations in the comparative analysis that has a relatively simple architectural layout are based on the hand calculation methods presented in the SFPE Handbook (refer to Equation 2) [Gwynne, 2016a].

$$t = \frac{P}{F_s W_e}$$

Where:

- t the queuing time, sec.
- P the population in persons.
- F_s specific flow, persons/s/m.
- W_e effective width, m.

Equation 2: Queuing time at exit

The assumed travel speed is 0.8 m/s and a specific flow rate of 1.0 persons/s/m of effective width [DFES, 2021].

The effective width of an exits is determined by subtracting the boundary layer width of 304 mm from the width of the exit [Gwynne, 2016b]. For example, the effective width of a single 1.0 m door is 0.696 m.

Evacuation modelling of large occupant numbers from the GSC is carried out using computer model Pathfinder [TE, 2024]. The results are conservative because the modelling process assumes that the first person starts to move towards an exit after the cue and response times have elapsed, whereas in fact some people may commence moving towards the nearest available exit earlier due to direct visual contact with the fire and smoke.

It is hard to predict the exact occupant mix for a shopping centre; however, if it is based on a general population mix, it is considered to be an appropriate assumption. Based on the 2011 Australian Census 67.6% of Australian population are aged between 15 and 64 years old. Children under 15 comprise 18.9% and people over 65 years old – 13.5%. The outcomes of the Census indicate that 18.5% of the population have a disability.

To determine the movement speed of the building population it was assumed that people with a disability or otherwise physically impaired, people over 65 years old and children under 15 years old would be moving at 0.8 m/s. The rest of the population would be moving at 0.93 m/s [DFES, 2021a]. Assuming that 18.5% of the 15 to 64 years old age group is disabled (12.5% of the total population), the percentage of the total occupants moving at 0.93 m/s is approximately 55%.

The Pathfinder input parameters were adjusted accordingly to reflect that 55% of the population have a movement speed of 0.93 m/s and 45% of the population have a movement speed of 0.8 m/s.

It is assumed that contractors who may be present in the plantrooms are all able-bodied people and would have a movement speed of 0.93 m/s.

10.2.4 Safety Factors

The International Fire Engineering Guidelines state that ASET should be greater than RSET x λ_{esc}, where λ_{esc} is a factor of safety incorporated to ensure conservatism in the analysis of the reasonable worst credible fire scenario. There should be a margin incorporated in this to account for uncertainty and the potential consequence of any deficiencies in the analysis. The safety factor λ_{esc} is usually taken to be between 1 and 2.

The main uncertainties with the RSET are associated with the cue, pre-movement and egress times. Given that considerable conservatism is built into the quantification of these variables as detailed above, it is not considered appropriate to add significantly to this conservatism by requiring a high safety margin.

A margin of 50% (i.e., 1.5) greater than that calculated for cue, pre-movement and egress times is considered appropriate for the base case design fire scenarios.

Hence the criterion for acceptability of an outcome from a time-line analysis for the credible worst case design fire scenarios is:

ASET $\geq$ 1.5 x RSET

Redundancy and sensitivity fire scenarios normally attract a safety factor of 1, as these scenarios are less likely to happen and generally are assessed only to establish the robustness of the fire safety strategy.

ASET $\geq$ 1.0 x RSET

The IFEG also state that "*in a comparative evaluation, it should not be necessary to include explicit factors of safety because the same methods and assumptions for the analysis would be used for both the deemed-to-satisfy or prescriptive design and the proposed design*". The comparative analysis therefore does not include a safety factor.

10.3 Available Safe Egress Time (ASET) Modelling & FDS Input Parameters

The ASET is determined through smoke development and movement modelling of the design and redundancy fire scenarios using computational fluid dynamics computer model FDS-6.8.0.

10.3.1 Mesh Size

In FDS the approximate form of the conservation equation for mass, momentum, and energy is solved on a numerical grid. The size of the grid cells will determine how accurate the output results are. A coarse grid can provide reasonable predictions of certain quantities, especially those that can be traced directly to conservation equations of mass and energy, like temperature and visibility. However, with coarser grids the results are generally less reliable than those obtained with finer grids, and certain results cannot be obtained at all.

With any grid resolution study, a point of diminishing returns is reached when the improvement in the quality of the results is outweighed by the "cost" of the computation. When this point is reached depends on the application. It also depends on the quantities that are of interest. Some quantities, like hot smoke layer temperature or height, do not typically require as fine a numerical grid as quantities such as the heat flux to targets near the fire [McGrattan, 2023].

The "FDS User Guide" indicates that there is an alternative method of determining the appropriate grid cell size. It suggests that for simulations involving buoyant plumes, the cell size (δx) can be correlated to the characteristic fire diameter (D^*) [McGrattan, 2007]. A validation study sponsored by the US Nuclear Regulatory Committee [Stroup, 2013] indicates that the $D^*/\delta x$ values in the range between 4 and 16 achieve good agreement with the experimental data for various fire scenarios.

The characteristic fire diameter can be determined using the following equation [McGrattan, 2007]:

$$D^* = \left(\frac{Q}{\rho_\infty c_p T_\infty \sqrt{g}} \right)^{\frac{2}{5}}$$

Equation 3: Characteristic fire diameter

Where:

D^* - characteristic fire diameter;

Q - total heat release rate of the fire (kW);

ρ_∞ - air density at ambient temperature ρ_∞ = 1.204kg/m³;

c_p - specific heat at ambient temperature c_p = 1.005kJ/kg.K;

T_∞ - ambient temperature T_∞ = 23°C (296K);

g - the acceleration due to gravity g = 9.81m/s²

10.3.2 Fire Reaction Parameters

In computational fluid dynamics (CFD) modelling where the smoke layer is generally not stratified, as opposed to zone modelling, it is also paramount to establish parameters (input data) that would correctly reflect the amount of toxic volatiles of smoke produced during the combustion process, as these will determine the tenability of the environment through which occupants may have to evacuate.

The contents of the retail mall present a mix of plastics, cellulosic materials and hydrocarbons. The fuel composition is therefore based on the following parameters: CO_2 – 1.9 g/g; CO yield – 0.04 g/g; soot yield – 0.07 g/g; heat of combustion – 20 MJ/kg; and radiative fraction – 0.35 [MBIE, 2020].

It should be noted that the above values are more conservative than the values suggested in the Society of Fire Safety "Practice Note for Design Fires" [SFS, 2012].

10.3.3 Heat Release Rate per Unit Area

The heat release rate per unit area (HRRPUA) in sprinklered shopping centres can vary between 270 kW/m² and 1,200 kW/m² [Hopkin, 2019]. "Verification Method: Framework for Fire Safety Design" [MBIE, 2020] suggests HRRPUA values that range between 500 kW/m² and 1,000 kW/m² for "*all buildings including storage with a stack height of less than 3.0 m*".

It is conservatively assumed that the HRRPUA is 750 kW/m², as a lower HRRPUA is expected to result in a cooler fire and less buoyant smoke.

10.4 Occupant Evacuation Limiting Criteria

To establish the point in time at which the ASET is reached the following limiting criteria have been adopted to evaluate the performance-based egress.

10.4.1 Visibility and Temperature Limits

It is widely accepted that occupants can evacuate safely if the visibility through the smoke stays at above 10 m in large spaces, and above 5 m in smaller spaces, and the smoke temperature does not exceed 60°C. Familiarity with the environment plays an important role as well [Purser, 2002].

The above notwithstanding, in experiments conducted by Jin it was determined that people would still walk through non-irritant smoke if the visibility was reduced down to 2.3 m [Purser, 2002]. However, in other experiments [Proulx, 2002] it was established that people would generally turn back if the visibility was around 3 m.

Therefore, the adoption of a visibility limit of 10 m and a temperature limit of 60°C is considered appropriate.

10.4.2 Availability of Exits

The hot smoke layer height and its temperature are typically used as limiting criteria to determine the ASET for occupant evacuation in simulations using zone fire models. Typically, when the hot smoke layer descends below a defined height (e.g. 2.1 m), tenability is deemed to be lost across the entire compartment.

This concept however is too simplistic an approach when using field (CFD) fire models. CFD models can consist of hundreds of thousands of cells to simulate geometrical and spatial characteristics of a fire environment that could not be simulated in a zone fire model and the output data is correspondingly complex and detailed, and as such, more refined limiting criteria are considered appropriate.

For the purposes of this assessment the visibility and temperature limits are applied at a height of 2.1 m, however, some loss of tenability at this height may not be considered to result in ASET being reached.

For example, when using CFD models smoke may descend below the 2.1 m benchmark in different parts of the model environment without impeding safe evacuation of the occupants, i.e. one of the alternative exits can become obscured or even blocked by smoke; however, other exits are not compromised and are available (this concept is in line with the BCA DtS provisions – if one exit is blocked, an alternative exit must be available). Therefore, strictly using the 2.1 m benchmark across the entire domain may be inappropriate and the analysis may consider the specific building configuration where multiple exits are available and transient areas of low visibility that may not pose a significant risk to occupants.

10.4.3 Summary

For the purpose of this assessment, it is assumed that it is acceptable for smoke during a fire simulation to descend below the 2.1 m benchmark above the finished floor level. However, smoke below this benchmark must satisfy the following limiting criteria:

- Visibility along required exit travel paths does not reduce to less than 10 m and the temperature does not exceed the 60°C benchmark at 2.1 m above the finished floor level [Purser, 2002]; or
- If travel paths to alternative exits are available from a point of choice, some localised loss of tenable conditions may be acceptable, only if alternative travel paths to an exit are available.

10.4.4 Fire Brigade Intervention Limiting Criteria

The limiting criteria for DFES internal intervention are outlined in Table 18 below. The values indicated in Table 18 are described in the Australasian Fire Authorities Councils Fire Brigade Intervention Model (FBIM) as the limiting conditions for fire-fighters in full turnout gear.

Tenability Criteria	Limiting Value for Fire-fighters (relative to 1.5 m above floor level)	
	Air Temperature (°C)	Radiation (kW/m^2)
Routine Conditions (25 minutes maximum exposure)	100	1
Hazardous Conditions (10 minutes maximum exposure)	120	3
Extreme Conditions (1 minutes maximum exposure)	160	4.0 – 4.5

Table 18: Maximum critical radiant heat flux allowed for fire brigades personnel in their protective clothing

DFES recommends a maximum radiant heat flux for all calculations to be no greater than 2.5 kW/m² [DFES, 2021b], as snatch rescue situations cannot be predicted and should not be modelled. For conservatism, routine conditions, based on a maximum temperature of 100°C at a height of 1.5 m above floor level, are considered the limiting criteria for fire fighters.

10.5 Design Fires

There is a large amount of data concerning the burning rates of items and materials; however, rarely is this information sufficiently generic to be universally adopted and applied to specific buildings. Also, what can be representative of current fuel loading for an enclosure may not be the case in the future. Therefore, it would be a rare assessment in which the specific items forming the fuel load had been tested to provide the fire heat release data.

Much experimental work has been carried out on the burning rates. These have been closely examined and translated into a simplified mathematical expression relating heat release to time after commencement of the flaming stage of the fire growth [Buchanan, 2001]. The unpredictable incubation phase (incipient stage) of fire development is not included. The basis of the mathematical simplification arises from the fact that the fire growth during the flaming stage can be approximated by a smooth curve that can be expressed mathematically.

Studies of actual fires have led to the adoption of five (5) standard fire growth rates covering a wide range of potential fire scenarios and fuel loads. As noted, the times of fire incubation are not included in the t-squared growth fire models.

Figure 39 illustrates the five typical fire growth rates. The design fire curve represents the initial stage of the fire. There is no or very little reliable data for fires where the rate of heat released exceeds 10 MW. This fire size represents the approximate limit for current test facilities.

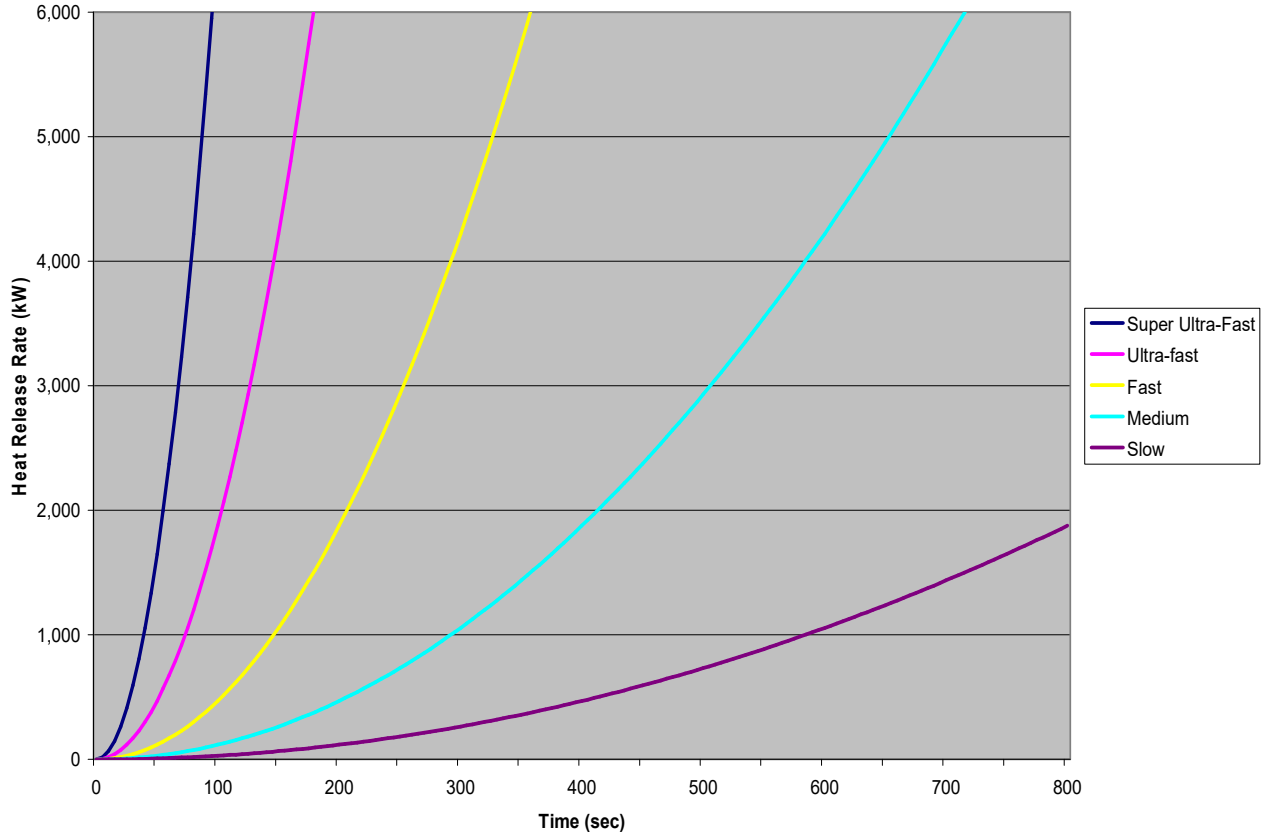


Figure 39: t-squared growth rate fires based on test data

Considering that it is impossible to predict with complete accuracy what fire will occur, it is reasonable to use a t-squared growth rate.

10.5.1 Fire Growth Rates

The heat release rate (HRR) of a t-squared (t^2) growth rate fire at any given time can be determined using the following equation [Buchanan, 2001]:

$$Q = \alpha \times t^2$$

Equation 4: Heat release rate of a t-squared fire

where:

Q - the heat release rate of the fire, kW.

α - fire intensity coefficient, kW/s^2.

t - time, s.

The heat release rate vs. time relationship for a range of t^2 growth rate fires is illustrated in Table 19 below [Buchanan, 2001]:

Time (s)	Heat Release Rate (kW)				
	Slow (K-600)	Medium (K-300)	Fast (K-150)	Ultra-fast (K-75)	Super Ultra-fast (K-40)
α	0.0029	0.0117	0.0469	0.1876	0.6594
0	0	0	0	0	0
25	2	7	29	117	412
50	7	29	117	469	1,649
100	29	117	469	1,876	6,594
150	66	264	1,055	4,221	14,837
200	117	469	1,876	7,504	26,376
250	183	733	2,931	11,725	41,213
300	264	1,055	4,221	16,884	59,346
350	359	1,436	5,745	22,981	80,777
400	469	1,875	7,504	30,016	105,504
450	593	2,373	9,497	37,989	133,529
500	733	2,931	11,725	46,900	164,850
550	886	3,545	14,187	56,749	199,469
600	1,055	4,221	16,884	67,536	237,384

Table 19: Time vs. Heat Release Rate for a range of t^2 growth rate fires

Retail occupancies in general are comprised of a variety of stores that contain mixed types of commodities and have different types of storage configurations. Some areas could have a specific line of products, but most have a mix of cellulosic, plastic, and non-combustible materials. Combustibles displayed and/or stored in vertical configurations are expected to create the worst fire growth rates.

A lot of research has gone into determining the appropriate fire growths rates for different occupancies. While some researchers indicate that for retail occupancies 'ultra-fast' t-squared growth rate fires would be appropriate for design fire scenarios [Karlsson, 1999], the majority of publications [SFS, 2012; MBIE, 2020] indicate that the most appropriate t-squared growth rate fire for retail areas is 'fast'. The sensitivity fires however are assessed using an 'ultra-fast' t-squared growth rate.

10.5.2 Fire Size

The design fire curve represents the initial stage of the fire. For a nominated fire scenario, the design fire is modified to take into account either the action of the fire suppression measures, or the reduction of the available fuel load, or lack of ventilation. These design fires are used in computer models to determine the smoke spread throughout or between the enclosures.

Occupant intervention and its impact on the fire size is usually ignored, as it cannot be relied upon (except for industrial fire brigades) and generally cannot be quantified.

The maximum fire size in a building that is not fitted with an automatic fire sprinkler system is either ventilation or fuel controlled and can be determined using appropriate equations.

It is also possible to establish the maximum fire size in a building that is provided with an automatic fire sprinkler system. Sprinkler activation could result in three possible outcomes (refer to Figure 40 below) [ABCB, 2005b; Staffansson, 2010]:

(A) Sprinkler activation does not have any effect on the fire growth rate – red line in Figure 40. This outcome is highly unlikely; however, under certain conditions (the sprinkler system is not designed for the fire load present; inadequate water supply; abnormal fire growth rate; etc.) it is possible; or

(B) Sprinkler activation controls the fire growth rate – blue line in Figure 40. Generally, this is a conservative assumption; or

(C) Sprinkler activation results in the fire being extinguished – green line in Figure 40. Upon activation, appropriately designed; installed and maintained fire sprinkler systems are highly likely to reduce the heat release rate of a fire and potentially extinguish it; however, this approach is not considered sufficiently conservative for most applications.

There are different ways of determining the HRR versus time curve during a sprinkler-controlled fire scenario.

Based on research carried out in Sweden, Nystedt [2011] suggests that for heat release rates below 5 MW at the time of sprinkler system activation (Q_{act}), the HRR could remain constant for 60 seconds and then be reduced to 1/3 of the Q_{act}, after which time the HRR should remain constant for the duration of evaluation. For Q_{act} of greater than 5 MW, Nystedt suggests that upon sprinkler activation the HRR shall remain constant for the rest of the evaluation and be equal to $Q_{act.}$

This approach suggests that Q_{act} can be equal to Q_{ctrl}. However, fire tests replicating an office environment that were carried out in China [Chow, 2005], indicate that an increase of HRR after sprinkler system activation could be as high as 50% (refer to Figure 41 below), however, the fire size then quickly reduces compared to a similar fire with no sprinkler activation.

To make sure that a conservative assessment is provided, the following approach has been adopted to determine the HRR versus time curve for the design and sensitivity fire scenarios:

i. Fire grows with a given t-squared growth rate (e.g. ‘medium’, ‘fast’, or ‘ultra-fast’) until activation of a sprinkler on the first row of sprinkler heads. The axis of the fire plume is assumed to be located in the middle of a rectangular array of four (4) sprinkler heads as illustrated in Figure 43.

ii. Upon activation of the first sprinkler, the growth rate of the fire is reduced to the next lower growth rate, e.g. ‘fast’ is reduced to ‘medium’ growth rate.

iii. Thereafter, the fire keeps growing at the reduced t-squared growth rate until at least five (5) sprinklers are activated, i.e. at least one (1) sprinkler has activated on the second row of sprinkler heads.

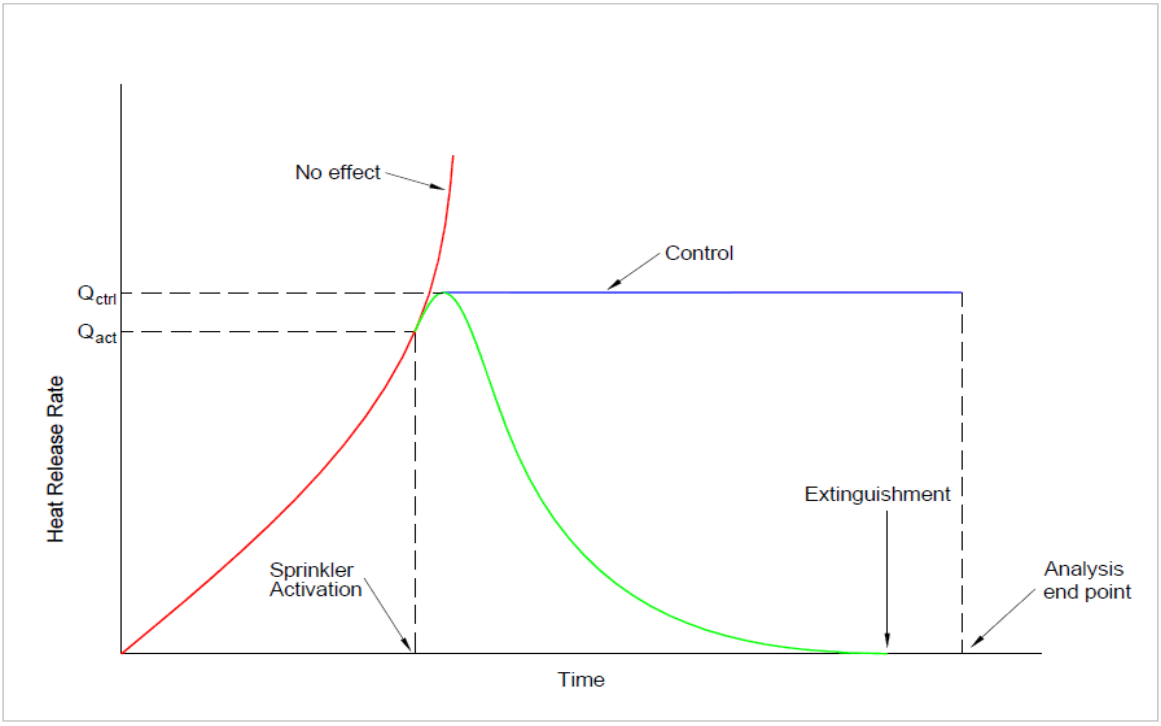


Figure 40: Possible effects of sprinkler system activation on the fire heat release rate

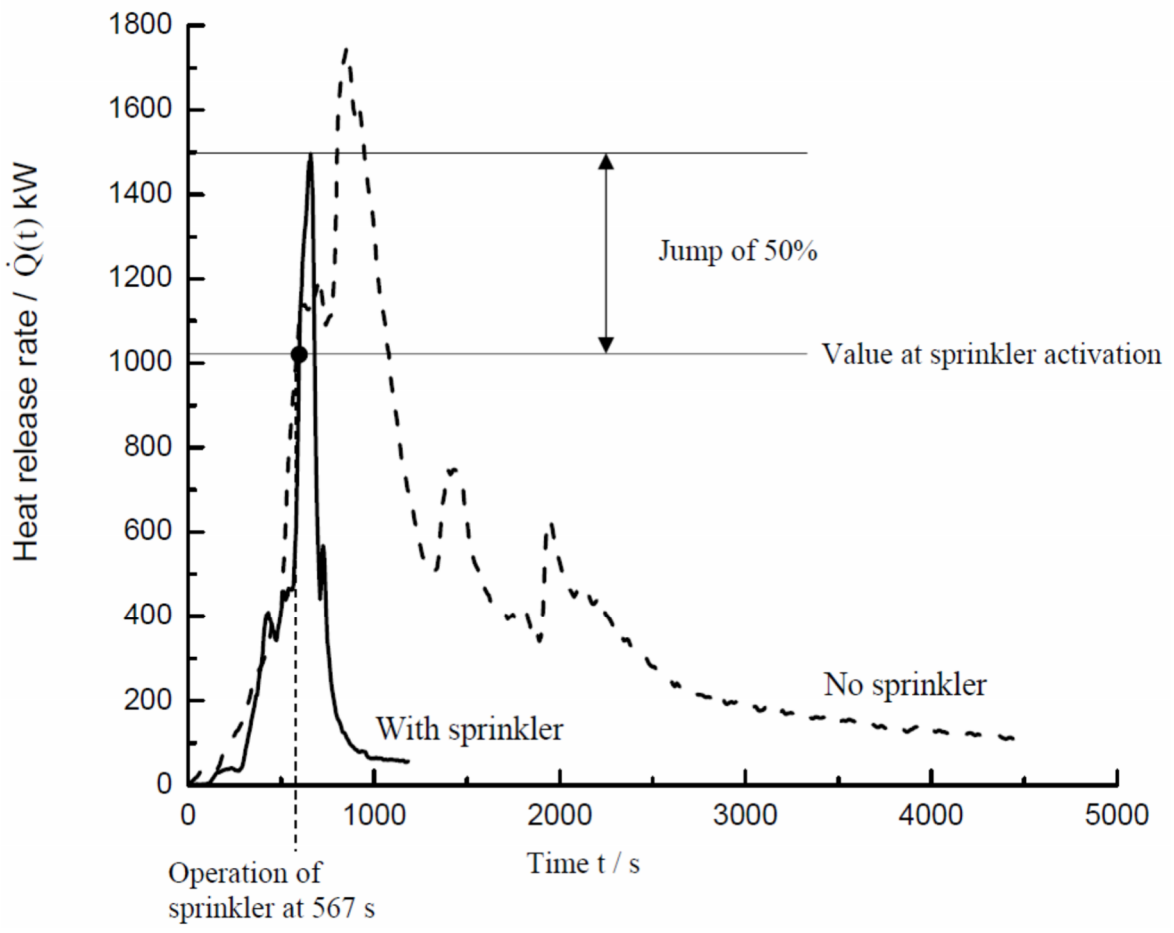


Figure 41: Heat release rate observed in experiment carried out at Chinese Assembly Calorimeter

The above approach results in a schematic fire design curve illustrated in Figure 42 below.

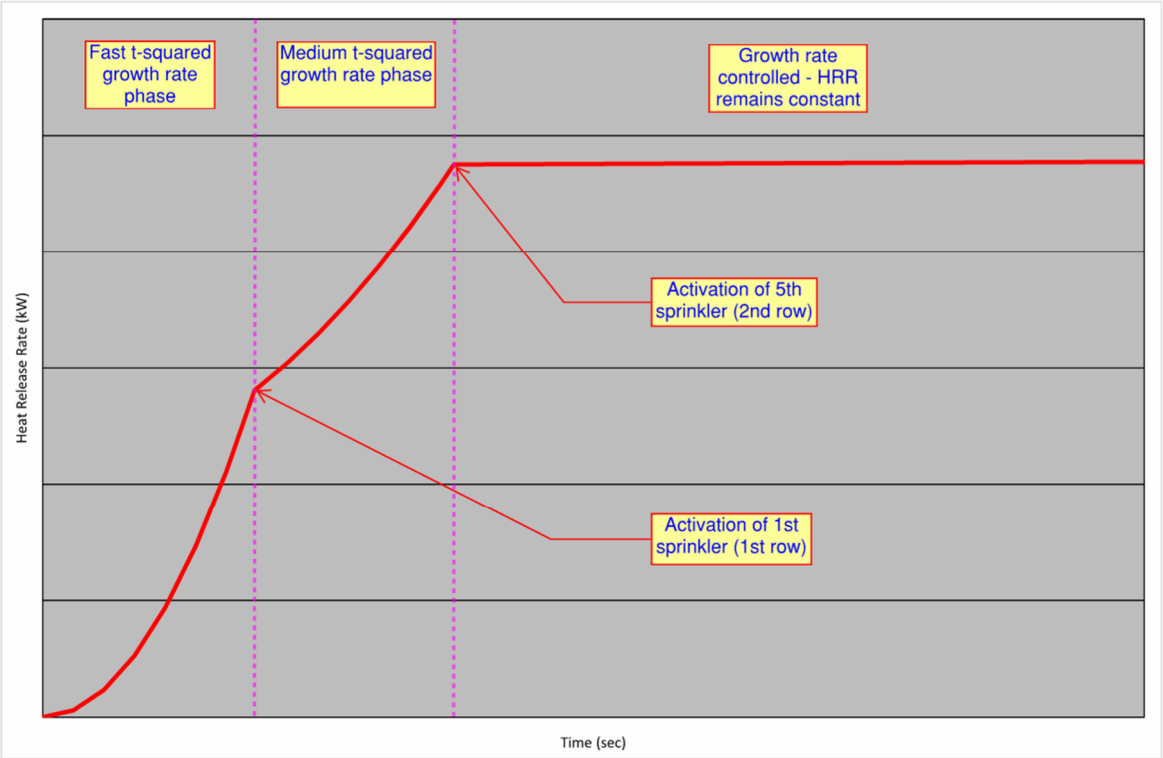


Figure 42: Schematic fire design curve for design fire scenarios

Module Sprinkler from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013a] is used to calculate sprinkler activation times.

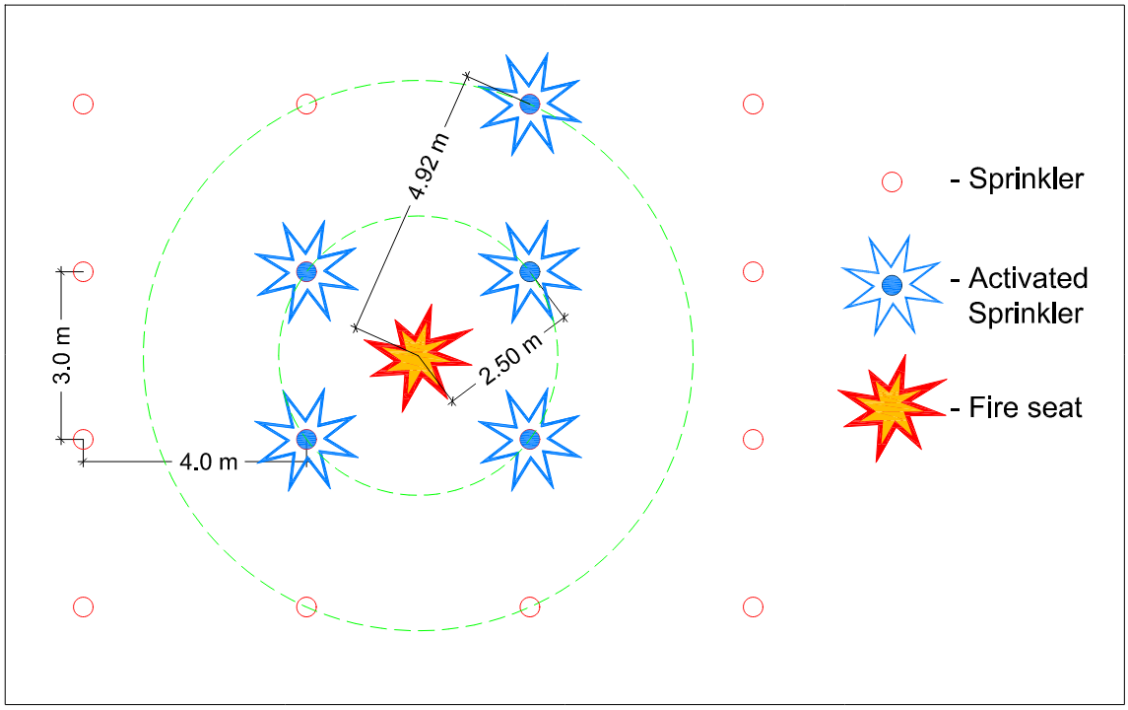


Figure 43: Distance from the axis of a fire plume to the first and fifth sprinklers installed on a nominal 3 m x 4 m grid in accordance with AS 2118.1-2017

11. Performance Solution No. 1 – Performance-based FRL of Loadbearing Structure

11.1 Relevant BCA DtS Provisions

BCA Clause C2D2(1) states that the fire-resisting construction of a building must be that specified in Table C2D2, i.e. a 3-storey building containing Class 6 and Class 9b parts, where Class 6 is the top floor, shall be of Type B construction.

BCA Clause C2D2(2) states that each building element must comply with Specification 5 as applicable.

Table S5C21e of BCA Specification 5 states that loadbearing fire-resisting lift and stair shafts in a Class 6 and Class 9b building of Type B construction where different classifications are not fire separated shall achieve FRL180/120/120.

Table S5C21g of BCA Specification 5 states that loadbearing internal walls and columns in a Class 6 and Class 9b building of Type B construction where different classifications are not fire separated shall achieve FRL180/--/--.

11.2 Performance Solution

The GSC is an existing 3-storey mixed use development that contains Class 6 (retail) and Class 9b (cinema) parts that are not fire-separated (Class 6 is the top floor); therefore, the prescribed construction type is Type B.

The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120, which does not comply with the DtS provisions of Table S5C21e of BCA Specification 5.

The loadbearing columns and walls that support the First Floor slab in areas highlighted red in Figure 44 and Figure 45 below achieve FRL 120/--/-- in lieu of FRL 180/--/--, which does not comply with the DtS provisions of Table S5C21g of BCA Specification 5.

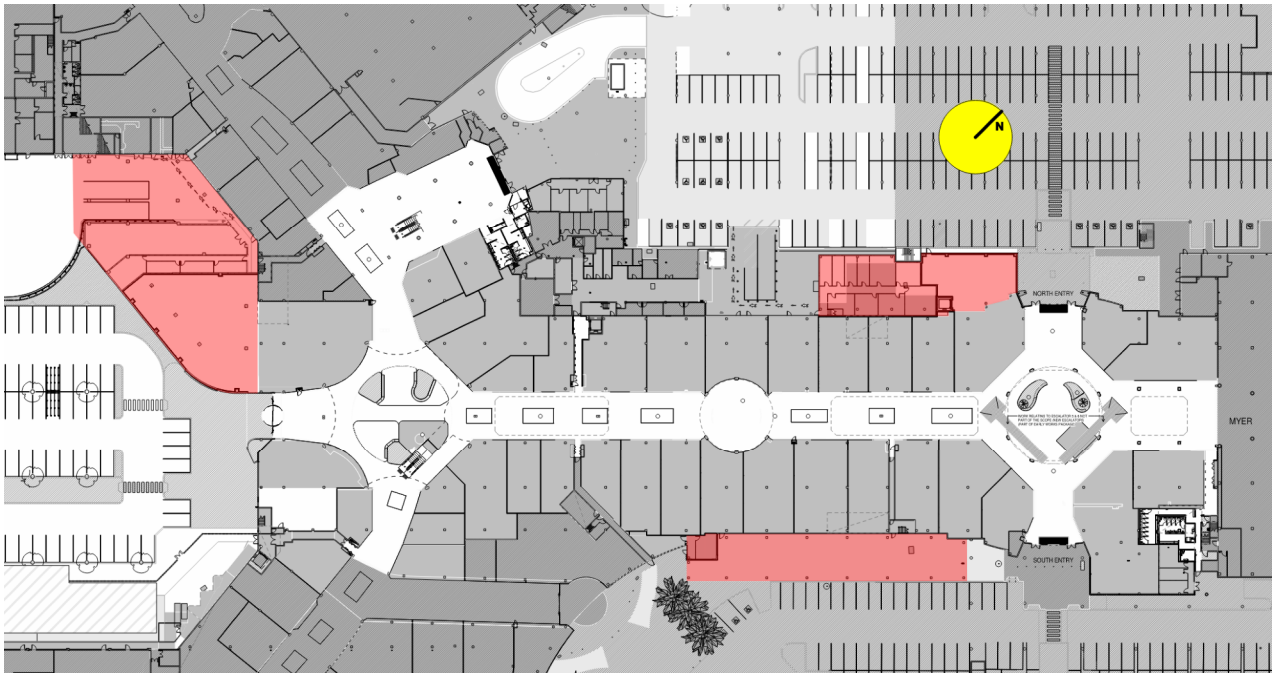


Figure 44: Ground Floor areas where load bearing structure has performance-based reduced FRL

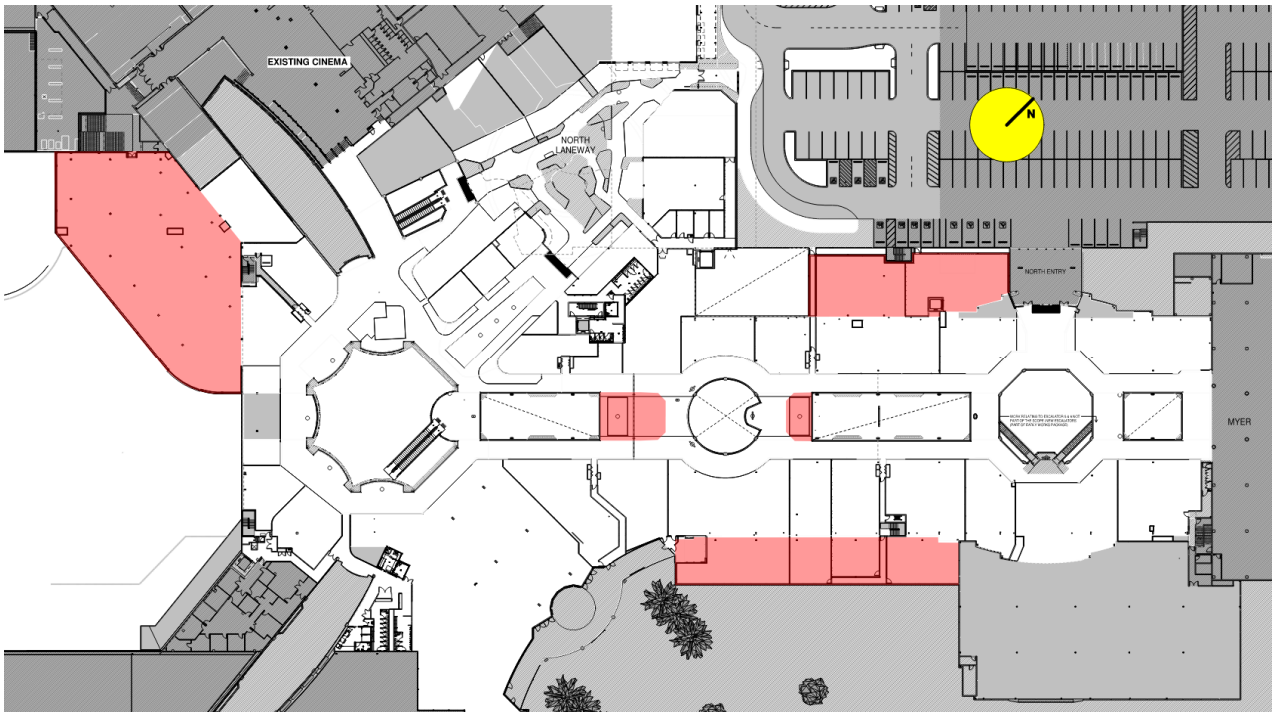


Figure 45: First Floor areas where load bearing structure has performance-based reduced FRL

11.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as C1P1, C1P2(1)(a), C1P2(1)(c) and C1P2(1)(d).

11.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

11.5 Intent of the BCA

The intent of Performance Requirement C1P1 (formerly CP1), in accordance with the Guide to the BCA, which provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020-2], is to ensure that the building has a structure that, "*to the degree necessary*", should withstand the impact of a fire and should not have localised or catastrophic collapse as a result of it.

The Guide to the BCA states that the use of words "*to the degree necessary*" means that the "*BCA recognises that different building elements require differing degrees of structural stability during a fire. The expression is intended to allow the appropriate authority to determine the degree of compliance necessary in each particular case*".

The above notwithstanding, the Guide states that "*while assessment of a building proposal must have regard to the differing needs of each building element, the proposal must make sure that the elements have an appropriate structural stability during a fire so that*:

- "*the fire does not endanger the occupants by entering escape routes*; and

- "*the fire does not endanger fire fighters while they are undertaking search and rescue operations*".

The intent of Performance Requirement C1P2(1)(a) (formerly CP2(a)(i)) is to avoid a situation where fire either endangers occupants evacuating by way of exits or impedes the capacity of emergency services personnel to access the building and fight the fire or effect rescue occupants.

The intent of Performance Requirement C1P2(1)(c) (formerly CP2(a)(iii)) is to minimise the risk of fire spreading from one building to another that could endanger the occupants of both buildings and impede the actions of the fire brigade.

The intent of Performance Requirement C1P2(1)(d) (formerly CP2(a)(iv)) is to minimise the risk of fire spreading through a building that could endanger the occupants and impede the actions of the fire brigade.

The Guide to the BCA states that "*the BCA recognises that different building elements require differing degrees of protection to avoid the spread of fire*". The Guide also highlights that compliance with the DtS provisions in regards to fire separation "*is not compulsory if alternative means can be found to satisfy the appropriate authority that the Performance Requirements will be achieved*". This provision is intended "*to allow the appropriate authority to determine the degree of compliance necessary in each particular case after considering each building scenario*".

It is evident that the reduced FRL of the loadbearing structure may contribute to premature structural failure, which may lead to fire spread to exits, to adjacent buildings or in the building.

11.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based reduced FRL of the Ground Floor and First Floor loadbearing structure would not increase the risk of structural collapse, and the risk of fire spread to exits, between buildings and in the building.

If it can be demonstrated that an uncontrolled fire during a sprinkler failure scenario and without relying on fire brigade intervention burns out before the nominal FRL is reached, it is considered that compliance with Performance Requirements C1P1, C1P2(1)(a), C1P2(1)(c) and C1P2(1)(d) is achieved.

The methodology adopted for the assessment is a quantitative deterministic analysis in accordance with the following:

1. Identify fire scenarios that potentially could cause collapse of the loadbearing structure.
2. Identify fire loads and ventilation conditions for areas where a fire could cause collapse of the performance-based loadbearing structure.
3. Undertake burn-out calculations using the Eurocode formula [EC1, 2002] to establish the equivalent fire severity during a total burnout.
4. Determine whether burnout of the critical areas is expected to occur before the nominal FRL is reached, without relying on fire brigade intervention.

11.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *The equivalent fire severity in areas that could cause collapse of the loadbearing structure shall be less than 120 minutes.*

12. Performance Solution No. 2 – Non-fire-rated Plant Rooms and Cabling to AHUs

12.1 Relevant BCA DtS Provisions

BCA Clause C3D13(1)(c) states that central smoke control plant must be separated from the remainder of the building with construction complying with (4).

BCA Clause C3D13(4)(a)(i) states that separating construction must have an FRL as required by Specification 5, but not less than 120/120/120.

Specification 5 does not prescribe an FRL for non-loadbearing internal walls bounding plant rooms in a building of Type B construction. Therefore, the walls bounding plant rooms that contain central smoke control plant shall achieve FRL 120/120/120.

BCA Clause C4D15(1) states that the requirements of (2) apply where an electrical, electronic, plumbing, mechanical ventilation, air-conditioning or other service penetrates a building element (other than an external wall or roof) that is required to have an FRL with respect to integrity or insulation or a resistance to the incipient spread of fire.

BCA Clause C4D15(2) states that the installation mentioned in C4D15(1) must comply with any of the following: (a) tested systems; (b) in the case of ventilation or air-conditioning ducts or equipment, the installation is in accordance with AS 1668.1; (c) compliance with Specification 13.

Clause E2D15(2)(a) states that a building "*containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit*" in a fire compartment with a floor area greater than 2,000 m² must be provided with "*an automatic smoke exhaust system complying with Specification 21*".

Clause S21C7(7) of BCA Specification 21 states that "*power supply wiring to exhaust fans together with detection, control, and indication circuits (and where necessary to automatic make-up air supply arrangements) must comply with AS 1668.1*".

Note 1 to Figure 4.1 of AS 1668.1-2015 prescribes that all cabling, where not protected from fire by fire-resistant construction shall be fire-resistant.

12.2 Performance Solution

The Plaza (SZ-02), the Myer retail mall (SZ-03), the Coles wing mall (SZ-01 – not part of this project but may activate during a fire in SZ-02) and the Target wing mall (SZ-04 – not part of this project but may activate during a fire in SZ-02) are provided with dedicated automatic smoke exhaust systems. The layout of smoke exhaust zones is illustrated in Figure 46 below.

The operation of the smoke exhaust systems is supported by multiple existing plant rooms that contain Air Handling Units (AHU) and mechanical service switchboards (MSSB) for smoke exhaust fans (SEF).

The plant rooms are enclosed with pre-cast concrete panels and reinforced concrete slabs; hence the bounding construction is expected to achieve FRL 120/120/120. The above notwithstanding, some cabling penetrations through the walls are not fire-stopped and the AHU ductwork is not provided with fire dampers where it penetrates fire-rated walls, which does not comply with the DtS provisions of Clause C4D15(2).

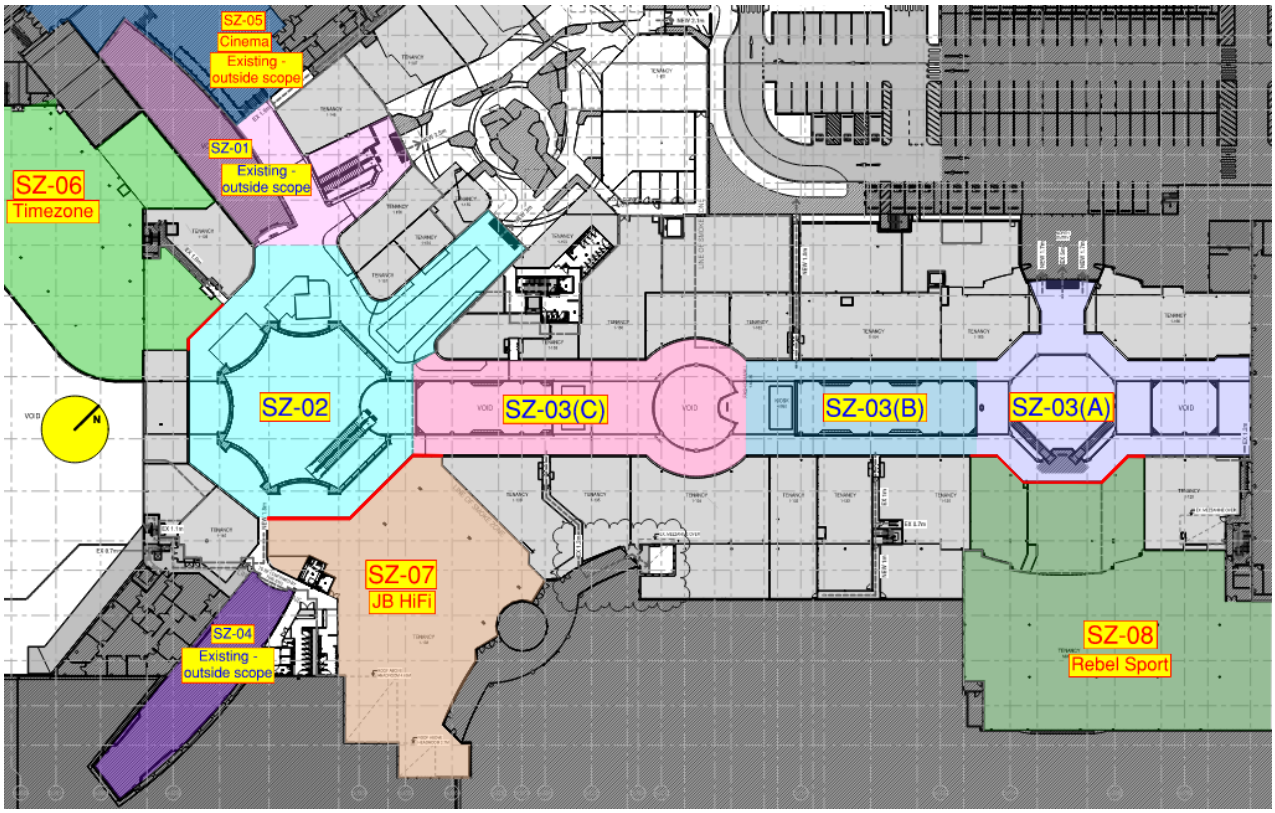


Figure 46: Layout of the smoke exhaust zones on First Floor

Power supply to the AHUs that provide make-up air to the smoke exhaust systems is provided from the non-essential chassis of the MSSBs and is not fire-rated, which does not comply with the provisions of AS 1668.1-2015 and the DtS provisions of Clause S21C7(7) of BCA Specification 21.

12.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as C1P2(1)(d) and EP2.2.

12.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

12.5 Intent of the BCA

The intent of Performance Requirement C1P2(1)(d) (formerly CP2(a)(iv)) is to "*minimise the risk of fire spreading through a building that could endanger the occupants, and impede the actions of the fire brigade*".

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that the main objective of fire rating plant rooms that contain central smoke control plant and power cables to the AHUs that provide make-up to the smoke exhaust system is to ensure that during a potential fire the smoke exhaust system operates to a level that facilitates safe occupant evacuation and fire brigade intervention.

12.6 Assessment Methodology

The purpose of this assessment is to demonstrate that if a fire compromises one or more plant rooms due to service penetrations that are not fire-stopped and/or disables one or more AHUs due to non-fire-rated cabling the operation of the smoke exhaust system is not compromised to a point where it would not be able to support safe occupant evacuation and fire brigade intervention.

If it can be demonstrated that a fire that could compromise plant rooms and/or AHUs would not reduce the operational capability of the smoke exhaust system below the critical level, i.e. a level where safe occupant evacuation and fire brigade intervention cannot be facilitated, then compliance with Performance Requirements C1P2(1)(d) and E2P2 is achieved.

The methodology adopted for the assessment is an absolute, quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify plant rooms that cannot be considered fire-rated due to service penetrations that are not fire-stopped.
2. Identify AHUs that are serviced by non-fire-rated cabling.
3. Identify worst-case fire scenarios that could compromise the maximum number of plant rooms and or AHUs simultaneously.
4. Determine the make-up air volume and smoke exhaust volume that could be lost during the worst-case scenario.
5. Undertake fire and smoke modelling for the worst-case (redundancy) fire scenarios in the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria (refer to Performance Solution No. 5).
6. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters (refer to Performance Solution No. 5).
7. Compare the derived ASET and RSET to determine if the design is acceptable.
8. If occupant evacuation and fire brigade intervention with a reduced capacity smoke exhaust system can be facilitated, then compliance with the relevant Performance Requirements is achieved.

12.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *If plant rooms that contain smoke control plant or AHUs providing make-up air to the smoke exhaust system, the ASET calculated for the redundancy fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

13. Performance Solution No. 3 – Performance-based Non-fire-isolated Exits

13.1 Relevant BCA DtS Provisions

BCA Clause D2D5(3)(a) states that in a Class 6 building "*no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*".

The BCA Glossary defines an exit as:

(a) Any, or any combination of the following if they provide egress to a road or open space: (i) an internal or external stairway; (ii) a ramp; (iii) a fire-isolated passageway; (iv) a doorway opening to a road or open space; or

(b) A horizontal exit or a fire-isolated passageway leading to a horizontal exit.

13.2 Performance Solution

The GSC is provided with multiple non-fire-isolated exits that discharge either into covered carparks or into open spaces from where occupants need to travel either via covered carparks on Ground Floor (refer to Figure 47) or under a roofed area on First Floor (refer to Figure 48 below) before they reach a road or open space.

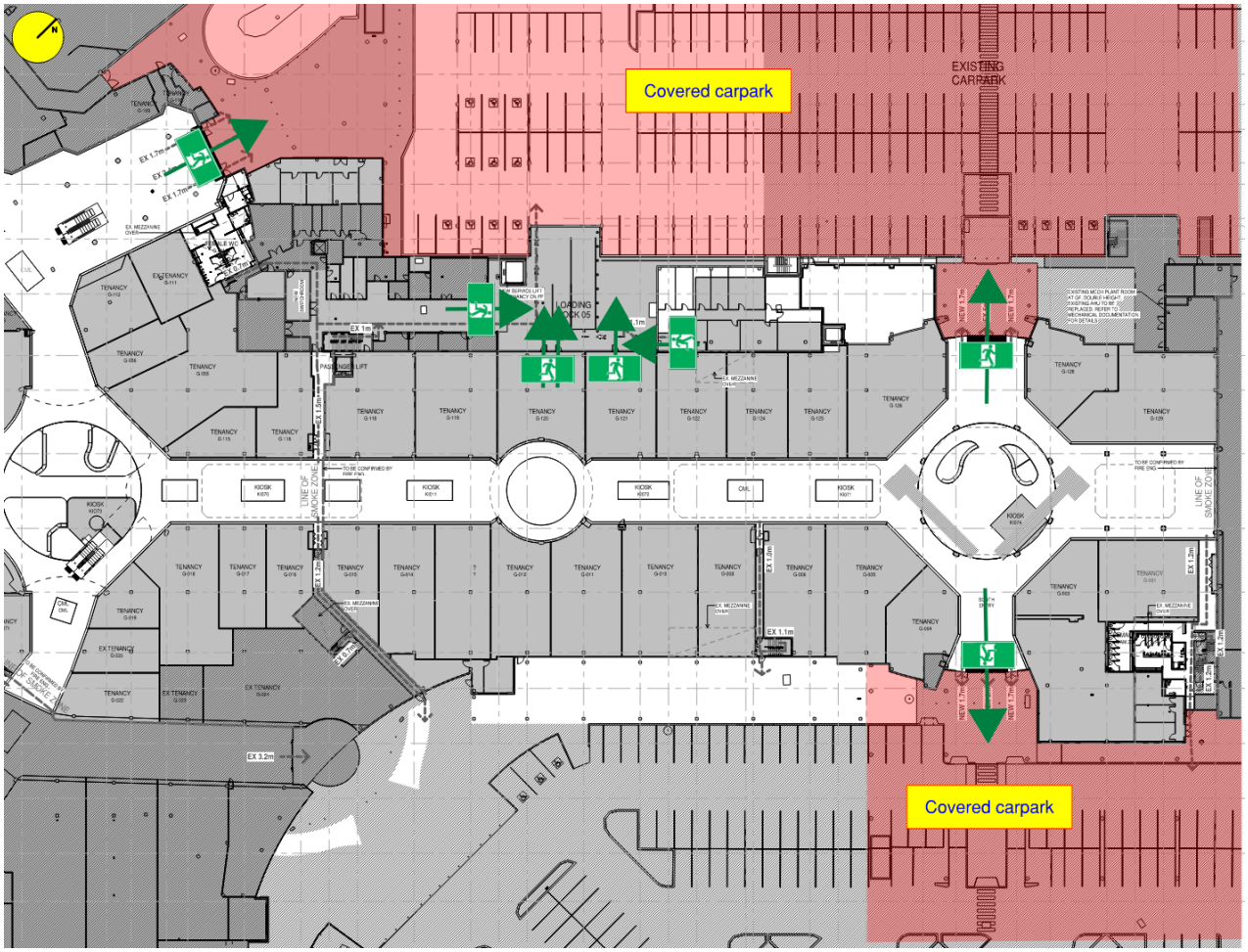


Figure 47: Performance-based non-fire-isolated exits discharging from Ground Floor

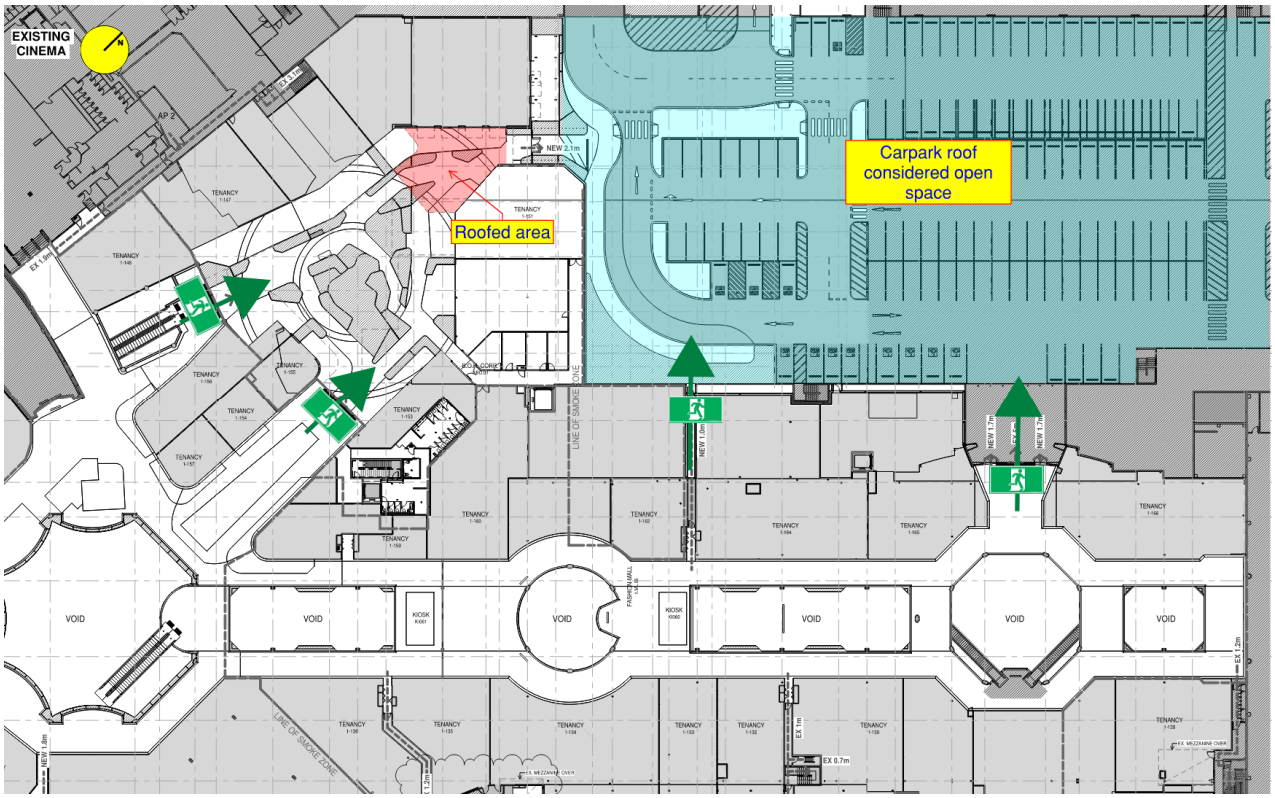


Figure 48: Performance-based non-fire-isolated exits discharging from First Floor

Travel distances in this assessment are measured either to internal stairways, fire-isolated passageways and to performance-based non-fire-isolated exits.

The performance-based non-fire-isolated exits are doorways opening into the covered carparks and into open spaces from where occupants need to travel either via covered carparks on Ground Floor or under a roofed area on First Floor before they reach a road or open space in lieu of directly to a road or open space, which does not comply with the DtS provisions of Clause D2D5(3)(a).

Performance-based discharge from internal stairways and fire-isolated passageways is subject of Performance Solution No. 7.

13.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P4 and E2P2.

13.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

13.5 Intent of the BCA

The intent of Performance Requirement D1P4 (formerly DP4), in accordance with the Guide to the BCA that provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020], is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is reasonable to conclude that once a person reaches an exit they should no longer be exposed to dangerous products of combustion and can safely reach a road or open space.

13.6 Assessment Methodology

The purpose of this assessment is to demonstrate that doorways that do not discharge directly to a road or open space may be considered performance-based non-fire-isolated exits and that travel distances can be measured to these doors instead of to the edge of the covered carparks on Ground Floor and the roofed area on First Floor.

If it can be demonstrated that during a fire in the retail (Class 6) or entertainment (Class 9b – cinemas) parts of the GSC once occupants leave the fire-affected part they would not be exposed to dangerous products of combustion and can safely evacuate through the covered carparks or under the roofed area, then compliance with Performance Requirements D1P4 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute, qualitative deterministic analysis in accordance with the following:

1. Identify the non-fire-isolated exits that discharge into the covered carparks and into open spaces from where occupants need to travel either via covered carparks on Ground Floor or under a roofed area on First Floor before they reach a road or open space.

2. Determine whether the spaces where occupants discharge could be compromised by a potential fire in Class 6 or Class 9b parts.

3. Identify fire scenarios that could compromise safe occupant evacuation through the covered carparks and the roofed area on First Floor and determine whether occupants need to evacuate via the fire-affected areas.

4. Determine whether fire brigade is facilitated, i.e. firefighters can connect to external fire hydrants safely before entering the fire-affected areas.

13.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Safe occupant evacuation through the covered carparks on Ground Floor and under the roofed area on First Floor shall not be compromised during a potential fire in the Class 6 or Class 9b parts of the GSC.*

2. *Fire brigade intervention shall be facilitated, i.e. shall not be exposed to dangerous products of combustion when they connect to external attack fire hydrants installed in or adjacent to the covered carparks.*

14. Performance Solution No. 4 – Extended Travel Distances from Areas not Provided with Automatic Smoke Exhaust

14.1 Relevant BCA DtS Provisions

BCA Clause D2D5(3)(a) states that in a Class 6 building "*no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*".

14.2 Performance Solution

The following areas within the GSC that are not prescribed to be provided with automatic smoke exhaust have extended travel distances:

1. Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m.
2. Travel distances from parts of the GF BoH area to a point of choice are extended up to 25 m in lieu of 20 m.
3. Travel distances from parts of the GF storage area to a single exit are extended up to 30 m in lieu of 20 m.
4. Travel distances from FF amenities (Male Amenities 1.AM.11, Parent Room 1.AM.0, Female Amenities 1.ST.03 and Male Amenities 1.ST.24) to a point of choice are extended up to 27 m in lieu of 20 m.
5. Travel distances from the GF BoH area to the nearest of the alterative exits are extended up to 50 m.

The dead-end travel distances therefore do not comply with the DtS provisions of Clause D2D5(3)(a).

14.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as D1P4 and E2P2.

14.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(d), i.e. "*comparison with the Deemed-to-Satisfy Provisions*".

14.5 Intent of the BCA

The intent of Performance Requirement D1P4 (formerly DP4), in accordance with the Guide to the BCA that provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020], is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that time plays a crucial role in safe occupant evacuation. The overall evacuation time consists of three (3) main components: detection time, pre-movement (response) time and egress (movement) time. Generally, if the egress time is increased due to extended travel distances, the detection and/or pre-movement times must be reduced to facilitate safe occupant evacuation.

14.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design with extended travel distances to a point of choice or a single exit should not compromise safe occupant evacuation and should not adversely affect fire brigade intervention.

The level of fire safety inherent in a BCA DtS compliant design represents an acceptable community standard for new building works in Australia.

If it can be demonstrated that in the performance-based design the RSET is shorter than in a BCA DtS complaint design, compliance with Performance Requirements D1P4 and E2P2 is achieved on a comparative basis.

The methodology adopted for the assessment is a quantitative and qualitative comparative analysis in accordance with the following:

1. In consultation with the building surveyor develop and document a hypothetical reference base case design that complies with the BCA DtS provisions and document the characteristics of the performance-based design. These designs are detailed in Table 20 below.

2. Calculate the detection time for the BCA DtS compliant design using module 'Sprinkler' from the FireWind 3.6 suite of fire safety engineering software. The detection time is based on the activation of automatic fire sprinkler system installed to AS 2118.1 and fitted with standard response sprinkler heads installed on a 3.0 m x 4.0 m grid.

3. Calculate the detection time for the performance-based design (areas where provision of smoke detectors may cause spurious alarms) using module Sprinkler from the FireWind 3.6 suite of fire safety engineering software. The detection time is based on the activation of automatic fire sprinkler system installed to AS 2118.1 and fitted with fast response sprinkler heads installed on a 3.0 m x 4.0 m grid.

4. Calculate the detection time for the performance-based design (specialty shops, amenities and BoH areas) using program CFAST. The detection time is based on the activation of fire detection and alarm system installed to AS 1670.1 and fitted with smoke detectors installed on a 10.0 m x 10.0 m grid.

5. Calculate travel times for the BCA DtS compliant design and the performance-based design.

6. Determine RSET for the BCA DtS compliant design and the performance-based design.

7. Compare RSET for the BCA DtS compliant design and the performance-based design. If the RSET for the performance-based design is less than or equal to that of the BCA DtS compliant design, then the relevant Performance Requirements of the BCA are satisfied.

14.7 Comparative Characteristics

The comparative characteristics of the BCA DtS compliant design and the performance-based design are summarised in Table 20 below:

Item	BCA DtS compliant design	Performance-based design
Building classification	Class 6 (Retail)	
Floor-to-ceiling height	3.6 m to 9.4 m	
Maximum travel distance to a point of choice or to a single exit	20 m	30 m
Maximum travel distance to the nearest of the alternative exits	40 m	50 m
Fire suppression	Automatic sprinkler system to AS 2118.1-1999	
	Standard response sprinkler heads on a 3.0 m x 4.0 m grid	Fast response sprinkler heads on a 3.0 m x 4.0 m grid (where smoke detectors could cause spurious alarms)
Fire detection and alarm in specialty shops, amenities and BoH areas	Automatic fire sprinkler system to AS 2118.1-1999 with standard response sprinkler heads	Smoke detectors to Clause S20C4 of BCA Specification 20; and Automatic fire sprinkler system to AS 2118.1-1999 with fast response sprinkler heads (where smoke detectors could cause spurious alarms)
Smoke exhaust	Not prescribed and not provided	
Building occupant warning	Building occupant warning to Clause 6 of BCA Spec. 20 and AS 1670.1-2018	EWIS to Clause E4D9(d) and AS 1670.4-2018

Table 20: Comparative characteristics for the BCA DtS compliant design and the performance-based design

14.8 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *RSET for the performance-based design shall be less or equal to the RSET for the BCA DtS compliant design:*

$$RSET\ (performance\text{-}based\ design) \leq RSET\ (BCA\ DtS\ compliant\ design).$$

14.9 Fire Scenarios

An important factor of a fire safety engineering assessment is identifying appropriate fire scenarios.

Extended travel distances are present in areas that may have different fire growth rates that may vary from ‘medium’ in amenities to ‘ultra-fast’ in some stores. Therefore, ‘medium’ and ‘ultra-fast’ t-squared growth fire rates are considered.

For the purpose of this comparative analysis the fire scenarios detailed in Table 21 were assessed.

Fire Scenario	Location of Fire	Fire Description
BCA DtS compliant designs		
BCD-11	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
BCD-12	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
BCD-21	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
BCD-22	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
Performance-based designs – sprinkler detection / smoke detection		
PBD-11-Spkl	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-12-Spkl	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-21-Spkl	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-22-Spkl	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-11-SD	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1-2015 on a 10 m by 10 m grid
PBD-11-SD	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid
PBD-21-SD	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid
PBD-22-SD	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid

Table 21: Summary of the fire scenarios

15. Performance Solution No. 5 – Performance-based Egress and Smoke Hazard Management Provisions in the Retail Malls

15.1 Relevant BCA DtS Provisions

The BCA sets out the following DtS requirements regarding travel distances and smoke hazard management systems:

1. Clause D2D5(3)(a) states that in a Class 5 to 9 building "*no point on the floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*".

2. Clause D2D6(c)(iii) states that in a Class 6 building the maximum distance between the alternative exits must not exceed 60 m.

3. Clause E2D15(2)(a) states that a building "*containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit*" in a fire compartment with a floor area greater than 2,000 m² must be provided with "*an automatic smoke exhaust system complying with Specification 21*".

4. Clause S21C2(2) of BCA Specification 21 state that smoke "*exhaust rates must be determined in accordance with Figure S21C2, with the height measurement taken from the lowest floor level to the underside of the smoke layer and the fire load determined in accordance with Table S21C2*".

5. Clause S21C4(2) of BCA Specification 21 states that "*the horizontal area of a smoke reservoir must not exceed 2,000 m^2 and in enclosed walkways or malls of a Class 6 building must not exceed 60 m in length*".

6. Clause S21C6(3) of BCA Specification 21 states that "*within a multi-storey fire compartment, make-up air must be provided across each vertical opening from a building void to the fire-affected storey at an average velocity of 1 m/s so as to minimise the spread of smoke from the fire-affected storey to other storeys*".

15.2 Performance Solution

The GSC is provided with multiple exits around the perimeter of the building. The multiple escape paths notwithstanding, egress provisions from parts of the centre that are prescribed to be provided with automatic smoke exhaust and from tenancies with paths of travel via areas that are prescribed to be provided with automatic smoke exhaust, and some smoke hazard management provisions, do not achieve full compliance with the BCA DtS provisions as outlined below.

1. Travel distances to the nearest of the alternative exits in multiple areas are extended up to 61 m in lieu of 40 m (refer to Figure 49 and Figure 50 below), which does not comply with the DtS provisions of BCA Clause D2D5(3)(a).

2. Distances between the alternative exits, when measured through a point of choice, are extended up to 118 m in lieu of 60 m (refer to Figure 51 and Figure 52 below), which does not comply with the DtS provisions of BCA Clause D2D6(c)(iii). When distances are measured between an exit and a "place of intermediate safety" or between "places of intermediate safety" they are extended only up to 86 m.

Figure 49: Travel distances to the nearest of alternative exits on Ground Floor

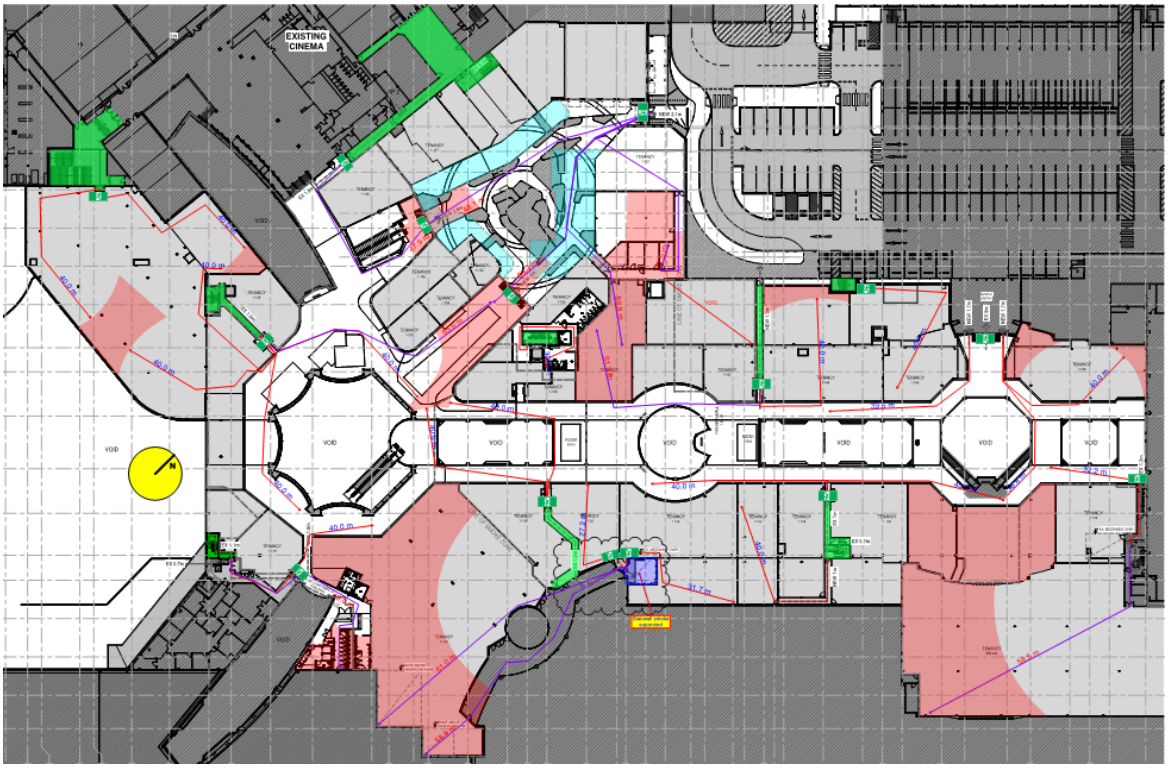


Figure 50: Travel distances to the nearest of alternative exits on First Floor

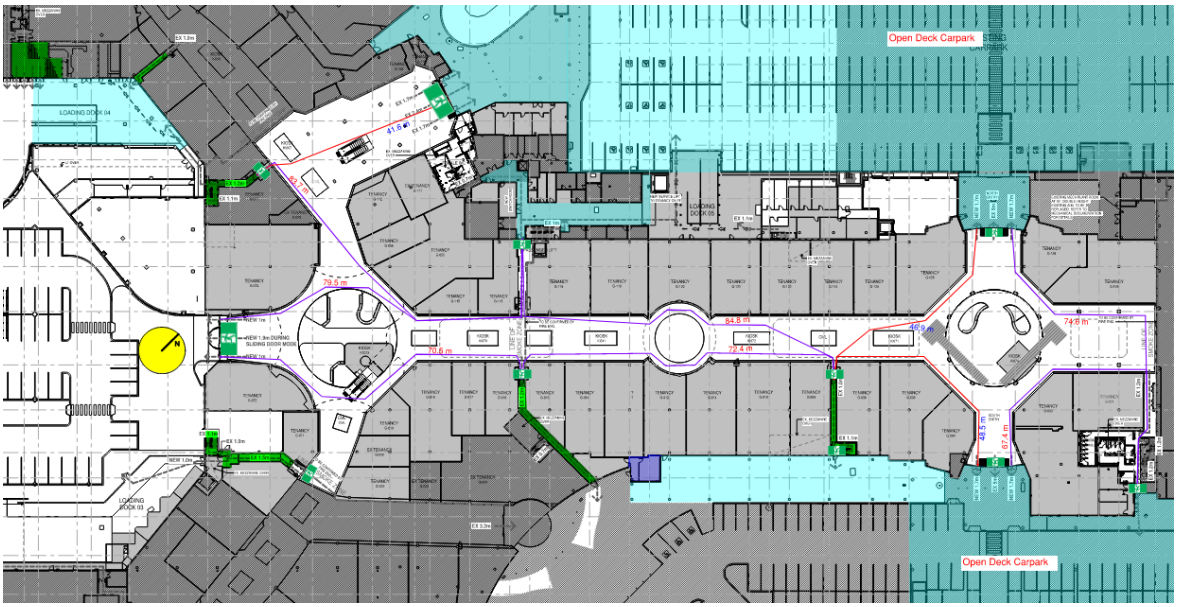


Figure 51: Distances between alternative exits when measured through a point of choice on Ground Floor

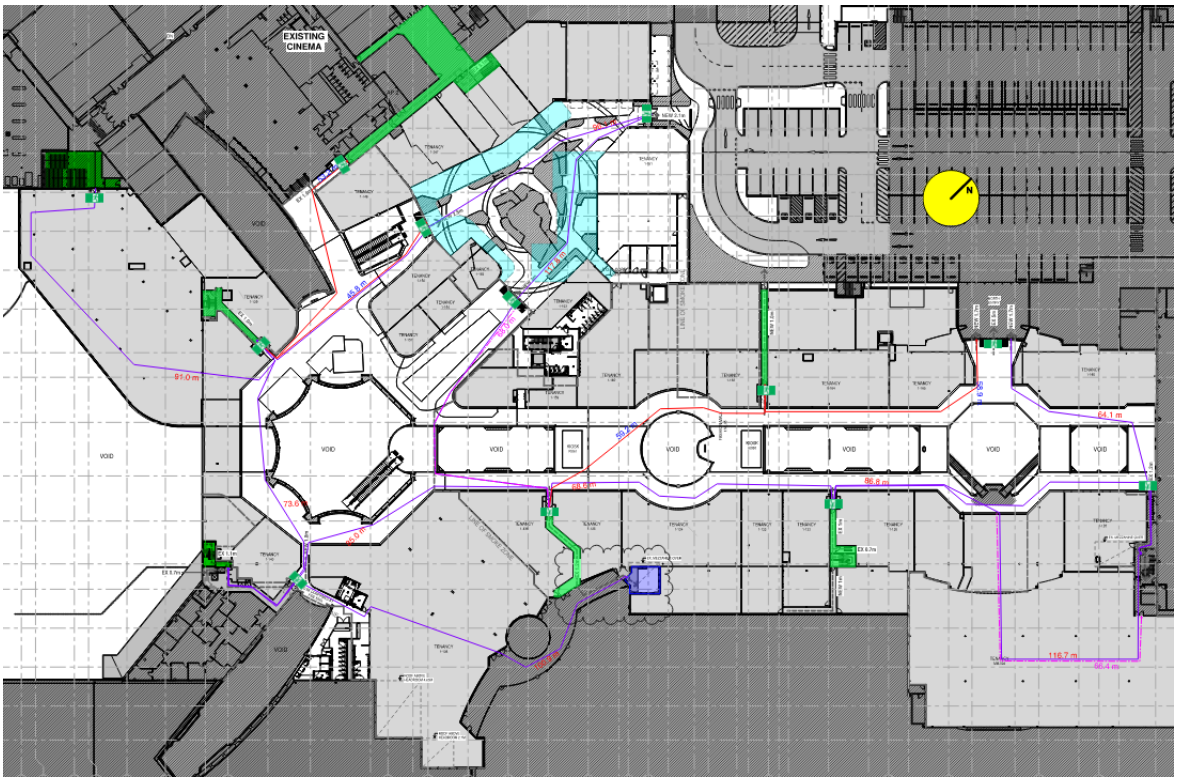


Figure 52: Distances between alternative exits when measured through a point of choice on First Floor

3. The smoke exhaust rates for the Myer retail mall and the Plaza (refer to the configuration of smoke zones as shown in Figure 53 below) are determined on a performance basis in lieu of compliance with Figure S21C2, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C2(2) of BCA Specification 21.

4. The Myer retail mall (smoke zones SZ-03(A), SZ-03(B) and SZ-03(C)) forms a single smoke reservoir with a horizontal length of 144 m in lieu of 60 m, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C4(2) of BCA Specification 21.

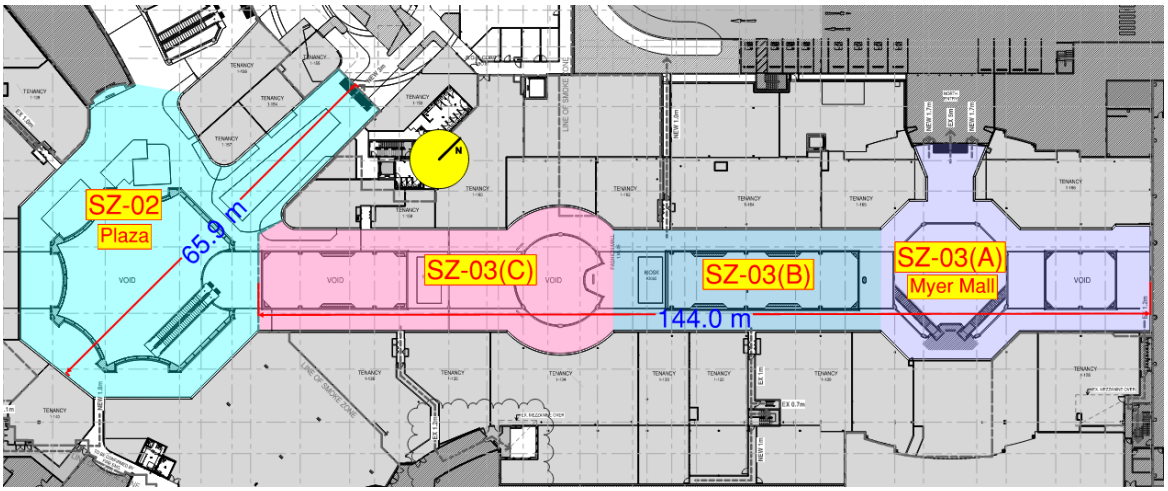


Figure 53: Extended length of smoke reservoirs

5. The Plaza and the associated retail mall (smoke zone SZ-02) form a single smoke reservoir with a horizontal length of 66 m in lieu of 60 m, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C4(2) of BCA Specification 21.

6. Make-up air velocities through vertical openings are determined on a performance basis in lieu of achieving an average velocity of 1 m/s, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C6(3) of BCA Specification 21.

15.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P4 and E2P2.

15.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e., "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

15.5 Intent of the BCA

The intent of Performance Requirement D1P4 is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that for a successful completion of an emergency evacuation a building must be provided with a smoke hazard management system that is appropriately sized and exits that are adequately located, sized and designed so as to provide occupants with safe means of egress from the fire affected areas.

The Guide states regarding the smoke reservoir size that the purpose of specifying maximum smoke reservoir size is because "*smoke reservoirs are necessary to contain the hot layer in the upper levels of compartments, thus preventing the lateral spread of smoke resulting in excessive cooling and downward mixing of the smoke with the relatively clear layer below*" and that in doing so, the design:

- *"enables occupants to make their way through the comparatively clear air below the hot smoke layer; and*
- *"maintains the smoke above any openings between compartments, thus minimising the risk that smoke will migrate to other areas."*

The Guide further states that "*to maximise the effectiveness of smoke reservoirs, the horizontal area formed by a reservoir is limited by Clause S21C4(2) to 2,000 m^2*" and that "*the maximum length of a smoke reservoir in a shopping mall is limited by Clause S21C4(2) to 60 metres, due to the distance people would be expected to travel below a smoke layer while evacuating to a safe place, having regard to the potential for smoke, from a fire in a mall or adjacent specialty shop, to flow into more than one reservoir.*"

The relevant BCA DtS provisions are intended to maintain tenable conditions so that occupants can evacuate and therefore if a building is provided with fire safety measures designed to maintain conditions tenable in the evacuation routes for the duration of the evacuation, including adequate safety factors, occupants should be able to leave the building safely, which satisfies the relevant Performance Requirements.

15.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design with extended travel distances to the nearest of the alternative exits and extended distances between the alternative exits in the parts of the GSC that are prescribed to be provided with automatic smoke exhaust, and a performance-based smoke hazard management system in the retail malls should not compromise safe occupant evacuation and should not adversely affect fire brigade intervention.

If it can be demonstrated that during a fire in the retail mall or in a specialty shop not provided with smoke exhaust the installed fire safety measures are capable of maintaining tenable conditions in the escape paths for a period of time sufficient for all occupants to leave the GSC, and fire brigade intervention is facilitated, compliance with Performance Requirements D1P4 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute quantitative deterministic assessment in accordance with the following:

1. Analyse the proposed egress provisions for the GSC identifying all exits, including exits directly to the outside of the building; fire-isolated stairways and corridors; etc.
2. Analyse the smoke hazard management systems in the retail malls, including the type of automatic fire sprinkler and fire detection and alarm systems, and the mechanical smoke exhaust and make-up air supply systems.
3. Identify reasonable worst-credible design fire scenarios, specifying the locations of fires that are expected to have the worst impact on occupant evacuation and fire brigades' intervention.

4. Identify reasonable worst credible sensitivity and/or redundancy fire scenarios. Fire brigade intervention for the sensitivity and redundancy fire scenarios is not considered, as the size of an uncontrolled fire could be beyond the extinguishing capacity of the first arriving units and would require multiple alarms transmitted to be brought under control. DFES operations in the early stages of sensitivity and redundancy fire scenarios are expected to be limited to search and rescue (if conditions permit) and/or protection of exposures.

5. Undertake fire and smoke modelling for the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria.

6. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters.

7. Compare the derived ASET and RSET to determine if the design is acceptable.

15.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *ASET calculated for the design fire scenarios must be equal to or greater than the RSET for the design fire scenarios incorporating a safety factor of 1.5:*

$$ASET \geq 1.5 \times RSET$$

2. *ASET calculated for the redundancy and sensitivity fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

3. *Routine conditions for fire fighters must be maintained up until fire brigade apply water to the fire for the design fire scenarios.*

15.8 Fire Scenarios Selection

The ASET is dependent on the fire characteristics, such as the fire growth rate, the heat release rate, the soot yield, the species concentrations, and the location of a fire. Therefore, an important factor in a fire safety engineering assessment is identifying appropriate fire scenarios.

The derivation of fire parameters (such as soot yield and heat release rate) is discussed in Section 10.3. It is recognised that modelling every possible fire location is not practical, however, the fire locations chosen are considered worst credible locations and appropriate for the analysis. The fire locations are discussed in Table 22 and are shown in Figure 54 below.

Fire Location		Comment
1	DF-01/RF-01/SF-01 In the Plaza atrium	A fire located under the Plaza atrium is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread.
2	DF-02/RF-02/SF-02 In the Myer Mall GF circulation space under the void	A fire located in the Myer Mall circulation space under the void is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread.

Fire Location		Comment
3	DF-03/RF-03/SF-03 In the Myer Mall atrium	A fire located under the Myer Mall atrium is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread.

Table 22: Fire locations

Figure 54: Fire locations

Based on the above fire locations, the discussion provided in Section 10.5 and accounting for the redundancy and sensitivity fire scenarios, the summary of fire scenarios that are assessed as part of this Performance Solution are provided in Table 23.

Fire scenario	Fire Location	Fire growth rate	Comment
WW-DF-01	In the Plaza Atrium – under 20.6 m high roof	Fast t^2 to medium t^2	Design fire scenario
WW-RF-01		Fast t^2 to medium t^2	Redundancy scenario – single plant room failure
WW-SF-01		Ultra-fast t^2 to fast t^2	Sensitivity fire scenario – increased fire growth rate
WW-DF-02	In the Myer Mall GF circulation space – under 8.8 m high roof	Fast t^2 to medium t^2	Design fire scenario
WW-RF-02		Fast t^2 to medium t^2	Redundancy scenario – single plant room failure
WW-SF-02		Ultra-fast t^2 to fast t^2	Sensitivity fire scenario – increased fire growth rate
WW-DF-03	In the Myer Mall Atrium – under 25.5 m high roof	Fast t^2 to medium t^2	Design fire scenario
WW-RF-03		Fast t^2 to medium t^2	Redundancy scenario – single plant room failure
WW-SF-03		Ultra-fast t^2 to fast t^2	Sensitivity fire scenario – increased fire growth rate

Table 23: Fire scenarios for the assessment

16. Performance Solution No. 6 – Performance-based Access to Fire-Isolated Corridor 03

16.1 Relevant BCA DtS Provisions

BCA Clause D2D12(1) states that "*a doorway from a room must not open directly into a passageway that is required to be fire-isolated unless it is from: a public corridor, public lobby or the like; a sole-occupancy unit occupying all of a storey; or a sanitary compartment, airlock or the like*".

16.2 Performance Solution

The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03), as shown in Figure 55, which does not comply with the DtS provisions of Clause D2D12(1).

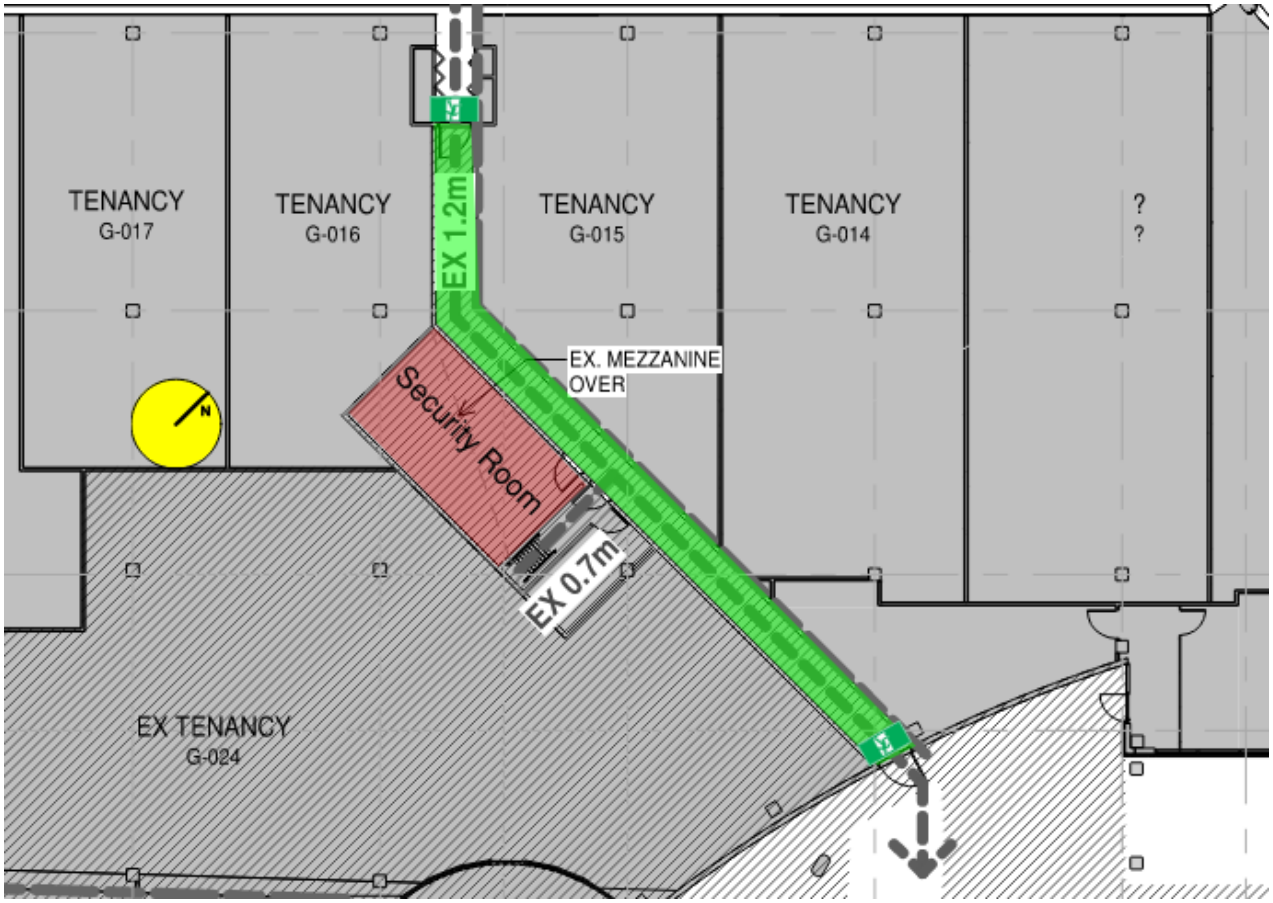


Figure 55: Security room open directly into fire-isolated corridor 03

16.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P5 and E2P2.

16.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

16.5 Intent of the BCA

The intent of Performance Requirement D1P5 (formerly DP5) is to provide fire-isolated exits, where necessary, to facilitate safe evacuation of occupants and fire brigade intervention. The Guide to BCA states that fire-isolated exits are used to:

- "*Enable people to evacuate safely past a storey on fire*;
- *"Facilitate fire brigade access to carry out operations such as search and rescue and fire-fighting*;
- *"Minimise the distance people need to travel in a fire affected area before they are able to access a "safe place", such as a fire-isolated stairway*."

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident from the above that fire-isolated exits are required to provide occupants with safe means of egress while reducing the time they might have to travel through the fire affected areas, as well as facilitating fire brigade's personnel fast and safe access to these areas. However, to understand how doorways opening directly into a fire-isolated exit from a room that does not occupy the whole storey could impact safe evacuation of the occupants the intent of Clause D2D12(1) (formerly D1.7(a)) must be understood.

The Guide to the BCA indicates that the intent of Clause D1.7 is "*to enable occupants to safely enter a fire-isolated exit which discharges to a safe location*", and the intent of sub-clause (a) is "*to limit the number of entry points into a fire-isolated exit to retain its fire resisting performance*".

The BCA DtS provisions allow a public corridor, public lobby [smoke lobby], or the like, as well as a "*sole-occupancy unit occupying all of a storey*" to open directly into a fire-isolated exit. It is reasonable to assume that a public corridor and to a lesser degree a retail mall in a shopping centre should have a performance that is not dissimilar to that of a smoke lobby, as they are reasonably free of combustible materials and create a buffer between the fire affected area and a fire-isolated exit. However, it is not clear why a "*sole-occupancy unit occupying all of a storey*" can open directly into a fire-isolated exit and one that does not, cannot provide direct access. The Guide to the BCA remains silent on this issue.

It is understood that independent of a floor/storey configuration the main intent of the BCA in relation to access to fire-isolated exits is to protect occupants using these exits from dangerous combustion products, so the building can be evacuated safely. This can be achieved only if the doors to fire-isolated exits remain closed and an effective barrier to smoke spread is provided.

It is understood that the main concern of the BCA, as reflected in Clause D1.7(a), is that sole-occupancy units that do not occupy the whole of a storey are generally smaller tenants, who may not be concerned with keeping the door to the fire-isolated exit closed, as they may use it regularly to move stock, access other parts of the building, or even use it for ventilation. Hence with several smaller tenants occupying the same floor/storey the risk of a door being left open multiplies.

Sole-occupancy units occupying the whole of a storey are generally major tenants who take particular care of their security arrangements. In such tenancies the likelihood of a door opening into a fire-isolated exit being left open is significantly reduced, as keeping a door properly closed becomes self-regulatory due to security reasons.

16.6 Assessment Methodology

The purpose of this assessment is to demonstrate that safe occupant evacuation of building occupants and fire brigade intervention should not be compromised due to a room that does not occupy the whole of a storey opening directly into a fire-isolated corridor.

If it can be demonstrated that during a potential fire occupants from the existing security room and MDF room on Ground Floor and from the existing plant room AP7 on Ground Floor Mezzanine can evacuate safely via fire-isolated corridor 03 and occupants elsewhere in the GSC are provided with adequate warning that evacuation via fire-isolated corridor 03 should be avoided, and fire brigade personnel are provided with alternative access routes to the fire affected area, then compliance with Performance Requirements D1P5 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute qualitative deterministic analysis in accordance with the following:

1. Identify the doorway that opens into fire-isolated corridor 03 directly from a room that does not occupy a whole storey.
2. Identify occupants who have to or may be evacuating via fire-isolated corridor 03.
3. Develop a fire safety strategy that would limit the potential for smoke spread into fire-isolated corridor 03 in the initial stages of fire development and would also enable occupants from other rooms and parts of the GSC either to evacuate via the corridor safely or avoid evacuation via this corridor altogether.
4. Identify alternative access routes for fire brigade and determine whether their intervention is facilitated.
5. If the adopted fire safety strategy limits the potential for smoke spread into fire-isolated corridor 03, provides an adequate warning to occupants that would enable them to evacuate safely and facilitates fire brigade intervention, then compliance with the relevant Performance Requirements of the BCA is achieved.

16.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *Smoke from security room shall not spread into fire-isolated corridor 03 in the initial stages of fire development.*
2. *Occupants who have to evacuate via fire-isolated corridor 03 shall be provided with timely and adequate warning that tenability conditions in the corridor may be quickly compromised due to a fire in the security room.*
3. *Occupants in other parts of the GSC shall be provided with adequate warning that evacuation via fire-isolated corridor 03 may not be safe and alternative escape routes shall be used.*

4. *Fire brigade shall be provided with alternative access routes to the GSC that do not involve travel via fire-isolated corridor 03.*

17. Performance Solution No. 7 – Performance-based Discharge from Fire-Isolated Exits

17.1 Relevant BCA DtS Provisions

BCA Clause D2D12(2) in part states that "*each fire-isolated stairway or fire-isolated ramp must provide independent egress from each storey served and discharge directly, or by way of its own fire-isolated passageway— (a) to a road or open space; or (b) to a point— (i) in a storey or space, within the confines of the building, that is used only for pedestrian movement, car parking or the like and is open for at least 2/3 of its perimeter; and (ii) from which an unimpeded path of travel, not further than 20 m, is available to a road or open space*".

17.2 Performance Solution

First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) from where occupants need to use a required non-fire-isolated stairway to leave the building (refer to Figure 56) in lieu of to a road or open space, which does not comply with the DtS provisions of Clause D2D12(2)(a).

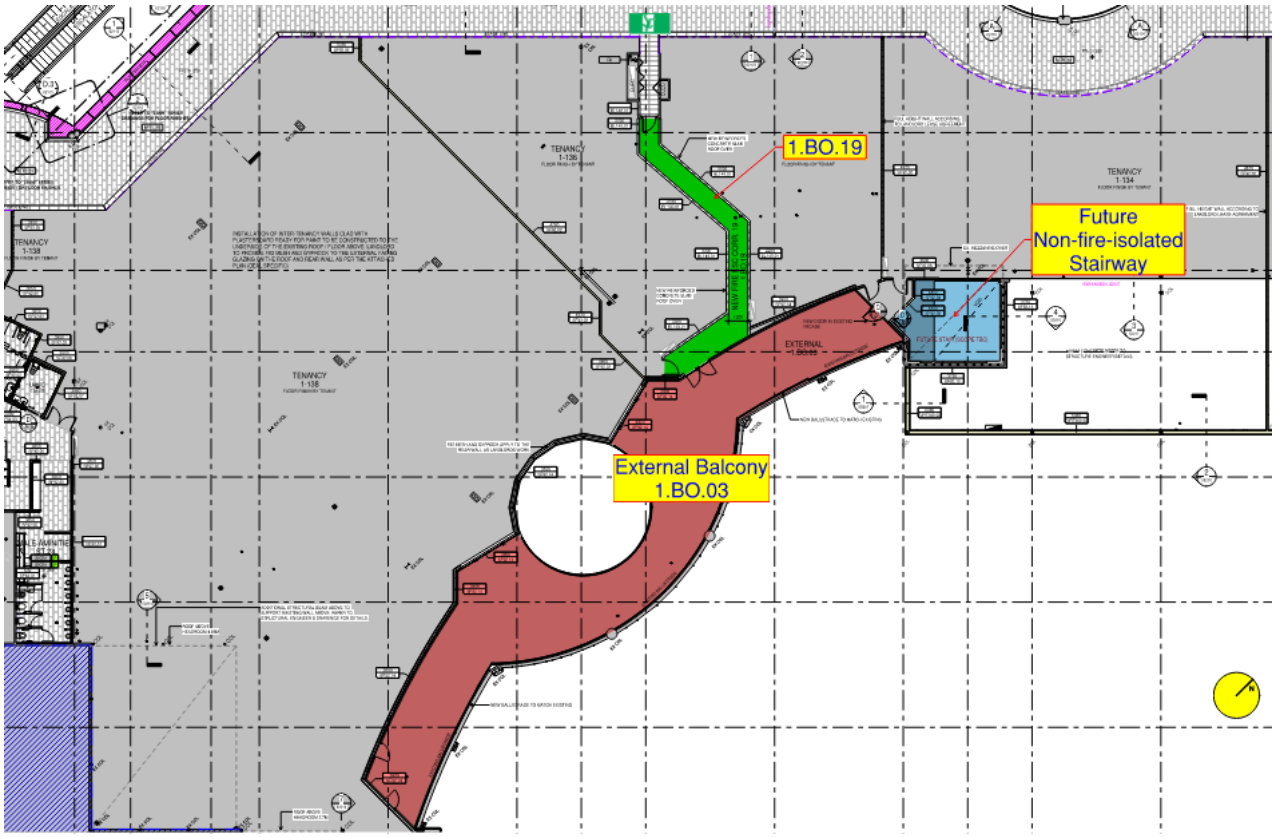


Figure 56: Fire-isolated corridor 19 that discharges onto an external balcony

Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space (refer to Figure 57, where the extent of the loading dock is highlighted red, and Figure 58 below), which does not comply with the DtS provisions of Clause D2D12(2)(b).

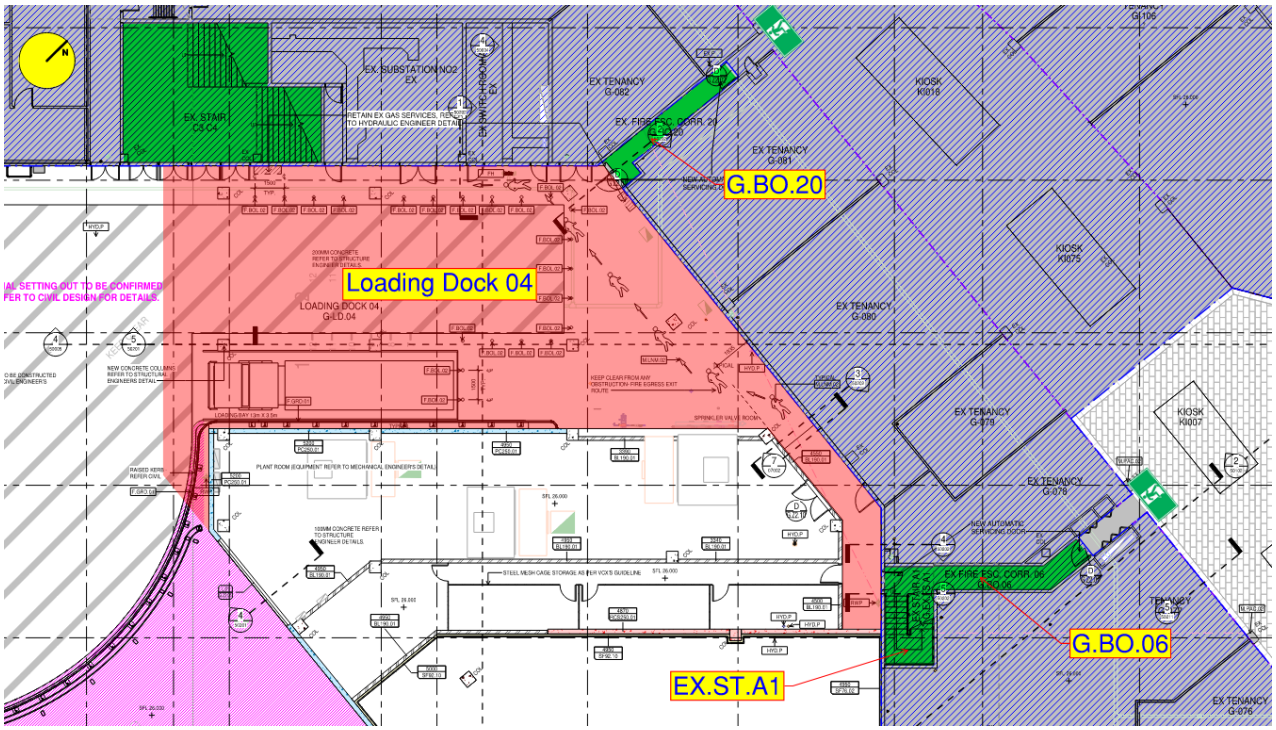


Figure 57: Fire-isolated corridors 06 and 20 that discharge into Loading Dock 04 on Ground Floor

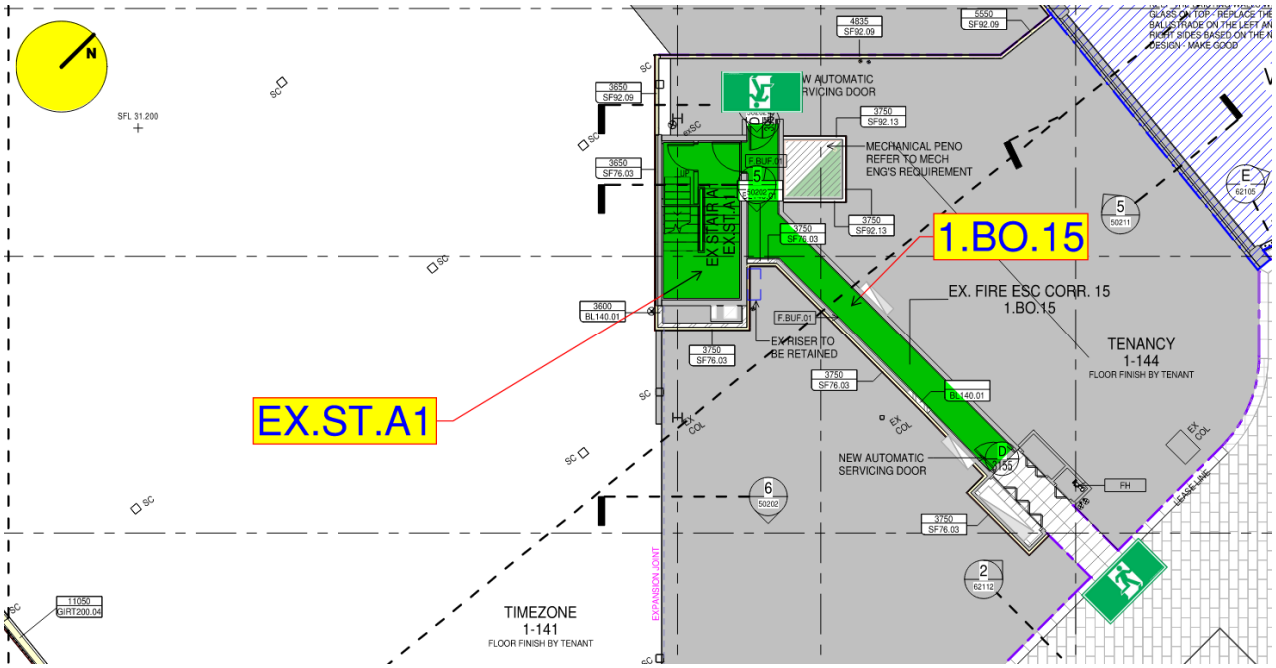


Figure 58: Fire-isolated corridor 15 that discharges into fire-isolated Stair A1 on First Floor

17.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P5 and E2P2.

17.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

17.5 Intent of the BCA

The intent of Performance Requirement D1P5 (formerly DP5) is to provide fire-isolated exits, where necessary, to facilitate safe evacuation of occupants and fire brigade intervention. The Guide to BCA states that fire-isolated exits are used to:

- "*Enable people to evacuate safely past a storey on fire*;
- *"Facilitate fire brigade access to carry out operations such as search and rescue and fire-fighting*;
- *"Minimise the distance people need to travel in a fire affected area before they are able to access a "safe place", such as a fire-isolated stairway*."

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident from above that fire-isolated exits in a building are required to provide occupants with safe means of egress while reducing the time they might have to travel through the fire affected areas, as well as facilitating fire brigade's personnel fast and safe access to these areas.

The Guide to the BCA indicates that the intent of Clause D2D12 (formerly D1.7) is "*to enable occupants to safely enter a fire-isolated exit which discharges to a safe location*". While the BCA allows fire-isolated exits to discharge into semi-enclosed parts of the building provided with adequate openings "*to aid smoke ventilation*", the path of travel from the point of discharge of a fire-isolated exit must be adequately protected from combustion products so occupants may reach a road or open space safely.

17.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design should facilitate safe occupant evacuation and fire brigade intervention even though some fire-isolated exits discharge into areas that do not comply with the BCA DtS provisions.

It is considered that if it can be demonstrated that occupants do not have to evacuate via the fire-escape corridors that discharge into areas that do not comply with the BCA DtS provisions if a fire stars in those areas, and alternative escape paths that would facilitate safe occupant evacuation are available, and fire brigade personnel are provided with alternative access routes, then compliance with Performance Requirements D1P5 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute qualitative deterministic analysis in accordance with the following:

1. Identify where fire-isolated exits discharge into non-compliant locations and assess the configuration of those spaces.
2. Identify fire scenarios that could occur in those spaces, and whether they could compromise safe occupant evacuation from the fire-isolated exits.
3. Identify occupants who have to or may be evacuating via the subject fire-isolated exits.

4. Develop a fire safety strategy that would allow occupants from the rooms that discharge into the subject fire-isolated exits and from other parts of the GSC to evacuate the building safely.

5. Identify alternative access routes for fire brigade intervention and determine whether their intervention is facilitated.

6. If the adopted fire safety strategy provides an adequate warning to occupants that would enable them to evacuate safely and facilitates fire brigade intervention, then compliance with the relevant Performance Requirements of the BCA is achieved.

17.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *Occupants from plant room AP4 on Ground Floor Mezzanine and from Tenancy 1-144 on First Floor shall be provided with timely and adequate warning that conditions in Loading Dock 04 may not be tenable and evacuation via fire-isolated corridors 06 and 15 may not be safe and shall be provided with an alternative escape path.*

2. *Occupants in other parts of the GSC shall be provided with adequate warning that evacuation via fire-isolated corridors 06, 15, 19 and 20 may not be safe and alternative escape routes shall be used.*

3. *Fire brigade shall be provided with alternative access routes to the GSC that do not involve travel via fire-isolated corridors 06, 15, 19 and 20.*

18. Performance Solution No. 8 – Performance-based Fire Hydrant System

18.1 Relevant BCA DtS Provisions

BCA Clause E1D2(2) states that a fire hydrant system must be installed to AS 2419.1-2021.

Clause 3.5.1(b) of AS 2419.1-2021 states that where external fire hydrants are installed, fire hydrant coverage from an external attack fire hydrant shall be used to achieve coverage to the lowest four storeys included in the calculation of the rise in storeys in compliance with the DtS provisions of the NCC and the storey immediately below these storeys, provided all parts of the building are covered.

Clause 3.5.1(c) of AS 2419.1-2021 states that where all parts of the building are not covered by external hydrants in accordance with (b), internal fire hydrants located in accordance with Clause 3.6.2 shall be installed to provide coverage to those arts of the building not protected by external fire hydrants.

Clause 3.5.3.3(a)(i) of AS 2419.1-2021 states that each external attack fire hydrant shall be located not more than 50 m from a fire brigade pumping appliance located on a hardstand.

Clause 3.5.3.3(a)(ii) of AS 2419.1-2021 states that each external attack fire hydrant shall be located less than 100 m from a fire brigade pumping appliance located on a hardstand when providing fire hydrant protection from— (A) a podium; (B) to a building that is provided with a sprinkler system conforming to AS 2118.1; and (C) to a Class 9c building.

Clause 3.5.3.3(b) of AS 2419.1-2021 states that all parts of a building that are protected by an external attack fire hydrant located in accordance with Item (a)(i) (not more than 50 m from a fire brigade pumping appliance located on a hardstand), shall be not more than 70 m from the external attack fire hydrant.

Clause 3.5.3.3(c) of AS 2419.1-2021 states that all parts of a building that are protected by an external attack fire hydrant located in accordance with Item (a)(ii) (less than 100 m from a fire brigade pumping appliance located on a hardstand), shall be not more than 40 m from the external attack fire hydrant.

Clause 3.6.1(e) of AS 2419.1-2021 states that where internal fire hydrants are installed, all parts of the floor shall not be more than 40 m from an internal fire hydrant installed in accordance with Clause 3.6.2.

Clause 3.6.2(a)(ii) of AS 2419.1-2021 states that where fire-isolated exits are provided, internal fire hydrants shall be located in every required fire-isolated exit, other than where coverage is provided in accordance with Clause 3.5.1, regardless of the number of fire hydrants needed to provide coverage.

Clause 3.6.2(b) of AS 2419.1-2021 states that where required non-fire-isolated exits are provided, internal fire hydrants shall be located not more than 4 m 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.

Provisions of AS 2419.1-2021 notwithstanding, DFES requests that performance-based fire hose coverage is measured based on the provisions of AS 2419.1-2005, i.e. each hose length used shall be 30 m, and 10 m hose stream with at least 1 m of hose extended into the last protected room is considered. This requirement is reflected in the DFES Built Environment Branch (BEB) Info Note: "*Variations to AS 2419.1:2021 fire hydrant installations based on the FES Commissioner's Operational Requirements*".

18.2 Performance Solution

Fire hose coverage to the GSC is provided from external and internal attack fire hydrants. External fire hydrants are located outside the footprint of the building and internal fire hydrants are located in the retail malls, the existing open-deck carpark on the north-west side of the centre and in the new Loading Dock 04 (refer to the fire hose coverage diagrams in Appendix D).

Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m, which does not comply with the provisions of Clause 3.5.3.3(b) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m, which does not comply with the provisions of Clause 3.5.3.3(c) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m, which does not comply with the provisions of Clause 3.6.1(e) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Internal fire hydrants are not located in every fire-isolated exit, which does not comply with the provisions of Clause 3.6.2(a)(ii) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Internal fire hydrants installed in retail malls are provided more than 4 m from required exits, which does not comply with the provisions of Clause 3.6.2(b) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

18.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P3.

18.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

18.5 Intent of the BCA

The intent of Performance Requirement E1P3 (formerly EP1.3) is to install a fire hydrant system that is capable of providing "*adequate water, under sufficient pressure and flow, to allow the fire brigade to fight fires*".

The Guide to the BCA highlights that fire hydrant systems "*are intended for use only by a fire brigade"* and stresses that compliance with the DtS provisions of Clause E1D2 (formerly E1.3) is not compulsory if alternative means can be found to satisfy the appropriate authority that Performance Requirement E1P3 is satisfied.

It is reasonable to assume that an extra length of hose from internal and external fire hydrants required to achieve complete fire hose coverage and/or the performance-based locations of fire hydrants may have an adverse impact on fire brigade intervention.

It is therefore necessary to consult with the local fire brigade to determine whether a performance-based fire hydrant system facilitates their intervention. DFES are the main authority in Western Australia that can provide expert advice in regard to fire brigade intervention requirements.

18.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based fire hose coverage with 2 lengths of hose from internal fire hydrants, 3 lengths of hose from external fire hydrants and hydrants installed on the podium, fire hydrants not provided in every fire-isolated exits and internal fire hydrants located more than 4 m from non-fire-isolated exits do not have an adverse impact on DFES intervention.

If DFES confirm that the performance-based aspects of the fire hydrant system facilitate their intervention, then compliance with Performance Requirement E1P3 is achieved.

The methodology adopted for this assessment is an absolute, qualitative deterministic analysis in accordance with the following:

1. Identify configuration of the fire hydrant system and locations of the onsite attack fire hydrants.
2. Assess the performance-based locations of fire hydrants installed more than 4 m from non-fire-isolated exits and the potential impact these locations may have on firefighting operations.
3. Assess the ability of the fire brigade to identify where additional hose may be required to achieve coverage and the impact on fire brigade operations.
4. Review the water supply capacity and the performance of the fire hydrant system to ascertain the required demand is available.
5. Consult with DFES in regard to the proposed fire safety strategy and determine whether their intervention is facilitated.

18.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *External attack fire hydrants at street level shall be located not more than 50 m from a DFES pumping appliance parked on a hardstand.*
2. *External attack fire hydrants located on the podium (the roof of the north-east open-deck carpark) shall be located not more than 100 m from a DFES pumping appliance parked on a hardstand.*

3. *Internal attack fire hydrants shall be located not more than 25 m from exits.*

4. *Where additional internal attack fire hydrants are required in the retail mall, they shall be located not more than 25 m from the hydrants that are located within 25 m from exits.*

5. *Extended fire hose coverage to the building must facilitate DFES intervention, i.e.:*

    a. *All parts of the building shall be not more than 90 m from external attack fire hydrants; and*

    b. *Where parts of the building cannot be reached with hose connected to external attack fire hydrants, these parts shall be not more than 60 m from internal attack fire hydrant installed in the retail malls.*

    c. *The length of fire hose laid inside the building must not exceed 60 m.*

    d. *At least 1 m of hose must extend into the furthermost protected room.*

6. *The flow and pressure at the discharge outlets of the attack fire hydrants shall comply with the requirements of AS 2419.1-2021, i.e. 15 l/sec flow @ 700 kPa pressure without the use of a fire brigade pumping appliance and 30 l/s flow @ 700 kPa pressure when boosted by a fire brigade pumping appliance.*

7. *Signage must be provided to enable DFES identify the areas that require additional length of fire hose to achieve complete coverage.*

19. Performance Solution No. 9 – Performance-based Attack on Fire by Building Occupants

19.1 Relevant BCA DtS Provisions

BCA Clause E1D3(2)(a) states that a fire hose reel system must be provided to serve the whole building where one or more fire hydrants are installed.

19.2 Performance Solution

Fire hose coverage to the GSC is provided both from internal and external attack fire hydrants; hence fire hose reels are prescribed.

Fire hose reels in the refurbished and extended parts of the GSC (areas highlighted pink and cyan in Figure 59 and Figure 60 below) are not provided and the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, which does not comply with the DtS provisions of Clause E1D3(2)(a).

Figure 59: Areas where fire hose reels are omitted on Ground Floor

19.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P1.

19.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

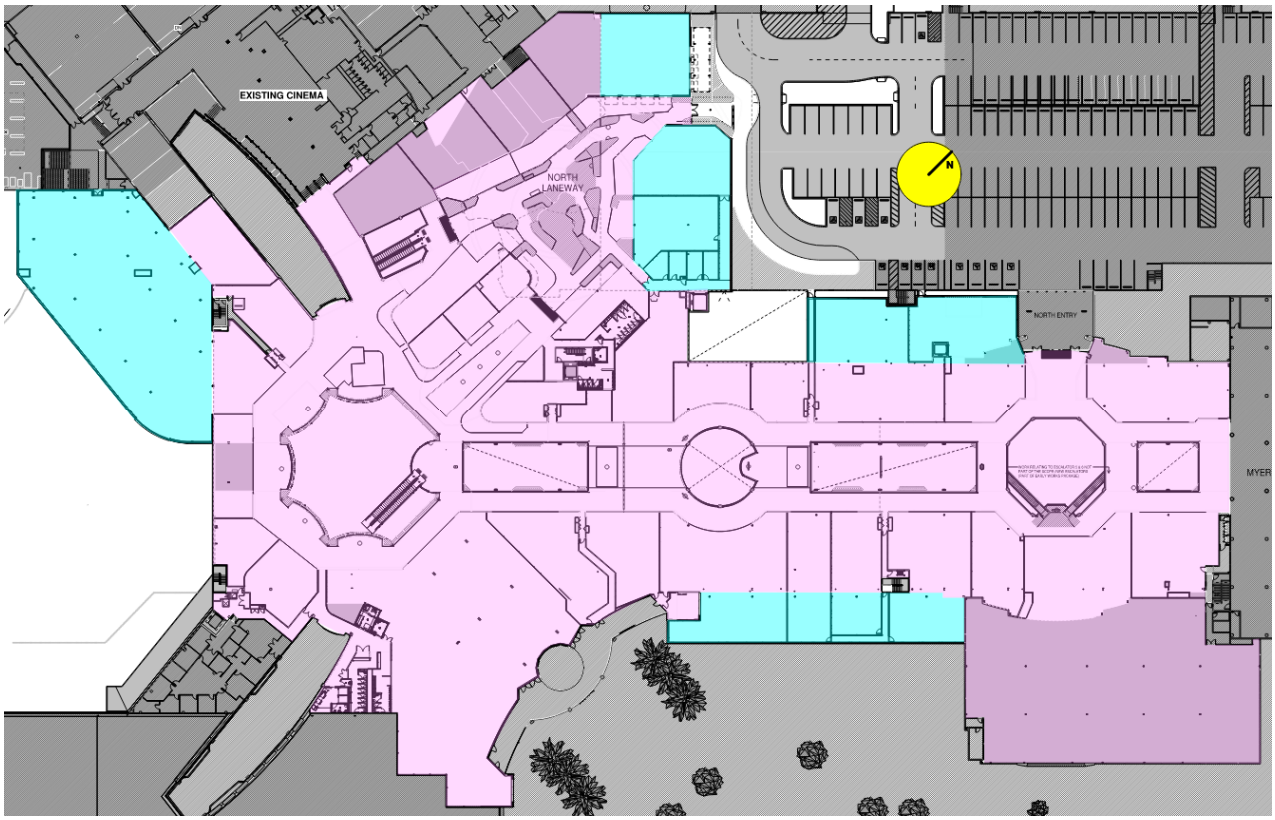


Figure 60: Areas where fire hose reels are omitted on First Floor

19.5 Intent of the BCA

The intent of Performance Requirement E1P1 (formerly EP1.1) is to allow occupants to fight fire in the initial stages of its development, which "*may reduce the hazard, allow more time for evacuation and prevent structural damage*". The Guide to the BCA also indicates that fire hose reels "*must be installed when necessary, and be appropriate to a number of factors, including*:

- *the size of the fire compartment which is a measure of the size of any potential fire;*
- *the function of the building will affect the fire load in the building;*
- *the fire-safety systems which can affect the rate of fire spread (e.g. if a sprinkler system is installed in a building, it should extinguish the fire or reduce its growth rate); and*
- *the fire hazard which means the danger in terms of potential harm and degree of exposure arising from the start and spread of fire, and the smoke and gases generated by a fire*".

The Guide to the BCA stresses that compliance with BCA Clause E1D3 (formerly E1.4) is not compulsory if alternative means can be found to satisfy the appropriate authority that Performance Requirement E1P1 is satisfied.

It is evident that fire hose reels are provided for occupants to commence the initial attack on a fire. The above notwithstanding, the design must adequately address occupant safety. It is therefore reasonable to conclude that if deployment of a fire hose reel could potentially compromise occupant safety, alternative means of initial attack on a fire may be more appropriate.

19.6 Assessment Methodology

The purpose of this assessment is to demonstrate that omission of fire hose reels will not have an adverse impact on the ability of occupants to fight fire in the initial stages of its development.

If it can be demonstrated that provision of portable fire extinguishers in lieu of fire hose reels facilitates the initial occupant attack on a fire, then compliance with Performance Requirement E1P1 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative deterministic analysis in accordance with the following:

1. Develop a fire safety strategy to facilitate occupants' initial attack on a fire and assess the following aspects of the provision of portable fire extinguishers:

    a. Class of fire risk that portable fire extinguishers are suitable for, and the typical fire risks expected to be present in the building, including forklifts.

    b. Usability of portable fire extinguishers with regard to approaching the fire.

    c. The risk of users of portable fire extinguishers impeding their own egress or the egress of others.

19.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Occupants shall be provided with adequate fire safety measures that would facilitate their initial attack on a fire.*

20. Performance Solution No. 10 – Omission of Sprinklers from Skylights and External Covered Area

20.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17 and Specification 18 as applicable.

Clause S17C2(a) of BCA Specification S17 states that an automatic sprinkler system must comply with AS 2118.1-2017.

Clause 3.1.2 of AS 2118.1-2017 states that for a building to be classified as a sprinkler protected building, the building shall be sprinkler protected throughout, other than where exceptions are permitted in Clause 3.1.3. Clause 3.1.3 does not provide an exemption for omission of sprinklers under skylights.

20.2 Performance Solution

Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy (areas highlighted red in Figure 61 and Figure 62, respectively), which does not comply with the DtS provisions of Clause 3.1.2 of AS 2118.1-2017 and the DtS provisions of Clause S17C2(a) of BCA Specification S17 and Clause E1D4(b).

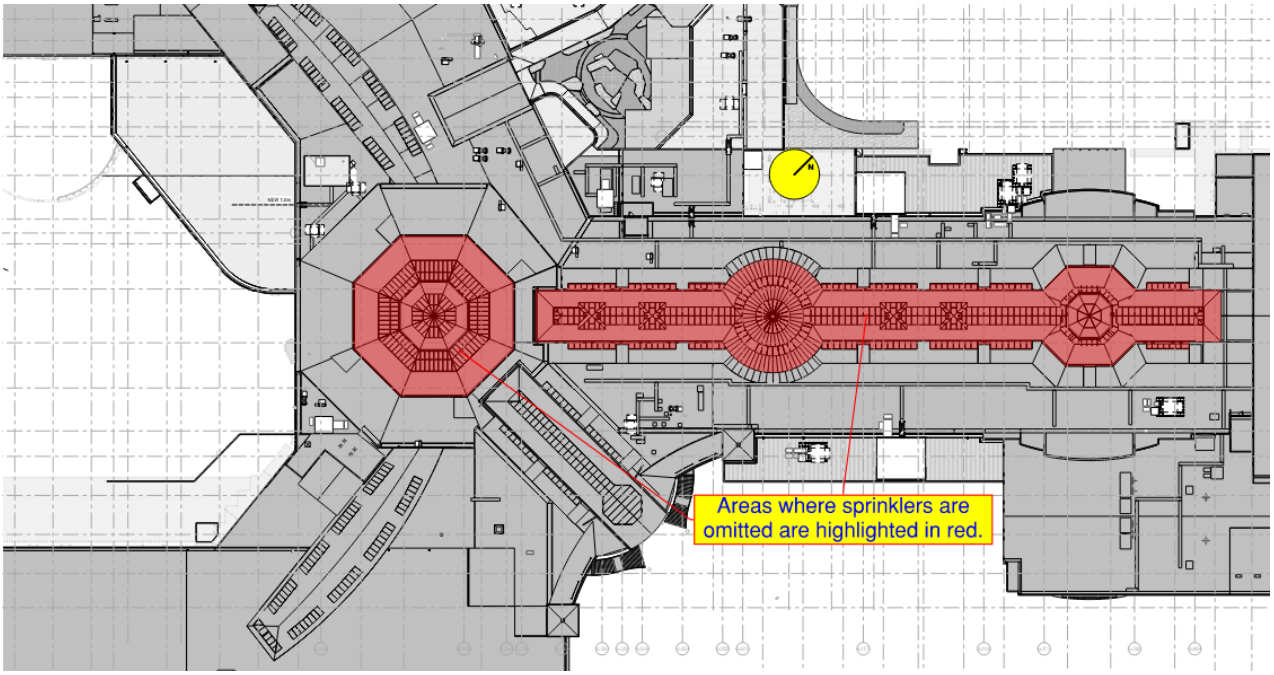


Figure 61: Omission of sprinkler from Plaza and Myer mall skylights

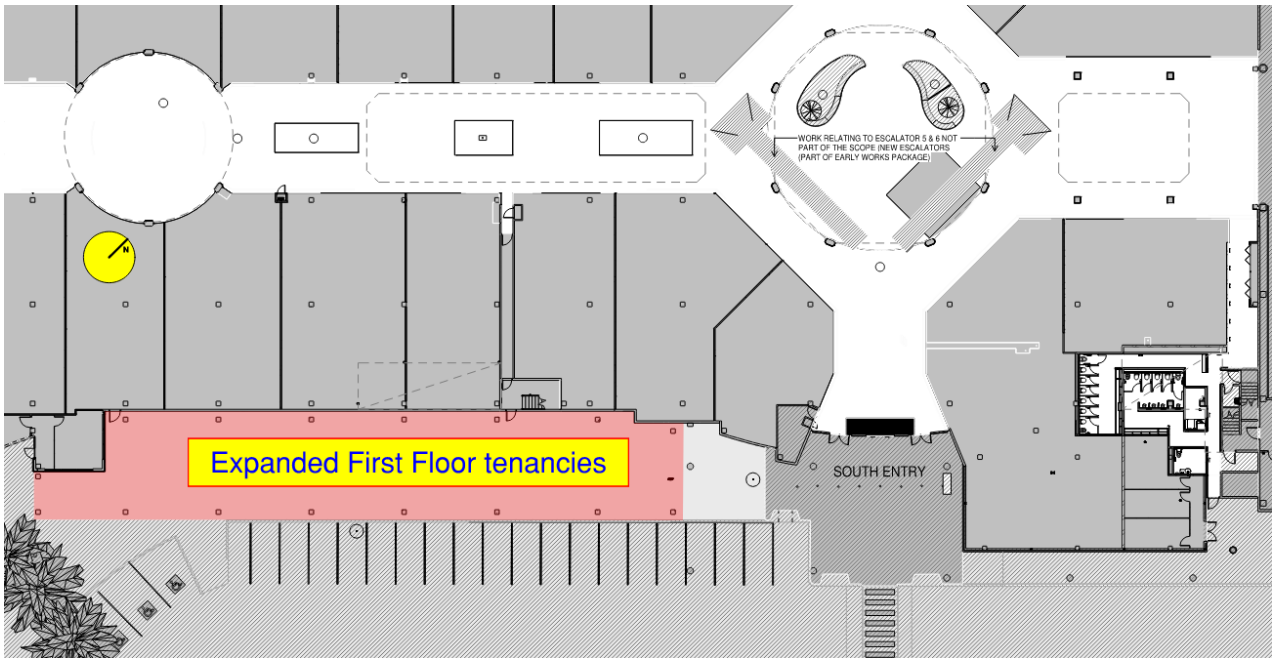


Figure 62: Omission of sprinkler below new extended tenancies on First Floor

20.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as E1P4 and E2P2.

20.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

20.5 Intent of the BCA

The intent of Performance Requirement E1P4 (formerly EP1.4) is "life safety and fire suppression".

Performance Requirement E1P4 uses the term "*to the degree necessary*". The Guide to the BCA states that the use of this term means that the "*BCA recognises that not all buildings need an automatic fire suppression system*".

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that parts of a building that present a very low fire risk or where the height of the roof above the fire seat would result in significant delay in sprinkler activation may not need sprinkler protection to satisfy Performance Requirements E1P4 and E2P2, as long as adequate fire safety measures are provided to warn occupants of a potential fire and facilitate their evacuation; to minimise the risk of fire spread throughout the building; and to facilitate fire brigade intervention.

20.6 Assessment Methodology

The purpose of this assessment is to demonstrate that omission of sprinkler protection from selected areas in an otherwise sprinkler protected building would not result in a fire that could spread uncontrolled through the rest of the building.

If it can be demonstrated that a fire originating in an area that is not provided with sprinkler protection will not spread to adjacent areas and occupant evacuation during a fire that is not sprinkler controlled is facilitated, then compliance with Performance Requirement E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative and quantitative deterministic analysis in accordance with the following:

1. Determine the type of sprinkler system provided in the retail mall and identify areas where sprinkler protection is not provided.
2. Identify worst-case fire scenarios that could occur in the retail mall where sprinkler protection is not provided, i.e. fires involving kiosks or displays, including vehicle displays.
3. Undertake fire and smoke modelling for the worst-case fire scenarios in the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria (refer to Performance Solution No. 5).
4. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters (refer to Performance Solution No. 5).
5. Compare the derived ASET and RSET to determine if the design is acceptable.
6. Identify the expected fire load in the area below the First Floor tenancies expansion along the south-east façade.
7. Determine whether a fire that has a potential to spread to the rest of the building could start in this area.
8. Develop a fire safety strategy that would enhance the fire safety measures in the areas where sprinklers are not provided (if required).

20.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *Where sprinklers are omitted from the retail mall skylights, the ASET calculated for the sensitivity fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

2. *Where sprinklers are omitted from the retail mall skylights, routine conditions for fire fighters must be maintained up until fire brigade apply water to the fire for the design fire scenarios.*

3. *Where sprinklers are omitted from the soffit below the First Floor tenancies extension, the area shall be kept free of combustibles and used as circulation space only.*

21. Performance Solution No. 11 – Performance-based Separation between Sprinklered and Non-sprinklered Parts

21.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17 and Specification 18 as applicable.

Clause S17C3(a) of BCA Specification 17 states that where a part of a building is not protected with sprinklers, the sprinklered and non-sprinklered parts must be fire-separated with a wall or floor which must comply with any specific requirements of DtS provisions of the BCA.

BCA Clause C3D9(1)(b) states that if a building has parts of different classifications located alongside one another in the same storey, the parts must be separated in that storey by a fire wall if each building element in that storey does not have the higher FRL prescribed by Specification 5.

Clause S5C22(3)(c)(i) of BCA Specification 5 states that fire walls between the carpark and the rest of the building shall achieve a minimum FRL 60/60/60 from the direction used as a carpark.

Glazed openings in fire walls are not covered by BCA Part C4, and therefore shall be considered a performance-based design. The benchmark FRL for a glazed opening in a fire wall that achieves FRL 60/60/60, considering that glazed openings are non-load-bearing, should be --/60/60.

21.2 Performance Solution

The existing north-west open-deck carpark that is not provided with sprinkler protection abuts parts of the centre that have glazed sections in the bounding walls. These glazed sections are located at the north and north-west entrances to the retail mall and along the façade of the external tenancy adjacent to the north-west entrance to the mall (the glazed sections of the walls are clouded red in Figure 63).

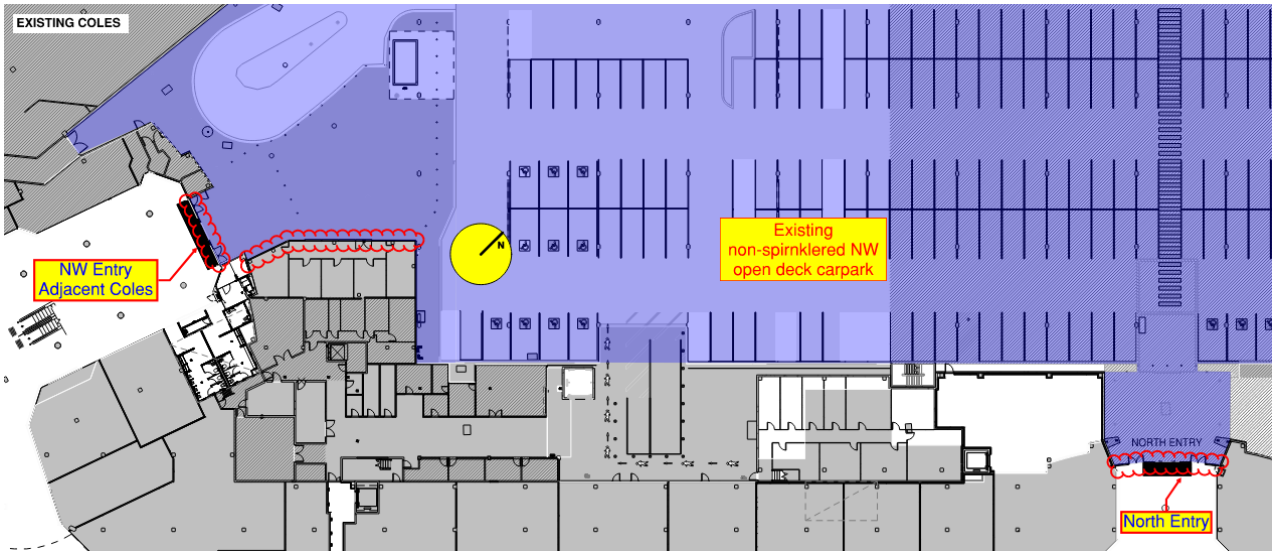


Figure 63: Locations where the walls between the sprinkler protected retail parts of the centre and the open-deck carpark that is not sprinkler protected have glazed sections

The glazed sections of the walls that are exposed to the open-deck carpark that is not sprinkler protected will not be protected and will not achieve FRL --/60/60, which does not comply with the DtS provisions of Clause S17C3(a) of BCA Specification 17 and Clause E1D4(b).\

21.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as C1P2(1)(d) and E1P4.

21.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

21.5 Intent of the BCA

The intent of Performance Requirement C1P2(1)(d) (formerly CP2(a)(iv)) is to minimise the risk of fire spreading through a building that could endanger the occupants and impede the actions of the fire brigade.

The Guide to the BCA states that "*the BCA recognises that different building elements require differing degrees of protection to avoid the spread of fire*". The Guide also highlights that compliance with the DtS provisions in regards to fire separation "*is not compulsory if alternative means can be found to satisfy the appropriate authority that the Performance Requirements will be achieved*". This provision is intended "*to allow the appropriate authority to determine the degree of compliance necessary in each particular case after considering each building scenario*".

The intent of Performance Requirement E1P4 is "*life safety and fire suppression*".

Performance Requirement E1P4 uses the term "*to the degree necessary*". The Guide to the BCA states that the use of this term means that the "*BCA recognises that not all buildings need an automatic fire suppression system*".

It is evident that if adequate separation is not provided between parts of the building that are not protected with sprinklers and the sprinkler-protected parts, a fire in the non-sprinklered part may overwhelm the sprinkler system in the protected part, which may lead to fire spread through the building.

21.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based separation between sprinklered and non-sprinklered parts would not increase the risk of fire spread through the building.

If it can be demonstrated that a fire starting in the non-sprinklered part of the building will not spread to the sprinklered part via the unprotected glazed openings, then compliance with Performance Requirements C1P2(1)(d) and E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify the type of construction between sprinklered and non-sprinklered parts.

2. Establish fire scenarios in the non-sprinklered open-deck carpark that may have the worst impact on the glazed openings.

3. Identify the location of fire in each fire scenario relative to the exposed openings.

4. Determine the configuration of the radiant heat sources that may radiate heat toward the glazed openings.

5. Identify target points at the glazed openings that are likely to be exposed to the highest radiant heat flux during a fire in the open-deck carpark.

6. Calculate the radiant heat flux at the target points using module Radiation from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013].

21.7 Acceptance Criteria

There is a lot of information about critical heat fluxes for different combustible materials, i.e. heat fluxes at which combustible materials are expected to ignite under piloted and non-piloted conditions.

The Australian Building Codes Board suggests the following heat flux intensity that can cause piloted and non-piloted ignition of timber and curtain materials [ABCB, 2020-2a]:

Material	Piloted Ignition	Non-piloted Ignition
Timber	20 kW/m²	35 kW/m²
Curtain material	10 kW/m²	20 kW/m²

Table 24: Heat flux required to cause piloted and non-piloted ignition of some materials

The above values form part of the BCA Verification Method C1V1 [ABCB, 2022a]. In accordance with C1V1 a wall located 3 m of the side or rear boundary of an allotment needs to withstand a radiant heat flux of 20 kW/m². BCA Clause C4D3(2)(a) states that only those openings that are less than 3 m from the fire-source feature shall be protected. It is therefore reasonable to conclude that an opening located 3 m from the side or rear boundary of the allotment and exposed to a radiant heat flux of 20 kW/m² without protection achieves compliance with the BCA Performance Requirements.

AS 1530.4-2014 “Methods for fire tests on building materials, components and structures; Part 4: Fire-resistance tests for elements of construction” [SA, 2014] suggests different values for critical radiant heat flux (refer to Table 25 below).

TABLE A3

TYPICAL RADIANT HEAT INTENSITIES FOR VARIOUS PHENOMENA

Phenomena	kW/m^2
Maximum for indefinite exposure for humans	
Pain after 10 s to 20 s	4
Pain after 3 s	10
Piloted ignition of cotton fabric after a long time	13
Piloted ignition of timber after a long time	13
Non-piloted ignition of cotton fabric after a long time	25
Non-piloted ignition of timber after a long time	25
Non-piloted ignition of gabardine fabric after a long time	27
Non-piloted ignition of black drill fabric after a long time	38
Non-piloted ignition of cotton fabric after 5 s	42
Non-piloted ignition of timber in 20 s	45
Non-piloted ignition of timber in 10 s	55

Table 25: Typical radiant heat intensities for various phenomena, as per AS 1530.4-2014

The values provided by the BCA are more conservative than those provided by the Australian Standard. Still it is evident that radiant heat from a fire should not cause non-piloted ignition if the heat flux does not exceed 20 kW/m², or piloted ignition if the heat flux is 10 kW/m² or less.

Before a fire can spread from one area to the other, the exposed combustible materials must be heated to a temperature at which piloted or non-piloted ignition can occur. Piloted ignition occurs when a combustible material is directly exposed to a pilot flame generally in the presence of a heat source. Considering that all glazed openings have doors in them, it is conservatively assumed that during a worst-case fire scenario piloted ignition of lightweight furnishings adjacent to these doors may occur.

Therefore, the acceptance criterion for this assessment is:

1. *Radiant heat flux at the closest edge of the exposed glazed openings must not exceed the critical limit for piloted ignition of light-weight furnishings, i.e. 10 kW/m².*

21.8 Radiant Heat Flux Assessment Input Parameters

21.8.1 Fire Scenario Selection

An essential aspect of a fire safety engineering assessment is the identification of appropriate fire scenarios.

The most likely and highest risk fire scenario for the north-west entrance adjacent to Coles involves a fire occurring in a vehicle parked in the Click and Collect drive-through area. In this scenario, the vehicle is positioned closest to the glazed entry. This scenario is illustrated in Figure 64 below and is identified as Fire Scenario 1 (FS-01). As shown in Figure 64, the vehicle is located approximately 12 m from the glazed entry. Such fire could also adversely impact the shopfront glazing of the adjacent tenancy, which is approximately 13.6 m from the vehicle.

Another potential scenario that could affect the shopfront glazing is a fire occurring in a vehicle parked in the driveway of the open-deck carpark. This scenario is illustrated in Figure 64 below and is identified as Fire Scenario 2 (FS-02). As shown in Figure 64, the vehicle is located approximately 7.6 m from the glazed entry.

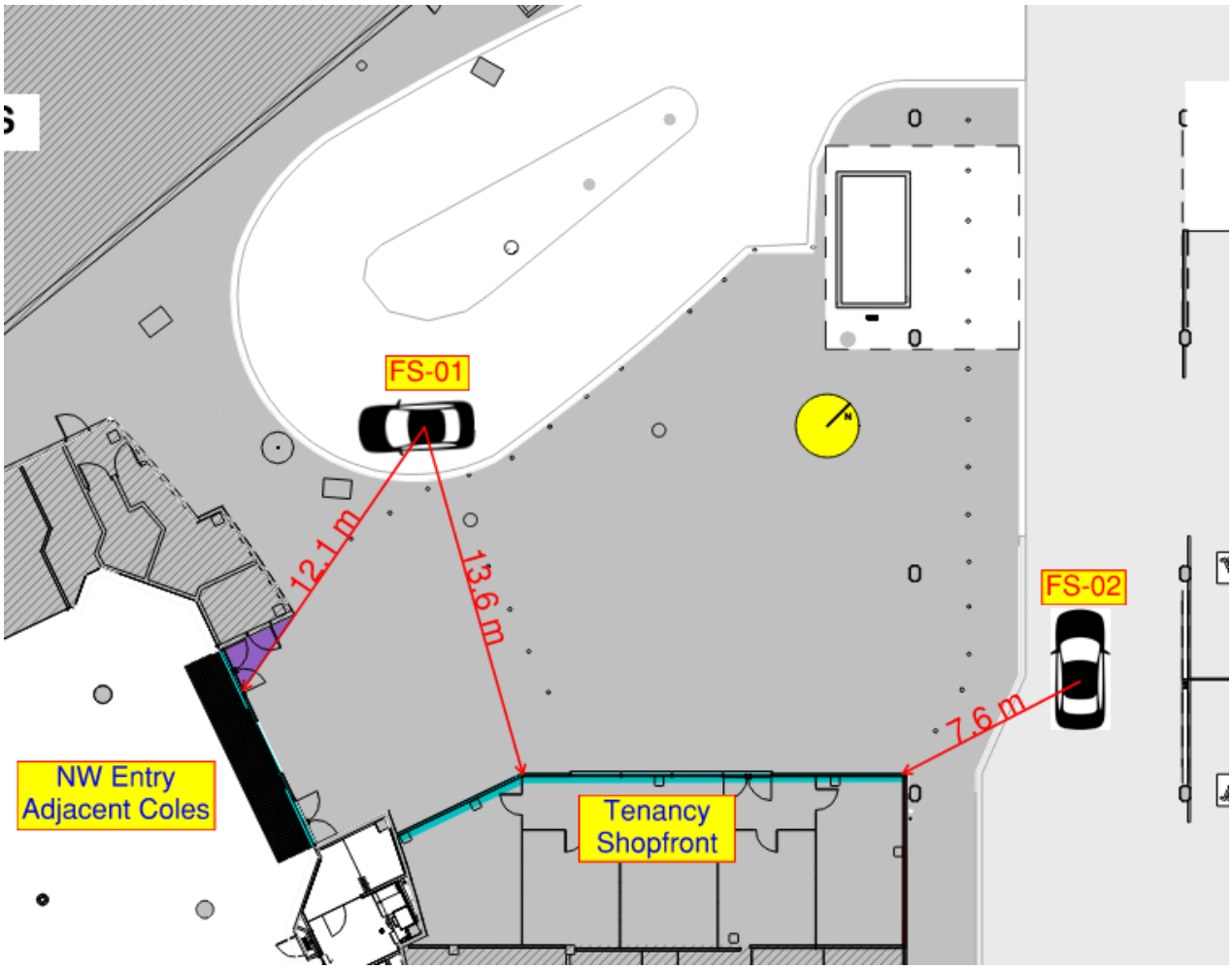


Figure 64: Fire scenarios for the north-west entrance adjacent Coles to the adjacent tenancy

The most likely and highest risk fire scenario for the north entrance involves a fire occurring in a vehicle parked in the bay closest to the north entrance. This scenario is shown in Figure 65 and is identified as Fire Scenario 3 (FS-03).

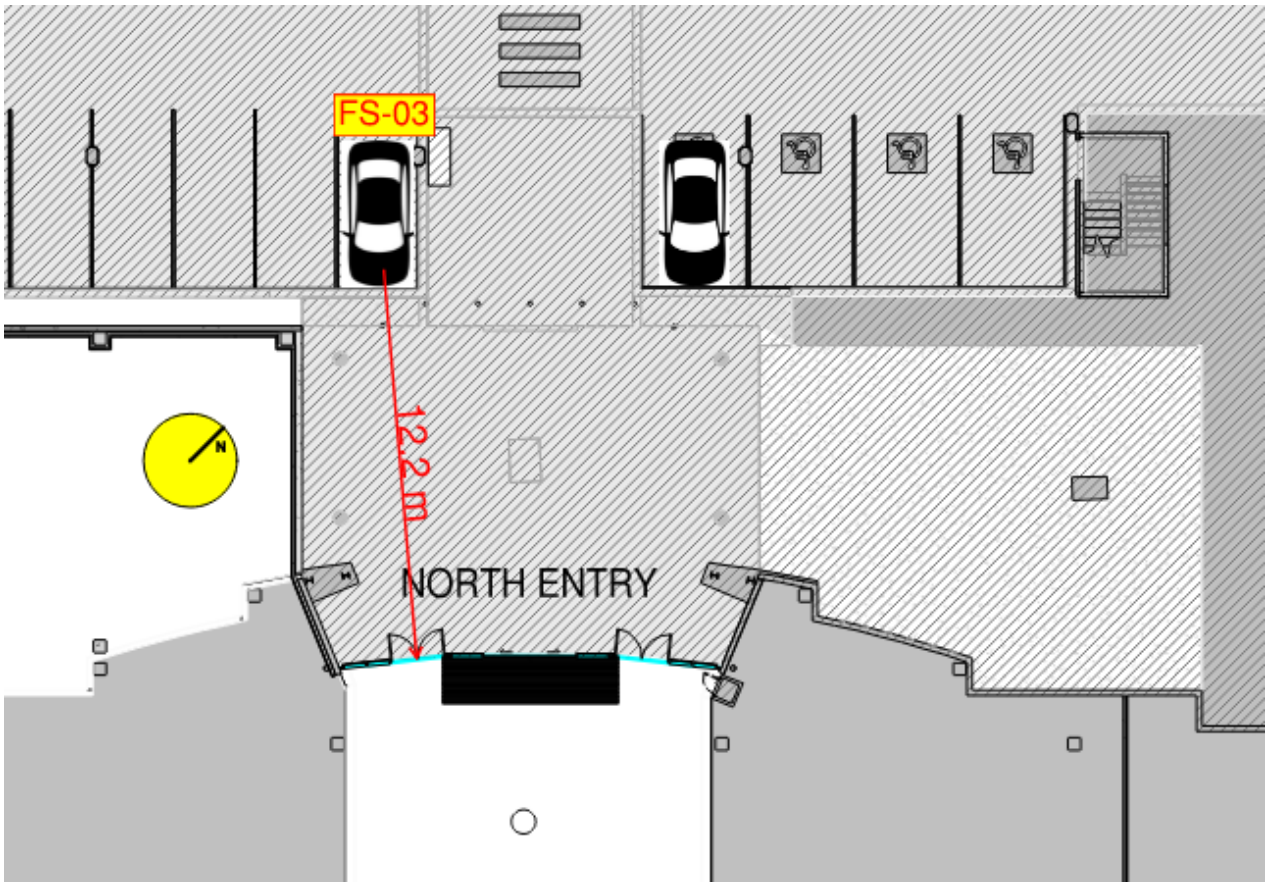


Figure 65: Fire scenario for the north entrance

22. Performance Solution No. 12 – Performance-based Increased Air Velocity through Make-up Air Openings

22.1 Relevant BCA DtS Provisions

BCA Clause E2D15(2)(a) states that *"where the floor area of a Class 6 part of a fire compartment … is more than 2,000 m², the fire compartment, including the enclosed common walkway or mall, must be provided with— an automatic smoke exhaust system complying with Specification 21"*.

Clause S21C6(2) of BCA Specification 21 states *"the velocity of make-up air through doorways must not exceed 2.5 m/s"*.

22.2 Performance Solution

Make-up air is provided for the smoke exhaust systems in the Timezone and JB Hi-Fi tenancies from the retail mall via the shopfronts. The smoke exhaust rates in both tenancies and the make-up air provisions during trading hours are BCA DtS compliant for both tenancies.

After-hours however the net free open area of the openings does not allow to achieve make-up air velocity of less than 2.5 m/s. The size of the make-up air openings is currently not available and will be confirmed at the FSER stage of the project; however, the make-up air velocity through these openings is not expected to exceed 3.5 m/s, which does not comply with the DtS provisions of Clause S21C6(2) of BCA Specification 21 and Clause E2D15(2)(a).

22.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E2P2.

22.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

22.5 Intent of the BCA

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

The intent of Clause S21C6 of Specification 21 (formerly Clause 6 of Specification E2.2b) is *"to provide air to replace that being exhausted by the smoke exhaust system"*.

The Guide to the BCA states that the intent of Clause S21C6(2) (formerly Clause 6(b) of Specification E2.2b) is to ensure that make-up air introduced below the smoke layer is at relatively low velocities, to minimise any disturbance to the smoke layer. The Guide further clarifies that *"make-up air introduced at higher velocities may cause:*

- *"smoke to be drawn down from the hot layer, called the "venturi effect", leading to a loss of visibility in the space below; and*
- *"difficulties for people attempting to exit against the in-rush of air through doorways"*.

It is evident that the intent of the BCA is to ensure that the make-up air velocity is low enough to prevent significant disturbance to the smoke layer that could compromise safe occupant evacuation.

22.6 Assessment Methodology

The purpose of this assessment is to demonstrate that after-hours the increased make-up air velocity through the Timezone and JB Hi-Fi shopfront openings does not have an adverse impact on safe occupant evacuation and fire brigade intervention.

It is considered that if it can be demonstrated that the increased make-up air velocity through the roller-shutters does not disturb the smoke layer to a degree that could impede safe occupant evacuation and fire brigade intervention, compliance with Performance Requirement E2P2 is achieved.

The methodology adopted for the assessment is an absolute, quantitative deterministic analysis in accordance with the following:

1. Determine the after-hours make-up air velocity through the Timezone and JB Hi-Fi shopfront openings.
2. Carry out Computational Fire Dynamics (CFD) modelling using computer program FDS-6 [McGrattan, 2023] and determine air velocities on the Timezone and JB Hi-Fi side of the shopfronts.
3. Determine whether increased make-up air velocities through the shopfront openings has an adverse impact on the smoke layer.

22.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *The increased after-hours make-up air velocity through the Timezone and JB Hi-Fi shopfront openings must not disturb the smoke layer in the tenancy to a point where it could compromise safe occupant evacuation and fire brigade intervention.*

23. References

- ABCB, 2020: "*National Construction Code, Guide to Volume One, 2019, Amendment 1"*, Australian Building Codes Board, Canberra.
- ABCB, 2022: "National Construction Code, Volume One, Building Code of Australia 2022", Australian Building Codes Board, Canberra.
- ABCB, 2021: *"Australian Fire Engineering Guidelines 2021"*, Australian Building Codes Board, Canberra, Australia.
- ABCB, 2021a: "*Australian Fire Engineering Guidelines 2021*", Australian Building Codes Board, Canberra, Australia – Section 2.1.1, Table 2.1.1, p. 28.
- Buchanan, A.H., 2001: "Fire engineering design guide, Second edition", Centre for Advanced Engineering, Christchurch, New Zealand – Section 4.3, pp. 29-33.
- DFES 2021: "*Guideline No: GL-03 – Fire Safety Equipment Signage, March 2023*", Government of Western Australia; Department of Fire & Emergency Services – Section 05 – "On-site Hydrant".
- DFES 2023: "*Guideline No: GL-11 – DFES Site Planning and Fire Appliance Specifications, February 2023*", Government of Western Australia; Department of Fire & Emergency Services.
- FCRRP, 1998a: "*Fire Safety in Shopping Centres – Final Research Report, Project 6*", Fire Code Reform Research Program, Sydney, Australia – Section 10.3.4.2, Table 10.3, p. 67.
- FCRRP, 1998b: "*Fire Safety in Shopping Centres – Final Research Report, Project 6*", Fire Code Reform Research Program, Sydney, Australia – Section 11.4.3, p. 91.
- FCRRP, 1998c: "*Fire Safety In Shopping Centres – Final Research Report, Project 6*", Fire Code Reform Research Program, Sydney, Australia – Section 10.3.3, p. 66.
- FMC, 2013a: "*SPRINKLER – Sprinkler Activation Simulation Computer Model*", Part of the FireWind 3.6 package – Fire Modelling and Computing Pty. Ltd., Australia.
- Gwynne, S. V. M. and Rosenbaum, E. R., 2016a: "*The SFPE Handbook of Fire Protection Engineering, Fifth Edition – Employing the Hydraulic Model in Assessing Emergency Movement*", the Society of Fire Protection Engineers, Quincy, Massachusetts, USA – Section 59.

24. Appendix A – Assumptions and Limitations

The following assumptions and limitations apply to this report:

a) The assessment provided in this report is limited to the analysis of fire safety; specifically, the ability of the performance-based building design to satisfy the BCA Performance Requirements in respect to fire safety arising out of accidental fires and arson attacks of opportunity (i.e., arson attacks that use ignition sources readily available in the building, and do not involve use of accelerants and/or tampering with the installed fire safety measures). The assessment only takes into consideration fires originating from a single source, with fuel load and distribution compatible with the use of the area under consideration. Acts of premeditated arson (i.e., introduction of accelerants; fuel loads that are not typical for the area under consideration; tampering with fire safety measures), terrorism or any other fires initiated due to malicious acts of one or more individuals are specifically excluded from the scope of the assessment.

b) The assessment specifically excludes assessment of all other types of emergency situations and assumes that suitable measures will be set in place to handle those types of emergencies. The building surveyor and/or permit authority must ensure that they are satisfied that the performance-based building design has adequate provisions for life safety in emergency situations other than those originating from accidental fires or arson attacks of opportunity.

c) The report specifically excludes assessment of property damage / loss of business continuity as a result of a fire; or insurer requirements; or environmental protection requirements, unless specifically stated otherwise in this report. The assessment is based on the objectives of the BCA as outlined in Section 2.1.

d) The Performance Solution(s) is(are) developed to demonstrate compliance with the BCA Performance Requirements and may not provide the level of property protection inherent in a BCA DtS compliant design.

e) The BCA Performance Requirements identified in this report may have parts which are not entirely fire safety related and which are not specifically covered by this fire safety engineering assessment. Such aspects include but are not limited to general occupational health and safety matters (i.e., safety during day-to-day operations, or during emergencies other than emergencies arising from accidental fires), and access and amenity. The building surveyor and/or permit authority or other specialist parties shall be responsible for assessing and certifying the ability of the design to satisfy those portions of the BCA Performance Requirements that are not fire safety related and for ensuring that the design provides adequate safety for day-to-day operation and/or emergencies other than those arising from accidental fires.

f) This report relies on third parties for the identification of non-compliances with the BCA DtS provisions. BCA Consultants take no responsibility for the accuracy of the information provided by third parties.

g) This report may in parts rely on input from stakeholders to develop an appropriate fire engineering brief (FEB) criteria and assessment parameters. Fire scenarios, identified during the FEB process as being worst credible fire scenarios, are considered representative of such scenarios. This report does not assess system performance and the ability of the design to meet the BCA Performance Requirements for fire scenarios that are more severe or hazardous than the fire scenarios identified as requiring assessment. Fire engineering methodologies and acceptance criteria identified during the FEB process as being appropriate for this project are considered appropriate for justifying compliance with the BCA Performance Requirements. Acceptance of this report by the stakeholders is considered to be acceptance that the report satisfies the requirements set out in the FEB.

h) The FSER may use in parts comparative assessment to determine compliance with the BCA Performance Requirements and relies on the BCA DtS provisions to achieve an adequate level of fire safety.

i) This fire safety engineering assessment aims to provide appropriate supporting evidence demonstrating that the Performance Solutions are capable of satisfying the nominated BCA Performance Requirements in respect to fire safety. This report may in parts rely on:

1. The accuracy of conclusions and opinions drawn in past research when assessing the level of performance achieved by the performance-based design.

2. The opinions of the fire engineers and other stakeholders working on the project in respect to the intent of the BCA Performance Requirements (i.e., the BCA DtS provisions require the fire safety design to facilitate the safe evacuation of the occupants; however, no fire safety design can guarantee occupants will be safe in the event of a fire). This report has been produced on the basis that new fire safety designs need to provide suitable measures that can be shown (using appropriate supporting evidence) to either facilitate the safe evacuation of the occupants in the event of identified reasonable worst credible fire scenarios; or provide at least equivalent fire safety performance to a design complying with the BCA DtS provisions).

3. Opinions of other professionals as part of the FEB process (i.e., in confirming acceptance of nominated reasonable worst credible fire scenarios and appropriate assessment methodologies, tenability criteria and acceptance criteria, etc.).

4. Opinion of the building surveyor and/or permit issuing authority in respect of the suitability of the selected base case BCA DtS compliant designs used for comparative assessments.

5. Modelling tools developed by other organisations as a means of assessing performance.

6. Minimum BCA DtS provisions for achieving an acceptable level of fire safety and compliance with the BCA Performance Requirements.

j) This FEB has been produced and issued by BCA Consultants and any intellectual property contained within this report is to remain the property of BCA Consultants and must not be distributed to parties except for those directly involved in the project to which this report relates without written approval of BCA Consultants.

25. Appendix B – DFES FEB Meeting Minutes

The following is a copy of the minutes for the FEB Meeting with DFES on 22 April 2025 prepared by BCA Consultants (WA) Pty Ltd.

The document is included in its entirety and the original page numbering is maintained.

Minutes of FEB Meeting No.1

CLIENT/DEPARTMENT: Multiplex
PROJECT/SUBJECT: Galleria Schopping Centre
PURPOSE: FEB meeting
DATE: 22/04/2025 **STARTED:** 9.00am **FINISHED:** 10.00am
LOCATION: DFES Built Environment Branch (Teams Meeting)
OUR REFERENCE: 20240380-E0302-Mn-0001
PRESENT:

Name	Company/Position	Contact	Initials
Brendan O'Regan	DFES – Fire Engineer	Brendan.O'Regan@dfes.wa.gov.au	BO'R
Alexis Wake	DFES – Building Fire Safety Officer	Alexis.Wake@dfes.wa.gov.au	AW
Kylie Judd	Multiplex – Project Manager	Kylie.Judd@multiplex.global	KJ
Vincent Chi	Buchan – Architect	Vincent.Chi@buchan.au	VC
Nick Rae	Buchan – Architect	Nick.Rae@buchan.au	NR
Nikola Stojanovic	Build Plus Group – Project manager client	nik.stojanovic@buildplusgroup.com	NS
Mark Viska	BCA – Building Surveyor	mviska@bcagroup.com.au	MV
Chris Meisinger	BCA – Fire Engineer	cmeisinger@bcagroup.com.au	CM
Alex Alexandrovski	BCA – Fire Safety Engineer	aalexandrovski@bcagroup.com.au	AA
Amy Chao	BCA – Fire Safety Engineer	achao@bcagroup.com.au	AC

APOLOGIES:

Name	Company/Position	Contact	Initials
No apologies			

OBJECTIVE:
Present the fire safety strategy for the project to DFES and agree on the methodology to document the proposed Performance Solutions.

Item	Topic	Who	Due Date
Note:	*We believe the following record to be an accurate summary of decisions and related discussions. We will appreciate notification of exceptions to this record within three (3) business days of its receipt. Failing such notification, we will consider this a statement of fact in which you concur.*	BO'R, AW, KJ, VC, NS, NR, MV, CM, AC, AA	30.04.2025
1.	**Acceptance of previous minutes: No Previous Minutes**		
2.	**General**		
2.1.	AA started the meeting by introducing the project.		
2.2.	The previous design was completed by Arup; BCA Consultants has now taken over.		
2.3.	The scope of works has slightly changed from the previous design by Arup. The work is now limited to the central part of the mall, with a new Timezone tenancy and minor extensions to JD Sports and the tenancies along the southeast side adjacent to Rebel Sport.		

Item	Topic	Who	Due Date
2.4.	The two circular stairs (previously part of the food court) located on the south side are to be removed, and the food court will be converted into a JB Hi-Fi store.		
2.5.	Myer is fire-separated from the rest of the mall by fire-rated sliding doors that close upon fire alarm activation.		
3.	**Perf. Sol. 1 – Reduction in structural fire rating**		
3.1.	MV explained that, generally, all areas with three storeys—including Myer and the plant rooms—are fire separated from the rest of the centre. Hence, the shopping mall is classified as Type B Construction, which requires a 180-minute fire rating.		
3.2.	AA followed by explaining that the proposed Performance Solution is to reduce the fire rating requirement from nomial 180 minutes to 120 minutes.		
3.3.	The proposed approach is to carry out a burnout calculation using the Eurocode, Law and CIB W14 formulae.		
3.4.	As the building is sprinkler-protected, the assessment will concentrate on a redundancy scenario assuming sprinkler failure.		
3.5.	A 75% glass breakage will be used for the sprinkler failure scenario.		
3.6.	BO'R commented that DFES recommend a 50% glass breakage.		
3.7.	AA noted DFES's comments and will look into it.		
3.8.	BO'R asked about the slab.		
3.9.	AA responded that it is a reinforced concrete slab, which would inherently provide a fire rating. However, this will need to be confirmed with the structural engineer for the exact rating provided.		
3.10.	BO'R acknowledged the comments.		
4.	**Perf. Sol. 2 – Extended travel distances in areas without smoke exhaust**		
4.1.	Extended travel distances to a single exit or a point of choice are capped at 30 metres.		
4.2.	A proposed quantitative comparative assessment will be carried out, comparing the Deemed-to-Satisfy (DtS) sprinkler detection time to the performance-based smoke detection time, i.e. a comparison of DtS RSET time versus performance-based RSET.		
4.3.	BO'R had no objections.		
5.	**Perf. Sol. 3 – Extended travel distances in areas with smoke exhaust**		
5.1.	Extended travel distances between alternative exits and to the nearest of the alternative exits were discussed.		
5.2.	The proposed solution is to maintain tenable conditions in the retail malls for the duration of occupant evacuation.		
5.3.	The existing smoke exhaust system has multiple exhaust points. The size of the system will be determined through CFD modelling.		
5.4.	There are no smoke baffles in the retail mall, so the smoke reservoir length will exceed 60 metres.		

Item	Topic	Who	Due Date
5.5.	BO'R noted that DFES provided response to ARUP report and advised that incorporating original DFES comments into the current report would resolve most of DFES concerns.		
5.6.	DFES also commented that they disagree with the medium fire size proposed by ARUP.		
5.7.	AA responded that fast fire growth scenarios will be used as the base case, along with the failure of the largest smoke exhaust fan as a redundancy fire scenario.		
5.8.	BO'R had no objection.		
5.9.	AA continued that the Rebel Sport and Timezone tenancies will have smoke exhaust systems that are Deemed-to-Satisfy (DtS) compliant.		
5.10.	For the JB Hi-Fi tenancy, smoke exhaust provision will depend on the selling floor area.		
5.11.	If the area is less than 1,000 m², smoke exhaust will be omitted; otherwise, it will be provided.		
5.12.	BO'R had no objection to the proposed smoke exhaust approach.		
5.13.	BO'R asked about occupant egress from tenancies with an alternative exit leading directly to the outside.		
5.14.	ARUP proposed that all occupants from such tenancies will use the external exit and not re-enter the mall. DFES disagrees with this approach.		
5.15.	DFES believes that if the mall is the main entrance, occupants are likely to re-enter the mall.		
5.16.	AA explained that BCA Consultants propose a 50/50 occupant split in such tenancies if the main entrance is connected to the mall.		
5.17.	This approach is based on Project 6, and evacuation will be modelled using Pathfinder.		
5.18.	BO'R had no objection.		
5.19.	AA added that the two curved stairs are being removed. A new internal stair will be provided to replace the curved stairs.		
5.20.	Smoke detection will be installed in the tenancies adjacent to the balcony.		
5.21.	BO'R asked whether the new internal stair will be fire-isolated.		
5.22.	AA responded that the stair will be smoke-separated only, as it connects just two levels.		
6.	**Perf. Sol. 4 –Fire isolated corridors discharge into covered areas**		
6.1.	The discharge of fire-isolated corridors into covered areas or fenced loading dock was discussed.		
6.2.	Potential solutions are still being considered. Dynamic signage may be provided if the escape path could be compromised.		
6.3.	BO'R asked, in scenarios where occupants egress into a fenced off loading dock, whether the exit gates in the fence can be located closer to the exit doors to avoid the need to traverse the loading dock to reach open space.		

Item	Topic	Who	Due Date
6.4.	AA will look into this.		
6.5.	BO'R also inquired about egress widths.		
6.6.	AA confirmed that all egress routes will be modelled, and any minor shortfalls in width (if present) will be identified and addressed in the Fire Safety Engineering Report (FSER).		
6.7.	BO'R agreed and noted that DFES will review the FSER to understand the egress discharge provisions, with particular attention to the availability of alternative exits.		
7.	**Perf. Sol. 5 – Class 6 exits discharge into non-compliant areas**		
7.1.	Discharge into a roofed car park, which is a separate building but connected to the retail mall, was discussed.		
7.2.	Once occupants leave the retail building, they are considered to be in a place of relative safety.		
7.3.	BO'R had no objections.		
8.	**Perf. Sol. 6 – Fire hose coverage**		
8.1.	The proposed approach is to provide two lengths of hose for internal hydrants within the mall (i.e. hydrants spaced 25-30 metres apart within the mall). However, 2 lengths of hose used to reach into deeper tenancies.		
8.2.	BO'R asked whether the hydrants are existing.		
8.3.	AA responded that some hydrants may be changed or replaced and confirmed this will be looked into.		
8.4.	BO'R noted that DFES prefers hydrants to be spaced at 24 metres apart but will accept 25–30 metres in areas where a 24-metre spacing is not achievable due to layout constraints. However, DFES prefers internal hydrants within large tenancies if adequate coverage cannot be achieved from two directions (i.e. from the retail mall and from outside).		
9.	**Perf. Sol. 7 – Extinguishers in lieu of Fire Hose Reels**		
9.1.	Fire extinguishers are proposed in lieu of fire hose reels throughout the mall, except in the car park and major tenancies.		
9.2.	BO'R had no objection to the proposal.		
10.	**Perf. Sol. 8 – Omission of sprinklers from particular parts**		
10.1.	AA explained that sprinklers are proposed to be omitted from the north laneway canopy.		
10.2.	VC added that the canopy is constructed of lightweight steel with a solid polycarbonate roof.		
10.3.	BO'R noted that if the canopy is non-combustible and fuel loads are managed, the omission may be acceptable.		
10.4.	AA clarified that polycarbonate is combustible and has a low melting temperature.		
10.5.	BO'R responded that if it can be justified that fire spread is not a concern—due to surrounding sprinkler protection, absence of nearby fire sources, and appropriate design—then the omission may be acceptable.		

Item	Topic	Who	Due Date
10.6.	AA acknowledged this.		
10.7.	AA continued that the roofs of the atrium and of the Meyer Mall are not sprinkler-protected and that the proposed assessment will consider any potential fuel load below these roofs.		
10.8.	BO'R asked whether a larger fire size will be considered in the CFD modelling.		
10.9.	AA confirmed that this is the intention.		
10.10.	AA further noted that the southeast extension of the first-floor tenancy has created a 'covered walkway' on the ground floor below. Sprinklers are proposed to be omitted from this area.		
10.11.	Management will be asked to ensure no fire load is present in this walkway. If that cannot be assured, sprinklers will be installed.		
10.12.	The walls are not fire-rated but are made of concrete slabs and walls.		
10.13.	BO'R had no objection, on the understanding that it is essentially a 'covered walkway' with no fire load present.		
11.	**Perf. Sol. 9 – Omission of fire-resistant cabling to the AHUs**		
11.1.	AA explained that in a worst-case scenario, four AHUs (air handling units) will be lost, but there will still be enough AHUs to support the operation of the smoke exhaust system.		
11.2.	BO'R asked whether a reduced AHU scenario, such as after-hours operation, will be considered.		
11.3.	AA will check the operations after-hours. The original design, as understood, is that all doors will open on fire alarm at all times.		
11.4.	BO'R asked whether security will be in place if all doors are open during nighttime.		
11.5.	AA responded that, to our understanding, security will be in place during such occasions.		
12.	**Perf. Sol. 10 – Existing smoke exhaust fans produce noise levels exceed maximum prescribed**		
12.1.	Noise levels produced by the existing smoke exhaust fans will be assessed to determine whether they interfere with alarm signals.		
12.2.	BO'R suggested the use of visual alarms.		
12.3.	AA responded that visual alarms will be considered if noise levels could interfere with the alarms.		
12.4.	DFES had no further comments regarding the proposed performance solution.		
13.	**EWIS system**		
13.1.	BO'R asked whether the EWIS (Emergency Warning and Intercommunication System) covers the entire shopping centre.		
13.2.	BO'R explained that the DFES records indicate that the existing parts of the mall do not have EWIS coverage. This may fall outside the current scope.		

Item	Topic	Who	Due Date
13.3.	KJ responded that she will resolve this with the client and confirm the coverage as part of the FEB submission.	KJ	30.04.2025

Next Meeting: N/A **Location:**

Chair: Alex Alexandrovski **Title:** Senior Fire Engineer

PREPARED BY: Amy Chao

DISTRIBUTION: All present

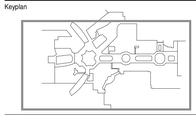
26. Appendix C – Fire Rated Corridors

The following is a copy of the markup within the area of scope that identified the fire rated corridors.

The document is included in its entirety and the original page numbering is maintained.

Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC

Keyplan



File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION

ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

BCA Legend

- Fire rated corridor
- Non fire rated corridor

Rev. A 06.05.2025

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status
TENDER

Date Plotted
17/04/2025 5:50:40 PM

Scale
As indicated @A0

0 1 2.5 5 10 15 20M

Drawing Title
GROUND FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number
GAL-BUC-AR-04-0L-0-18001

Revision
B

BUCHAN

Perth Studio
+ 61 8 9211 9898 / buchan.au

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION

Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC

EXISTING CINEMA

DN

AP 2

EX 3.1m

Need clarification whether this existing corridor is fire rated

NEW 2.1m

TENANCY 1-147

TENANCY 1-151

EX 1.9m

TENANCY 1-146

NEW 2.5m

VOID

TENANCY 1-156

TENANCY 1-155

TENANCY 1-154

NEW 3m

B.O.H. CORR. LB0301

LINE OF SMOKE ZONE

TENANCY 1-153

TENANCY 1-139

EX 1.6m

TENANCY 1-157

NEW 1.0m

NEW 1.7m

EX 5m

NEW 1.7m

NORTH ENTRY

TENANCY 1-160

TENANCY 1-162

TENANCY 1-164

TENANCY 1-165

TENANCY 1-166

TENANCY 1-159

FASHION MALL 1-ML45

KIOSK K1061

KIOSK K1060

VOID

EX 1.2m

TENANCY 1-136

TENANCY 1-135

TENANCY 1-134

TENANCY 1-133

TENANCY 1-132

TENANCY 1-130

TENANCY 1-128

EX. MEZZANINE OVER

EX 1m

EX 0.7m

NEW 1m

EX 1.2m

EX 1.1m

TENANCY 1-140

NEW 1.8m

EX 0.7m

TO BE CONFIRMED BY FIRE ENGINEER

LINE OF SMOKE ZONE

Considered non fire rated corridor.

Sprinklers to be provided into the corridor and stairs.

TENANCY 1-138

Discharge to be resolved.
Option 1 - balcony remains open. No change required. Performance Solution to address discharge not directly to the outside.

Option 2 - balcony enclosed. Connect corridor to the stair and make stair fire isolated (highlighted in purple).

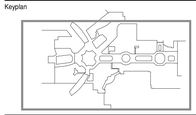
ROOF ABOVE HEADROOM 4.65M

ROOF ABOVE HEADROOM 2.7M

TENANCY MM-004

EXISTING TARGET ROOF

Keyplan



File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION
- ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

BCA Legend

- Fire rated corridor
- Non fire rated corridor

Rev. A 06.05.2025

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status TENDER

Date Plotted 17/04/2025 5:50:09 PM

Scale As indicated @A0

0 2.5 5 10 15 20M

Drawing Title
FIRST FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number
GAL-BUC-AR-04-1L-0-18003

Revision
B

BUCHAN

Perth Studio
+ 61 8 9211 9898 / buchan.au

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION

27. Appendix D – Fire Hydrant Coverage Plans

The following is a copy of the “Fire Hydrant Coverage” plans for the GSC within the area of scope prepared by Firesafe Group Pty Ltd.

The document is included in its entirety and the original page numbering is maintained.

GENERAL NOTE:

- HYDRANT COVERAGE IS BASED ON 3 x 30M HOSE LENGTHS (30M EXTERNAL + 60M INTERNAL) AS PER FIRE ENGINEERING BRIEF
- HYDRANT COVERAGE IS BASED ON 2 x 30M HOSE LENGTHS FOR INTERNAL HYDRANTS AS PER FIRE ENGINEERING BRIEF

NOTE:

1. EXISTING SINGLE STAIR FIRE HYDRANT TO BE REPLACED WITH A NEW DUAL HEAD FIRE HYDRANT.
2. EXISTING FIRE HYDRANT TO BE RELOCATED OUTSIDE OF L1 BUILDING ENVELOPE TO BE CLASSIFIED AS AN EXTERNAL FIRE HYDRANT.
3. EXISTING FIRE HYDRANT SHOWN IS CLASSIFIED AS AN INTERNAL FIRE HYDRANT DUE TO LOADING DOCK CANOPY/COVER ABOVE.

TOLERANCE: DIMENSIONS NOTED AND ANY SETOUTS ARE CORRECT TO WITHIN +/- 50MM

REFERENCE DRAWINGS

DRAWING TITLE	DRAWING NUMBER	REV	DATE
ARCHITECTURE	GAL-AR-BUC-MOD-BUILD (MODEL)	0	08.09.2025
STRUCTURE	GAL-HRA-ST-MOD-BUILD (MODEL)	8	17.04.2025
MECHANICAL			
ELECTRICAL			
HYDRAULICS			
INTERIORS			

APPLICABLE STANDARDS

☐	AS2118.1 - 2017	AUTOMATIC FIRE SPRINKLER SYSTEMS
☐	AS2118.6 - 2012	COMBINED SPRINKLER & HYDRANT SYSTEMS
☐	AS2419.1 - 2005	FIRE HYDRANT SYSTEMS
X	AS2419.1 - 2021	FIRE HYDRANT SYSTEMS
☐	AS 2441 - 2005	FIRE HOSE REEL SYSTEMS
☐	AS2419 - 2013	FIRE PUMP SETS
☐	AS2304 - 2019	WATER STORAGE TANKS FOR FIRE PROTECTION SYSTEMS
☐	AS2444.1 - 2001	PORTABLE FIRE EXTINGUISHERS & FIRE BLANKETS
☐	AS1670.1 - 2018	FIRE DETECTION, WARNING CONTROL & INTERCOM SYSTEMS
☐	AS1670.4 - 2018	EMERGENCY WARNING & INTERCOM SYSTEMS
☐	AS 1668.1 - 1998	FIRE & SMOKE CONTROL IN MULTI-COMPARTMENT BUILDINGS
	PROJECT SPECIFIC DOCUMENTATION:	
X	FEB / FER	FEB GAL-BCA-FE-RPT-0002 [B]
☐	SPECIFICATION	

DESIGN CRITERIA SUMMARY

LEGEND OF SYMBOLS

eDFH	EXISTING DUAL HEAD FIRE HYDRANT
FH	NEW FIRE HYDRANT
DFH	NEW DUAL HEAD FIRE HYDRANT
	FIRE HOSE EXTERNAL LENGTH (MAX 30 METRES)
	FIRE HOSE INTERNAL LENGTH (MAX 60 METRES)
	FIRE HOSE SPRAY (MAX 10M)
	INTERNAL HYDRANT TO HYDRANT DISTANCE

FOR INTERNAL INFORMATION

WCG		WCD	
WMG		WMD	
WCS	25009	WCH	
WMS		WMH	

KEY / SITE PLAN

REVISIONS

REV.	BY	DESCRIPTION	DATE
A	DM	PRELIMINARY ISSUE	06/05/25
B	DM	BUILDING LICENCE	14/05/25

BUILDING LICENCE

CLIENT: VICINITY CENTRES / PERRON GROUP

CONTRACTOR:

Firesafe GROUP PTY LTD
U2/16 ASPIRATION CCT BIBRA LAKE WA 6163
PH (08) 9437 7777 FAX (08) 9418 6355

PROJECT:

GALLERIA

COLLIER RD & WALTER RD W,
MORLEY, WESTERN AUSTRALIA

DESCRIPTION:

FIRE WET - MAIN WORKS
FIRE HYDRANT COVERAGE
LAYOUT - LEVEL 00

DRAWN: DM	SCALE: 1 : 500	SHT SIZE: A0	
CHECKED: RB	DATE: 29.04.2025		
PROJECT NO: WCS25009	DRAWING NO: GAL-FCS-FW-05-0L-0-401	REV: B	

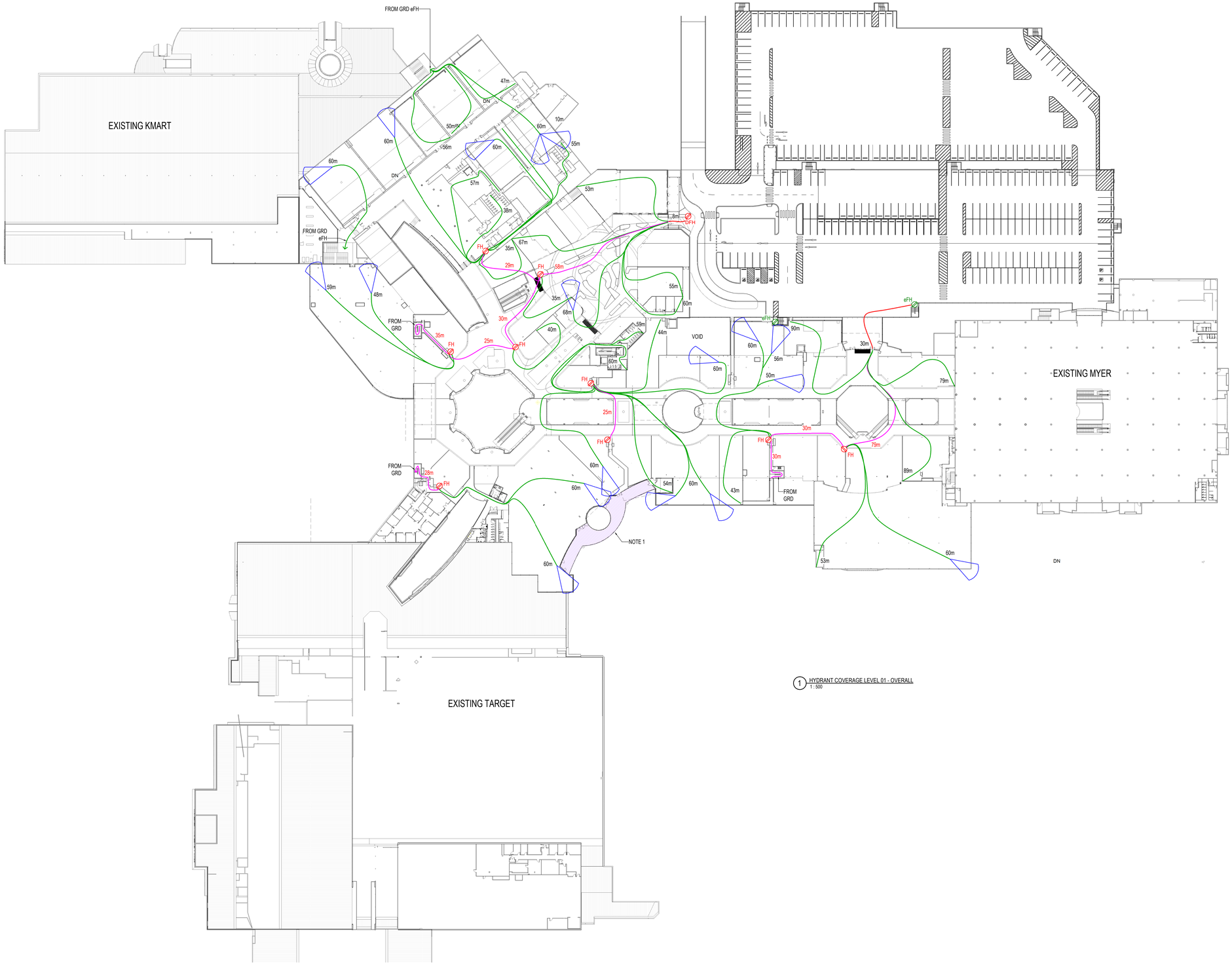
1 : 500 (0, 5, 10, 20, 40m)

GENERAL NOTE:

- HYDRANT COVERAGE IS BASED ON 3 x 30M HOSE LENGTHS (30M EXTERNAL + 60M INTERNAL) AS PER FIRE ENGINEERING BRIEF
- HYDRANT COVERAGE IS BASED ON 2 x 30M HOSE LENGTHS FOR INTERNAL HYDRANTS AS PER FIRE ENGINEERING BRIEF

NOTE:

1. POTENTIAL HYDRANT COVERAGE SHORTFALL IF FACADE LINE IS EXTENDED TO FRONT OF EXISTING BALCONY



1 HYDRANT COVERAGE LEVEL 01 - OVERALL
1 : 500

1 : 500
0 5 10 20 40m

BUILDING LICENCE

TOLERANCE: DIMENSIONS NOTED AND ANY SETOUTS ARE CORRECT TO WITHIN +/- 50MM

REFERENCE DRAWINGS

DRAWING TITLE	DRAWING NUMBER	REV	DATE
ARCHITECTURE	GAL-AR-BUC-MOD-BUILD (MODEL)	0	08.09.2025
STRUCTURE	GAL-HRA-ST-MOD-BUILD (MODEL)	8	17.04.2025
MECHANICAL			
ELECTRICAL			
HYDRAULICS			
INTERIORS			

APPLICABLE STANDARDS

☐	AS2118.1 - 2017	AUTOMATIC FIRE SPRINKLER SYSTEMS
☐	AS2118.6 - 2012	COMBINED SPRINKLER & HYDRANT SYSTEMS
☐	AS2419.1 - 2005	FIRE HYDRANT SYSTEMS
X	AS2419.1 - 2021	FIRE HYDRANT SYSTEMS
☐	AS 2441 - 2005	FIRE HOSE REEL SYSTEMS
☐	AS2419 - 2013	FIRE PUMP SETS
☐	AS2304 - 2019	WATER STORAGE TANKS FOR FIRE PROTECTION SYSTEMS
☐	AS2444.1 - 2001	PORTABLE FIRE EXTINGUISHERS & FIRE BLANKETS
☐	AS1670.1 - 2018	FIRE DETECTION, WARNING CONTROL & INTERCOM SYSTEMS
☐	AS1670.4 - 2018	EMERGENCY WARNING & INTERCOM SYSTEMS
☐	AS 1668.1 - 1998	FIRE & SMOKE CONTROL IN MULTI-COMPARTMENT BUILDINGS
	PROJECT SPECIFIC DOCUMENTATION:	
X	FEB / FER	FEB GAL-BCA-FE-RPT-0002 [B]
☐	SPECIFICATION	

DESIGN CRITERIA SUMMARY

LEGEND OF SYMBOLS

eDFH	EXISTING DUAL HEAD FIRE HYDRANT
FH	NEW FIRE HYDRANT
DFH	NEW DUAL HEAD FIRE HYDRANT
	FIRE HOSE EXTERNAL LENGTH (MAX 30 METRES)
	FIRE HOSE INTERNAL LENGTH (MAX 60 METRES)
	FIRE HOSE SPRAY (MAX 10M)
	INTERNAL HYDRANT TO HYDRANT DISTANCE

FOR INTERNAL INFORMATION

WCG		WCD	
WMG		WMD	
WCS	25009	WCH	
WMS		WMH	

KEY / SITE PLAN

REVISIONS

REV.	BY	DESCRIPTION	DATE
A	DM	PRELIMINARY ISSUE	06/05/25
B	DM	BUILDING LICENCE	14/05/25

CLIENT:
VICINITY CENTRES
PERRON GROUP

CONTRACTOR:

Firesafe GROUP PTY. LTD
U2/16 ASPIRATION CCT BIBRA LAKE WA 6163
PH (08) 9437 7777 FAX (08) 9418 6355

PROJECT:
GALLERIA
COLLIER RD & WALTER RD W,
MORLEY, WESTERN AUSTRALIA

DESCRIPTION:
FIRE WET - MAIN WORKS
FIRE HYDRANT COVERAGE LAYOUT - LEVEL 01

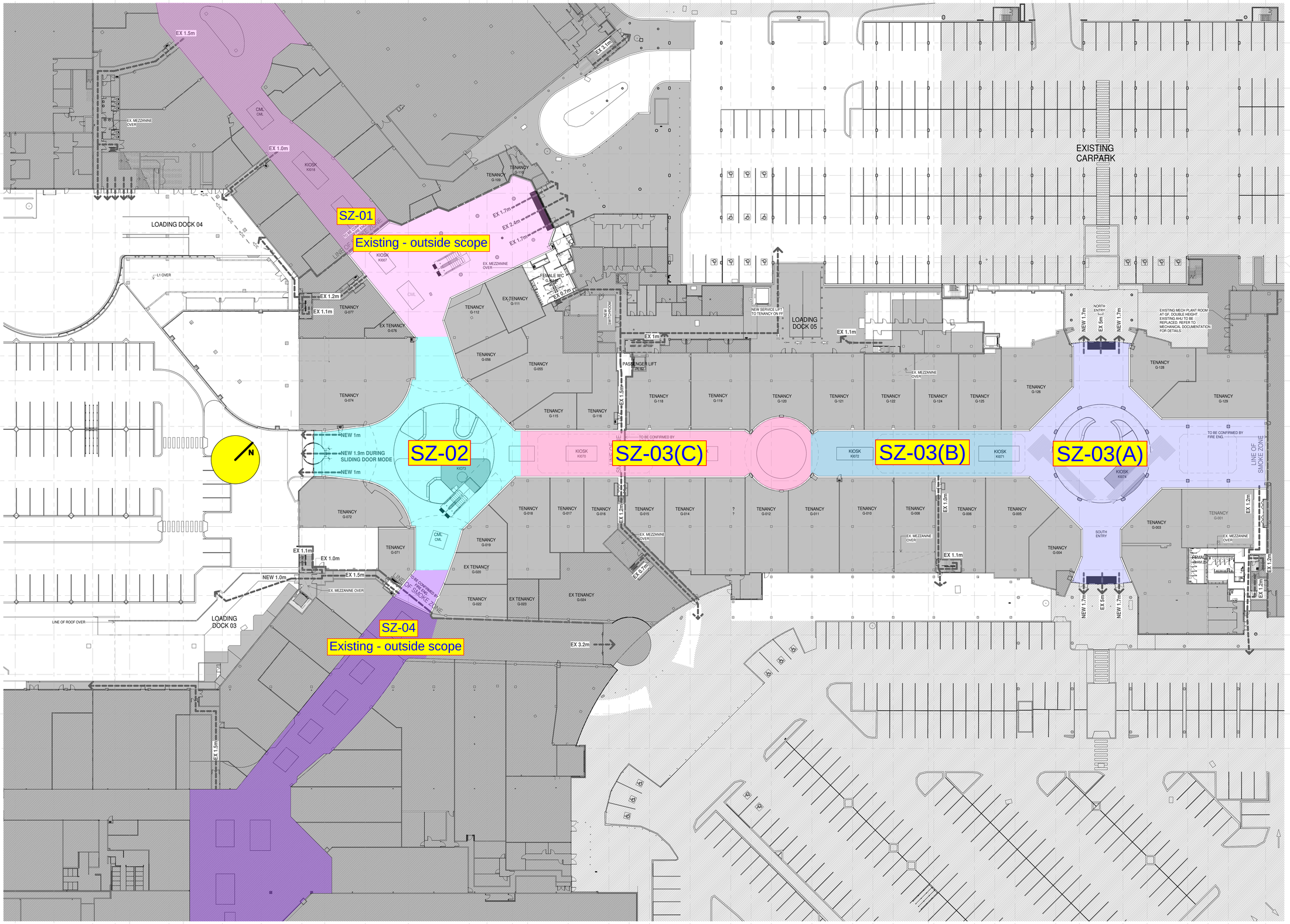
DRAWN: DM	SCALE: 1 : 500	SHT SIZE: A0
CHECKED: RB	DATE: 29.04.2025	
PROJECT NO: WCS25009	DRAWING NO: GAL-FCS-FW-05-1L-0-401	REV: B

28. Appendix E – Smoke Zones

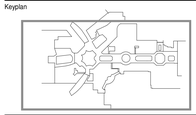
The following is a copy of the markup within the area of scope, identifying the designated smoke zones.

The document is included in its entirety and the original page numbering is maintained.

Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC



Keyplan



File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION

ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status TENDER

Date Plotted 17/04/2025 5:50:40 PM

Scale As indicated @A0

0 2.5 5 10 15 20M

Drawing Title
GROUND FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number
GAL-BUC-AR-04-0L-0-18001

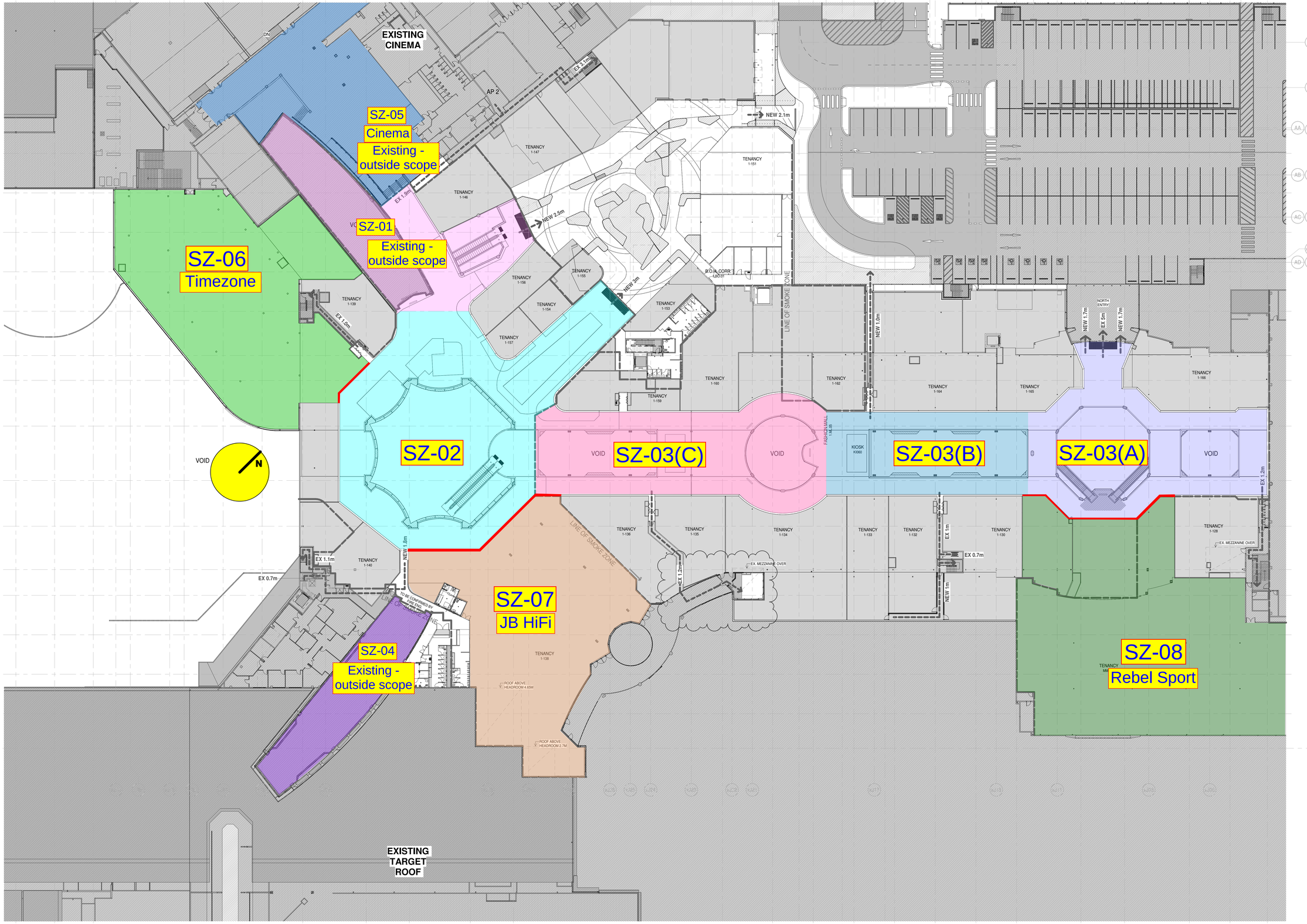
Revision
B

BUCHAN

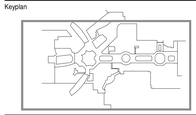
Perth Studio
+ 61 8 9211 9898 / buchan.au

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION

Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC



Keyplan



File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION
- ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status
TENDER

Date Plotted
17/04/2025 5:50:09 PM

Scale
As indicated @A0

0 1:250 2.5 5 10 15 20M

Drawing Title
FIRST FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number
GAL-BUC-AR-04-1L-0-18003

Revision
B

BUCHAN

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