ETHOS URBAN

Precinct Management Plan
NSW Rugby Centre of Excellence

Cook Avenue & Gwea Avenue, Daceyville

MDA-2022/71

Submitted to Bayside Council
On behalf of NSW Rugby

12 December 2022 | 2200025

CONTACT

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This document has been prepared by:		This document has been reviewed by:	
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Jethro Yuen	9 December 2022	Michael Rowe	9 December 2022

VERSION NO.	DATE OF ISSUE	REVISION BY	APPROVED BY
V1 Draft	9/12/2022	JY	MR
V2 Issue to Council	12/12/2022	JY	MR

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Appendices

1.0 Introduction

This Plan of Management has been prepared in support of Modification Application MDA-2022/71 (the Modification Application) that seeks to modify Development Consent DA-2020.455 relating to 35 Banks Avenue, Daceyville, which provides consent for the development of the NSW Rugby Centre of Excellence, to be used for high performance training, administration and community development programs. The report has been prepared on behalf of NSW Rugby (the Applicant) and is submitted to Bayside Council (Council).

The Modification Application relates to:

- Updated signage plans to include UNSW signage as the landowner of David Phillips Sports Ground (DPSG);
- Deletion of Condition 21 to enable the provision and use of a public address system; and
- Minor amendments to Condition 22 for hours of operation and flood lighting to align the site with the existing approved hours of operation and flood lighting across the remainder of the David Phillips Sports Grounds (DPSG), and for the hours of operation for the indoor high performance facility.

The NSW Rugby Union Centre of Excellence will serve as the NSW Rugby Union headquarters, training base for the NSW Waratahs and proposed match day venue for development, community and women's levels of rugby in NSW. The vision is, *"A place for NSW's rugby players to be their best sporting selves, to strive for NSW Rugby's continued success and for rugby lovers and the broader community to come together, celebrate, nurture and grow the sport of Rugby and all that is good about it –both on and off the field".*

The proposed development has been designed to achieve the following outcomes that will contribute to NSW Rugby's continued success:

- Align to and support NSW Rugby's values.
- Create a unique address and destination for NSW Rugby.
- Cater for the current and future needs of NSW Rugby.
- Support the growth of the NSW Rugby membership and fan base.
- Enhance the NSW Rugby brand and match day product offering.
- Enhance player (men's, women's and development teams) attraction, retention and team performance.
- Enhance NSW Rugby team working environment, health and wellbeing.

2.0 Background

NSW Rugby operations were historically based at the Sydney Football Stadium (SFS) precinct in Moore Park. However, in anticipation of the SFS redevelopment that commenced in late 2018, NSW Rugby was required to relocate its training and administration premises to continue its operations. NSW Rugby subsequently formed a partnership with the University of New South Wales (UNSW) to locate its training and administration premises in a temporary facility in demountable form at the UNSW-owned David Phillips Sports Grounds in Daceyvillle from January 2018.

Whilst long-term relocation of NSW Rugby to David Phillips Sports Grounds was proposed, the timing of securing funding, and the subsequent DA and construction process prohibited the immediate construction of a permanent facility. As such, the temporary facilities allowed NSW Rugby to operate, albeit in a temporary capacity until such time that funding could be secured for a new permanent, purpose-built facility.

To realise NSW Rugby's vision of continued success on the field and engagement with the rugby-loving and broader community to celebrate and grow the sport of Rugby, permanent, state of the art and purpose built facilities are required.

Development consent DA-2020/455 was granted by Bayside Council on 1 July 2021 for the construction of a two storey training facility for NSW Rugby Union at the David Phillips Sports Grounds (DPSG) to include grandstand, gymnasium, medical and rehabilitation facilities, upper level administration, common multipurpose areas and signage. Hours of operation from 8:00am to 8:30pm Monday to Friday, with occasional weekend/public holiday use. This development will be known as the NSW Rugby Centre of Excellence and will allow NSW Rugby deliver on a vision for continued success on the field and engagement with the broader community to celebrate and grow the sport of Rugby.

As at December 2022, the NSW Rugby CoE has been completed and officially opened.

This Plan of Management reflects the approved operation of the NSW Rugby CoE and includes the proposed changes to operation arising from the proposed modifications.

3.0 Site Description

The site is located at the corner of Cook Avenue and Gwea Avenue, Daceyville within the Bayside Council Local Government Area (LGA). It is located within the north-western corner of David-Phillips Sports Complex. The site is approximately 7km south of the Sydney CBD and 5km east of Sydney Airport, as illustrated in the location plan at **Figure 1.**

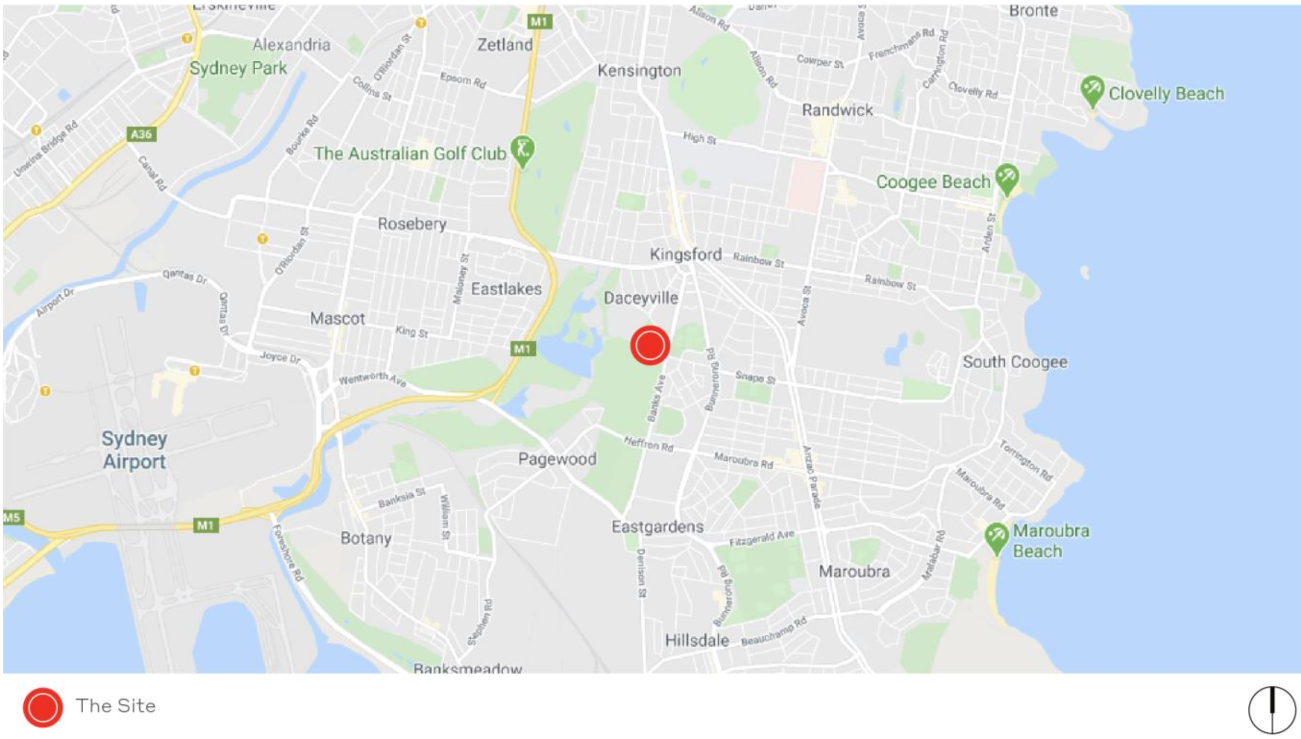

Figure 1 Site Context Map
Source: Google Maps

The David-Phillips Sport Complex is irregular in shape and legally described as Lot 3876 in DP 91234 and owned by the University of New South Wales. It has a total area of approximately 6.3 hectares and is bound by Banks Avenue to the east (approximately 200m frontage) which is its primary street frontage, Gwea Avenue to the north (approximately 250m frontage) and Cook Avenue to the west (approximately 250m frontage).

David-Phillips Sport Complex is improved by a number of existing sports fields and facilities used for cricket, tennis, hockey, soccer, rugby and baseball. It has one oval field, one oval/rectangular field, one rectangular rugby field, one synthetic football pitch and one synthetic hockey pitch and two hard court tennis courts. It also has a central amenities block and a smaller western amenities block, a ground maintenance depot and existing NSW Rugby sporting offices and facilities in demountable form. All facilities are contained within the fenced boundary.

The site is located at the corner of Cook Avenue and Gwea Avenue. It has frontages to Cook and Gwea Avenue, with the entrances accessed via Gwea Avenue and a service gate to the south of the development site on Cook Avenue. The existing ground level of the development site is approximately 1 metre above the Cook Avenue street level.

The site is currently occupied by the completed NSW Rugby CoE.

Prior to the completion of the NSW Rugby CoE, the site was occupied by the Western Amenities Block alongside Cook Ave and the David Phillips Field Maintenance Facility. The Western Amenities Block consists of a grandstand, toilets and change rooms. It is occupied on an occasional basis by the UNSW Rugby Club. Match days are occasionally hosted with food and beverages provided to spectators. During Winter, the adjacent field is used for rugby. During Summer, the adjacent field is used for cricket. During both summer and winter seasons, small crowds utilising existing dedicated spectator seating are in attendance to spectate the matches run by UNSW's various sporting clubs.

A site aerial illustrating the site and the development site is provided below at **Figure 2**.

Figure 2 Aerial photograph of the site and the development site

Source: Nearmap

4.0 Overview of Proposed Development

The proposal relates to a Modification Application MDA-2022/71 (the Modification Application) that seeks to modify Development Consent DA-2020.455 relating to 35 Banks Avenue, Daceyville, which provides consent for the development of the NSW Rugby Centre of Excellence, to be used for high performance training, administration and community development programs.

Specifically, the Modification Application relates to:

- Updated signage plans to include UNSW signage as the landowner of David Phillips Sports Ground (DPSG);
- Deletion of Condition 21 to enable the provision and use of a public address system; and
- Minor amendments to Condition 22 for hours of operation and flood lighting to align the site with the existing approved hours of operation and flood lighting across the remainder of the David Phillips Sports Grounds (DPSG), and for the hours of operation for the indoor high performance facility.

5.0 Pre-DA Requirements for Plan of Management

Written feedback (dated 24 March 2020) provided by Bayside Council following the Pre-DA Lodgement meeting for the now approved DA-2020/455 held at Council offices on 16 March 2020 requested the submission of a Plan of Management to accompany the DA. At a minimum, the Plan of Management is required to include the following items listed in **Table 1**.

Table 1 Pre-DA requirements for Plan of Management

Requirement	Reference
Objectives	Section 1.0
Operational details	Section 6.0
Hours of operation	Section 6.2
A schedule of likely events (both external and internal)	Section 7.2
Any Liquor Licences and/or entertainment approvals	Section 8.2
Staffing and organisation overview	Section 6.1
Measures to minimise unreasonable impacts on adjoining properties	Sections 9.0, 10.0 & 11.0
Maintenance of fire safety	Section 16.0
Deliveries and loading/unloading (If any)	Section 13.0
Managing customers or patrons	Section 8.0
Security details	Section 12.0
Complaint recording and handling process	Section 13.0

6.0 Operations

6.1 Staffing Requirements and Organisational Overview

The NSW Rugby CoE will facilitate approximately 53 staff and 36 contracted athletes. Staff of the NSW Rugby organisation are categorised into the following departments, which will share the NSW Rugby CoE facility:

- Administration – including Commercial, Ticketing, Events and Marketing
- Football / High Performance Department
- Community Department

6.2 Hours of Operation

The hours of operation of the NSW Rugby CoE are as follows:

Outdoor Facilities:

- Monday: 8:00am – 10:00pm
- Tuesday-Friday: 8:00am – 9:00pm
- Saturday: 8:00am – 10:00pm
- Sunday: 8:00am – 6:00pm
- Public Holidays: 8:00am – 9:00pm

Floodlighting is to be consistent with the hours of operation for the outdoor facilities.

For clarity, it is not intended for the outdoor facilities to be used every day in the year. Instead, these hours of operation provide NSW Rugby with flexibility in the scheduling of training sessions and occasional games. Use of floodlighting on weekends and public holidays is expected to be limited to occasional use.

Indoor High-Performance Unit and Gym:

- Monday to Sunday: 7:30am – 7:30pm (generally only in use for certain hours of the day depending on team training schedules)

Indoor Administrative Spaces:

- Monday – Friday: 8:00am – 5:30pm

7.0 Proposed Uses

This section will analyse the use of the NSW Rugby CoE from the perspective of three main uses:

1. High Performance and Training
2. Community
3. Administration

These proposed uses will be analysed to demonstrate that the proposed works can provide acceptable amenity in all proposed uses, including any management or mitigation measures to address potential impacts.

7.1 High Performance and Training

The NSW Rugby CoE will be the primary training venue for the NSW Rugby High Performance programs. The NSW Rugby CoE high performance training facilities include:

- Gym
- Rehabilitation and medical areas;
- Recovery areas;
- Sports science areas;
- Change rooms;
- High performance workspace; and
- Media and analysis areas.

NSW Rugby employs approximately 36 contracted athletes. The number of contracted athletes may vary year to year. These athletes are supported by a team of people including coaches, team managers, medical staff, sports scientists and analysists.

A typical day for an athlete is outlined below:

Phase 1: Arrival

- Arrive approximately 7:30am
- Access change rooms and organise belongings and locker; and
- Breakfast and coffee in the team room

Phase 2: Pre-Training Preparation

- Strapping and/or treatment required for training; and
- Pre-training meeting with coaches in the team room

Phase 3: Training On-Field

- Warm-up
- Unit Work – team split between forwards and backs, may be on separate parts of the field
- Team run

Phase 4: Post-On-Field-Training

- Ice baths;
- Shower; and
- Lunch in team room.

Phase 5: Strength & Conditioning Training

- Use of the Gym for strength and conditioning training

Phase 6: Post-Training and Departure

- Shower; and
- Depart at approximately 4.00pm
- Women's Team or Waratahs Academy arrive after 4.00pm two nights a week each.

7.2 Community

The NSW Rugby CoE is intended to be the main community rugby destination for Rugby in NSW. NSW Rugby host a range of programs and training for community rugby players, volunteers and officials.

The below summarises the range of community rugby programs:

- Coach Education Programs;
- Referee Courses;
- Match Officials Courses;
- TracTahs program; and
- Regional Hub Days.

In addition to the community rugby programs, the NSW Rugby CoE will also host rugby performance programs:

- Super W – NSW Women's Rugby Team;
- Waratahs Academy;
- Gen Blue – under-age representative pathway program; and
- NSW Schoolboys.

The adjacent field will be used for matches.

The administrative level on the first floor of the NSW Rugby CoE will include flexible meeting and multipurpose spaces capable of accommodating meetings and presentations both with and without NSW Rugby staff attendance. The placement of meeting and functions rooms and provision of video conferencing facilities ensures the capability to service regional areas.

The multipurpose space on the first floor will also be used for certain NSW Rugby functions such as:

- Waratah's business networking events;
- Annual General Meeting;
- Meetings with affiliates;
- Leadership courses with our corporate partners;
- Corporate partner events and functions;
- Away game screenings with corporate partners and/or staff; and
- Media conference calls with players and/or Coaches.

7.3 Administration

The NSW Rugby CoE will become the administrative base for NSW Rugby. The NSW Rugby CoE will facilitate approximately 53 staff.

The NSW Rugby CoE will facilitate all administrative requirements through flexible meeting and workshop spaces, collaborative team spaces and focused workspaces, with a technology overlay to ensure the efficiencies, collaboration and communication across the business.

8.0 Pedestrian Access and Egress

The site's primary pedestrian access and egress is from Gwea Avenue at the north of the site. Pedestrian access is also available from the existing service gate at the south of the site from Cook Avenue. Players, staff and guests will be directed to park within the existing Cook Avenue on street parking servicing the site, then walk to Gwea Avenue to utilise the primary entrance.

Players and staff will enter the CoE building at the reception. A lift is provided within the CoE building to achieve accessibility requirements. Direct access between the changerooms and the field is provided between the two flanks of the grandstand. The gym also provides direct access to the field.

9.0 Traffic, Parking and Vehicle Access

Car parking for players and staff will be accommodated by a total of 544 on-street car parking spaces and 154 spaces within off-street car parks that service existing public parks, that are all within a 400m radius of the site. This includes:

- 169 spaces on Banks Avenue;
- 20 spaces on Birdwood Avenue;

- 53 spaces on Prince Edward Circuit;
- 66 spaces on Gwea Aveune;
- 52 spaces on Haig Avenue;
- 45 spaces on Cook Avenue;
- 28 spaces on Astrolabe Road;
- 37 spaces on Isaac Smith Street;
- 45 spaces on Boussole Road;
- 39 spaces on Wills Crescent;
- 43 spaces in the Rowland Park Car Park off Banks Avenue;
- 16 spaces in the end of road car park on Astrolabe Road servicing Astrolabe Park;
- 20 spaces in the Rowland Park Car Park off Prince Edward Circuit; and
- 75 spaces in the Astrolabe Car Park off Cook Avenue.

Players and staff will be encouraged to access the site by car pooling, public transport and/or active transport.

The nearest major public transport option to the site is the L3 Kingsford Light Rail line operating between Circular Quay and Kingsford, with the nearest stop being Juniors Kingsford which is 800m from the site or a ten minute walk. The light rail operates as a turn-up-and-go service, with services running every eight to 15 minutes between Central and Randwick on a daily basis 5am to 2am throughout the week.

The nearest train station to the site is Mascot Station which is located 3.7 kilometres north west of the site. Mascot Station is on the T8 Airport and South Line, which provides services to the City and South Area every 10 minutes during the peak and off-peak periods.

Connections from Mascot Station by bus and walking to the site are available and add approximately 20-30 minutes of travel time.

Bus routes 342, 302, 391, 392, X92 and 307 operate near the site with the nearest bus stop located on Gwea Avenue after Cook Avenue. The bus services provide routes to Eastgardens and Redfern, Mascot and Port Botany, La Perouse and Central Railway Square, Little Bay and Circular Quay, Kingsford and City Museum. Most bus services run every 20 minutes during peak periods and every half an hour during off-peak periods.

A network of on-road and off-road cycle routes surrounds the site. There are existing on-road cycling facilities along Banks Avenue, Gwea Avenue, Cook Avenue and Isaac Smith Street providing connectivity to Kingsford and key sub-arterial roads such as Gardeners Road and Anzac Parade.

A service gate at the south of the site is provided for deliveries and waste collection vehicles only.

10.0 Noise Management

The following noise management measures will be implemented:

- Advising staff and patrons to be considerate and minimize noise when leaving or arriving on the premises, during the early and later hours, that being the time people are most sensitive to noise emissions;
- Implementation of Audio Ducker to reduce announcements trying to compete with the level of the background music and can be clearly audible. When announcements are made, the level of the background music will automatically be reduced under the voice and returned to the previous level once the announcement has concluded.

- Use of signage, for example, having signs reminding attendees to consider neighbours and avoid excessive noise. Signage should also be visible at the offsite parking to be mindful of noise when coming and going.

11.0 Security

The NSW Rugby CoE will adopt standard security measures including, but not limited to, 24 hour CCTV and swipe pass access.

12.0 Complaints Recording and Handling Process

The contact details, phone number and general email for the NSW Rugby CoE will be available on the NSW Rugby website for the general public to access, should they wish to make a complaint.

All complaints whether by phone, email or in-person will be handled by reception, logged in a complaints register. The complaint will be discussed with the Senior Management Team and a response will be formulated. A response will be communicated to the complainant within 5 business days of the complaint.

13.0 Deliveries / Loading and Unloading

A loading and servicing area is located at the southern end of the site utilising existing access from Cook Avenue at Gate 7. NSW Rugby staff will open the service gate when there is a scheduled delivery. The deliveries will be unloaded at the southern end of the site and then transferred into a storage area adjacent to the loading and servicing area on the ground floor of the NSW Rugby CoE. Smaller delivery vehicles are to use the on-street parking along Cook Avenue and provide deliveries using the main entrance to the NSW Rugby CoE on Gwea Avenue. Deliveries to the site will be infrequent.

14.0 Waste Collection

Waste will be initially collected in bins located within each level. Cleaners will manually transfer waste and recycling from both levels to the waste room, located at the southern end of the Ground Level. On collection day, the building manager will transfer the bins from the waste storage room to the hardstand area at the loading dock via the adjacent ramp. Waste will be collected by a private contractor at the loading dock off Cook Avenue at Gate 7 to the south of the building. The waste collection point is suitable for a waste collection vehicle up to 7.7m in length to perform a three-point turn in order to exist the collection point in a forward direction.

15.0 Fire Safety and Evacuation

The NSW Rugby CoE shall adhere to all fire safety and evacuation measures contained within the appended Emergency Management Plan (**Appendix A**) and Fire Engineering Report (**Appendix B**). In the event of an emergency, the evacuation gathering point will be the front of the centre on Gwea Avenue, and the following procedure is to be followed:

1. Alarm raised and relevant emergency services authorities contacted.
2. Wait for evacuation signal.
3. Follow fire warden instructions.
4. Calmly evacuate the premises from nearest emergency exit.

5. Arrive at evacuation location.
6. Locate and account for all staff.

16.0 Flood Management

The NSW Rugby CoE shall adhere to all flood safety measures contained within the appended Emergency Management Plan (**Appendix A**) and Flood Risk Management Plan (**Appendix C**). In the event of a flood emergency, the evacuation gathering point will be the second storey of the Centre of Excellence building, and the following procedure is to be followed:

1. Call the State Emergency Service and advise that the centre site is flooding, and that assistance may be required.
2. Erect temporary warning signs at each building exit, stating the car park is currently flooding and to remain within the centre.
3. If floodwaters appear to be likely to enter the building, turn off the buildings power to reduce the risk of electrocution.
4. Announce (over the loudspeaker and in-person) to occupants of the building that flooding is occurring outside, and to remain calm and stay within the building until the flooding passes. The centre should not be evacuated during the flood event as the greatest flood risk is experienced in the carpark and surrounding areas.
5. Check outside if any vehicles or pedestrians have been caught in floodwaters or injured. Assist them if safe to do so (fast moving or deep floodwaters should be avoided) and if injuries are noted, call an ambulance.
6. If floodwaters enter the building, announce to building occupants that they must evacuate to the second story of the building which is above the level of the Probable Maximum Flood.
7. Assist the elderly or those with children in finding a safe area to wait within the building.

Appendix A – Emergency Management Plan

New South Wales Rugby Union

Emergency management plan

Date: 31/10/2022

Download the latest version of this template from www.business.gov.au/emergencyplan

Plan management

Date last updated	31/10/2022
Person responsible	Lauren Thomas

Business details

Registration details

Business name	New South Wales Rugby Union Ltd
Australian business number (ABN)	70000222711
Australian company number (ACN) If a company.	000222711

Contact details

Name	Lauren Thomas
Phone	9323 3300
Mobile	0492 918 492
Email	35 Banks Avenue, Daceyville NSW 2032
Address	Lauren.Thomas@nsw.rugby

Contents

The continuity plan

This plan outlines **how we'll prepare our business for an emergency** or disruption such as a major flood, bushfire or disease outbreak. Our continuity plan identifies essential areas of our business and how we'll keep them running in an emergency situation.

Our key products/services

- Team Sponsorship
- Waratahs Membership & Match Day Ticket Sales
- TV Broadcast funding

Our main customers

The key customers we need to notify in the case of an emergency.

Customer or business name	Contact method
Member Unions	We would contact our member unions via phone calls
Rugby Community	We would contact our rugby community via direct email and our fans via social media
Sponsors, Members & Fans	We would contact our sponsors directly via phone calls, our members via direct email and our fans via social media
General Public	We will advise the general public via our social media channels

Insurance

Insurance type	**Property Insurance**	**Interruption Insurance**
Policy coverage	All tangible property both real and personal of every kind and description.	Loss resulting from the interruption of or interference with the business caused by damage occurring during the period of insurance.
Policy exclusions	Non tangible property.	
Insurance company	Chubb Insurance Australia Limited	Chubb Insurance Australia Limited
Contact name	Deb Gibson	Deb Gibson
Phone number	02 9253 7335	02 9253 7335
Date product disclosure statement reviewed	31 October 2022	31 October 2022
Payments due Amount and frequency.		

Property and infrastructure

How we protect our property and infrastructure.

The building contains the following fire protection: Hose Reels, Extinguishers, Thermal detectors, Local Alarm, and Back to Base

The building contains the following security measures: Key Windows/Deadlock Doors, Local Alarm, Back to Base, and CCTV Footage

We clear grass and leave from around the building and clean gutters every 6 months

Relocation options

Temporary business accommodation we can quickly access in an emergency situation.

Location type	Office Building	University Campus
Address (and name if a business)	Rugby Australia Moore Park Road, Moore Park NSW 2022	UNSW ANZAC Parade, Kensington NSW 2033
Resources and equipment available	Computers, internet, phones, storage, staff, training equipment, training field	Computers, internet, phones, storage, staff, training equipment, training field
Resources needed	Computers, internet, phones, storage, staff, training equipment, training field	Computers, internet, phones, storage, staff, training equipment, training field

Information back up

How we back up our essential business information.

Information type	How often	Who's responsible Name and mobile number.	Procedure
Every single item of data	Immediately	Sunil Kalidindi +61 2 8005 5555 Infrastructure Systems Manager	Everything is kept on a cloud-based storage – Dropbox for business and can be accessed from anywhere/anytime. We also have backup server should this go down.

The emergency action plan

This plan outlines **what to do in an emergency** and who to contact.

Communication methods

Our Office Manager would contact the General Manager of each department via telephone call and text message. Each General Manager would be responsible for calling his or her team's employees.

Emergency contacts

Organisation name	Contact	Position title	Phone number
Emergency services – triple zero	Fire, police, ambulance	-	000
State Emergency Services (SES)	SES	-	132 500
Poison information line	Poison Control	-	13 11 26
ADT Security	Call Centre	Operator	13 10 05
ATT Maintenance	Jack Kwon	Team Leader	0430 985 950

Emergency procedures

Emergency procedure	What to do	Evacuation location	Where to find the full procedures	Supporting documents
Fire Evacuation procedure	1. Alarm raised and relevant emergency services authorities contacted.	Front of building on Gwea Avenue	The Fire and emergency procedures are outlined in FE-	Map of Evacuation Diagrams

Emergency procedure	What to do	Evacuation location	Where to find the full procedures	Supporting documents
	2. Wait for evacuation signal. 3. Follow fire warden instructions. 4. Calmly evacuate the premises from nearest emergency exit. 5. Arrive at evacuation location. 6. Locate and account for all staff.		FER-NSW Rugby Union COE-007.pdf and in section 16.0 of 221012_Plan of Management_Post Approval_V5_DRAFT.pdf These documents are in the shared drive under the 'Emergency' folder.	

Flood Management Plan	1. Call the State Emergency Service and advise that the centre site is flooding, and that assistance may be required. 2. Erect temporary warning signs at each building exit, stating the car park is currently flooding and to remain within the centre. 3. If floodwaters appear to be likely to enter the building, turn off the buildings power to reduce the risk of electrocution. 4. Announce (over the loudspeaker and in-person) to occupants of the building that flooding is occurring outside, and to remain calm and stay within the building until the flooding passes. The centre should not be evacuated during the flood event as the greatest flood risk is experienced in the carpark and surrounding areas. 5. Check outside if any vehicles or pedestrians have been caught in floodwaters or injured. Assist them if safe to do so (fast moving or deep floodwaters should be avoided) and if injuries are noted, call an ambulance. 6. If floodwaters enter the building, announce to building occupants that they must evacuate to the second story of the building which is above the level of the Probable Maximum Flood. 7. Assist the elderly or those with children in finding a safe area to wait within the building.	Second story of the building	The flood management procedures are outlined in R060922_35_Banks_Avenue_FRMP_.pdf and in section 17.0 of 221012_Plan of Management_Post Approval_V5_DRAFT.pdf These documents are in the shared drive under the 'Emergency' folder.	-

Emergency action plan drill schedule

Procedure type	How often	Position/person responsible	Next drill date
Flood Management	Yearly	Terry Woodward	1/12/2022
Fire Evacuation	Bi-Yearly	Terry Woodward	1/12/2022

Emergency kit

Location

First Aid equipment is located in the Medical Office and Kitchen.

An automatic External Defibrillator is located in the medical office and under sink in kitchen on level 1.

Emergency kit contents

Object	Checked/reviewed date	Person responsible
Emergency management and recovery plan	31/10/2022	Lauren Thomas
Emergency and recovery contacts	31/10/2022	Emma Guggenheimer
Insurance documents	31/10/2022	Stanley Thyssen
Financial documents	31/10/2022	Stanley Thyssen
Torch	2/11/2022	Terry Woodward
First-aid kit	2/11/2022	Emma Guggenheimer
Portable radio	2/11/2022	Terry Woodward
Plastic bags	2/11/2022	Emma Guggenheimer
Spare batteries	2/11/2022	Emma Guggenheimer
Adhesive tape	2/11/2022	Emma Guggenheimer
Pen/pencil and notepad	2/11/2022	Emma Guggenheimer
List of employees and contact details	2/11/2022	Emma Guggenheimer
Bottled water	2/11/2022	Lauren Thomas
Non-perishable food	2/11/2022	Emma Guggenheimer
Other	2/11/2022	N/A

Emergency team roles and responsibilities

Role	Details of responsibilities	Person responsible	Email	Phone numbers
First Aid Officer	Administer first aid support in an emergency. Contact ambulance services when necessary. Attend regular first aid training courses.	Emma Guggenheimer	emma.guggenheimer@nsw.rugby	(02) 9323 3300
Chief Fire Warden.	Communicate procedures to all staff. Supervise and action emergency evacuation procedures. Attend relevant training courses. Conduct regular drills. Update procedures regularly.	Terry Woodward	Terry.woodward@nsw.rugby	(02) 9323 3300
Fire Warden	Attend relevant training courses. Help evacuate staff according to evacuation procedures. Assist with regular drills. Assume Chief Fire Warden duties when required.	Will Stuart and Michael Doyle	Will.stuart@nsw.rugby and Michael.Doyle@nsw.rugby	(02) 9323 3300

Supporting document checklist

Attached documents (where relevant):

- ☐ Emergency procedures
- ☐ Floor plan
- ☐ Impact assessment
- ☐ Insurance information
- ☐ Market assessment
- ☐ Staff contact list

Appendix B – Fire Engineering Report

NSW Rugby Union Centre of Excellence, Cook Ave.

Fire Engineering Report

Prepared for: Rugby NSW c/o Ontoit

Attention: Sep Naderi

Date: 06/10/2022

Prepared by: Jacob Sherwin

Ref: Project No. 46005

Stantec Australia Pty Ltd
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Stantec

Revision

Revision	Date	Comment	Prepared By	Approved By
01	20-11-2020	FER	JS	EJ
02	13-01-2021	Update based on stakeholder comments	JS	EJ
03	20-08-2021	Update to address FEBQ comments	JS	EJ
04	15-02-2022	Update to address FEBQ comments and include Performance Solution 4	JS	JT
05	29-06-2022	Updates to address peer review comments	JS	JT
06	29-08-2022	Draft update to address comments peer review comments	JS	SM
07	06-10-2022	Final FER	JS	JT

JT – Jason Toh, Fire Engineering, Fire Engineer
C10 – Accredited Certifier – Registration No: BDC3205 (NSW – Fire Safety)
RPE: Registration No: PE0002949 (VIC – Fire Safety)
GradDip Building Fire Safety and Risk Engineering, Victoria University

SM – Steven Maguire, Fire Engineering, Team Leader

EJ – Ettienne Jordaan, Fire Engineering, Fire Engineer
MSc Fire Safety Engineering, University of Western Sydney
BEng (Mech), University of Technology Sydney

JS– Jacob Sherwin, Fire Engineering, Fire Engineer
BEng Mechanical Engineering, University of Wollongong

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Contents

Executive Summary

This document is a Fire Engineering Report (FER) for the proposed multipurpose sports centre. The buildings are located along Cook Avenue, Daceyville, NSW 2032.

As per the Building Code of Australia (BCA) 2019 Amdt 1[1], the proposed redevelopment is classified as a Class 5 office space and Class 9b gym, multipurpose and function space and open spectator seating with a rise in storeys of 2 and an effective height of less than 12m. As such, the building is required to be of Type B construction.

The proposed Performance Solutions for this development are listed in Table 1, with the applicable BCA Deemed-to-Satisfy (DtS) Provisions, relevant BCA Performance Requirements and the proposed methods of assessment.

All other items of fire and life safety which have not been identified in Table 1 are to be in accordance with the BCA DtS provisions. Any change in this information to suit future building works or re-organisation will require further analysis to confirm compliance with the regulations and the fire engineering assessment.

The fire safety strategy outlined in this report has been developed to provide a practical fire safety design for the scheme, taking into account the various design constraints incumbent on the design by virtue of its site, whilst ensuring a robust fire safety philosophy for both building occupants and the Fire Brigade.

Table 1: Summary of Performance Solutions

No.	Description of Performance Solutions	BCA Clauses	Performance Requirements	Assessment Method
1	Rationalise extended travel distance to an exit and between alternative exits	D1.4, D1.5	DP4, EP2.2	A2.2(2)(b)(ii)
2	Booster and hydrant locations not in accordance with AS2419.1-2005	E1.3	EP1.3	A2.2(2)(b)(ii)
3	Permit reduced egress widths from the terrace seating	D1.6	DP4, DP6, EP2.2	A2.2(2)(b)(ii) A2.2(2)(d)
4	Permit the use of PLAE flooring material within the Gym area.	C1.10	CP2, CP4, EP2.2	A2.2(2)(b)(ii)

1. Introduction

1.1 General

Stantec has been engaged to develop a performance-based fire safety strategy for the development located along Cook Avenue, Daceyville, NSW 2032. The fire safety objective of this strategy is limited to achieving compliance with the Performance Requirements of the Building Code of Australia (BCA 2019 Amdt 1) [1]. Fundamentally the BCA aims to protect life safety, prevent fire spread to adjacent buildings, and facilitate Fire Brigade operations.

Figure 1: Scope of works

Our approach to Fire Engineering is in accordance with the Australian Fire Engineering Guidelines (AFEG) [2]. Stantec adopt worldwide best practice and standards as outlined in Section 1.1.1 (of the AFEG) and using the document as general guidance on the analysis process without strictly following each individual sub-system as per Section 3 of the AFEG, which permits different approaches to demonstrate compliance. In this light guidance documentation such as the New Zealand Verification Method 2 [3] and C/AS2 – C/AS7 Acceptable Solutions for Buildings [4], British Standard PD 7974 Series [5], Society of Fire Protection Engineering Handbook of Fire Protection Engineering [6], CIBSE guide E [7] and the NFPA Series [8] are all referenced.

1.2 Design Team and Stakeholders

The relevant project stakeholders are listed in Table 2.

Table 2: Design team and stakeholders' information

Role	Organisation/Company	Person
Client	NSW Rugby Union (NSWRU)	-
Project Manager	Ontoit	Danny Liston Sep Naderi
Fire Project Engineer	Stantec	Steven Maguire
Architect	Cox Architecture	John Ferendinos Jamileh Jahangiri
PCA	Blackett Maguire and Goldsmith	Aaron Redfern

1.3 Relevant Documentation

The relevant documents and drawings reviewed and assessed as part of this report are listed in Table 3.

Table 3: Document Register

Document Name/Description	Organisation	Date	Revision
Proposed Site Plan, Issued for Construction	Cox Architecture	21-05-2021	2
Overall Plan – Ground Floor, Issued for Construction	Cox Architecture	20-08-2021	1
Overall Plan – Level 1, Issued for Construction	Cox Architecture	20-08-2021	1
General Sections East – West 02	Cox Architecture	20-08-2021	1
BCA Assessment Report	Blackett, Maguire and Goldsmith	09-12-2020	2
HY-SK-017 – Proposed Hydrant Booster Location	Stantec	05-11-2020	1
HY- 300-01 and HY- 300-02 - Pressure Services Ground Level 70% D&C Tender Issue	Stantec	10-12-2020	1
Ground – Lighting and Fire Detection Layout Zone B	Stantec	02-08-2021	2
Level 01 – Lighting and Fire Detection Layout Zone B	Stantec	02-08-2021	2
Fixtures, Fittings & Equipment Schedule	Cox Architecture	08- 12-2021	3

1.4 Regulatory Framework

The Building Code of Australia (BCA 2019 Amdt 1) is applied throughout the Australian States and Territories, legislated by Government Acts and Regulations, and is applicable to private construction projects. The BCA is considered to provide an appropriate representation of community fire safety objectives. The fire and life safety objectives of the BCA can be summarized as the following:

Compliance with the BCA is achieved by demonstration that the Performance Solution complies with the BCA Performance Requirements, as outlined in BCA Clause A2.2(1). Compliance with the relevant Performance Requirements are the only part of the BCA which must be satisfied.

Satisfying the Performance Requirements of the BCA through Fire Engineering Performance Solutions can be undertaken using a variety of methods, as detailed in Table 4. Where Performance Solutions are undertaken using a Verification Methods, documents such as AFEG [2] and BS 7974-0 [4] have been used to define the appropriate type of analysis, i.e. Absolute – Qualitative – Deterministic.

Table 4: BCA Clauses – A2.1 Compliance with the Performance Requirements and A2.2(2) Assessment Methodology

Clause A2.2(1)	Clause A2.2(2)
The Performance Solution is achieved by demonstrating - (a) Comply with the Performance Requirements; or (b) Be at least equivalent to the Deemed-to-Satisfy Provisions	A Performance Solution must be shown to comply with the relevant Performance Requirements through one or a combination of the following Assessment Methods: (a) Evidence to suitability in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets the relevant Performance Requirements. (b) Verification Methods such as— i. The Verification Methods in the NCC; or ii. Other Verification Methods as the appropriate authority accepts for determining compliance with the Performance Requirements. (c) Expert Judgement. (d) Comparison with the Deemed-to-Satisfy Provisions

1.5 Fire Engineering Brief

A Fire Engineering Brief Questionnaire (FEBQ) was submitted to FRNSW with prior review by the Design Team and other key stakeholders. This document is consistent with the requirements and purpose of a Fire Engineering Brief (FEB) / Performance-Based Design Brief (PBDB), to define the scope of work and basis for which the Fire Engineering analysis will be undertaken.

The Performance-Based Design Brief is triggered by BCA Clause A2.2(4) which is outlined in Table 5, below.

Table 5: BCA Clauses – A2.2(4)

Clause A2.2(4)

Clause A2.2(4)
Where a Performance Requirement is proposed to be satisfied by a Performance Solution, the following steps must be undertaken: (a) Prepare a performance-based design brief in consultation with relevant stakeholders. (b) Carry out analysis, using one or more of the Assessment Methods listed in A2.2(2), as proposed by the performance-based design brief (c) Evaluate results (b) against the acceptance criteria in the performance-based design brief. (d) Prepare a final report that includes – (i) All Performance Requirements and/or Deemed-to-Satisfy Provisions identified through A2.2(3) or A2.4(3) as applicable; and (ii) Details of steps (a) or (c); and (iii) Confirmation that the Performance Requirement has been met; and (iv) Details of conditions or limitations, if any exist, regarding Performance Solution.

The FEB consultation process was undertaken as follows:

- The FEBQ was issued to the Design Team for stakeholder review on the 20 November 2020.
- Comments were provided on the 23 November 2020.
- FEBQ was lodged with FRNSW on the 23 November 2020
- FRNSW provided their response to the FEBQ submission on the 12 December 2020.
- Subsequent revisions of the FEBQ were produced to address stakeholder comments.

The last revision of the FEBQ is FEBQ V07, FRNSW comments and where they are addressed within the FER are outlined in Appendix 2.

1.6 Assumptions and Limitations

Please note all referenced documentation, standards and texts are done so in the following style "[ ]". Appendix A 1.1 details the full references made mention of within this report.

It should be noted that the figures presented in the Performance Solutions provide an indicative supporting mark-up of the identified deviation(s) from the BCA Deemed-to-Satisfy provisions. The figures are used for illustrative purposes only and should be read in conjunction with the drawings prepared by the architect or engineers for this project.

The following assumptions will be incorporated into the Fire Engineering Analysis:

- Only one fire will occur at a time within the development.
- All exit routes are maintained clear of obstructions.
- The analysis is limited to the assessment of single / accidental fires as intended by the BCA. The fire scenarios investigated within this document may be representative of intentional fires caused by an opportunistic arsonist; however multiple fires, severe acts of malice intent, terrorism, sabotage, or by willful interference with fire and life safety systems are considered outside the scope of this assessment.
- No property protection requirements have been advised and therefore included within the design. Some property protection is inherent within the life safety measures required for the building however this is incidental.
- We have not been advised of any insurers requirements and therefore this has not been considered within the design.
- All essential services, equipment services and strategies will be maintained to the operational capacity to which they were designed and will correctly function during a fire situation.

- All other components of the building not addressed within this document will be installed to the requirements of the Deemed-to-Satisfy provisions of the Building Code of Australia applicable at the time of construction certificate application.
- The report assumes a complete and operational building and does not address protection of the building during construction, renovation or demolition.
- The Fire Engineering Assessment carried out is specific to this project. The findings and outcomes of this document shall not be used outside the scope of this project.
- The fire engineer is not an Authority Having Jurisdiction (AHJ), we will endeavour to identify all fire safety related issues. However, as we are not the AHJ we are not liable for any BCA departures identified as the project design develops.

As the fire engineer we are not responsible for reviewing general wall types, penetrations and any other non-specific item not previously identified by the principal certifier or the design team.

2. Building and Occupant Characteristics

2.1 Building characteristics

2.1.1 Building Location

The development is located at Cook Avenue, Daceyville, NSW 2032 as shown in Figure 2.

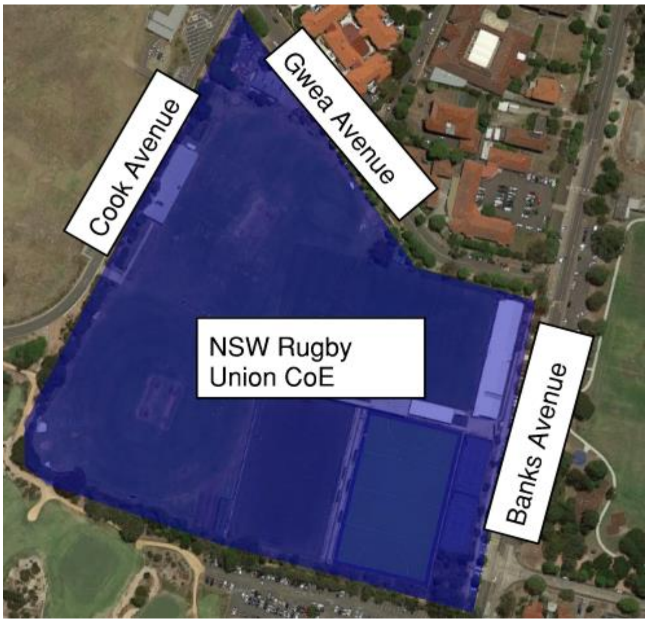


Figure 2: Building Location

2.1.2 Fire Brigade Access

The site is located approximately 4.1 km (as determined by Google Maps) from Fire and Rescue NSW Matraville.

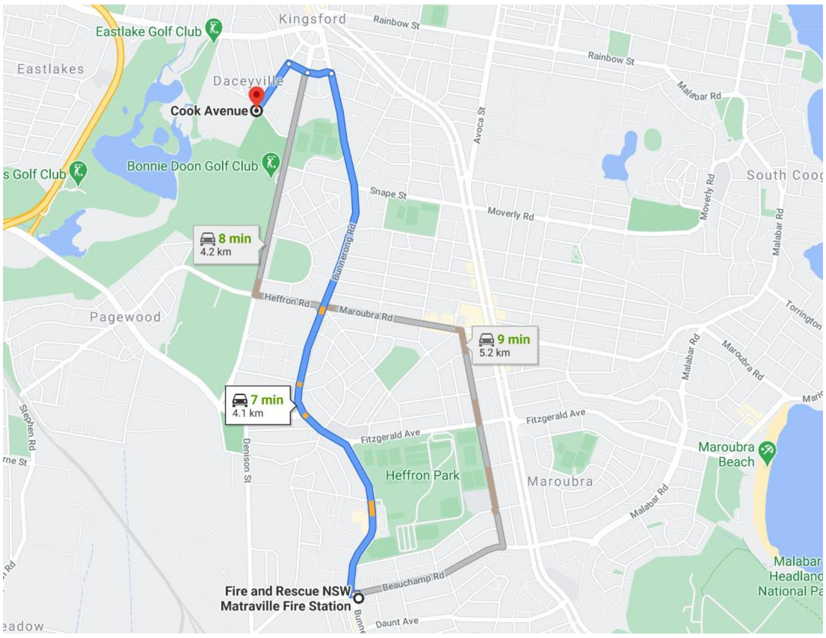


Figure 3: Closest Fire Station

The fire hydrant booster is located on Banks Avenue where the fire brigade will arrive on site and access the booster as shown in Figure 4, below. Note that the booster is not located at the main entrance of the building.

Figure 4: The fire hydrant booster located on Banks Avenue

2.1.3 Building Classification

The Building Classification has been tabulated in Table 6, based on the information provided in the BCA Assessment Report Table 2.1.

Table 6: Building Characteristics and Classification

BCA Clause/ Section	Description	Description of requirements
A1.1	Effective height	< 12m
A3.2	Building occupancy & BCA Classification	Class 5 and 9b
C1.1	Construction type	B
C1.2	Rise in Storeys	2
	Area of largest fire compartment	~ 3,000 m^2

2.2 Occupant characteristics

The characteristics of occupants and their corresponding interaction with the building environment, staff, queues and people around them is important when trying to understand the evacuation process. It is therefore necessary to consider the characteristics of the occupants that can be expected in the building when undertaking Fire Engineering Analysis, as highlighted in the AFEG [2].

The principal occupant characteristics for the building are listed in Table 7, using Table 2 of BS 9999 [7].

Table 7: Occupant Characteristics

Type	Description	Category
Staff	Administration, maintenance staff, home rugby union team staff: coaches, players, training assistants	Awake and familiar
Visitors	Visitors: Spectators at team games, members of visiting rugby union teams	Awake and unfamiliar
Note: Occupants are assumed able bodied, however, to ensure a robust approach to life safety where analyses herein assess occupant characteristics, a reduced travel speed over a nominal travel speed is considered to capture occupants who have impaired mobility.		

3. Fire Safety Requirements

3.1 General

The following sub-sections outline the key parameters of the building fire safety design for this project, either as required under the BCA Deemed-to-Satisfy provisions or included/amended as a result of the fire engineering assessment. In general, except where specifically modified, systems and components shall be designed and installed in accordance with the relevant Australian Standards and BCA Deemed-to-Satisfy requirements.

This document does not necessarily include each and every detail applicable to the building construction and services and should be read in conjunction with the BCA for requirements relating to slab edge details, fire resistance of shafts, treatment of penetrations, etc. not referred to below.

3.2 Construction

The bounding construction around the Ground Floor Storeroom 01 is to achieve a FRL of at least 60/60/60, the extent is shown in Figure 5, below.

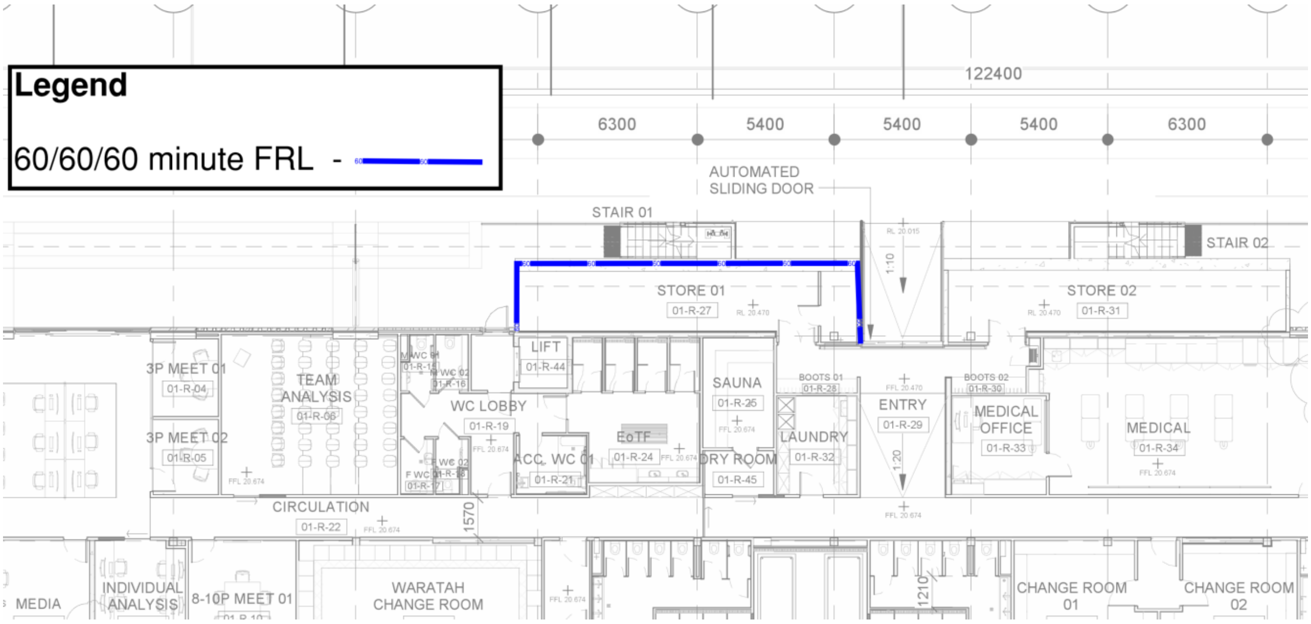


Figure 5: Ground Floor Storeroom 1 FRL

The walls separating the gymnasium from Level 1 and all openings and junctions around smoke proof walls are to be stopped with non-combustible materials and is to achieve hot temperature smoke proof construction as per BCA Specification C2.5. The extent of smoke proof construction is shown in Figure 6.

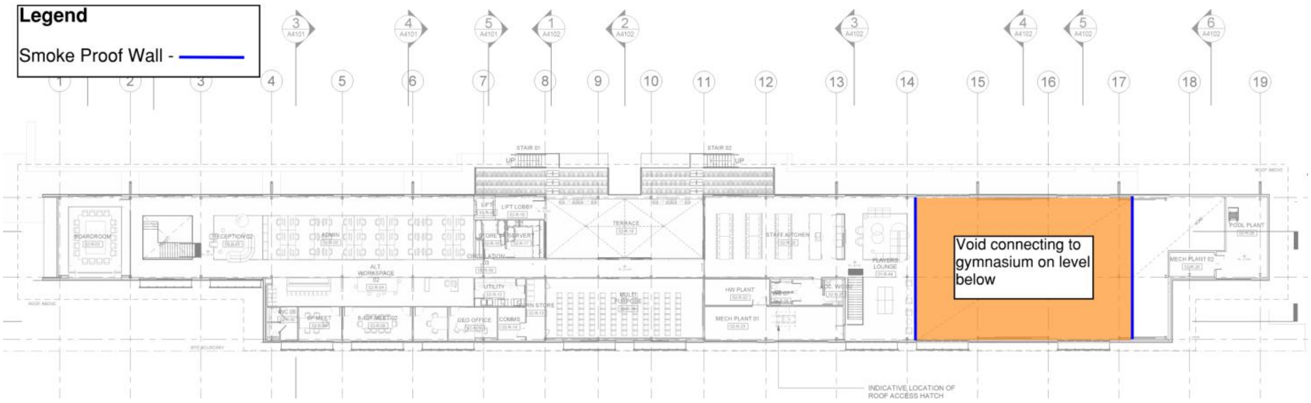


Figure 6: Smoke proof construction on Level 1

3.2.1 PLAE Flooring

PLAE rubber flooring material which is not in compliance with Spec C1.10 is to be used in the Gym area covering the extent of the gym floor as addressed within Performance Solution 4.

- This flooring is to continue up the gym wall no higher than 150mm from the floor.
- This flooring is to achieve a smoke development rate no higher than 1272 %.m and a critical heat flux no lower than 2.3 kW/m^2.
- If usage type of the gymnasium changes re-assessment of PLAE flooring is required.

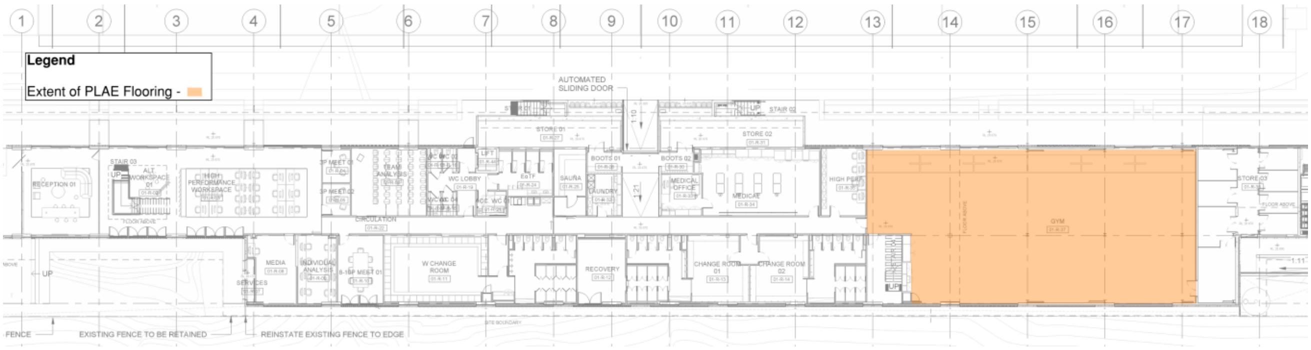


Figure 7: Location of Proposed PLAE Flooring

3.3 Egress Provisions

The grandstand is permitted to include a 600 mm egress path width either side of the barrier down the terrace stairs as shown in Figure 8.

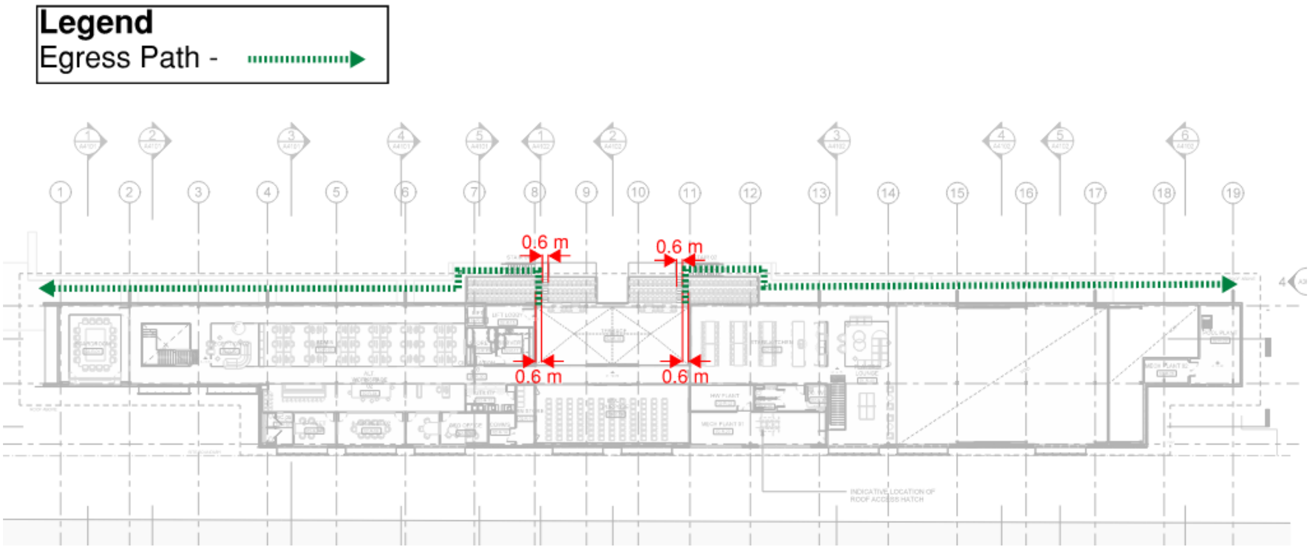


Figure 8: Egress paths through central grandstand area

Extended travel distances are permitted in the following areas:

- 42 m and 75 m in lieu of 40 m to nearest exit on ground floor and the extended travel distance of 69 m in lieu of 60 m between exits on Level 1
- 22.4 metres to a point of choice (POC) from the plant room on Level 1.

Egress paths out of the Ground Floor Gym space are to have exits signs at the exit doors. The doors are to be manually operable and form free passage doors which are to remain unlocked and operable during business hours and gym operation.

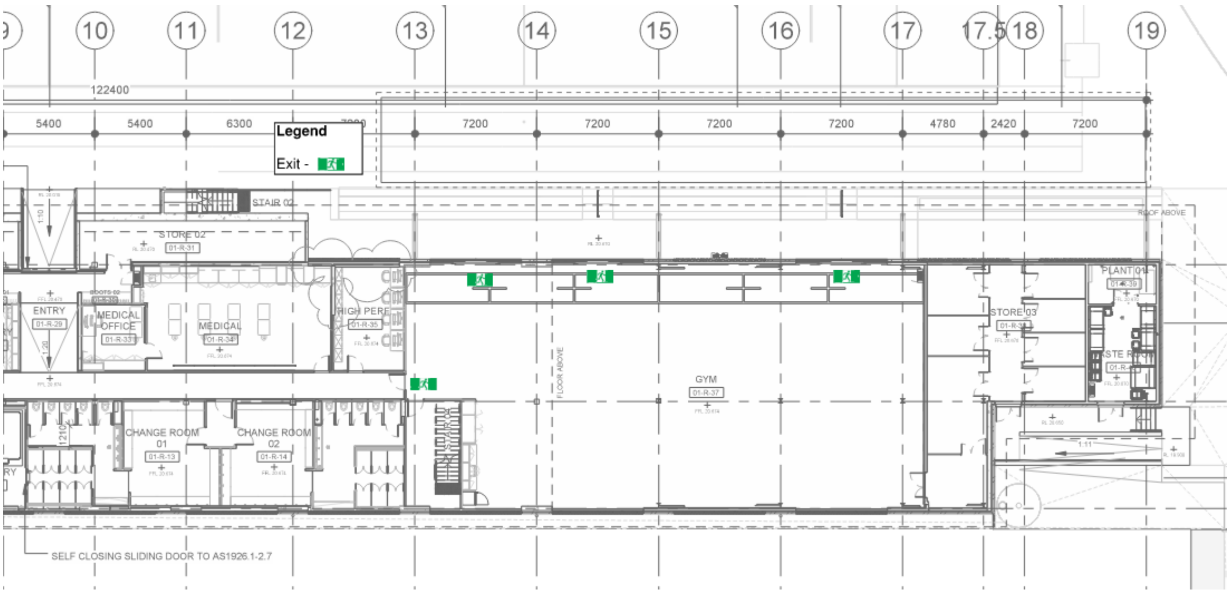


Figure 9: Gymnasium egress provisions

3.4 Services and Equipment

3.4.1 Smoke Detection and Alarm

A smoke detection and alarm system is to be installed throughout in accordance with BCA Specification E2.2a and AS1670.1-2018, the detector type is to be standard sensitivity smoke detectors installed throughout and are to have a grid spacing of 10m x 10m.

3.4.2 Fire Hose Reels

Fire hose reels are to be installed as per BCA E1.3 and in accordance with AS2441- 2005.

3.4.3 Fire Hydrants

A fire hydrant system is to be installed in accordance with AS2419.1-2005, with the exception of the distance of the central external attack hydrant not within 50m of the hardstand and the booster located not within the sight of the main entrance. The booster and external attack hydrant locations are shown in Figure 11. The central external attack hydrant is to be no further than approximately 75 m from the hard stand as shown in Figure 10.

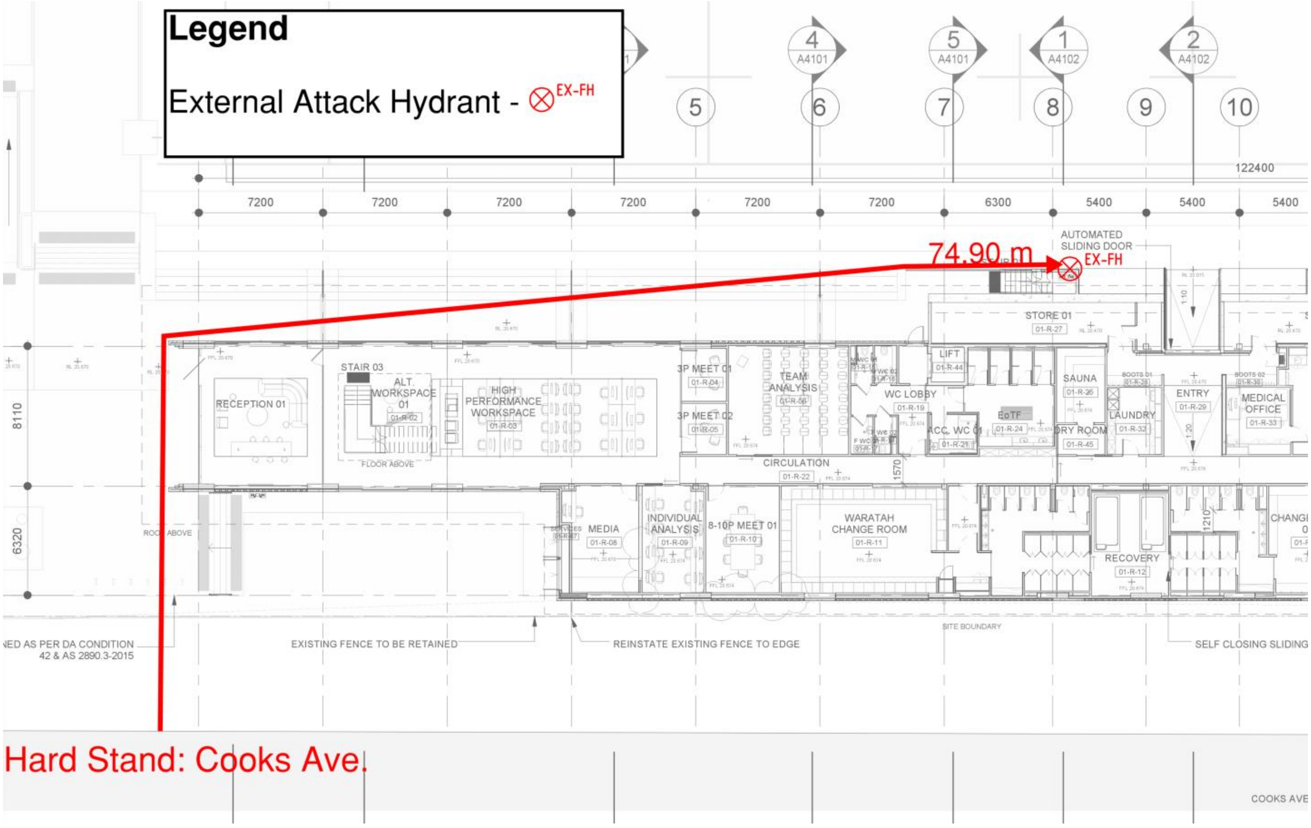


Figure 10: Central external attack hydrant location

3.4.4 Signage

- At the request of FRNSW:

  i. Signage is to be installed at the Fire Detection Control and Indicating Equipment (FDCIE) that is to identify the FDCIE identifying the presence and location of the alternative electrical generation system.

  ii. A block plan showing the location of all associated isolation switches, AC and DC isolators for the shut-off of generated electricity should be displayed at the FDCIE

iii. If the alternative electrical generation system automatically isolates on fire trip, signage should be provided at the FDCIE detailing this provision that can clearly be identified by firefighters.

iv. Signage is to provide notice of the type of alternative electrical generation system and the location of any isolation/shut-off switches and shut down procedures. Be provided on or adjacent to the FDCIE and provided on or adjacent to all sprinkler and hydrant block plans.

v. Signage is to be made of a fade resistant material with red lettering not less than 25mm high with a contrasting coloured background.

- A block diagram is to be installed within the Fire Detection Control and Indicating Equipment (FDCIE) panel affixed to the panel access door, that is to direct the Fire Brigade to the Fire Hydrant Booster location and external attack hydrant locations, an example block diagram is shown in Figure 11. The block diagram is to have dimensions corresponding to an A3 sheet of paper and is to be made of a fade resistant material.

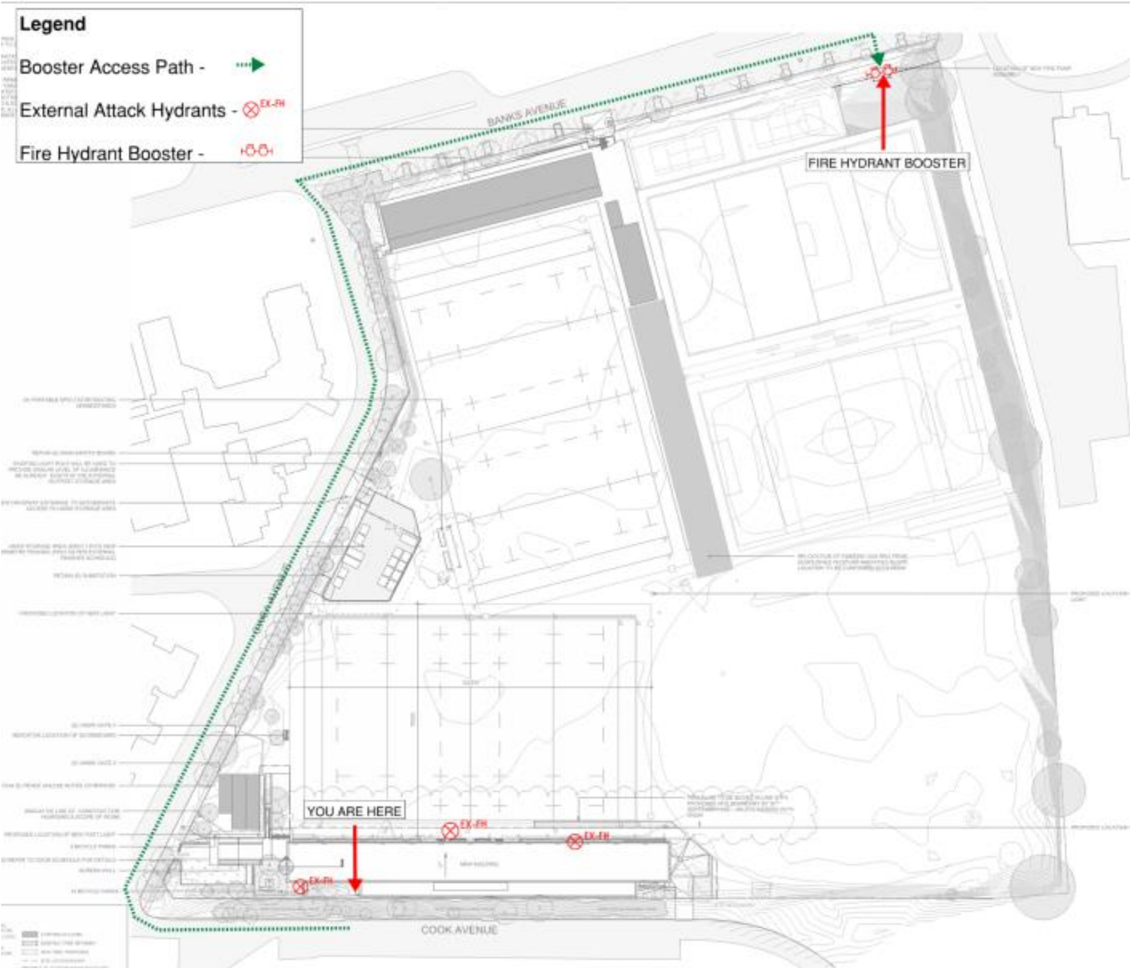


Figure 11: Example Block Diagram

3.5 Ongoing Maintenance & Management

The following is the management in use requirements which need to be understood by the building owners and operators and should be included as part of any management documentation and Annual Fire Safety Statement Certificate.

- A no smoking policy is to be implemented in all common property areas.
- Regular evacuation drills to be conducted annually (minimum) within the building.

- General housekeeping must be undertaken to maintain the egress paths and exits clear in order to allow unimpeded travel. This includes the gymnasium space where equipment is to be placed such that exits are unblocked at all times.
- Building management must ensure that all fuel load restrictions placed upon the building by this fire engineering report are enforced, including regular checks and monitoring of subject areas to ensure compliance.
- The Ground Floor gym space is to be served by the Ground Floor warden, if the gym is the only part of the Ground floor in operation a warden is to be present as confirmed in Appendix 6.

Commissioning and integrated function testing of all fire safety and protection systems including interfaces to ensure proper function must be undertaken.

The proposed Fire Engineering Strategy for the building imposes the following requirements on the eventual Building Managers:

- Maintain all active and passive Fire Safety Systems in accordance with the relevant section of AS 1851-2012 Amd 1:2016 with emergency lighting and exit signs to be maintained in accordance with AS/NZS 2293.2 – 2019.
- Evacuation diagrams in accordance with AS 3745-2010 to be provided. The standard emergency evacuation plans are to detail an accessibility specific emergency evacuation.
- Where services are modified as part of a Performance Solution, these must be included in the maintenance and annual certification.

3.6 Safety in Design

The Fire Engineering Analysis is conducted on the basis that any ramifications for “Safety in Design” will be covered by the risk management reporting of the relevant consultants/disciplines responsible for detailed documentation of works recommended by these disciplines including, but not limited to, the Architect and the relevant building services consultants. We will not produce a separate, standalone Risk Management Report for this discipline. We note that the Work Health and Safety (WHS) legislation places particular obligations on the developers and owners of property with respect to the management of WHS issues arising from the construction, use, maintenance and demolition of plant and buildings.

4. PS 1 – Extended Travel Distances

4.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

Table 8: Summary of Performance Solution 1

<table>
<tr><td>Description</td><td colspan="5">Rationalise the extended travel distances as follows:
• 42 m and 75 in lieu of 40 m to nearest exit on ground floor and the extended travel distance of 69 m in lieu of 60 m between exits on Level 1; and
• 22.4 metres to a point of choice (POC) from the plant room on Level 1.</td></tr>
<tr><td>DtS Clause</td><td>D1.4, D1.5</td><td>Performance Requirements</td><td>DP4, EP2.2</td><td>AFEG Sub-systems</td><td>D, E</td></tr>
<tr><td>A2.1. - BCA Approach</td><td>Performance Solution</td><td rowspan="2">A2.2 – Assessment Methods</td><td rowspan="2">A2.2(2)(d)</td><td rowspan="2">Analysis Methodology</td><td rowspan="2">Comparative
Qualitative
Deterministic</td></tr>
<tr><td>A2.2(1) - Performance Solution</td><td>Comply with the Performance Requirements</td></tr>
<tr><td>Fire hazards</td><td colspan="5">The fire hazard associated with this solution is that occupants are to evacuate along an egress path with a travel distance greater than the DtS provisions. As such the evacuation time will increase with this distance and occupants will egress through the building at a later stage in fire development whereby untenable egress conditions may have developed.</td></tr>
<tr><td>Acceptance Criteria</td><td colspan="5">The solution is considered to have met the acceptance criteria if it is demonstrated that occupants are able to evacuate the building at an earlier time than that of a BCA DtS compliant design.</td></tr>
<tr><td>Description of Alternative Solution</td><td colspan="5">The solution utilises a comparative and qualitative assessment to demonstrate that the risk to occupant life safety is less than that of a DtS compliant design.</td></tr>
</table>

4.2 Intent of the BCA Deemed-to-Satisfy Provisions

The BCA Clause D1.4 states that for Class 5, 6, 7, 8 or 9 buildings that no point on a floor must be more than 20 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 exit must not exceed 40 m.

The BCA Clause D1.5 states that for exits that are required as alternative means of egress must be not more than 60 m apart for all other cases than Class 2, 3 or 9a buildings.

The BCA Performance Requirement DP4 states that paths of travel to exits must have dimensions appropriate to occupant characteristics and building function.

The BCA Performance Requirement EP2.2 states that for safe evacuation routes that in the event of a fire in building the conditions in any evacuation route must be maintained that temperatures and toxicity will not endanger human life and the level of visibility will enable the determination of evacuation routes appropriate to the occupant characteristics, building function travel distance of the and other characteristics of the building, fire load, potential fire intensity, fire hazard, active fire safety systems and fire brigade intervention.

The extended travel distance to an exit on the ground floor is 42 m in lieu of 40 m as shown in

Figure 12 and the extended travel distance between alternative exits on Ground level of 75 m and Level 1 of 69 m in lieu of 60 m as shown in Figure 14.

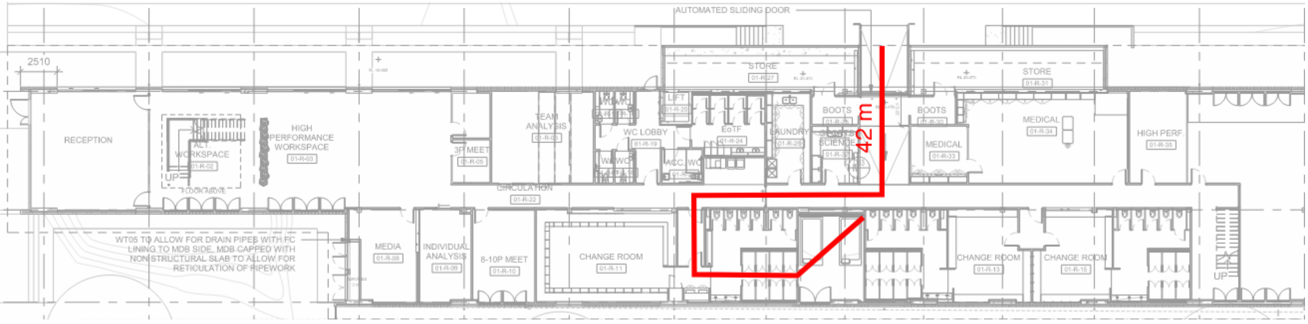


Figure 12: The extended travel distance to an exit on the Ground floor.

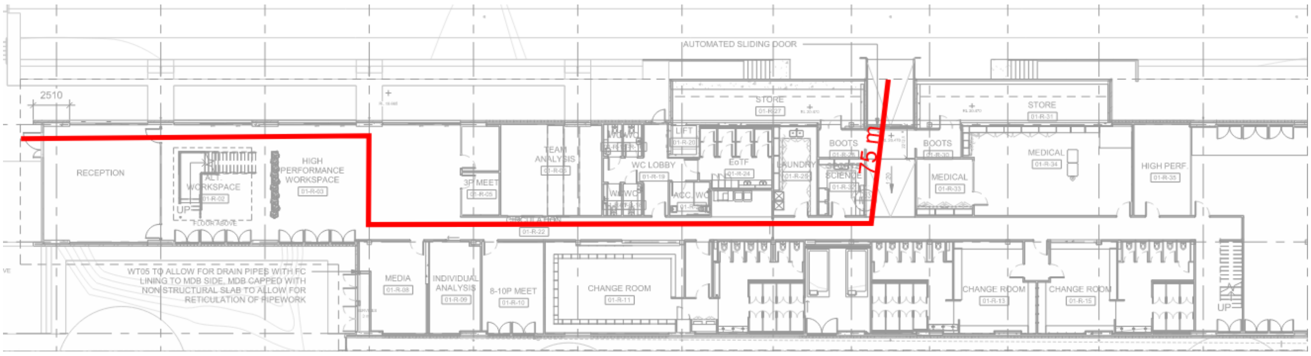


Figure 13: The extended travel distance between alternative exits on Ground floor.

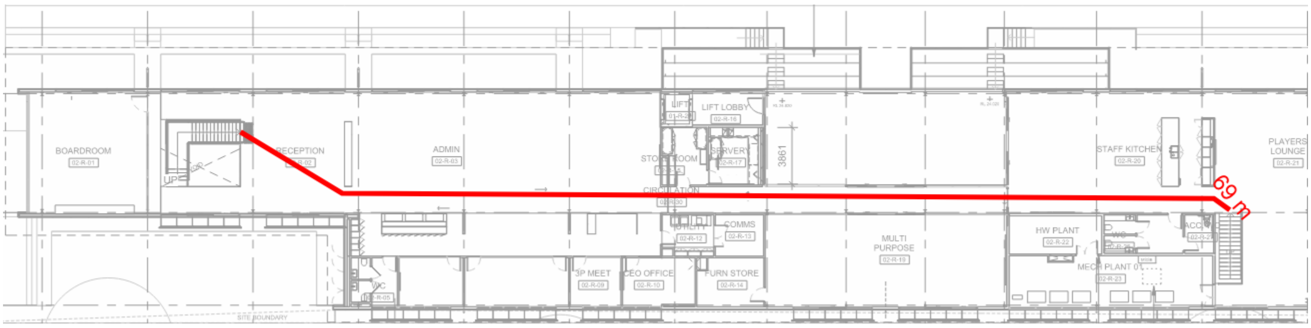


Figure 14: The extended travel distance between alternative exits on Level 1.

4.3 Qualitative Analysis

The general DtS provisions as outlined by BCA Table E2.2a state that for a building of Class 5 and 9b is required to have smoke detection installed only if the building has a rise in storeys of three (3) or more. The Centre of Excellence building is falls below that three (3) storey threshold with a rise in stores of two (2), however, it is proposed to install smoke detection throughout as per Spec E2.2a in order to facilitate safe occupant egress along extended travel distances as discussed in further detail below.

Extended travel distance to exit

The travel distance to an exit on the ground floor is greater than DtS provisions. The BCA states that for DtS travel distances that maximum travel distance to an exit is to be no greater than 40 m. There is a travel distance on the ground floor from the furthest point in a change room to an exit of 42 m a distance which is greater than the DtS provision by 2 m.

The extended travel distance results in an increased travel time, this additional travel time will increase the total evacuation time compared to egress along a DtS travel distance. In the event of a fire breaking out within the Ground floor the increased travel time may result in evacuation along the egress path corresponding to a later stage in fire growth whereby tenable conditions may not be maintained.

The provision of smoke detectors installed throughout the building will provide occupants with early warning to the initiation of a fire, the occupants will be alerted to the fire and will proceed to evacuate.

Due to the provision of smoke detectors it is expected that in the event of a fire, occupants will be alerted and proceed to evacuate at an earlier stage of fire development when compared to a DtS design which does not require smoke detection. Further, the additional travel time of 2.5 seconds that results from the extended travel distance (based on conservative travel speed of 0.8 m/s) is considered to present a minor increase to the evacuation time (an increase of only 5%) and is expected to be offset by the early warning provided by the smoke detectors and alarm system.

Extended travel distance between alternative exits

The extended travel distance between alternative exits on the Ground floor and Level 1 is greater than DtS provisions and is assessed in a similar manner to the extended travel distance to an exit as discussed above. The travel distances between exits on the Ground floor and Level 1 is 75 m and 69 m, respectively, in lieu of 60 m.

The additional travel distances of 15 m and 9 m (based on conservative travel speed of 0.8 m/s) results in additional travel time of 18.75 seconds and 11.25 seconds compared to DtS provisions, a respective increase in travel time of 25% along Ground floor and 15% along the Level 1 travel path.

In the event of a fire initiating on either the Ground floor or Level 1 the provision of smoke detectors affords occupants with early warning to begin evacuation which is expected to offset the additional travel time that occupants may encounter if they need to seek an alternative exit.

Therefore, it has been demonstrated that through the provision of detectors occupants are expected to begin evacuation at an earlier stage of fire development which should afford occupants with tenable egress conditions for the evacuation period.

Extended travel distance to a Point of Choice (POC)

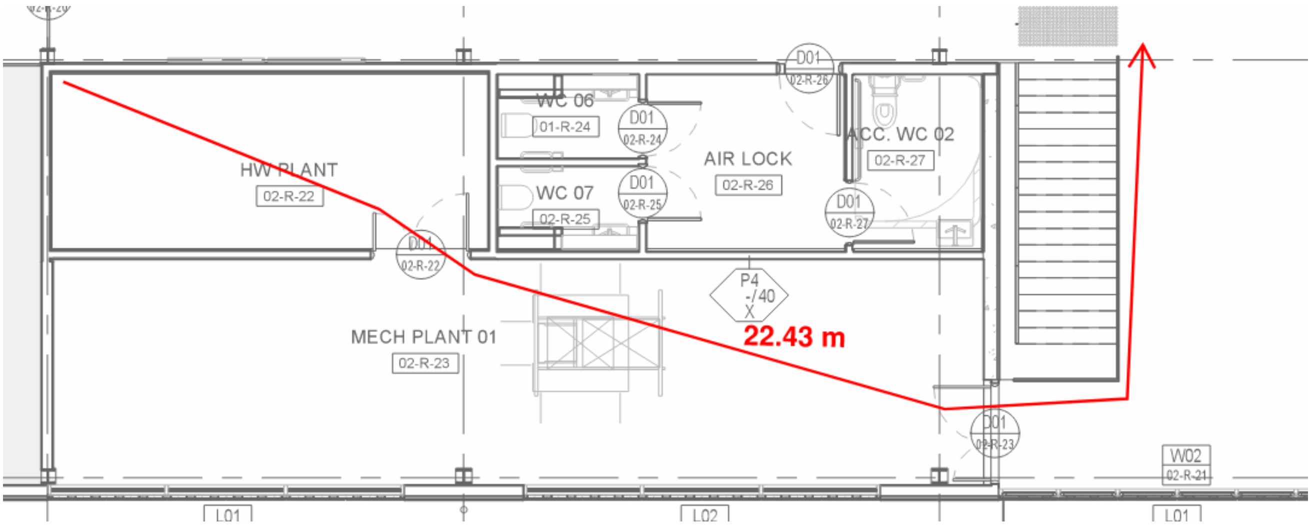
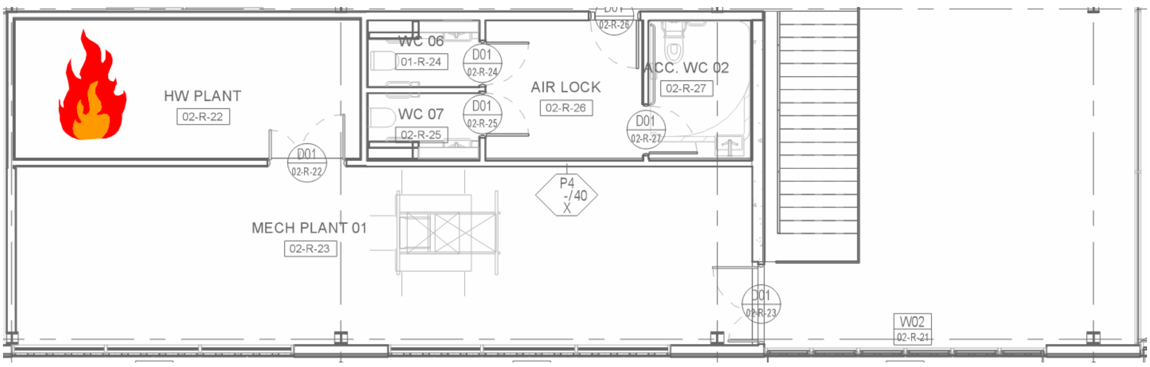
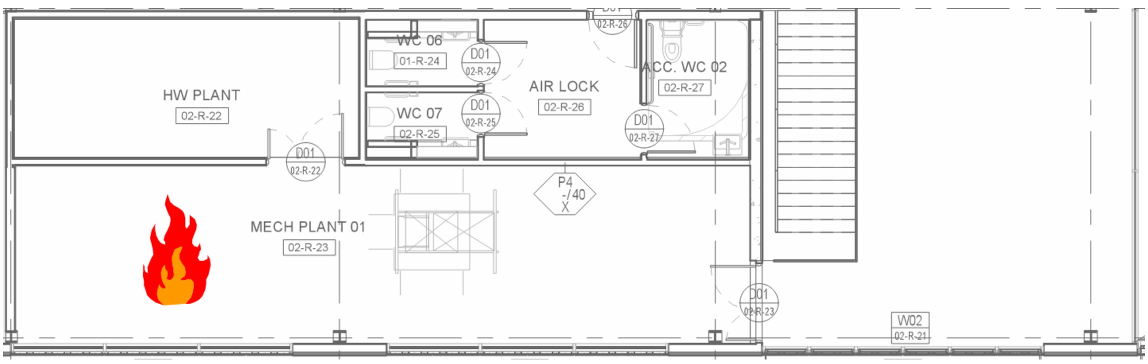
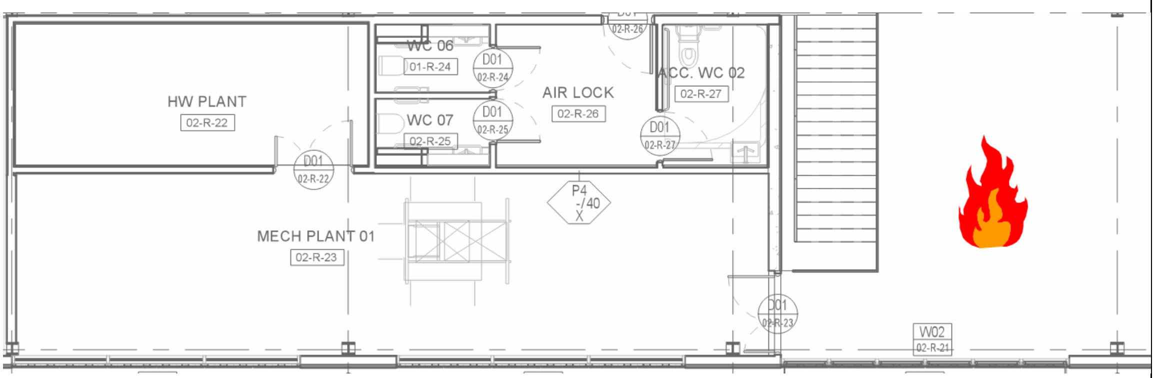


Figure 15: The extended travel distance from Level 1 plant room to a point of choice.

To rationalise safe egress along the extended path, three fire location scenarios will be considered along or near the path of egress as shown in the table below.

Table 9: Radiation Calculation

Scenario	Fire Location
Fire Scenario 1	Within the HW Plant room 
Fire Scenario 2	Within the Mechanical Plant Room 
Fire Scenario 3	Within the space outside of the Mechanical Plant Room, before the point of choice 

The three fire scenarios consider fire locations that could lead to untenable egress conditions for occupants evacuating from the HW Plant Room. The scenarios presented utilise smoke detectors connected to a Building Occupant Warning System (BOWS) to provide an audible alarm.

The provision of the smoke detection and alarm system alerts occupants of a fire initiating in any one of the compartments listed in the table above. The resulting evacuation time of an occupant from the HW Plant Room, based on auditory recognition of an alarm, is considered to be lower than the evacuation time of an occupant prompted by either visual, thermal or odorous indicators of a fire. Despite the extended distance of the egress path, the time taken to recognise a fire and then evacuate from the plant room is considered to be quicker than evacuation along a compliant path without a smoke detector triggered alarm system.

In addition, the provision of 1 exit in lieu of 2 is considered to not delay occupant evacuation, or pose undue risks of being trapped. Given the plant room is to be accessed by trained personnel who are familiar with the egress routes, then it is considered occupants will be afforded to egress on a timely manner before the exit could be blocked due to a fire. In addition, it is considered limited number of occupants will be within the plant room at a given time, as such reduced egress time due to queuing is not credible. The occupants are required to travel a total of 2.4 metres further than a DtS design in a worst-case scenario, and only applies to occupants within the far corner of the HW Plant area.

In Fire Scenario 1, occupants are alerted to a fire in two ways; an occupant visually recognises the hazard in the early stages of fire growth, and evacuate from the area before the fire grows to a size that creates hazardous egress conditions. If the fire is visually obscured by equipment, the alarm is triggered through the activation of smoke detectors installed within the HW Plant Room, and occupants are still able to evacuate in the early stages of fire growth. As the extended travel distance only applies to the HW Plant Room, all other occupants are considered to be subject to DtS travel distances and as such their egress is not adversely affected.

In Fire Scenario 2 and Fire Scenario 3, occupants are alerted to a fire solely by the alarm, triggered by detectors installed within the spaces adjoining the nominated fire location.

Occupants are expected to be alerted to a fire within scenario 2 and 3 in the early stages of fire growth, and will be afforded tenable egress conditions before a fire is able to grow to a large size. Furthermore, it is proposed that the paths of egress from the HW Plant Room and through each of the compartments that constitute the extended travel distance (as seen in Figure 15) be kept as sterile areas as per Management in Use Procedures to ensure that there is no obstruction of evacuation.

4.4 Quantitative Analysis

To further address the extended travel distances a quantitative assessment is conducted to show that occupants are able to safely egress along the extended travel distances outlined in Table 10, below, which assess the longer extended travel distances. The assessment considers the RSET of a DtS design and the RSET of the proposed design to demonstrate that the occupants within the proposed design will evacuate at an earlier time than a DtS design.

Table 10: Extended travel distances

Location	Proposed Travel Distance (m)	DtS Travel Distance (m)	Distance Difference (m)	Travel Time (seconds) (0.8 m/s)
Ground Level	69	60	9	86.25
Level 01	75	60	15	93.75

To determine the alarm activation time Alpert's Correlation is utilised.

Table 11: Results of Alpert's Correlation

Parameter	Standard Sensitivity Detectors Ground Floor
Ceiling Height (m)	2.4
Detector Spacing (m x m)	10 x 10
Fuel Height (m)	0.5
Time of Detector Activation (s)	**77**

It is noted that as per DtS requirements there is no provision for smoke detectors as such the DtS detection time is not applicable. It is therefore necessary to utilise an alternative metric to determine when an occupant in a DtS scenario would be made aware of a fire.

To determine the detection time in a DtS scenario, it is considered reasonable that occupants are aware of a fire when the smoke layer height is approximately 10% of the compartment height. The modelling considers a fire breaking out in a room on ground floor and the smoke spread up and out to fill the floor. The approach conservatively considers that when the smoke layer fills the Ground Floor with a layer thickness of 10% of the ceiling height occupants begin their evacuation, this is supported by Studies (SFPE Handbook, IFEG 2001) have shown that it is appropriate to take into account visual and other olfactory cues such as smell. Furthermore, it would be unreasonable to expect occupants who are being overcome by smoke to not respond until they hear an alarm if they are in close proximity to the fire. The analysis considers the Ground floor only as it presents the worst-case extended travel distance of 75m in lieu of 60m.

The quantitative analysis has been conducted utilizing the zone modelling software B-Risk to determine the time where the smoke layer height is at 10% of the compartment height.

NZ CVM2 states time of occupants which have focused activities to begin egressing as being immediately after activation of the fire alarm or when the fire in their space reaches 500 kW, whichever is first. A medium growth rate fire would reach a size of 500kW at 204 seconds after it has initiated. Given the analysis has determined occupants would start to egress at 192 seconds (132 seconds for smoke layer to descend 10% and 60 seconds pre-movement) it is considered that the value used is more conservative given the comparative nature.

Zone models have been extensively validated (McGrattan et al, 2010) against experimental data. Further research has shown that the accuracy of zone models may decrease as the compartment that is modelled becomes larger. There are studies that suggest that zone model compartments should be limited to 2000 m^2. To assess the worst-case travel distance present on the ground floor a zone model is developed based on the equivalent area of a room along the travel path and the Ground floor ceiling height.

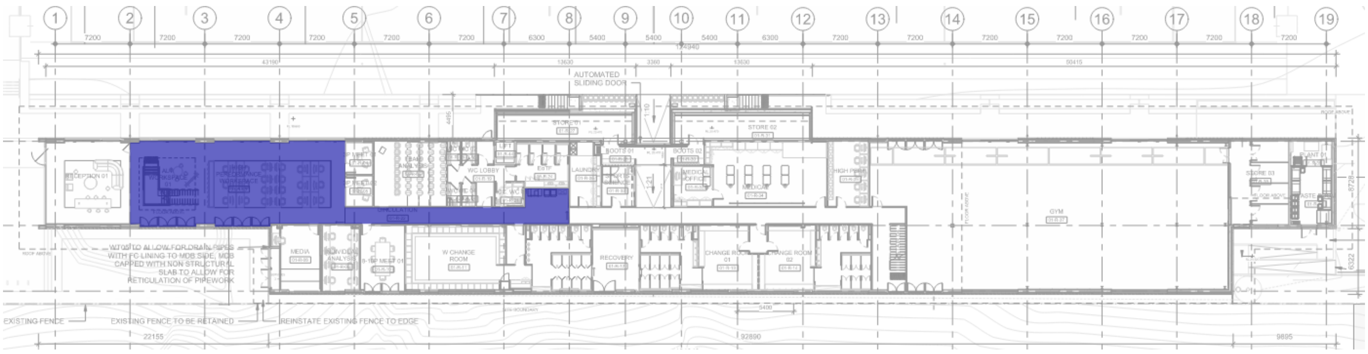


Figure 16: Ground floor zone

The software represents the space as a single zone and simulates a medium growth fire (Practice Notes for Design Fires, Society of Fire Safety, 2012) located in the middle of the zone. The results are shown below with the smoke layer height reaching 10% of ceiling height at approximately 2.2 minutes (132 seconds).

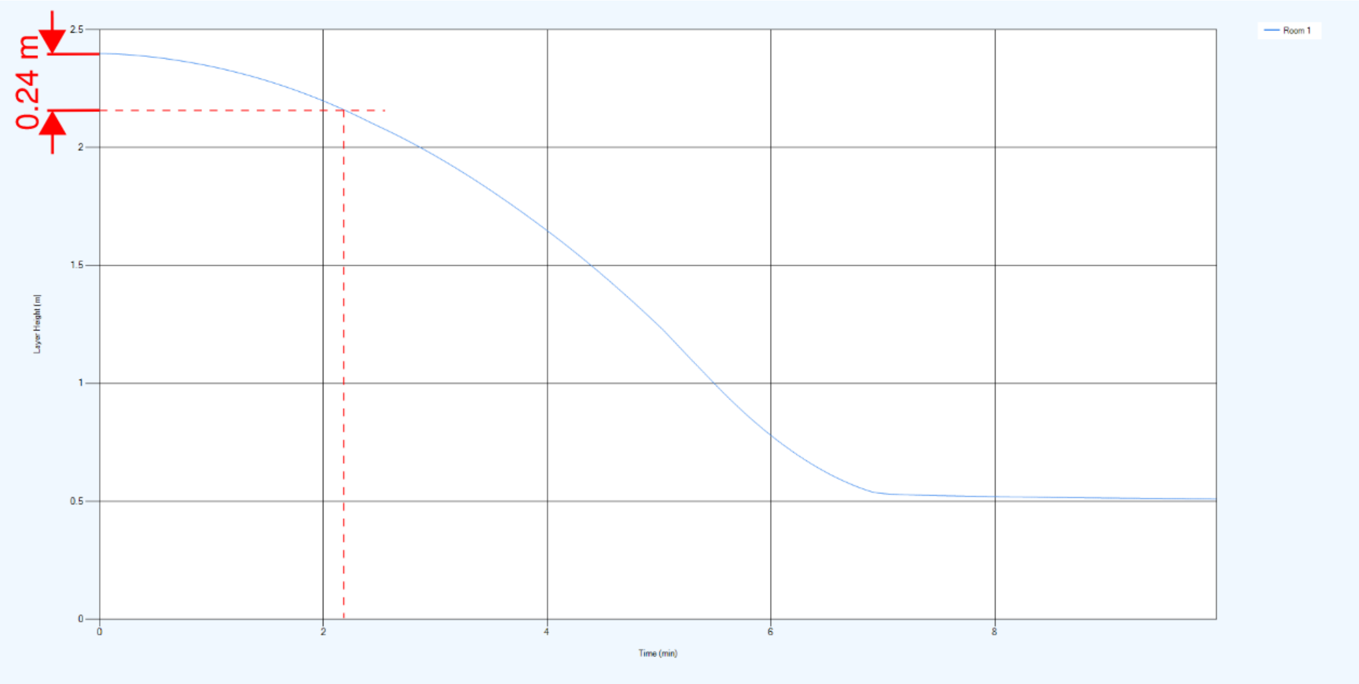


Figure 17: Zone modelling results

Table 12: Summary of RSET vs. RSET Comparison

Parameter	DtS Design	Proposed Design
Total Travel Distance (m)	60	75
Detector Activation Time / Alarm Activation time (s)	132	77
Pre-movement time	60	
Travel Time (s) *(assuming travel speed of 0.8 m/s)*	75	93.75
RSET (s)	267	230.75

It is demonstrated in Table 12 that due to the provision of smoke detectors the travel time along the longest travel distance is less than a DtS design. This demonstrates that under the worst case extended travel distance occupants are able to evacuate in time that is less than a DtS design hence it is considered that occupants are able to safely evacuate along the extended travel distances throughout.

4.5 Robustness or Safety Factor

The extended travel distance to an exit occurs from within a change room via a corridor to the central exit, it is expected that this space has a low fuel load as there will be no items that will be placed along this path. The change room is a wet area and as such can be considered a sterile area. Additionally, the corridor is unlikely to have items stored along this space as this would prevent the function of the corridor, it is expected that large items will be stored in the dedicated storage space nearby. Further, any fires that break out on Ground level are expected to occur within a room and as such the walls of these rooms will provide a degree of fire separation and delay the spread of smoke along the extended egress path.

The egress path on Level 1 that has an extended travel distance between alternative exits is similarly expected to have a low fuel load with any items unlikely to be stored along the egress path and any fire that breaks out likely to occur within a surrounding room with the room walls providing smoke separation which would delay the spread of smoke along the extended egress path.

4.6 Fire Brigade Intervention

The extended travel distances are not considered to present an increased risk to brigade activity. As the brigade enter the building and engage in fire-fighting activities they may need to pass along these extended travel distances. If these travel paths are fire affected the brigade will utilize the available external attack fire hydrant and connect their hoses to suppress the fire and the additional time it takes to travel along these travel paths is not expected to impede fire brigade activities.

4.7 Conclusion

It has been demonstrated that the increased travel time presented by the extended travel distance on the ground floor is offset by the provision of smoke detectors provide early warning of a fire. It is expected that the provision of the detector and alarm system allows for occupants to egress at an early time in fire development compared to a DtS complaint design which will offset the additional time it takes to travel along the extended egress path. Therefore, it has been demonstrated that Performance Requirements DP4 and EP2.2 have been met.

5. PS 2 – Booster and Hydrant Locations

5.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

Table 13: Summary of Performance Solution 2

Description	The booster is to be located not within sight of the main entrance. An external attack hydrant is not located within 50 m of the hardstand. A hydrant is within 10 m of the building and not fully protected in accordance with AS2419.1-2005.				
DtS Clause	E1.3	Performance Requirements	EP1.3	AFEG Sub-systems	C, F
A2.1. - BCA Approach	Performance Solution	A2.2 – Assessment Methods	A2.2(2)(b)(ii) A2.2(2)(d)	Analysis Methodology	Absolute Qualitative Deterministic
A2.2(1) - Performance Solution	Comply with the Performance Requirements				
Fire hazards	The hazard associated with this solution is that as the booster is not located within sight of the main entrance whereby the brigade will not be able identify its location within a timely manner. Additionally, the distance of the central external attack hydrant to the hardstand is greater than DtS provisions. The locations of these systems may delay brigade intervention.				
Acceptance Criteria	The acceptance criteria of the Performance Solution is considered to be met if it is demonstrated that the Fire Brigade are provided with clear direction to the hydrant booster to facilitate access and brigade activities.				
Description of Alternative Solution	This Performance Solution will demonstrate with an absolute and qualitative assessment that the brigade are able to conduct firefighting activities without delay.				

5.2 Intent of BCA Deemed-to-Satisfy Provisions

The BCA Clause E1.3 states that the fire hydrant system must be installed in accordance with AS 2419.1-2005. Furthermore, Clause E1.3 (b)(i)(C) states that a fire hydrant booster assembly is to be located within 3.5 m to 10 m of the building with AS 2419.1-2005 Section 7.3 (c)(i) states that the booster shall be within sight of the main entrance.

Additionally, AS 2419.1 – 2005 Section 3.2.2.2 (c) states that attack fire hydrant are to be within 50 m of a hardstand such that when connected directly to the external attack fire hydrant all portions of the building shall be within reach of a 10 m hose stream issuing from nozzle at the end of a 60 m length of hose laid on the ground.

The BCA Guide states that the intent of Clause E1.3 is *"To require the installation of suitable fire hydrant systems to facilitate the fire brigade's firefighting operations."*

The BCA Performance Requirement EP1.3 states that a fire hydrant must be provided to the degree necessary to facilitate the needs of the fire brigade appropriate to fire-fighting operations, the floor area of the building and the fire hazard. The intent of Performance Requirement EP1.3 is to set requirements of fire hydrants to be installed to the degree necessary in a building to allow fire brigade to undertake attack on the fire.

It is proposed that the booster is to be located on the other side of the site and is not to be within sight of the main entrance.

5.3 Qualitative Analysis

The assessment addresses the departures from the DtS provisions associated with this Performance Solution in the following headings.

5.3.1 Booster Location

The booster which is located at the southern end of Banks Avenue has been selected based on several constraints specific to the site. The site is an existing site is to contain both existing buildings as well as the proposed NSWRU Centre of Excellence building. These buildings are to be served by this one booster which will not be within sight of the main entrance of the new building. If the booster was to be relocated on Cook Avenue to achieve a compliant location as per AS2419.1-2005, this would consequently produce a similar issue for the other existing site buildings. Furthermore, the towns mains along the Gwea Avenue and Cook Avenue are not considered suitable to serve the booster without the introduction of large tanks.

Additionally, the nature of the site which is similar to a precinct development such as schools and hospitals where there are multiple buildings and building entrances, these sites are also commonly served by a single booster. In this DtS scenario the booster may also be located not within sight of a fire affected building. The brigade will drive up to the affected building whereby they may pass the booster. The brigade may need to access the booster in which case they will instruct the second fire truck to this location.

In a fire event within the NSWRU building the brigade will arrive on site whereby upon accessing the FIP will direct them to the booster location (as discussed below). In order to conduct their initial intervention, the brigade will utilise the available external attack hydrants to begin their intervention and if deemed necessary, direct the second truck to drive around to the booster location.

In the event of a fire within the Centre of Excellence building located along Cook Avenue, the brigade will arrive on site and will access the external attack hydrants to begin their initial attack on the fire depending on fire location and severity of fire spread. These hydrants are pressurized by the on-site fire hydrant pump to provide enough flow to achieve coverage to the site and appropriately fight a fire. In the event that the pump failure occurs, or the brigade wanted to increase the hydrant pressure and the available fire brigade appliance (truck) will access the Fire Hydrant Booster whereby it will connect to the booster and provide additional pressure.

The fire hydrant booster is to be located on the other side of the site whereby it is expected that the brigade will be unable to visually identify the booster. In the event of a fire the activation of the detector will trigger the Fire Detection Control and Indicating Equipment (FDCIE) panel to call the Fire Brigade. It is expected that the Brigade will be called to the location of the FDCIE located internally near the main entrance of building (in compliance with AS1670.1) on the northern side of the Centre of Excellence building, located along Cook Ave. It is not expected that the booster, located along Banks Avenue, will be noticed by the brigade as they arrive on site depending on the route taken to the site. The route identified in Section 2.1.2 shows that the most direct route to site bypasses Banks Avenue, further if the brigade were to pass along Banks Avenue and visually identify the booster they might not know to access the booster as it may not be clear that it serves the Centre of Excellence building due to its proximity to the site.

It is proposed to place a block diagram within the FDCIE panel affixed to the panel access door which shows the location of the booster in relation to the site. In the event of brigade call out it is expected that the two appliances will be sent to aid in firefighting. The brigade members in the lead fire truck will be first on site and access the FDCIE. Once these members access the FDCIE they will notice the block diagram and be made aware of the booster location, they will then coordinate with other brigade members in the additional fire truck and instruct them to travel to Banks Avenue via Gwea Avenue to access the booster. An example block diagram is shown in Figure 18.

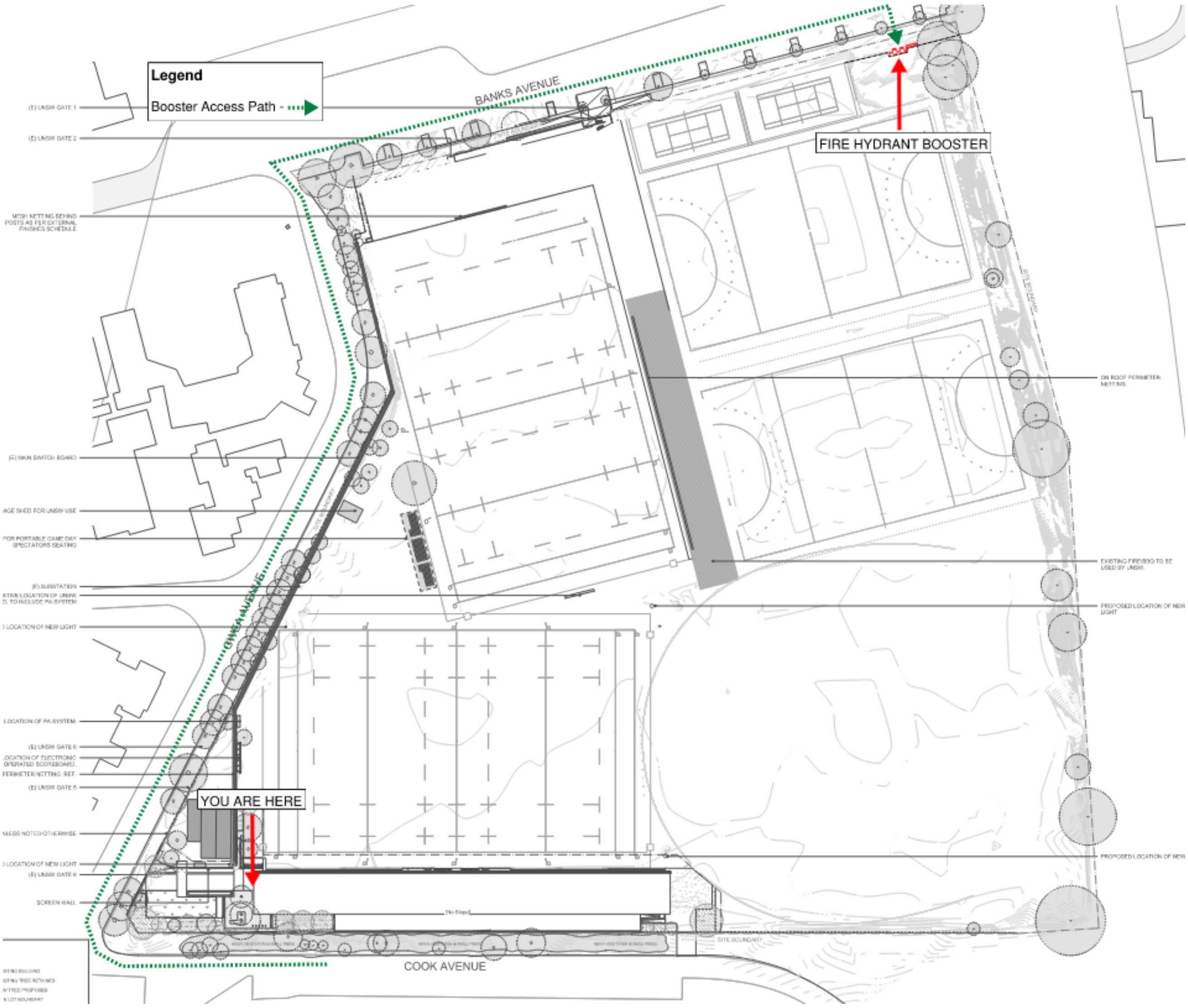


Figure 18: Example Block Diagram

The provision of the block diagram is expected to facilitate the brigade access to the booster and will minimize the delay to intervention. Given existing site layout and the provision of a block diagram, the location of the booster is not considered to present a risk of delaying brigade intervention that is at least equivalent to that of a similar large site as discussed above.

5.3.2 External Attack Hydrants

In the event of a fire, as the brigade arrives on site, they may need to access the external attack hydrants in order to engage in their initial attack on the fire depending on the location and the degree of fire spread. There is an external attack hydrant which is located further than 50 m from the hardstand of Cook Avenue. The hydrant on the left-hand side of the central exit as shown in Figure 19 is approximately 75 m from the hardstand. The intent of the proximity of the hydrant to the hardstand is to afford the brigade with a reasonable travel distance between the hardstand (where the fire truck will be located) and the hydrant whereby brigade intervention is not delayed.

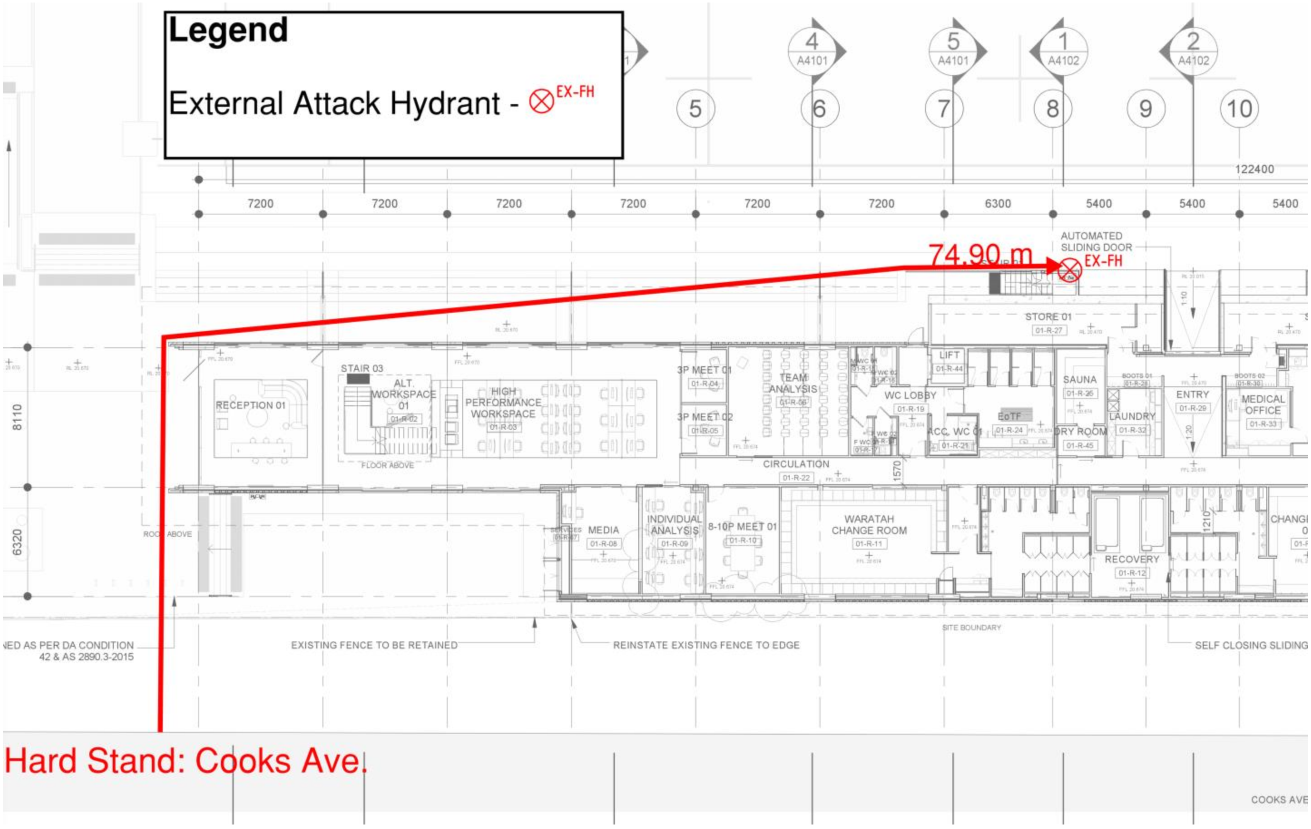


Figure 19: Fire hydrant not within 50 m of hardstand

The brigade as they arrive on site may need to access this hydrant depending on the location and extent of the fire. The brigade will arrive on site and access the FDCIE which will indicate initial fire affected areas of the building. Additionally, the brigade will be informed of the location of the external attack hydrants which will be indicated on a block diagram at the FDCIE. Although the distance to the central hydrant is further than 50 m from the hardstand, if the brigade are required to engage in attack of a fire towards the back of the building in an area where the central external hydrant provides coverage the brigade will need to travel around either the eastern or western extents of the building. It is expected that the brigade will access the external attack hydrants on either the east or west side of the building, as shown in Figure 20, prior to the central external hydrant depending on the severity of fire spread. If the coverage from these hydrants is not sufficient the brigade will then access the central hydrant under protection of either of the east or western hydrants.

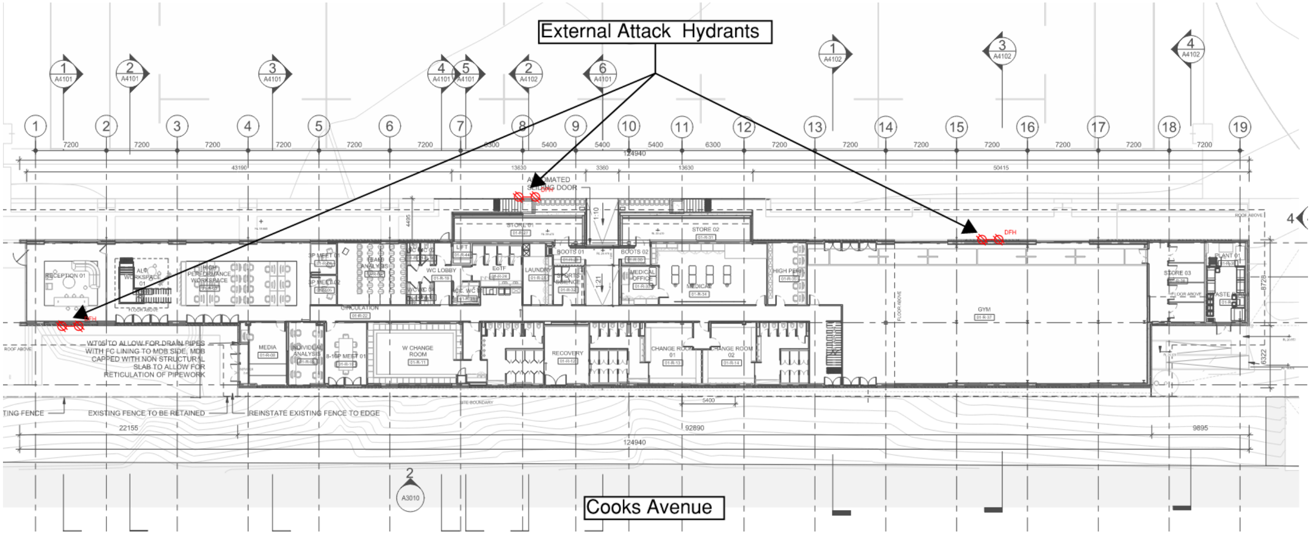


Figure 20: External Attack Hydrants

Finally, the additional time it takes for brigade members to travel to this central hydrant on foot is considered to be quicker than a DtS design where there would be a hardstand behind the back of the building (whereby the fire truck would be able to drive to the area between the building and the ovals) which would achieve the required 50 m to the central hydrant.

In a fire event the brigade will identify the general location of the fire and which floor is affected, this is determined either visually from the hard stand near the front of the building or by investigating the FDCIE. Once the fire location is determined the brigade will proceed to the nearest compliant hydrant. If they realise that they need to connect to the central hydrant they will then proceed to that hydrant.

It is expected to be quicker for the brigade to continue on to that central hydrant from either the eastern or western external attack hydrant than it is to return to the hardstand area at Cook Avenue (where the fire truck is parked) and then drive to the central hydrant. To facilitate brigade intervention the external attack hydrants are included on the site block diagram at the FDCIE.

Therefore, the proposed design is not considered to result in a delay nor extra effort by the fire brigade to conduct their intervention.

5.3.3 External Hydrant Protection

The central external hydrant located on the field side of the building is in a position that is within 10m of the building as shown in the figure below. The BCA DtS provisions require that this hydrant be protected by fire rated construction extending 2m on either side of the hydrant and 3m above the floor. Given the low hazard nature of the building within close proximity to that hydrant, it has been proposed to not provide this protection.

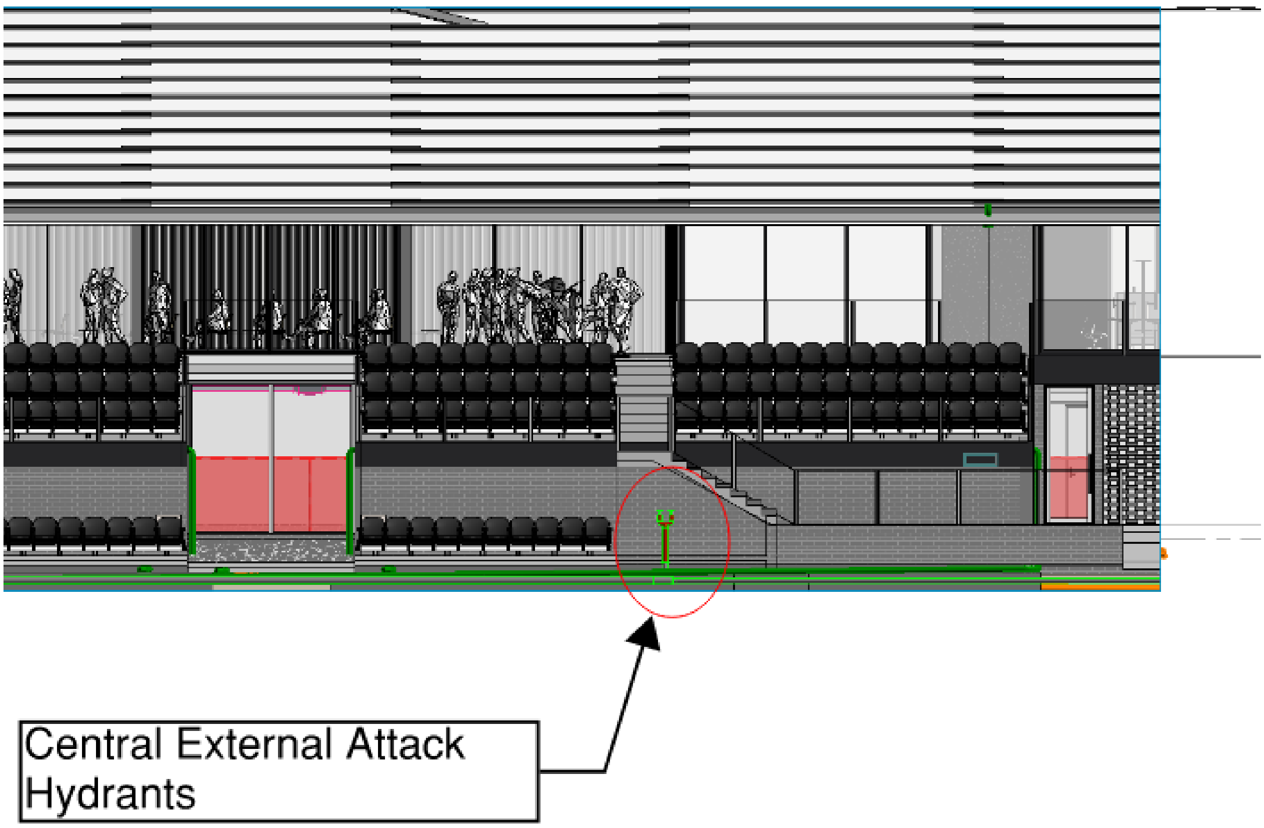


Figure 21: External attack hydrant requiring protection

As can be seen in the figures above and below, the subject hydrant within close proximity to only a store room which is enclosed in masonry construction and is also further shielded by the construction of the stair to the grandstand. The other parts that fall within the protection zone comprise of an open grandstand that is by nature a low fire hazard due to the minimal amount of combustible material expected.

The masonry construction is expected to provide the attending fire brigade with sufficient protection from a fire in the storeroom. Brick walls are known to achieve an FRL of approximately 60/60/60 which is considered to provide the fire brigade with a sufficient amount of time to connect to the hydrant and start the attack on the fire.

In the event of a fire occurring on the grandstand, it is considered that the limited combustible materials expected to be present would result in a small fire that is not sufficient to threaten the fire brigade as they attempt to access the hydrant. Therefore, in such a fire scenario, the fire brigade are also expected to be able to access the hydrant safely.

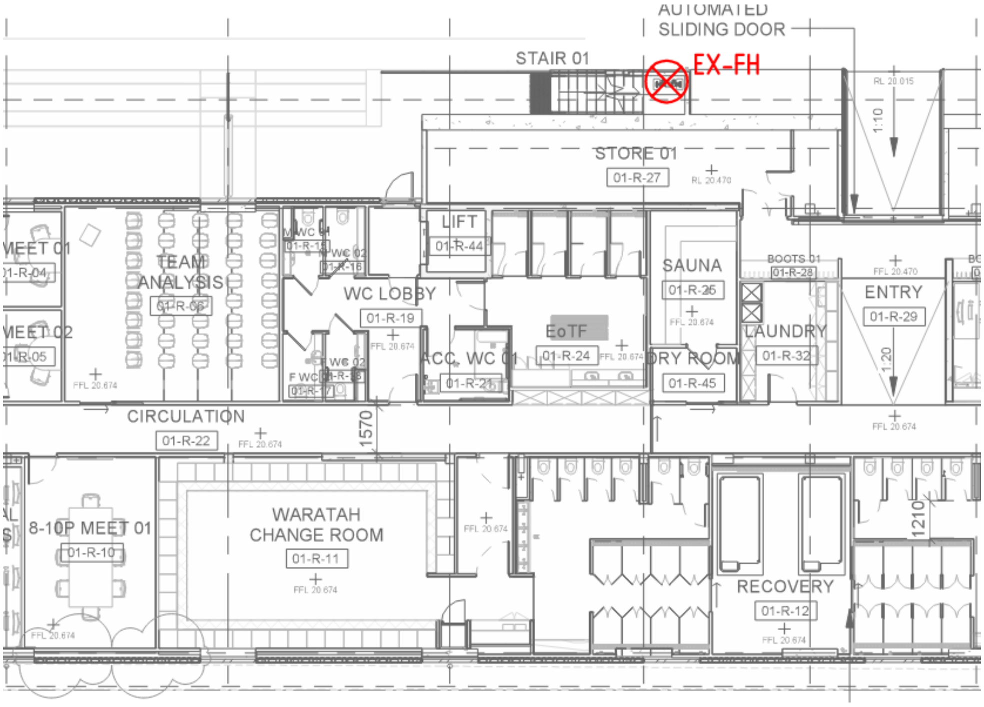


Figure 22: Storeroom in close proximity to the subject hydrant

In the unlikely event that this hydrant is compromised, the attending fire brigade would be able to approach this hydrant under the protection of the other external hydrants located on either side of the building. In such a scenario, if the subject hydrant is required, the fire brigade could access and connect to the hydrant whilst exposure protection is provided by the other hydrants.

5.4 Quantitative Analysis

The storeroom is constructed from concrete walls and ceiling as such if a fire was to break out within the store-room it is considered that there are no openings from the storeroom that can expose the brigade to untenable conditions.

For robustness, to demonstrate that the brigade are not exposed to harmful radiation conditions at the hydrant a quantitative radiation assessment is conducted from the nearest opening on Ground Level. The nearest opening to the hydrant is from the central exit. If a fire were to break out in the corridor in front of the glazed automatic doors serving the central exit, in a worst-case scenario the fire grows to a size whereby the glazing fails. CVM2 states that for non-sprinklered compartments a fire will emit 83 kW/m^2 for a room with a fuel load equal to or less than 400 MJ/m^2. As such the smoke and hot gases that spread out of this space are considered to have this heat flux.

The region of the smoke and hot gases that is considered to emit radiation towards the hydrant is shown below. This encompasses where there are no masonry obstructions between the smoke and the hydrant. Moreover, the orientation of the panel is face on to the hydrant to account for the three-dimensional behaviour of the smoke plume.

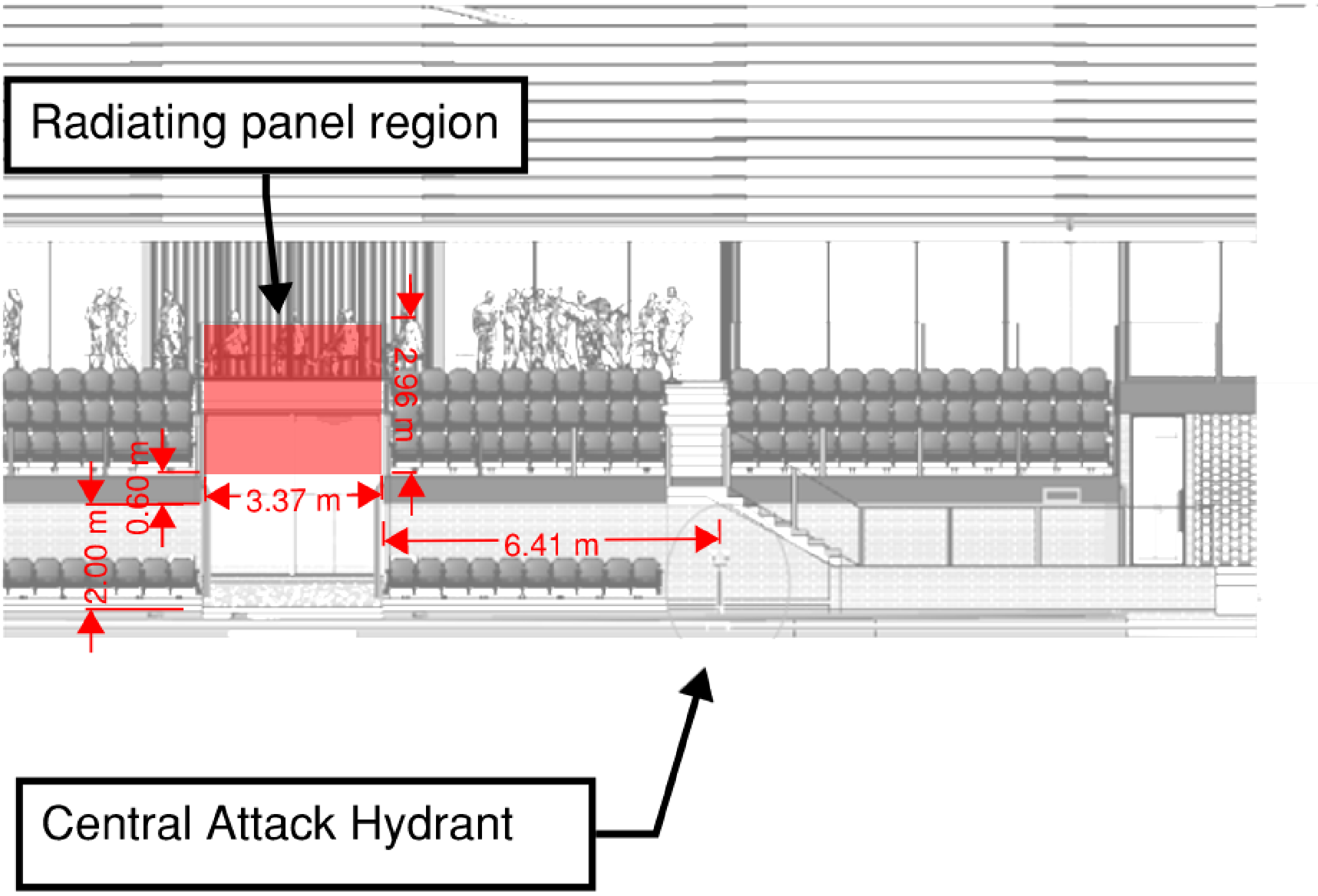


Figure 23: Region of smoke and hot gasses

Occupants can withstand heat fluxes below 2.5 kW/m^2 for relatively long periods of time (>5 mins as per SFPE Handbook) as shown below. Above 2.5 kW/m^2, the time reduces rapidly but can still be tolerated.

Table 2-6.19 ***Limiting Conditions for Tenability Caused by Heat***[106]

Mode of Heat Transfer	Intensity	Tolerance Time
Radiation	<2.5 kW·m^{-2}	>5 min
	2.5 kW·m^{-2}	30 s
	10 kW·m^{-2}	4 s
Convection	<60°C 100% saturated	>30 min
	100°C <10% H_2O^a	12 min
	120°C <10% H_2O	7 min
	140°C <10% H_2O	4 min
	160°C <10% H_2O	2 min
	180°C <10% H_2O	1 min

^{a}v/v

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Figure 24: Tenability conditions as outlined SFPE Handbook

The resulting radiation received at the hydrant is shown in Table 14 below, with the radiation is below the acceptance criteria. Therefore, it is expected that brigade access to the central hydrant is not impeded.

Table 14: Radiation Calculation

Parameter	Value
Panel Height (m)	2.96
Panel Width (m)	3.37
Vertical Offset (m)[1]	0.60
Horizontal Offset (m)	6.41
Distance to from panel (m)	6.06
Angle (°)	90
Emissivity[2]	1.0
Heat Flux Emitted (kW/m^2)	84
Heat Flux received at a point(kW/m^2)	**1.24**
Note: [1]Considers a head height of 2m from the ground [2]Maximum value of 1 is utilized to ensure an onerous assessment.	

Note: The assessment criteria has chosen to use values that permit occupants to be exposed for greater than 5 minutes, referring FBIM model V2.2 acceptable limits for brigade are said to be 25 minutes for radiation of 1 kW/m^2 and 10 minutes for a radiation of 3 kW/m^2. The actual radiation level determined of 1.24 kW/m^2 would permit the brigade to be exposed for approx. 20 minutes. This time period is sufficient for the brigade to connect to the attack hydrant, where once connected they would be protected by the hose stream and be able to more away from the radiating panel.

5.5 Robustness or Factor of Safety

The Fire Hydrant Booster is utilized as a redundancy measure to provide pressure to the fire hydrants located around the site. Although, the location of the booster on the other side of the site may provide a delay to access the booster, it is not solely relied on to pressurize the hydrants as such the brigade are considered to be able to adequately perform initial firefighting activities without significant delay.

The location of the central external attack hydrant is not considered to delay brigade intervention due to the provision of the additional external hydrants located on the east and west of the building which are located within the required distance to the hardstand. If coverage from these hydrants is not sufficient the brigade will then access the central hydrant under protection of either of the east and western hydrants.

5.6 Fire Brigade Intervention

The provision of a block diagram will facilitate the brigade accessing the booster in a timely manner. As discussed above, the brigade is expected to send out two fire trucks whereby brigade personnel who have arrived on site will be made aware of the booster location once they have accessed the FDCIE. They will then instruct personnel in an available fire truck to travel to the booster. Thus, the provision of the block diagram is expected minimize the delay to fire brigade intervention.

Additionally, the location of the central external attack hydrant is considered to present a minimal delay to the fire brigade intervention as rationalised above.

5.7 Conclusion

The above assessment has demonstrated that the location of booster and external attack hydrants do not pose a risk in preventing fire brigade operations. Therefore, Performance Requirement EP1.3 is considered to be met.

6. PS 3 – Reduced Egress Widths

6.1 Summary of Performance Solution

The following table provides a summary of the proposed Performance Solution.

Table 15: Summary of Performance Solution 3

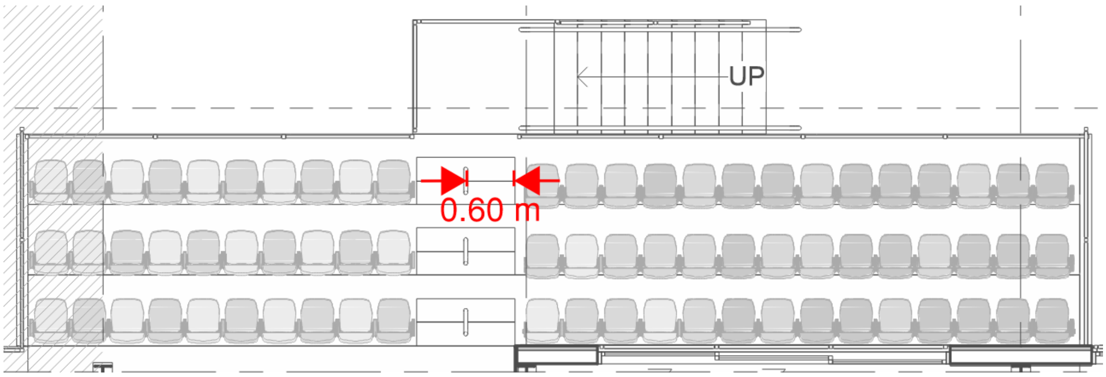
<table>
<tr><td>Description</td><td colspan="5">Permit a reduced egress width to 600mm in lieu of 1m within the terrace area as shown below.


Figure 25: Reduced egress width within the terrace area</td></tr>
<tr><td>DtS Clause</td><td>D1.6</td><td>Performance Requirements</td><td>DP4, DP6, EP2.2</td><td>AFEG Sub-systems</td><td>E</td></tr>
<tr><td>A2.1. - BCA Approach</td><td>Performance Solution</td><td rowspan="2">A2.2 – Assessment Methods</td><td rowspan="2">A2.2(2)(b)(ii)
A2.2(2)(d)</td><td rowspan="2">Analysis Methodology</td><td rowspan="2">Absolute
Qualitative
Deterministic</td></tr>
<tr><td>A2.2(1) - Performance Solution</td><td>Comply with the Performance Requirements
Be at least equivalent to the DtS provisions</td></tr>
<tr><td>Fire hazards</td><td colspan="5">The hazard associated with this solution is that a reduced egress width may result in increased queuing and hence increased egress time from the subject area. As a result occupants may be exposed to the effects of a fire for a longer period of time.</td></tr>
<tr><td>Acceptance Criteria</td><td colspan="5">The Performance Solution will be said to have met the acceptance criteria if it can be shown that both the reduced egress width and minimum egress width are only sufficient for occupants to egress in single file. Thus the total egress time is not increased.</td></tr>
<tr><td>Description of Alternative Solution</td><td colspan="5">The Performance Solution is absolute and qualitative in nature and points to international design standards regarding the design of sporting arenas and anthropometric data to compare the egress of both the DtS and proposed design.</td></tr>
</table>

6.2 Intent of BCA Deemed-to-Satisfy Provisions

BCA Clause D1.6 states in a required exit or path of travel to an exit, the unobstructed width of each exit or path of travel to an exit, except for doorways, must be not less than 1m apart.

According to the Guide to the BCA, the main intention of establishing a minimum dimension of exits and paths of travel to exits is to require exits and paths of travel to an exit to have dimensions to allow all occupants to evacuate safely within a reasonable time.

The following performance requirements are relevant to the proposed performance solution:

DP4

Exits must be provided from a building to allow occupants to evacuate safely, with their number, location and dimensions being appropriate to -

a) the travel distance; and

b) the number, mobility and other characteristics of occupants; and

c) the function or use of the building; and

d) the height of the building; and

e) whether the exit is from above or below ground level.

DP6

So that occupants can safely evacuate the building, paths of travel to exits must have dimensions appropriate to –

a) the number, mobility and other characteristics of occupants; and

b) the function or used of the building

EP2.2

(a) In the event of a fire in a building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building.

6.3 Qualitative Analysis

There are international design guidelines for sports grounds that are utilized to inform the grandstand design. In this instance The Guide to Safety at Sports Grounds Sixth Edition (Green Guide), a British design guide that outlines design requirements specific to sporting grounds, spectator stands, and grandstands has been utilized. As a result, the grandstand incudes a 600 mm egress path width either side of the barrier down the terrace stairs. Although this egress path is permitted by the Green Guide it presents a departure from BCA DtS provisions. The proposed 600 mm egress width is rationalized in the assessment below.

Anthropomorphic Data

The hazard specific to this solution is by reducing the width of the exit path there is an increased risk associated with life safety of the occupants as the occupants may take a longer time to evacuate.

The terrace area stairs with reduced clear egress widths is compared with a BCA compliant design stair which has the appropriate clear width of 1 m as required by BCA Clause D1.6(b)(i).

Anthropometric Data reproduced from NFPA 101, as illustrated in Figure 26, indicates that the 97.5 percentile largest body dimensions of an adult (male or female) is 0.51 m, hence the reduced width of 0.6m (for the area illustrated in Figure 25 above) provides an additional width of approximately 20% over and above the 97.5th percentile width adult.

The reduction in egress width exists where the stairs contain a central handrail only. As such it is not considered that the 760mm clear width for swaying of shoulders be applicable to the proposed design. Rather reference should be made to the swaying width of occupant hips which is noted to be 560mm and thus still within the confines of the proposed design.

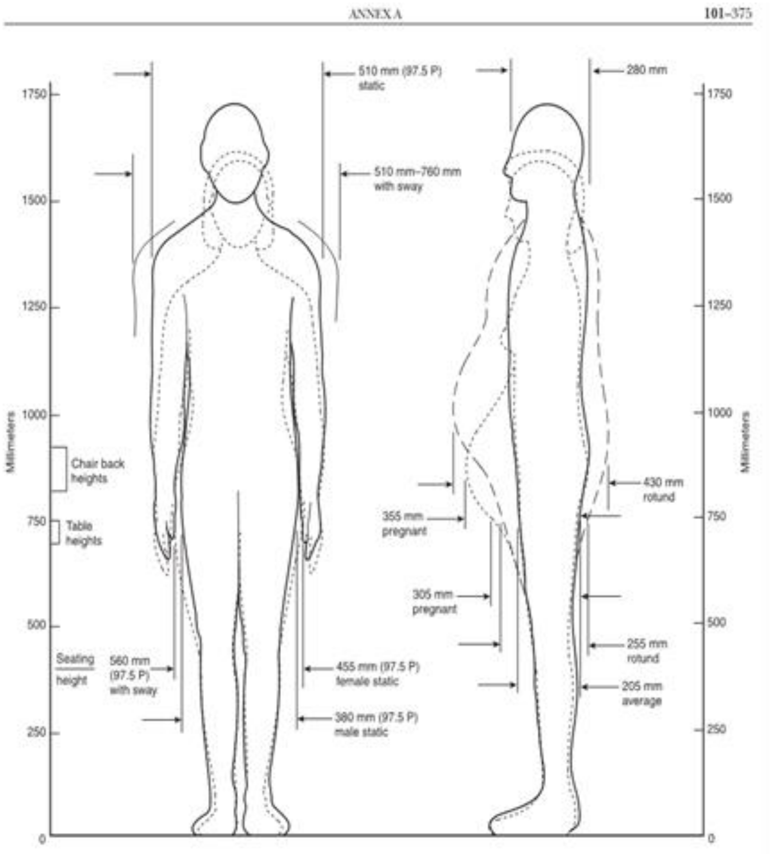


FIGURE A.7.3.4.1.1(b) Anthropometric Data (in mm) for Adults; Males and Females of Average, 50th Percentile, Size; Some Dimensions Apply to Very Large, 97.5 Percentile (97.5 P), Adults.

Figure 26: Anthropometric Data reproduced from NFPA 101

Neither an exit stair having a width or 1 m in accordance with BCA Clause D1.6 or a stair width of 0.6m is sufficient for two adults to egress side by side. They must be staggered in effectively single file as they pass though such paths of travel. It is therefore noted that a reduction to 0.6m would not impact on the total escape time as occupants are expected to still be evacuating in single file. The staggered single file spacing is illustrated Figure 27(note that this is not to scale and is meant to illustrate the concept only).

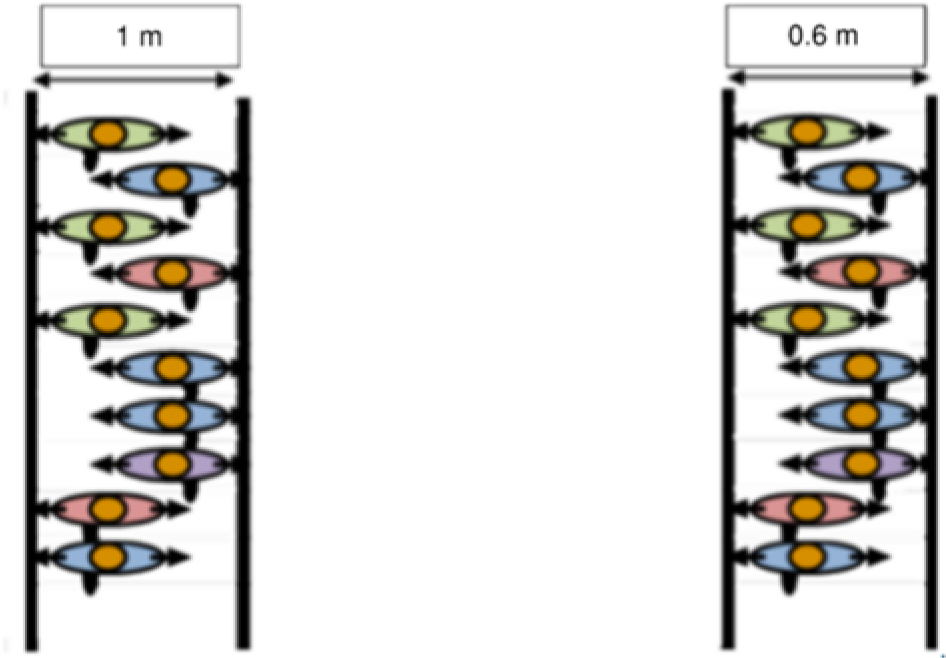


Figure 27: Staggered stair and egress through grandstand (not to scale for illustrative purpose only)

The above analysis addresses the means of egress and evacuation in the event of a fire and does not address or intend to address any other requirements such as DDA or other third-party certification / requirements.

Proposed Arrangement

The reduced egress width at the transition of row to aisle is less than 1 m and will only facilitate a single occupant as consistent with the analysis above. Occupants queuing to egress from the row will continue travelling towards the junction before rotating to face down the aisle in preparation to walk down the grandstand. When facing the direction of the aisle, the reduced egress width at the junction is perpendicular to the occupants, allowing them to egress from the row to the aisle.

Additionally, through the provision of smoke detectors within the grandstand structure connected to the BOWS alerts occupants of a fire within these areas. The alarm system alerts occupants to start evacuation prior to visual recognition of a fire spreading from within the nearby compartments to the grandstand terrace area.

This detection and alarm provision further compensates for any queuing that may occur along the grandstand egress paths. The grandstand area seats a 14 people on one side of the central path of egress, and 10 people on the other side, both sides merging into the path of reduced egress width highlighted in Figure 25. In a worst case scenario, in which all seats are occupied, occupants of the first row are not required to evacuate through the path of reduced egress width, instead bypassing the handrail, as seen in the Figure 28 below.

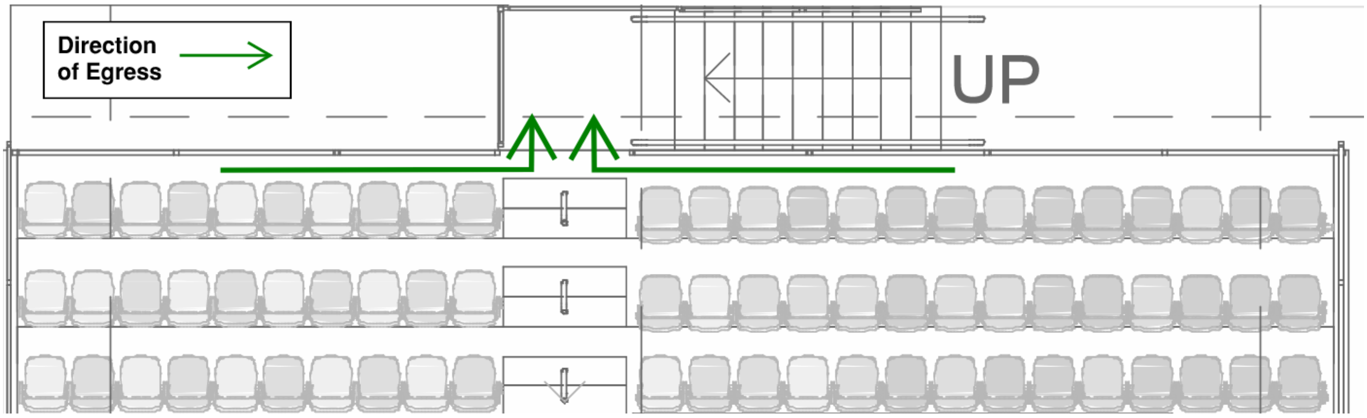


Figure 28: Evacuation of the first row in terrace area

The occupants of the second and third row will be required to pass through the reduced egress widths, and queuing may occur in the event of a fire scenario in which all seats are occupied, as there is a relatively high density of occupant population within this area. However, given the fact that the proposed design does not hinder evacuation over a DtS design (as per the anthropomorphic analysis above), and the provision of the AS 1670.1 compliant smoke detection system that provides an early warning to occupants, allowing for a safe evacuation, the relevant performance requirements are deemed as having been met.

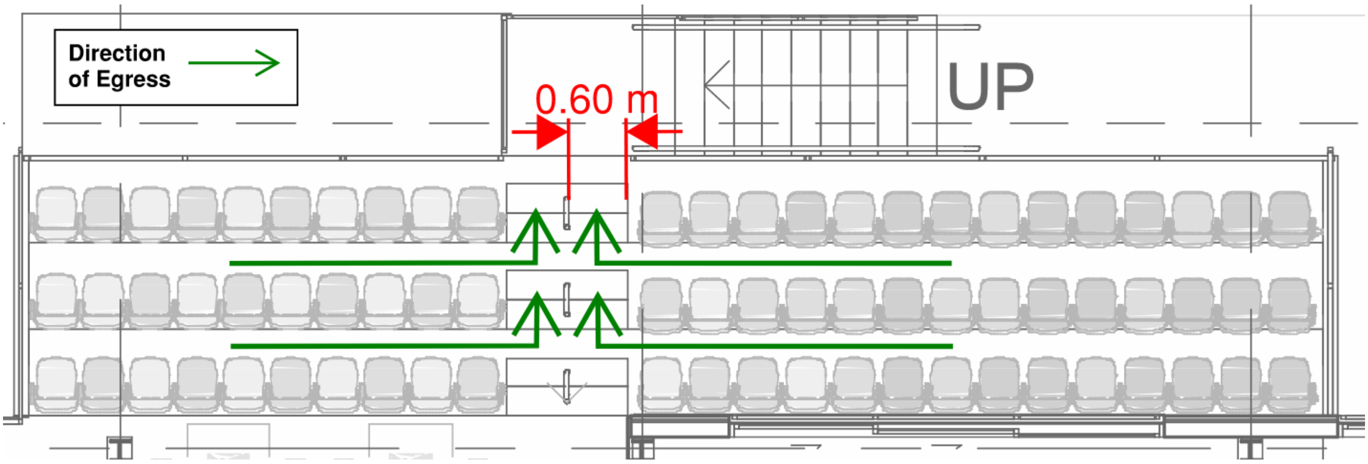


Figure 29: Evacuation of the second and third row in terrace area

Should a fire start within the grandstand terrace area itself, occupants will be able to quickly identify the hazard in the early stages of fire growth and evacuate before untenable egress conditions arise. The grandstand terrace area is located outdoors, meaning any heat and smoke produced by a fire within this area will vent to atmosphere, further mitigating the risk to any occupants evacuating from this area. Furthermore, the terrace area of the grandstand is only expected to contain a small number of occupants relative to the total population of the building, meaning the risk of queuing and the delay of occupant evacuation is minimized. The figure below illustrates the direction of egress from the terrace area.

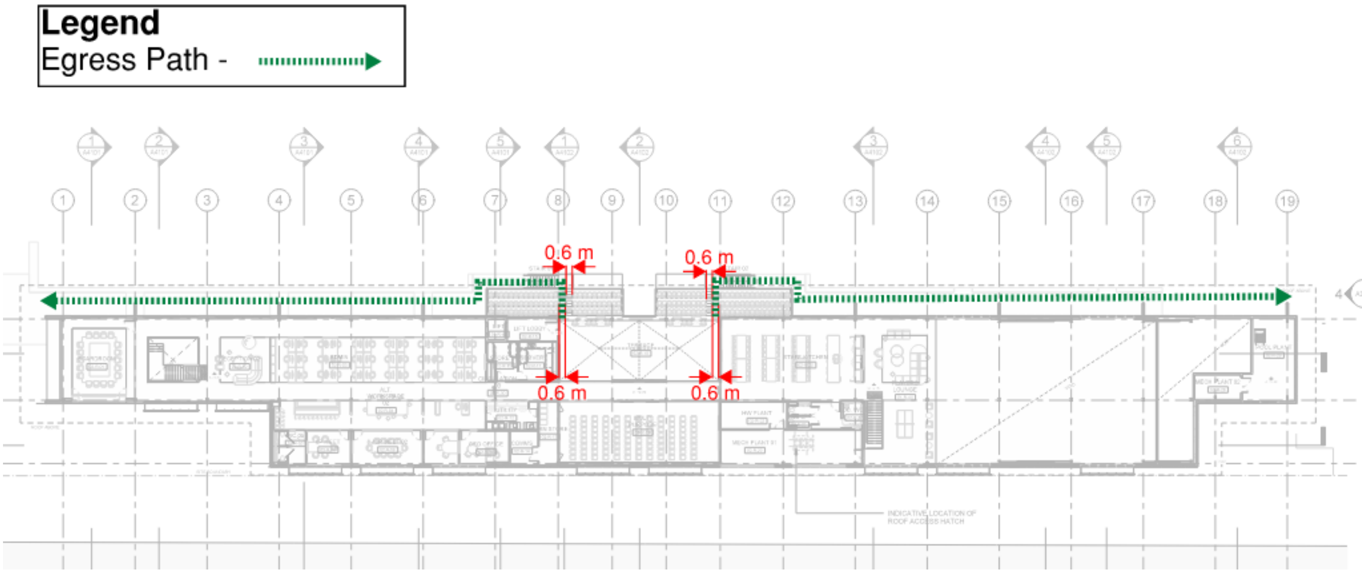


Figure 30: Direction of egress from terrace area

6.4 Robustness or Factor of Safety

The proposed arrangement contains two side by side stairs with a clear width of 0.6 m each, thus providing a clear egress width of 1.2 m from the terrace area. The provided clear egress width in combination with the low seating area in comparison to a general sporting arena grandstand, results in an orderly egress in a timely manor.

6.5 Fire Brigade Intervention

The location subject to the non-compliant egress widths is in the external tiered seating only, should FRNSW have issues passing through the space it is demonstrated below that they would be permitted to fight a fire with the 10m hose stream without passing beyond this point.

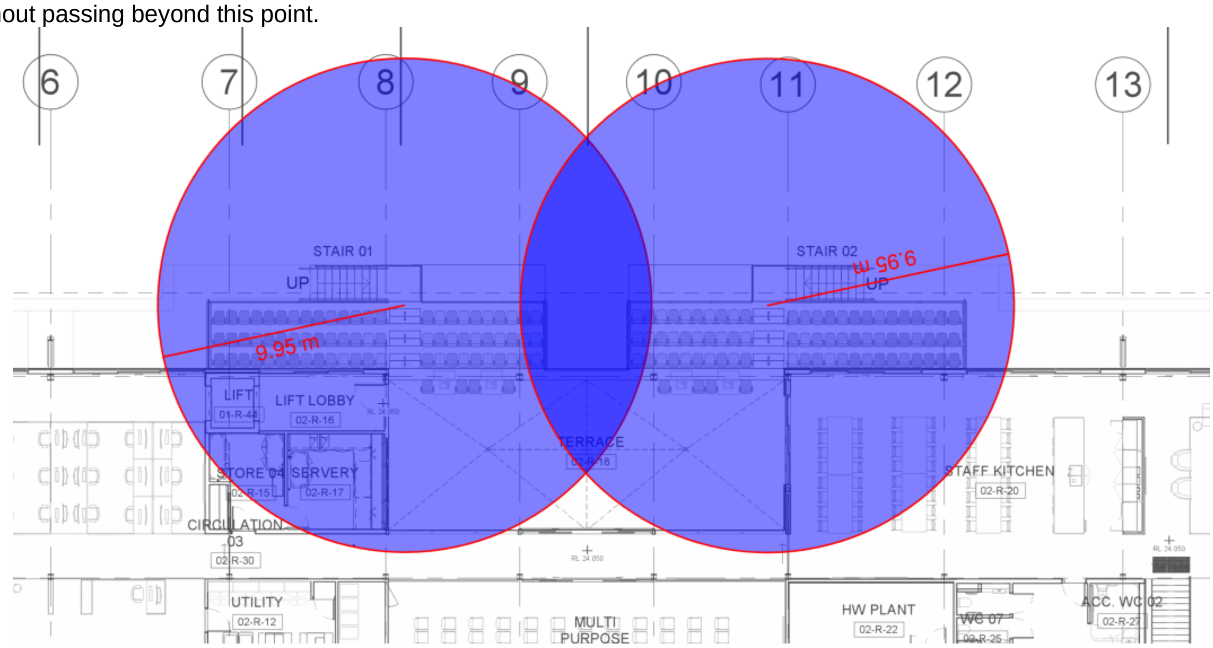


Figure 31: Hose stream length from the beginning of the reduced width

6.6 Conclusion

The above performance solution has demonstrated that the provided egress width is both in compliance with international design standards of sporting grounds and provides sufficient egress width for occupants. Furthermore the area subject to the non-compliance does not impact on FRNSWs ability to undertake fire fighting activities. As such, it is said that Performance Requirements DP4, DP6 and EP2.2 are said to have been met.

7. PS 4 – Permit PLAE Flooring

7.1 Summary of Performance Solution

A summary of the proposed Performance Solution is provided in Table 16 below.

Table 16: Summary of Performance Solution 4

<table>
<tr><td>Description</td><td colspan="5">Permit the use of PLAE flooring material within the gymnasium space as shown in Figure 32 below.</td></tr>
<tr><td>DtS Clause</td><td>C1.10</td><td>Performance Requirements</td><td>CP2, CP4, EP2.2</td><td>AFEG Sub-systems</td><td>A, B, C, D, E, F</td></tr>
<tr><td>A2.1. - BCA Approach</td><td>Performance Solution</td><td rowspan="2">A2.2 – Assessment Methods</td><td rowspan="2">A2.2(2)(b)(ii)</td><td rowspan="2">Analysis Methodology</td><td rowspan="2">Absolute
Quantitative
Deterministic</td></tr>
<tr><td>A2.2(1) - Performance Solution</td><td>Comply with Performance Requirements</td></tr>
<tr><td>Fire Hazards</td><td colspan="5">The non-compliant flooring may result in increased fire spread or an increase in smoke production rate and may result in conditions that impede occupant egress.</td></tr>
<tr><td>Acceptance Criteria</td><td colspan="5">The solution is considered to be met if in all modelling scenarios (as outlined in Appendix 3 and Appendix 4) tenable conditions are maintained during the evacuation period:
• Scenario 1: Non-Blocked Exit ASET>1.5xRSET, Blocked Exit ASET>RSET
• Scenario 2: Non-Blocked Exit ASET>1.5xRSET, Blocked Exit ASET>RSET
In addition to visibility and temperature tenability criteria, floor regions where the critical heat flux exceeds 2.0kW/m² will be considered untenable for occupants to travel past. The extent of safe egress paths areas will be assessed to demonstrate occupants are unlikely to be obstructed to reach a place of safety.</td></tr>
<tr><td>Description of Alternative Solution</td><td colspan="5">The assessment utilises a quantitative assessment to demonstrate that occupants are able evacuate from the gym space under tenable egress conditions.</td></tr>
</table>

7.2 Intent of the BCA Deemed-to-Satisfy Provisions

BCA Clause C1.10 details requirements of fire hazard properties permitted within construction materials. Sentence (a)(i) of Clause C1.10 states that floor linings must comply with BCA Specification C1.10. Clause 3 of BCA Specification C1.10 states that a building not sprinkler protected must contain floor linings with a critical radiant heat flux of not less than 2.2kW/m^2 and a maximum smoke development rate of 750 percent-minutes.

The subject building is proposed to contain an EPDM based floor lining known as PLAE "Achieve" in the gym area located on the Ground Floor and extending up the sides of the wall for 149 mm, the extent of the PLAE flooring is shown in the figure below.

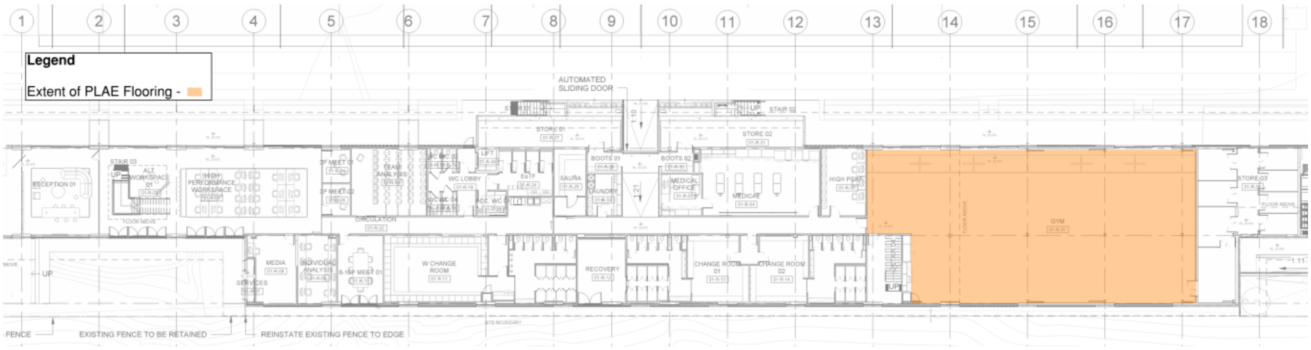


Figure 32: Location and extent of Proposed PLAE Flooring

The following performance requirement is relevant to the proposed performance solution:

<u>CP2</u>

A building must have elements which will, to the degree necessary, avoid the spread of fire to exits. Avoidance of fire spread must be appropriate to building function, fire load, fire compartment size, fire brigade intervention and evacuation time.

<u>CP4</u>

To maintain tenable conditions within during evacuation, a material and an assembly must, to the degree necessary, resist the spread of fire and limit the generation of smoke and heat, and any toxic gases likely to be produced, appropriate to the evacuation time, occupant characteristics, building function and active fire safety systems.

<u>EP2.2</u>

a) In the event of a fire in a building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building.

7.3 Qualitative Analysis

The gym area is proposed to contain PLAE flooring material, a test data was reviewed to determine the appropriate material properties of the PLAE flooring considered in that analysis, this test data assessed PLAE flooring material of thicknesses of 8 mm.

Testing of the material at hand was undertaken by AWTA Product Testing* in August 2018. The test results demonstrated that the of the samples tested the material has an average critical heat flux (CHF) of 2.3 kW/m^2 and a smoke development rate of 1272 %.min.

*AWTA Product Testing is a Registered Testing Authority achieving NATA testing compliance.

Comparing the proposed material properties to the BCA requirements, the non-compliance arises from the smoke development rate of the PLAE flooring exceeding DtS provisions.

The smoke development rate and critical radiant flux refers to a material's burning behaviour when exposed to a heat source, as interpreted from ISO/AS 9239.1-2003 Reaction to fire tests for flooring Determination of the burning behaviour using a radiant heat source:

- The Smoke Development Rate is a measure of smoke obscuration integrated over the test time.
- Critical Radiant Flux is a measure of the critical heat flux at extinguishment, this is the incident heat flux at the location on a specimen where the flame ceases to advance and may subsequently go out. This measure is inversely proportional to the distance that flame spread is said to occur along the flooring material.

As per the Guide to the BCA, the higher a materials critical radiant heat flux, the better the material performs i.e. the lower a material's propensity for fire spread, the BCA states the threshold for this measure is 2.2 kW/m^2, the proposed flooring material has a Critical Radiant Flux that is greater than DtS provisions and as such fire spread along the proposed material is expected to be less than a DtS flooring material. However, the Smoke Development rate is greater than what is permitted under DtS provisions.

It is noted that testing of the floor material is based on ISO/AS 9239.1, which states that testing to this standard should not be used alone to describe or appraise the fire hazard or fire risk of flooring under actual fire conditions. The assessment only considers the testing results as an indication of the proposed material's burning behaviour.

7.3.1 Fire Hazard

The hazard presented by the proposed flooring material is that if ignited and sustains flame spread it produces an amount of smoke that may impede occupant egress. The flooring is said to sustain flame spread along a region of flooring material if the critical heat flux on the floor from a fire is greater than 2.0 kW/m^2. This threshold is lower than both the proposed flooring material and DtS provisions and ensures that the assessment is onerous.

The gym area is expected to contain workout equipment including free weights, cable weights, gym balls, battle ropes, floor mats, towels and sports bags, these items present a fuel load within the space. Additionally, stationary cardio machinery may contain electric motors/electronics that presents a potential source of ignition. A review of the Fixtures and Fittings and Equipment Schedule indicate that the most credible fire scenario is whereby the failure of electrical components occurs within an item of exercise equipment and ignites combustible materials forming part of the equipment or combustibles equipment within close proximity. The expected equipment within the gym space is supported by the equipment layout as presented in Appendix 7. Note, this layout is not considered final and is only indicative of the expected layout and equipment schedule.

The equipment is expected to contain combustible rubber/ based materials distributed throughout the gym space, as such the distribution and behaviour of the present fuel load needs to be considered when assessing the hazard of the proposed floor material. Given that the presence of combustible materials throughout the space fire spread from the original fire source feature may occur presenting an additional source of heat applied to the flooring. Moreover, as the materials are expected to be rubber/polymer based, dripping of molten material directly on to the flooring may occur.

Conditions in which fire spread and dripping of molten materials are considered to occur are when the heat from the fire exceed the ignition temperature/heat flux and melting point, respectively, of the surrounding combustible materials. Based on values taken from SFPE [6], the conditions at which ignition of rubber/polymer-based materials is considered to occur corresponding to a minimum ignition temperature of 271°C (corresponding to the lowest ignition temperature listed for a range of polymers), similarly dripping is considered to occur at a minimum temperature of 215 °C (corresponding to the lowest melting temperature listed for a range of engineering thermoplastics

Considering the impacts of convective conditions (i.e. the temperature of the air, smoke and hot gases), as the smoke and hot gases from the fire initially rise to high level dripping of material and fire spread away from the primary fire source feature is considered to occur (from the convective conditions) when the hot layer descends to low level, where the equipment is expected to be located.

The temperature distribution along a slice is presented in Section A 3.3.3 at a height of 2.1 m, the temperature slices are shown throughout key stages in the evacuation period up to the point of the ASET. It is demonstrated that the hot layer of smoke and gas does not descend to low level during the evacuation period whereby high temperatures are localized to the primary fire source feature.

The convective temperature distribution within the gym space (presented over the evacuation period, refer to Appendix 3) is demonstrated to be below the lowest ignition and melting temperatures listed in the literature. Moreover, the impact of dripping of molten material onto the floor at the primary fire source feature is considered to be no worse than the impact of the fire itself.

As such to during the evacuation period a fire is expected to remain localized to the original fire source feature and the fuel load throughout the gym space is not considered to facilitate greater fire spread along the floor, nor is it considered to impede occupant evacuation.

Moreover, the principle of the fire engineering assessment is to address the smoke production rate of the non-compliant material lining. A HRR of 2.4 MW (discussed further in Section 7.4.1) is considered appropriate because the gym has a small floor area and travel distance to exit is less than 20 m. Taking this into consideration, it is expected that occupants would have evacuated before the fire grows beyond 2.4 MW. The objective of the assessment is to consider the tenability conditions within the compartments when it is occupied. The spread of flame index is equivalent to DtS and therefore, fire spread due to radiation between excise equipment is not a relevant factor.

7.4 Quantitative Analysis

To determine whether fire spread may occur under actual fire conditions, an absolute CFD modelling assessment is undertaken which considers two credible fire scenarios within the gymnasium space. This assessment shows the heat flux received at the surface of the proposed floor material from the heat generated by the fire and hot smoke within the space. The assessment utilizes an acceptance-criteria based on occupant tenability as well as a radiant heat flux criterion. The heat flux criterion is indicative of fire spread if the heat flux in a region of the floor away from the fire source feature is greater than the material's CHF. The threshold for the received heat flux is conservatively assumed to be 2.0 kW/m^2, which is lower than both the tested material's CHF and DtS requirements. This ensures that the assessment is onerous. The acceptance criteria are further discussed in Section 7.4.3 and Appendix 3.

Based on the above it is proposed to undertake CFD modelling to verify that the proposed design offers occupants a level of life safety that is at least equivalent to a design with a DtS flooring material.

The CFD modelling will be based on the following:

- The void space must be separated from Level 1 such that smoke will not spread directly to Level 1.
- A conservative assumption that flame spread is sustained where the heat flux on the flooring material is at 2.0 kW/m^2.
- Occupant tenability as outlined in Section 7.4.3.

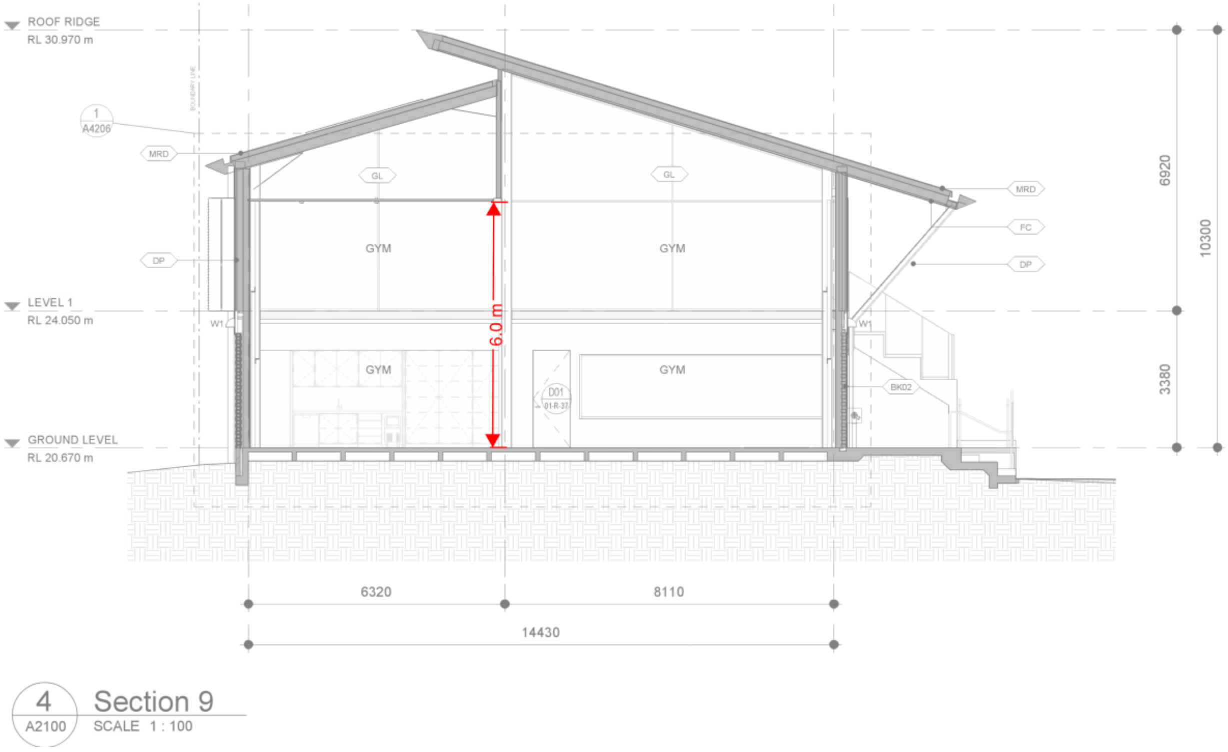


Figure 33: Section view of double height Gym space

7.4.1 ASET - CFD Modelling

The ASET modelling determines the time at which conditions within the modelled space become untenable. Two fire scenarios are considered and shown in Figure 34 and Figure 35, below.

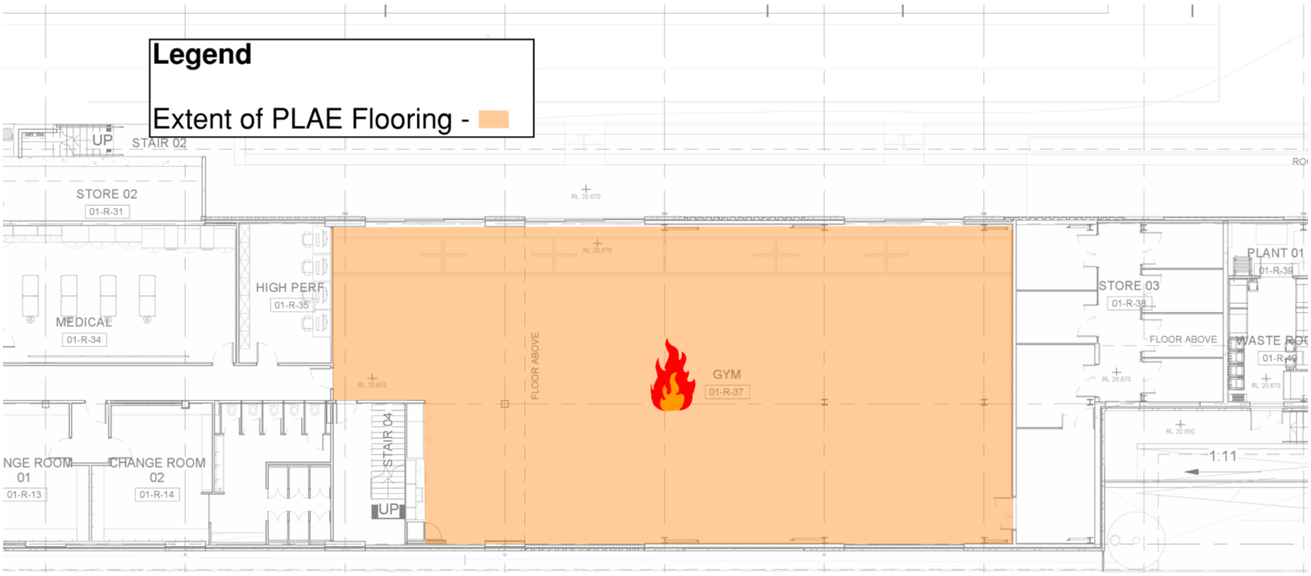


Figure 34: Scenario 1

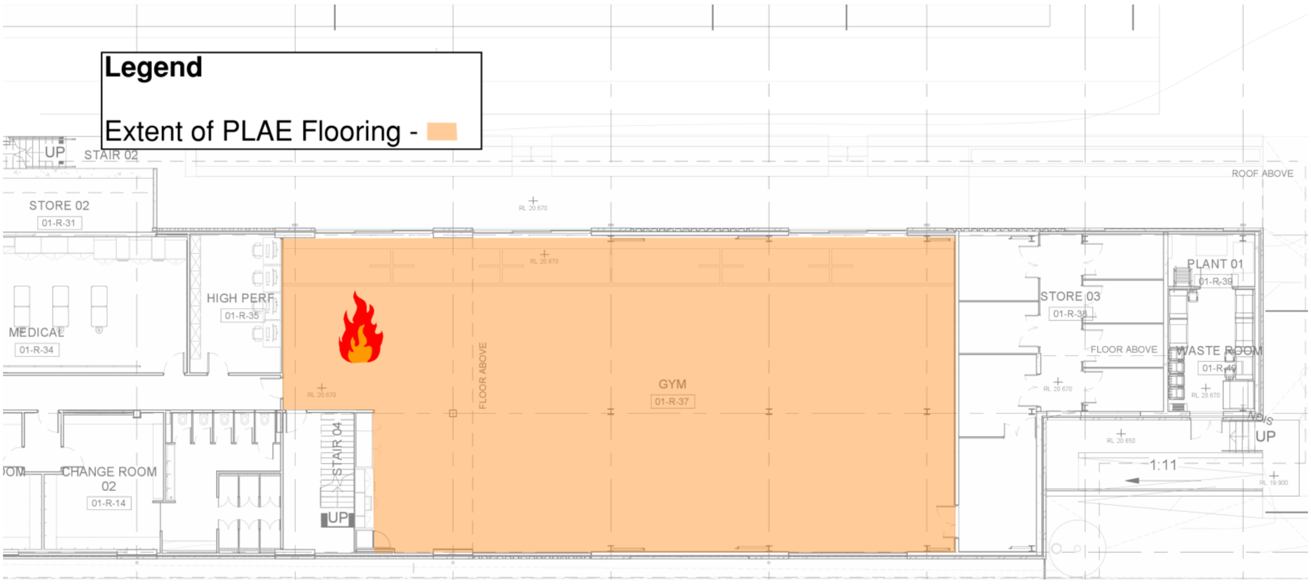


Figure 35: Scenario 2

Fuel Load and Design Fire

As discussed in Section 7.3.1, the gym is expected to contain a range of equipment whereby the most credible source of ignition is the failure of electrical components in an item of motorized exercise equipment. If this were to ignite combustible materials on the equipment the fuel load (combustible padded elements) is considered to be low. Considering, the potential close proximity of towels and/or gym bags containing clothing this fire may readily spread to these items, for reference a heat release rate of 1.2 MW is listed in the literature for bags on a piled high luggage trolley filled with clothing and other representative materials, this stated heat release rate is onerous when considering the expected amount and extent of clothing like material present.

The highest credible fuel load present within the gym space is rubber coated dumbbells/weight plates whereby a worst-case fire scenario occurs from ignition from nearby motorized exercise equipment.

The SP Technical Research Institute of Sweden undertook fire testing of a rubber tyre from heavy plant vehicle (front loader) and measured the HRR of the tyre. The tested rubber tyre is considered similar to the composition and combustion characteristics of gymnasium equipment which is a combination of non-combustible metals and combustible rubber/polymers. The mass of the tested tyre is considered to be at least equivalent to the expected combustible rubber weights. It was found that within the first 90 minutes the HRR reached a maximum of 2.4 MW, after this time the HRR briefly peaked at 3.0 MW before decaying for the remainder of the test as shown in Figure 36, below. The CFD modelling incorporates a fast growth rate t^2 fire with a maximum HRR of 2.4 MW. As the modelled period of time is 1800 seconds or 30 minutes, the chosen HRR 2.4 MW is considered appropriate, moreover, the HRR will be assumed to remain at 2.4 MW once fully grown for the remainder of the simulation.

Although there are no suppression systems installed within the gym to limit further fire growth, maintaining a constant heat release rate once the fire has grown to the peak of 2.4 MW is considered onerous as the peak heat release rate remains constant for the remainder of the simulation time, that is there is more heat being generated within the model over the given simulation time when compared to Figure 36.

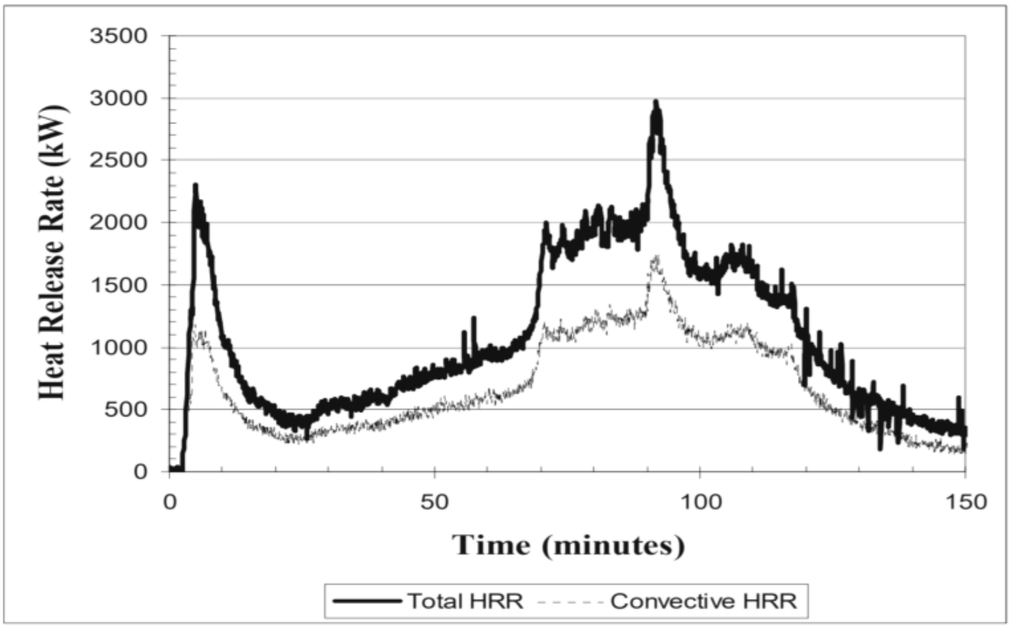


Figure 36: HRR of a front loader tyre – SP Technical Research Institute of Sweden

Table 17: Summary of design fire

Scenario	Fire Size (kW)	Growth Rate (t^2)	Description
Scenario 1	2.4	Fast	A fire initiates within the centre of the gymnasium, under the high portion of the ceiling.
Scenario 2	2.4	Fast	A fire initiates under the lower portion of gymnasium ceiling.

The time corresponding to untenable egress conditions is discussed and demonstrated in further detail in Appendix 3.

Occupant Alert Time

The occupant alert time and premovement time is often based on detector activation time and an additional delay time until occupants begin egress. This is based on device activation within the modelling summarised in Table 18, below.

Table 18: Detector Activation

Event	Scenario	
	1	1
Detector Activation Time (sec) [1]	35	39
Pre-movement Time (sec) [2]	30	
Total premovement time (sec)	65	69
Note:		

Event		Scenario	
		1	1
[1] Determined by detector activation within CFD modelling.			
[2] Based on available premovement time within the literature [24].			

A review of the Fire safety Verification Method Data Sheets Table 14 provide data on expected premovement times expressed as a distribution of the occupant population [24]. The following characteristics of the space are considered (as defined in the literature) with the most appropriate classification of the proposed development presented alongside in Table 19.

Table 19: Building characteristics

Characteristic	Classification	Description	Comment
Category	A	Staff in workplaces typically NCC Class 5, 6, 7, 8 ad 9 buildings	Considered the most applicable categorisation of the proposed development based on expected usage of the development. Rugby union players within gymnasium space may not technically be staff and are not expected to have the same level of training as staff. However, they are considered moderately familiar with the space. Moreover, the gym space is expected to be served by a fire warden under the emergency management organisation of the development, as confirmed by the building managers (NSW Rugby Union), see Appendix 6.
Emergency Management organisation	XM1	Long term occupants are trained to a high level with a comprehensive emergency management organisation with floor wardens, regular fire drills and training	
Detection and alarm	XA1	Detection and Alarm system installed throughout.	The development is proposed to have detectors and alarm installed throughout.
Building Complexity	XB1	Single building with few enclosures	Considered the most applicable categorisation of the proposed development for the purpose if the assessment given the assessed space consists of an open room on the Ground floor.

Based on the most applicable characteristics, the literature gives a premovement time of 30 seconds for 10% of the population, this document also states that characterisation of the distribution should be further refined if appropriate and secondary cues may reduce premovement time. This is further supported by studies cited in the SFPE Handbook which have shown that it is appropriate to take into account visual and other olfactory cues such as smell. It is reasonable to assume that occupants would not disregard the presence of flames and/or the build-up of thick smoke within a fire affected room or compartment, regardless of whether the alarm has activated (this provides a secondary cue that is considered in the justification for the premovement time).

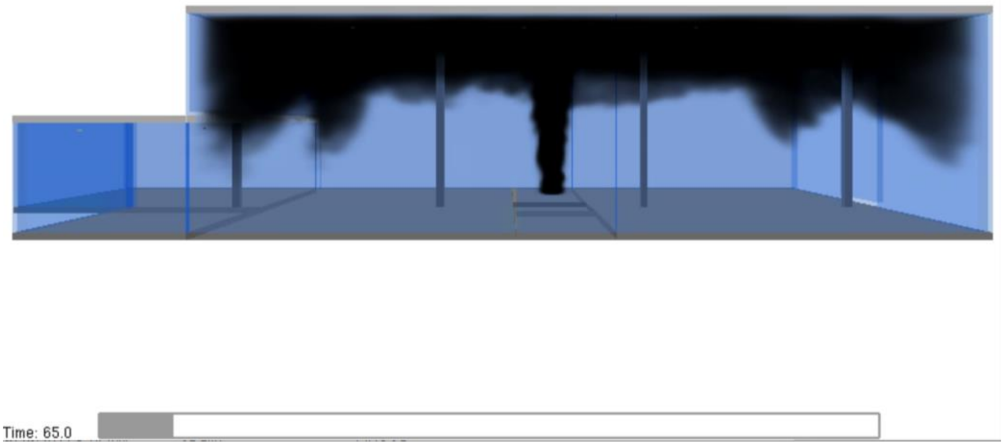
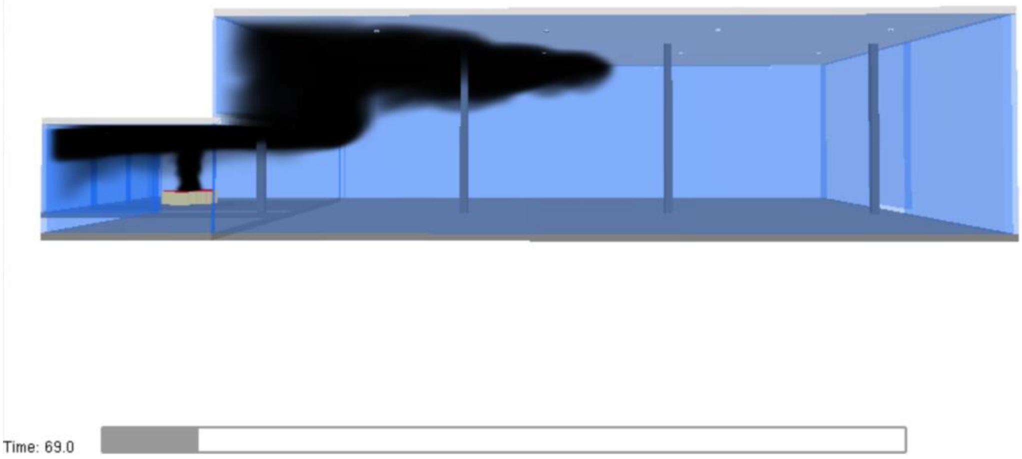
Due to the nature of gym space is it expected that occupants would have a relatively unobstructed view throughout the extent of the space, with gym equipment located sporadically at low level, the only potential visual obstruction to fire development being the lower portion of the split ceiling height, whereby a small region is stepped down from the 6m ceiling height.

Occupants within the space are considered alert and able bodied as such are expected to readily react to the appropriate cues if a fire were to initiate. The smoke spread within the space corresponding to the time to evacuation is shown in Table 20. For both scenarios, the extent of smoke spread is considered at the Time to Evacuation based on the premovement time of 30 seconds, given the alarm has activated and thick smoke from the fire is starting to billow up to the highest point of the space whereby it is starting to fill the space, all occupants within the space are considered to be alerted and have appropriate cues to have recognized the fire and begun evacuation. Hence a premovement time of 30 seconds is applied to the whole population within the gymnasium space.

In Scenario 1, a fire within the centre of the gym is able to jet up and spread under the higher portion of the gym unimpeded whereby the majority of occupants are expected to become alert of the fire. As these occupants are alerted and begin to evacuate, they will move towards the portion of the gym with the lower ceiling height, where one of the exits to the space is located, any occupants within this area who are unaware of the fire are expected to be prompted to evacuate by alarm activation and the recognition of a fire based on the extent of smoke spread and/or the already evacuating occupants moving through this area.

In Scenario 2, the fire is considered underneath the lower portion of the ceiling, as the fire develops it quickly fills this space and begins to spread towards the higher portion of the gym ceiling. Occupants near the fire are expected to be alerted early on in fire development and begin their evacuation via the nearest available exit, as the fire starts to vent up towards the higher portion of the ceiling it is expected that the remaining occupants within the gym will be alerted by alarm activation and the recognition of a fire based on the extent of smoke spread. To ensure a robust assessment the exit near this fire location is considered to be blocked, this is assessed within the evacuation assessment.

Table 20: Smoke Layer

Scenario	Smoke Layer
1	 Time: 65 seconds
2	 Time: 69 seconds

7.4.2 RSET – Evacuation Modelling

The RSET determines the time is takes for all occupants to evacuate from the modelled building space and is calculated from the summation of alarm time, premovement time, travel time and queuing time. Alarm time and premovement time is based on the modeling results and a review of appropriate premovement times within the literature, discussed in Section 7.4.1 above, travel time is calculated as the time taken for occupants to travel along the longest path to an exit point as determined through Pathfinder modelling. The travel paths considered within the modelling is shown in Figure 37 below and the key durations in the RSET are summarized in Table 21. The detection and premovement time are based on results of the CFD modelling and review of available data within the literature as discussed in the section above. Moreover, the CFD modelling shows that available exits do not get blocked by fire spread along the flooring material, that is the received heat flux on the PLAE flooring does not exceed value’s greater than 2.0 kW/m^2 regions away from the fire as shown in Appendix 4. To ensure an onerous assessment blocked exit scenario are considered for the two fire locations, the exits selected to be blocked in each scenario are considered appropriate to the fire location.

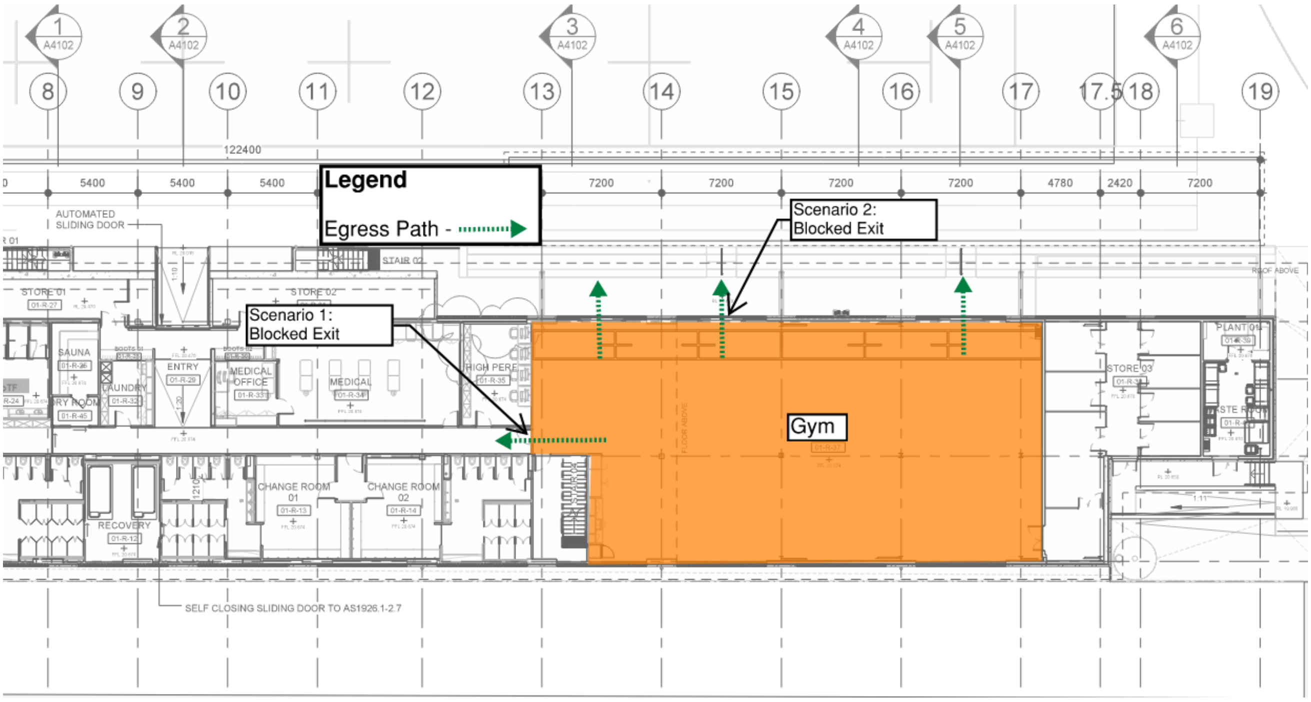


Figure 37: Gym egress paths

Table 21: Evacuation timeline

Parameter	Scenario 1		Scenario 2	
	Non-Blocked Exit	Blocked Exit	Non-Blocked Exit	Blocked Exit
Detection and Premovement Time (s) [1]	65		69	
Travel Time [2]	24.5	24.3	24.5	24.3
Total time to evacuation (sec)	89.5	89.3	93.5	93.3

Notes:

[1] Determined by the CFD modelling and available premovement data within the literature.

[2] Based on time it takes for the entire population in the modelled space to complete evacuation as determined by the Pathfinder modelling.

The evacuation assessment including inputs and assumptions, including the presentation of modelling results are discussed in more detail in Appendix 4.

The RSET results demonstrate that the blocked exit scenario is slightly less than where all exits are available, it is noted this is counter-intuitive, however, due to the number and location of available exits and travel distances the queue time in the blocked exit scenarios is marginally less than the travel time and queue time to the additional available exit in the non-blocked exit scenario. The difference between the travel time of the blocked exit and non-blocked exit scenarios is minor due to sufficient exits, compliant travel distances and long queuing is not expected to occur.

Occupant Characteristics

The egress assessment takes into consideration rationalized occupant characteristics, such as population size and travel speed which are fundamental to the assessment. It is assumed that given the nature of the space being a gymnasium, occupants within the space are alert and able bodied. It is expected that occupants will be able to respond to their surrounding conditions and evacuate based on available sensory cues (i.e., visual, olfactory, or auditory) without delay or assistance. It is reasonable to assume that although occupants may be unfamiliar with the space, the open layout of the gym facilitates occupants being able to readily identify the available exits.

The evacuation modelling considers the default SFPE settings with the exception of the occupant's evacuation speed which is assumed to be 0.8 m/s. This is approximately 25% slower than the stated SFPE value of 1.19 m/s.

Based on the occupancy numbers confirmed by NSW Rugby Union the gym space maximum capacity is 90 occupants, it is noted that the subject gymnasium is expected to be occupied by authorised sport's team members (40 NSW Rugby Players) and support staff (10 coaching support staff) under typical occupancy conditions. To ensure the assessment is onerous, the maximum of 90 occupants is considered within the evacuation modelling. Confirmation of this occupant size is provided in Appendix 6.

The above assumptions on population size and travel speed ensure that a worst-case condition is considered.

7.4.3 Acceptance Criteria

Within the ASET/RSET assessment the two criteria are considered as follows:

1. Floor regions where the critical heat flux exceeds 2.0kW/m^2 (hence where fire spread occurs) will be considered untenable for occupants to travel past. The extent of safe egress paths areas will additionally be assessed to demonstrate occupants are unlikely to be obstructed to reach a place of safety based on occupant tenability as summarised in Table 22 below.

Table 22: Occupant Tenability Criteria

Occupant Tenability Criteria		Reference
Convective heat	Temperature < 60 °C when smoke layer is below 2.1 m	BS 7974: PD 6 (PD7974-6, 2004)
Radiant heat exposure	Radiant flux < 2.5 kW/m^2 at 2.1 m, or smoke layer temperature < 177 ºC* when smoke layer is at or above 2.1 m	
Visibility	Visibility > 10m when the smoke layer is below 2.1m in large spaces and >5m when the smoke layer is in small spaces and queues	
*Note: a conservative equivalent temperature of 177ºC based on the heat flux of 2.5 kW/m^2 is used based on the smoke layer with an emissivity of 0.9 and compartment dimensions.		

2. For both fire locations, the assessment is considered accepted:
   i. Where all exits are available: ASET > 1.5 x RSET, and
   ii. Where one exit is blocked: ASET > RSET

7.4.4 Results and Discussion

The results documented in Appendix 3 compared the visibility, temperature and radiant heat flux to the acceptance criteria. It is demonstrated that occupants within the gym space are able to evacuate from gym space in time prior to conditions becoming untenable as shown Table 23. Comparing boundary and slice results to the acceptance criteria for the temperature, visibility and critical heat flux results show that the limiting condition for safe egress is based on visibility. In determining the ASET the visibility results are presented at various time throughout the run time with the extent of where the visibility limits of 10m (throughout the general space) and 5m (at exits where queuing occurs) are reached.

The ASET it determined at the point in time where the onset of untenable occupant conditions, this is considered to correspond where able occupants are no longer able to visually identify the available exits and egress paths. The summarized ASET and RSET results are present in Table 23, below, demonstrating that occupants are able to safely undergo evacuation.

Table 23: ASET/RSET results

Results	Scenario 1		Scenario 2	
	Non-Blocked Exit	Blocked Exit	Non-Blocked Exit	Blocked Exit
RSET (seconds)	134.25 [1]	89.3	140.25 [1]	93.3
ASET (seconds)	180		144	
Notes: [1] Includes 1.5 factor of safety.				

7.5 Robustness or Safety Factor

The assessment utilizes numerous assumptions throughout to ensure an onerous approach. This includes the occupant characteristics, fire spread acceptance criteria and the evacuation assessment considers a blocked exit scenario for both fire locations.

The performance solution is indicative of the building design based off Architectural Drawings referenced in Table 3 of this document. Any major changes to the architectural layout must be confirmed by Stantec for compliance with this FER, or rework may be required.

7.6 Fire Brigade Intervention

The proposed flooring material has demonstrated that fire spread is not supported during the evacuation period and is expected that occupants are capable of safely completing evacuation out of the gym space. The brigade are not expected to be required to assist in occupant evacuation and can focus on fire-fighting intervention. As part of this intervention the brigade are expected to fight the fire within the gym by accessing the nearby external attack fire hydrants (as shown in Figure 38) where safe to do so.

In a worst-case scenario, whereby occupants are unable to complete their evacuation prior to the onset of untenable conditions, the brigade are expected to utilize the attack hydrants to suppress the fire; either entirely extinguishing the fire or suppressing the fire to the extent necessary to facilitate their assistance in occupant evacuation.

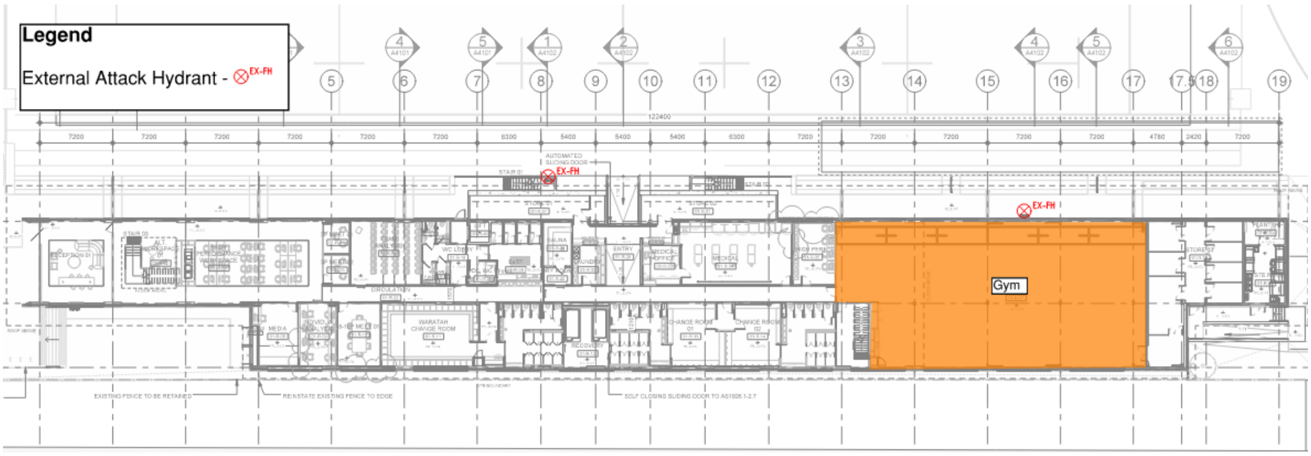


Figure 38: External Attack Hydrants

7.7 Conclusion

The performance solution above and results documented within Appendix 3 and Appendix 4 demonstrate that visibility levels and received heat flux at floor level do not exceed the acceptance criteria whereby tenable egress conditions are maintained for the duration of the evacuation time from the gym space. Moreover, the heat flux that the floor material experiences does not exceed the 2 kW/m^2 threshold away from the immediate fire location, as such it is considered that fire spread is not facilitated either through the space or towards exits. Therefore, BCA Performance Requirements CP2, CP4 and EP2.2 have been met.

Appendix 1 Referenced Information

A 1.1 Reference Documentation

Table 24: Summary of referenced documentation

[1]	ABCB 2019 Amdt 1, *National Construction Code Series, Volume 1, Building Code of Australia 2019 Amdt 1, Class 2 to Class 9 Buildings,* Australian Building Codes Board, Canberra.
[2]	ABCB 2021, Australian Fire Engineering Guidelines, 2021 Edition, Australian Building Codes Board, Canberra.
[3]	DBH 2012, C/VM2, Verification Method: Framework for Fire Safety Design, For New Zealand Building Code Clauses C1-C6 Protection from Fire, Department of Building and Housing, Wellington.
[4]	The hazard associated with removing smoke exhaust. Removal of mechanical smoke exhaust potentially result in compromised egress routes before all the occupants could safely egress.
[5]	PD7974-6 - 2004. “The application of fire safety engineering principles to fire safety design of buildings – Part 6: Human factors: Life safety strategies – Occupant evacuation, behaviour and condition (Sub-system 6)”, BSI British Standards.
[6]	Society of Fire Protection Engineers (SFPE) Handbook of Fire Protection Engineering 4th Edition, 2008.
[7]	CIBSE Guide E: Fire Safety Engineering, CIBSE, 2010.
[8]	NFPA 92B
[9]	Bennetts, I.D., and Thomas, I.R., Performance Design of Low-rise Sprinklered Shopping Centers for Fire Safety, Journal of Fire Protection Engineering, 2002.
[10]	Nystedt, F., Verifying Fire Safety Design in Sprinklered Buildings, Report 3150, Department of Fire Safety Engineering and Systems Safety Lund University, Sweden, 2011.
[11]	AS 1668.1
[12]	AS 4100
[13]	AS 2118.1
[14]	AS 2293.1
[15]	AS 1670.1
[16]	Hall, J 2010, ‘U.S experience with sprinkler and other automatic fire extinguishing equipment’, National Fire Protection Association, Quincy.
[17]	Ronchi, Enrico, et al. "Representation of the impact of smoke on agent walking speeds in evacuation models." Fire technology 49.2 (2013): 411-431.
[18]	Madrzykowski, D., The Reduction in Fire Hazard in Corridors and Areas Adjoining Corridor Provided with Sprinklers, Report NISTR 4631, NIST, US Department of Commerce.
[19]	Nystedt, Fredrik. "Verifying fire safety design in sprinklered buildings." LUTVDG/TVBB-3150-SE (2011).
[20]	Bliss, James P. "The cry-wolf phenomenon and its effect on alarm responses." (1993).
[22]	Babrauskas, V. “Glass Breakage in Fires”
[23]	“Laws of the Game Rugby Union Incorporating the Player Charter”, World Rugby (2015)
[24]	ABCB 2020, *Fire Safety Verification Method Data Sheets*, Handbook annex, Version 1.1, Australian Building Codes Board, Canberra.
[25]	Mayfield, C. and Hopkin, D., *Design Fires for use in Fire Safety Engineering*, BRE Trust (2011)

A 1.2 Device Activation Models

The change in temperature of a sprinkler sensing element in a ceiling jet is determined from the two-parameter sprinkler activation model developed by Heskestad (Heskestad, 1988) is defined by:

Equation 1

$$\frac{dT_s}{dt} = \frac{\sqrt{U}}{RTI}\left[(T - T_0) - \left(1 + \frac{C}{\sqrt{U}}\right)(T_s - T_0)\right]$$

Alpert's ceiling jet correlations (Alpert, 1972) are used to estimate the maximum ceiling jet excess temperature and velocity:

Equation 2

$$T - T_o = 16.9\frac{\dot{Q}^{2/3}}{H^{5/3}} \qquad for\ \frac{r}{H} \leq 0.15$$

$$T - T_o = 5.38\frac{\dot{Q}^{2/3}/H^{5/3}}{(r/H)^{2/3}} \qquad for\ \frac{r}{H} > 0.18$$

$$U = 0.95\left(\frac{\dot{Q}}{H}\right)^{1/3} \qquad for\ \frac{r}{H} \leq 0.15$$

$$U = 0.20\frac{(\dot{Q}/H)^{1/3}}{(r/H)^{5/6}} \qquad for\ \frac{r}{H} > 0.15$$

Where:

$\frac{dT_s}{dt}$	change in sensor temperature over time (°C/s)
U	gas speed at the sensing element (m/s)
RTI	Response Time Index of the element ($(m.s)^{1/2}$)
T	gas temperature (°C)
T_0	ambient temperature (°C)
C	conduction factor ($(m/s)^{1/2}$)
$\dot{Q}$	heat release rate (kW)
H	ceiling height (m)
r	radial distance of sensor from fire (m)

The conduction factor C and the RTI can be estimated for the various sprinkler response types from Figure 39 below (AS, 4118.1).

The slowest response for a listed fast response sprinkler is obtained for an RTI of 50 $(m/s)^{1/2}$ and a C-factor of 0.8 (m/s)1/2.

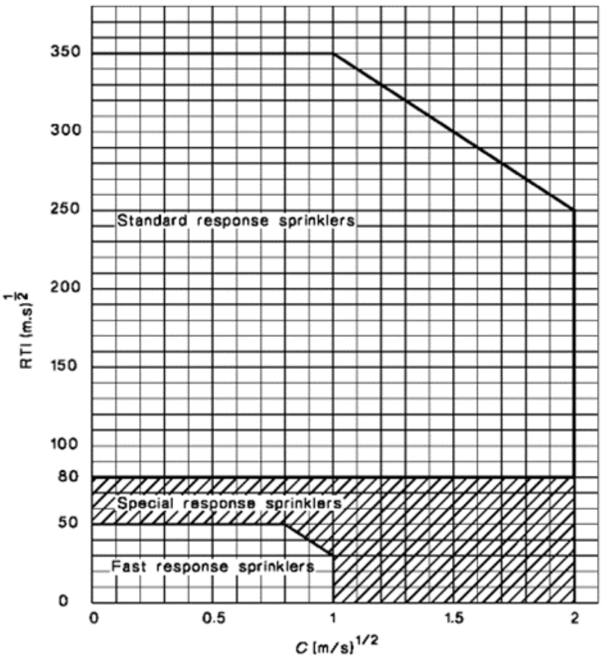


Figure 39: Standard Orientation Sprinkler RTI and C Limits

The activation time of smoke detectors is difficult to predict as there are a large range of variables that play a role; smoke detectors differ in operating principle, design, are sensitive to the mode of combustion, ventilation and the like. In addition, detection technology is also continuously advancing. Despite these difficulties, various generic methods are in use for the estimation of detector activation time. In this analysis, the constant temperature rise method will be used. This method assumes that the detector will activate when the temperature of the smoke at the location of the detector has increased by a certain value. For smoldering fires this value has been found be in the range between 1°C – 3°C as researched by Geiman (Geiman, 2003). For flaming fires, it was found that 90% of smoke detectors activated before the temperature at the detector rose by more than ~16°C.

The activation of a smoke detector is therefore predicted from Equation 2; with detector activation assumed to occur at a gas temperature of 16 °C above ambient. Standard detector spacing can be seen in Figure 40 below.

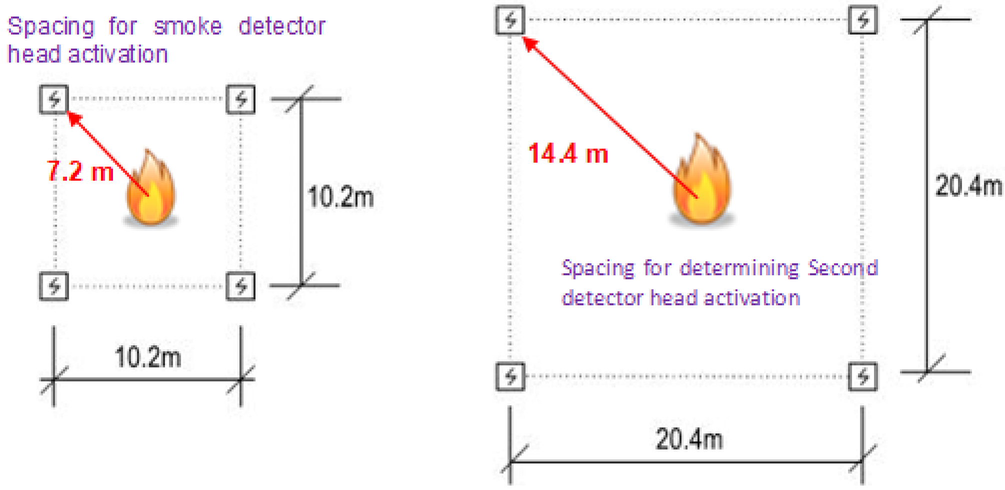


Figure 40: Standard Smoke Detector Spacing (AS, 1670.1, 2015)

Appendix 2 FRNSW Commentary

The table below outlines the finalised FRNSW comments on FEBQ V07. The FER appropriately addresses these comments with the relevant sections referenced.

Table 25: FRNSW commentary summary

<table>
<tr><th>Item</th><th>FEBQ V07 reference</th><th>FRNSW Comments (FEBQ V02)</th><th>Stantec Response</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Section 5 Hazards</td><td>Regarding the alternative electrical generation system, FRNSW recommend the following:
Signage must be clearly displayed at the FIP identifying the presence and location of the alternative electrical generation system.
A block plan showing the location of all associated isolation switches, AC and DC isolators for the shut-off of generated electricity should be displayed at the FIP
If the alternative electrical generation system automatically isolates on fire trip, signage should be provided at the FIP detailing this provision that can clearly be identified by firefighters.</td><td rowspan="2">This signage is listed on the Fire Safety Requirements, captured in Section 3.</td></tr>
<tr><td>FRNSW recommend the following be provided with regards to signage:
Be constructed of all-weather fade resistant material with red lettering not less than 25mm high with a contrasting coloured background.
Provide notice of the type of alternative electrical generation system and the location of any isolation/shut-off switches and shut down procedures.
Be provided on or adjacent to the fire indicator panel (FIP).
Be provided on or adjacent to all sprinkler and hydrant block plans.</td></tr>
<tr><td>2</td><td>Issue 1 – Extended Travel Distances</td><td>In regards to the extended travel distance to an exit on Ground Floor and Level 1 (i.e. 75m and 69m in lieu of 60m)
FRNSW recommend that a quantitative assessment be carried out, in order to adequately demonstrate that the fire safety strategy within the proposed</td><td>The quantitative assessment has been conducted to address the extended travel distances on the Ground Floor to demonstrate that occupants are afforded safe egress. This is captured in Section 4.

There are no measures required that are considered necessary to restrict combustibles and/or stored goods above</td></tr>
</table>

Item	FEBQ V07 reference	FRNSW Comments (FEBQ V02)	Stantec Response
		development will appropriately facilitate safe occupant egress to an equivalent or better-degree in comparison to a DtS-compliant design. This is to be addressed. • Additionally, it is to be outlined what measures are to be implemented (if any) to ensure that the egress paths on Ground Floor and Level 1 remain free of combustibles and/or stored goods	and beyond general housekeeping requirements outlined in Section 3.5.
		Commenting on the quantitative assessment to determine the RSET: • FRNSW recommend additional justification and information to be provided with regards to occupants being aware of a fire at a smoke layer height of 10%.	Justification for the 10% smoke layer height is provided in Section 4.4
		In regards to the extended travel distances between alternative exits on Ground Floor and Level 1(i.e. – 75m and 69m in lieu of 60m), in principle support is provided subject to: • All inputs and assumptions detailed in the FER and being agreed to by all relevant stakeholders; and • The analysis detailed in the FER demonstrating compliance with the relevant Performance Requirements of the NCC.	Inputs and assumptions are listed throughout Section 4. This section also demonstrates compliance with relevant performance requirements.
3	Issue 2 –**Booster and Hydrant Location**	The abovementioned signage is to be listed as an essential Fire Safety Measure, to be included on the Fire Safety Schedule	This sign is listed as an essential fire safety measure, captured in Section 3.
		As the building is not sprinkler-protected, consideration should be given to a fully developed fire within the store room (and adjacent regions in close proximity to the attack hydrant), to demonstrate that approaching fire fighters would not be exposed to dangerous conditions. A quantitative assessment is considered appropriate for this assessment. A fallback hydrant should be considered in this location	The assessment considers a fully developed fire within the storeroom and demonstrates that through the fire resistance of the bounding construction provides the brigade sufficient time to connect to the attack hydrant. A quantitative assessment has been conducted to demonstrate that brigade members are not exposed to harmful heat fluxes at the attack hydrant from smoke/hot gases from the nearby Ground floor Entrance. This is captured in Section 5.
		Additional information to be provided why the	The assessment criteria has chosen to

Item	FEBQ V07 reference	FRNSW Comments (FEBQ V02)	Stantec Response
		above time of less than 5 minutes was used to justify the assessment criteria. Consideration should be given to utilising the FBIM when quantifying fire brigade intervention.	use values that permit occupants to be exposed for greater than 5 minutes, referring FBIM model V2.2 acceptable limits for brigade are said to be 25 minutes for radiation of 1 kW/m^2 and 10 minutes for a radiation of 3 kW/m^2. The actual radiation level determined of 1.24 kW/m^2 would permit the brigade to be exposed for approx. 20 minutes. This time period is sufficient for the brigade to connect to the attack hydrant, where once connected they would be protected by the hose stream and be able to more away from the radiating panel. This captured in Section 5.4.
		FRNSW provide the following comments/recommendations: • Additional information to be provided on the emissivity of the radiative panel used for the assessment.	Information on the emissivity of the radiative panel has been provided in the table above. A maximum value of 1.0 is utilized. This is discussed in Section 5.4.
		In principle support is provided subject to: • The hydrant plan should clearly show the location of the hydrant pump. • All inputs and assumptions detailed in the FER and being agreed to by all relevant stakeholders; and • The analysis detailed in the FER demonstrating compliance with the relevant Performance Requirements of the NCC.	• Block diagram showing hydrants and booster locations is captured in Section 3. • Inputs and assumptions are listed throughout Section 5. This section also demonstrates compliance with relevant performance requirements.
4	Issue 3 – **Reduced Egress Widths**	The assessment has taken 510 mm for a static individual from the data provided, it is assumed that occupants will be moving during egress and this value would differ. Consideration should be given to occupants swaying (i.e.760 mm) from the provided NFPA 101 anthropometric data to maintain a conservative approach to the assessment.	The reduction in egress width exists where the stairs contain a central handrail only. As such it is not considered that the 760mm clear width for swaying of shoulders be applicable to the proposed design. Rather reference should be made to the swaying width of occupant hips which is noted to be 560mm and thus still within the confines of the proposed design. This is captured in 6.3.
		FRNSW provide the following comments/recommendations: • Consideration be given to the dimensions of firefighters accessing the reduced with whilst wearing full PPE, breathing apparatus and	• The location subject to the non-compliant egress widths is in the external tiered seating only, should FRNSW have issues passing through the space it is demonstrated below that they would be permitted to fight a fire

Item	FEBQ V07 reference	FRNSW Comments (FEBQ V02)	Stantec Response
		carrying fire brigade equipment. • The comments provided by FRNSW with regards to occupants swaying as stated in NFPA101 to be addressed satisfactorily.	with the 10m hose stream without passing beyond this point. This is captured in Section 6.5. • See response above.
		In principle support is provided subject to the analysis detailed in the FER demonstrating compliance with the relevant Performance Requirements of the NCC.	Section 6 demonstrates compliance with relevant performance requirements.
5	Issue 4 – **Permit the use of non-compliant floor lining**	FRNSW recommend additional clarification to be provided on why the two proposed tests (IGNL and AWTA) have large differences in the critical heat flux and smoke development rate as stated above. FRNSW recommend the AWTA test report be provided in order for FRNSW to undertake a review.	Note the performance solution has been updated to reflect an absolute assessment and addresses FRNSW that are considered still applicable to the updated assessment as captured in Section 7.
		FRNSW recommend additional clarification and information to be provided on how the fire testing of a rubber tyre from a heavy plant vehicle is relevant to the proposed floor lining used for a gym. Furthermore, as stated above, the HRR of the fire test peaked at 3.0 MW before decaying, therefore, FRNSW recommend clarification why a maximum HRR of 2.4 MW was considered for the assessment to ensure that that appropriate conservatism has been maintained within the assessment method.	
		FRNSW provide the following comments/recommendations: • It is noted that a soot yield value of less than 0.1kg/kg is proposed to be utilised within the assessment for the DtS proposed scenario. As such, appropriate justifications are to be provided for the proposed soot yield value. If this cannot be provided, FRNSW recommends a conservative soot yield value of 0.1kg/kg be adopted. • FRNSW recommend additional justification on the above equation to	

Item	FEBQ V07 reference	FRNSW Comments (FEBQ V02)	Stantec Response
		calculate the proposed soot yield utilised within the assessment. • FRNSW recommend additional information to be provided on what the proposed soot yield of 0.244 kg/kg will achieve in the proposed assessment.	
		FRNSW provide the following comments/recommendations: • The comments provided by FRNSW being addressed satisfactorily. • FRNSW recommend additional information to be provided on the proposed non-compliance in order for FRNSW to undertake an adequate review. FRNSW recommend clarification to be provided on whether the non-compliance relates to the critical heat flux and smoke development rate of the proposed PLAE-Achieve.	

Appendix 3 Fire and Smoke Analysis

A 3.1 Introduction

This analysis has been completed as part of the justification for Performance Solution 4, where a flooring material is proposed to be used that is not in compliance with C1.10.

The analysis documented herein details the calculated heat flux and tenability conditions in the modelled space, based on a considered fire scenario and the proposed active and passive Fire Safety systems.

A 3.1.1 Method of Analysis Used

The CFD model used in this analysis was Fire Dynamics Simulator 6.7.1 (FDS), produced by the National Institute of Science and Technology (NIST). The simulator has been extensively validated against both real and laboratory fires and is considered to be an industry standard.

The assumptions and limitations of the simulator are not reviewed here, and full reference should be made to NIST Special Publication 1018 'Fire Dynamics Simulator (Sixth Edition) Technical Reference Guide' (Kevin B. McGrattan, 2013). All models have been both undertaken and checked by experienced users in line with the recommendations of NIST.

A 3.1.2 Scenarios

Table 26 below outlines the simulated scenarios. Detailed locations of fires are shown in later sections of this appendix.

Table 26: Scenario Descriptions

Scenario	Description	Commentary	Run Time (s)
Scenario 1	Corner fire location with the lower ceiling.	The gym space was designed to show the actual tenability conditions within a fire scenario. Geometry was taken direct from architectural drawings.	1800 or until steady state conditions are reached
Scenario 2	Centre fire location with higher ceiling above.		1800 or until steady state conditions are reached

A 3.2 Description of Analysis

This section discusses all the assumptions, inputs, acceptance criteria and methodology used as part of this analysis.

A 3.2.1 Extent of Modelled Space

The extent of the modelled space in each Performance Solution is shown in below and should be viewed in conjunction with plans. The model has been created to replicate the proposed architectural design to a level of detail and accuracy which is considered to be acceptable.

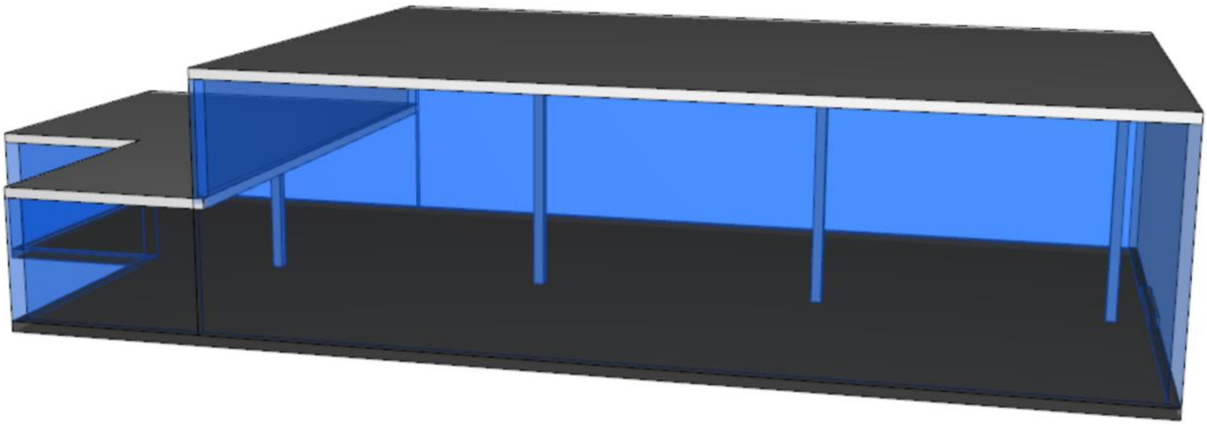


Figure 41: Extent of Modelled Space – Proposed Model

A 3.2.2 Design Fire

Fire Parameters

Table 27: Fire Parameters Used in Each Mode

Fire	Growth rate (t^2)	Peak Fire size (kW)	Scenario used	References
Tyre Fire	Fast	2400	Scenario 1 and 2	SP Technical Research Institute of Sweden

Products of combustion

Given the use of the spaces the reaction used in each model is based on referenced data provided in Table 28 with a Heat Release Rate Per Unit Area (HRRPUA) of 1000 kW/m^2.

The values used in Table 28 below have been taken from New Zealand Verification Method 2 (DBH, 2020) and SFPE Handbook (5th Edition), Table A.39. Table A.39 lists the Soot Yield, CO yield and Heat of Combustion of 12.6 kJ/g.

Table 28: Species, Soot Yield and CO Yield of the Design Fires

Fire	Carbon atoms	Hydrogen atoms	Oxygen atoms	Nitrogen atoms	Other atoms	CO yield [1]	Soot yield [1]	Hydrogen factor
Proposed Model	1.0	2.0	0.5	0.0	0	0.082	0.175	0.1
Notes: [1] Based on rubber like materials, specifically neoprene, as referenced in SFPE Handbook (5th Edition), Table A.39								

A 3.2.3 Outputs

Slice Files

Slice files have been placed at a height of 2.1m above the FFL in the two modelled scenarios. The slice files will be used as part of the study with visibility and temperature being taken into account as shown in Figure 42.

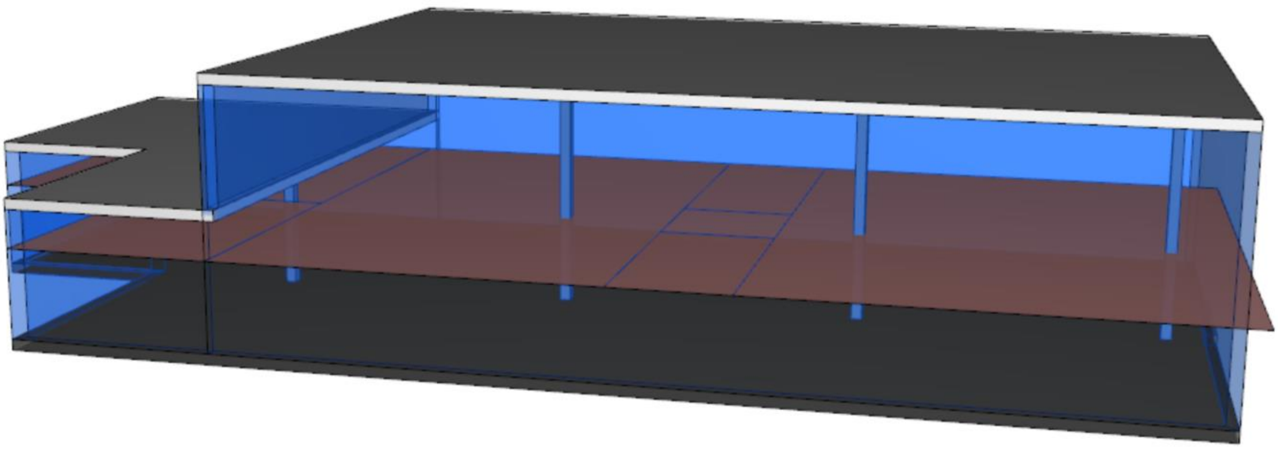


Figure 42: Slices

Devices

Smoke detectors are proposed to be installed throughout the development including the gym space with a 10 m x 10m spacing. The model incorporates these smoke detectors as devices with the stated spacing and measure the obscuration of the smoke, the detectors use a Cleary Photoelectric Model. The detectors are to be installed as per AS 1670.1-2018 with a standard sensitivity, to ensure an onerous assessment the devices are modelled with an obscuration of 15 %/m with device results shown in Section A 3.3.5.

A 3.2.4 Mesh Sizing

The accuracy of the CFD modelling is affected by the number and size of grid cells used in the CFD calculations and a correlation with the fire size. The area around the fire will have a finer mesh than the rest of the model, as this is a critical area for the formation of the products of combustion and entrainment of air.

When determining the appropriate mesh size the fire diameter is to be considered, as stated in the FDS User Guide:

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

Where:

D^*= Fire diameter (m)

$\dot{Q}$ = Heat Release Rate (kW)

ρ_∞ = Density of air (kg/m^3)

C_p = Specific heat of air, under constant pressure (kg/m^3)

T_∞ = Ambient Temperature (K)

g = Acceleration due to gravity (m/s^2)

Table 29 below shows a summary of the calculations to be done to determine the appropriate grid size for the area around the fire, as per FDS user guide (Kevin B. McGrattan, 2013) and NUREG (Commission, 2007).

Table 29: Mesh Sizing Calculations for Fire Area

Variable	Value	Variable	Value
Heat Release Rate (kW)	2400	**D***	1.361

Variable	Value	Variable	Value
Density (kg/m^3)	1.204	D*/dx ranges:	Mesh sizes
Specific Heat (kJ/kg K)	1.005	Fine mesh (m): D*/ 16	0.085
Gravity (m/s^2)	9.81	Medium mesh (m): D*/10	0.136
Ambient Temp (K)	293	Course mesh (m): D*/4	0.340
Actual Mesh Size (m)	0.25		
Actual Fire Mesh Size (m)	0.125		

On the above basis a 0.125 m uniform grid size has been used around the fire and 0.25m for the remainder of the model which equates to a D*⁄dx of 10.88 and 5.444, respectively, which falls within acceptable bounds. The meshes and location of the fine meshes are shown in Figure 43. This is further backed up by ranges listed in FDS Validation Guide.

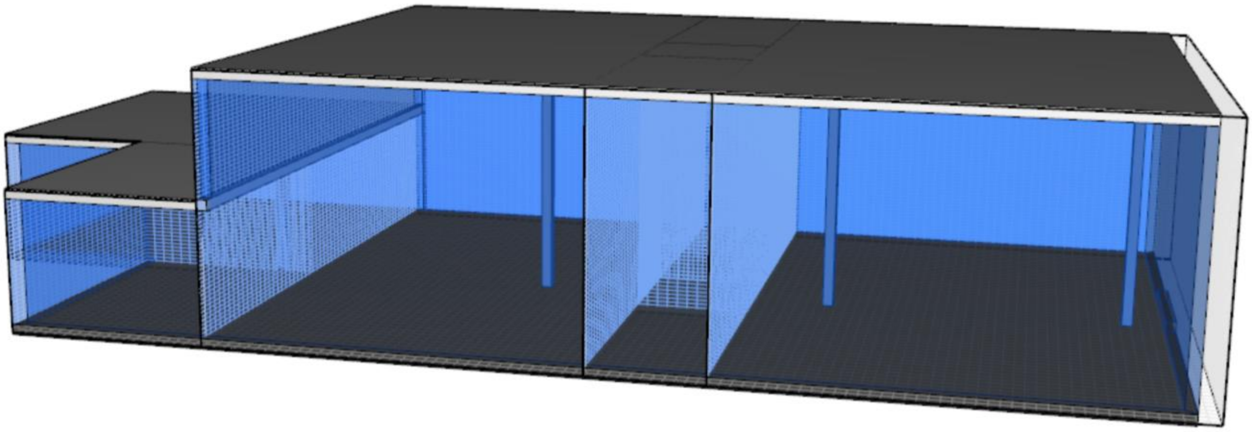
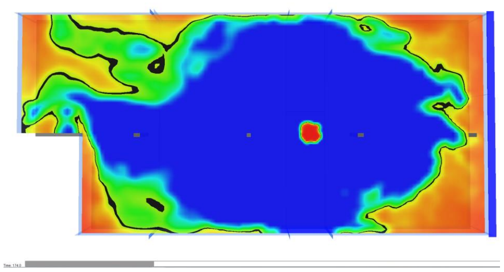
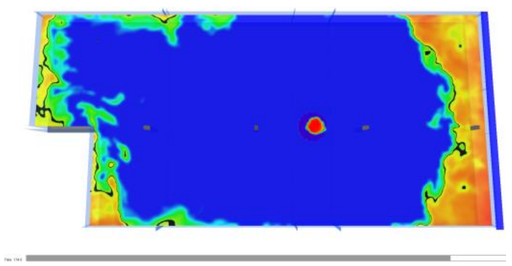
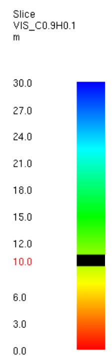


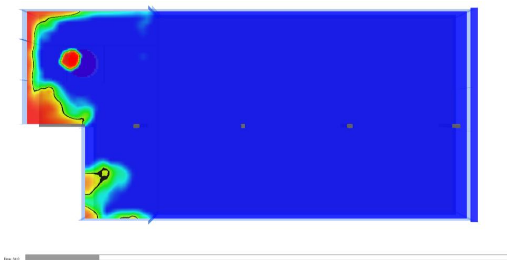
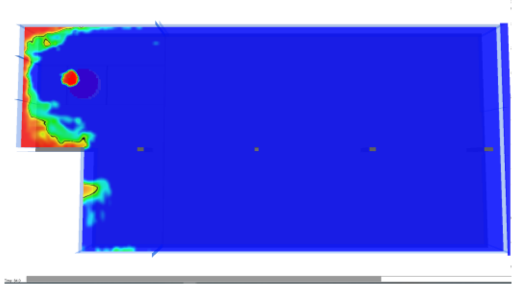
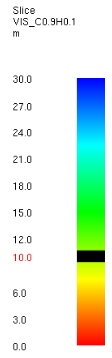
Figure 43: Extent of meshing around model

Grid Sensitivity

A grid sensitivity study has been undertaken to demonstrate that the selected mesh size is suitable based on the geometry and fire characteristics, and that the results presented are at an appropriate level of accuracy to review the fire engineering outcomes, and hence the assessment is valid. Slice results are presented for two different levels of mesh refinement at the same time step as shown in Table 30. The Course Mesh Refinement is presenting results for a grid size of 0.25m (global) and 0.125m (around the fire) and the Fine Mesh Refinement is presenting results for a grid size of half the coarse mesh, that is 0.125m (global) and 0.0625m (around the fire). For the purposes of the grid sensitivity visibility slice results are compared for both modelled scenarios at a the same simulation time.

Table 30: Modelling results

Scenario	Coarse Mesh Refinement	Fine Mesh Refinement	Legend
1	 Time: 174 Seconds	 Time: 174 Seconds	

Scenario	Coarse Mesh Refinement	Fine Mesh Refinement	Legend
2	 Time: 84 Seconds	 Time: 84 Seconds	

These results demonstrate that the finer mesh size results in improved visibility compared to the coarse mesh results for the modelled scenarios., with the finer mesh showing improved smoke buoyancy, i.e. the finer mesh results in slower descent of the smoke layer compared to the coarse mesh. As such, with consideration of the acceptance criteria, in particular in relation to visibility, the results from the coarser mesh are more conservative, and therefore appropriate for the determination of ASET For the fire engineering assessment.

A 3.2.5 Acceptance Criteria

Within the ASET/RSET assessment the two criteria are considered as follows:

1. Floor regions where the critical heat flux exceeds 2.0kW/m^2 (hence where fire spread occurs) will be considered untenable for occupants to travel past. The extent of safe egress paths areas will additionally be assessed to demonstrate occupants are unlikely to be obstructed to reach a place of safety based on occupant tenability as summarised in Table 31 below.

Table 31: Fire Modelling Acceptance Criteria

Occupant Tenability Criteria		Reference
Convective heat	Temperature < 60 °C when smoke layer is below 2.1 m	BS 7974: PD 6 (PD7974-6, 2004)
Radiant heat exposure	Radiant flux < 2.5 kW/m^2 at 2.1 m, or smoke layer temperature < 177ºC* when smoke layer is at or above 2.1 m	
Visibility	Visibility > 10m when the smoke layer is below 2.1m in large spaces and >5m when the smoke layer is in small spaces and queues	
*Note: a conservative equivalent temperature of 177ºC based on the heat flux of 2.5 kW/m^2 is used based on the smoke layer with an emissivity of 0.9 and compartment dimensions.		

2. For non-blocked exit scenarios: ASET > 1.5 RSET, for the blocked exit scenario: ASET > RSET.

A 3.3 Results and Discussion

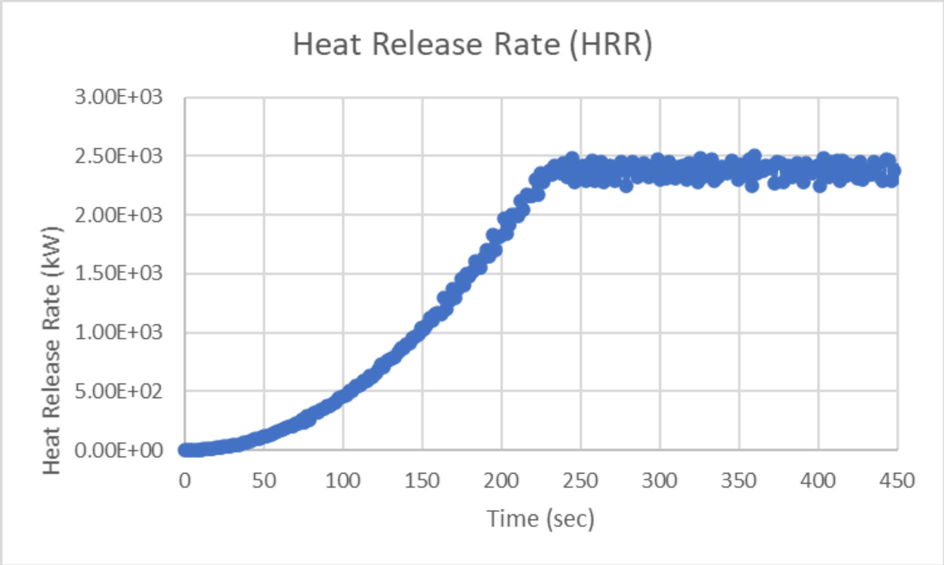
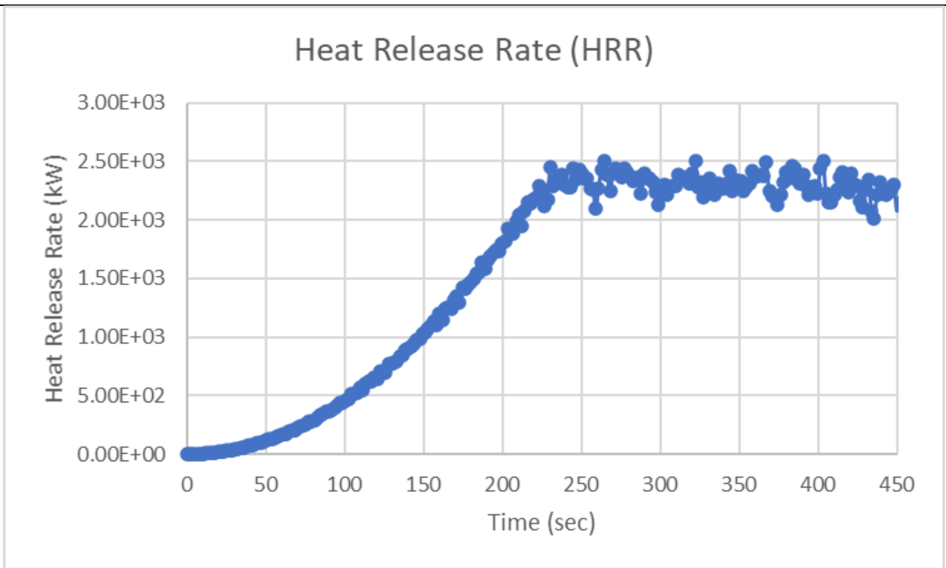
A 3.3.1 Heat Release Rates

Before assessing the visibility, temperature and Radiant Heat Flux measurements, to ensure that conditions are safe for the occupants to egress, it is necessary to ensure that the data provided in the CFD model is accurate. The graphs in Table 32 below show the specified and simulated heat release rate, which follows the specified fast growth rate and reaches a steady state as specified.

There is a small amount of deviation about the specified heat release rate in the controlled portion of the model is not sufficient to warrant any consideration. This can be attributed to the fire not becoming ventilation controlled and is an indication that sufficient oxygen is available for the fire size.

Table 32: Heat Release Rate – Internal Models

Scenario	Heat Release Rate (kW)

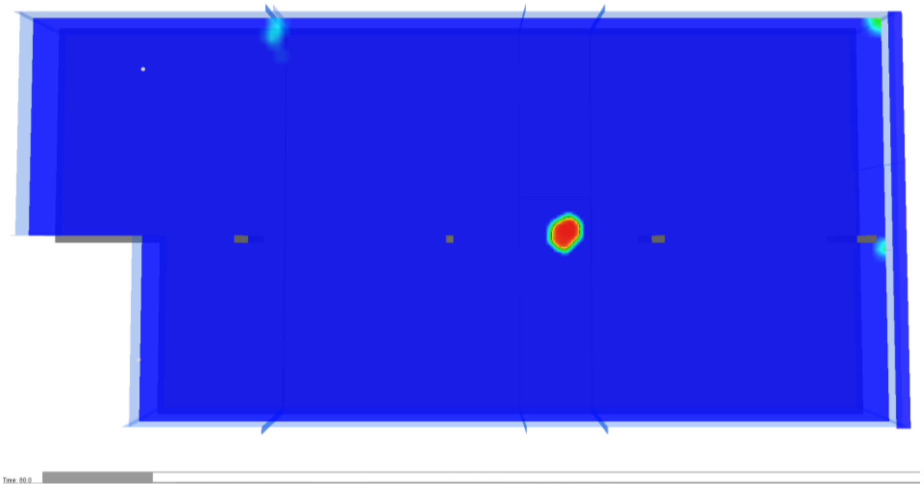
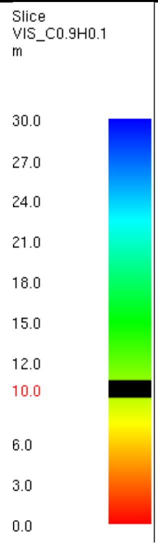
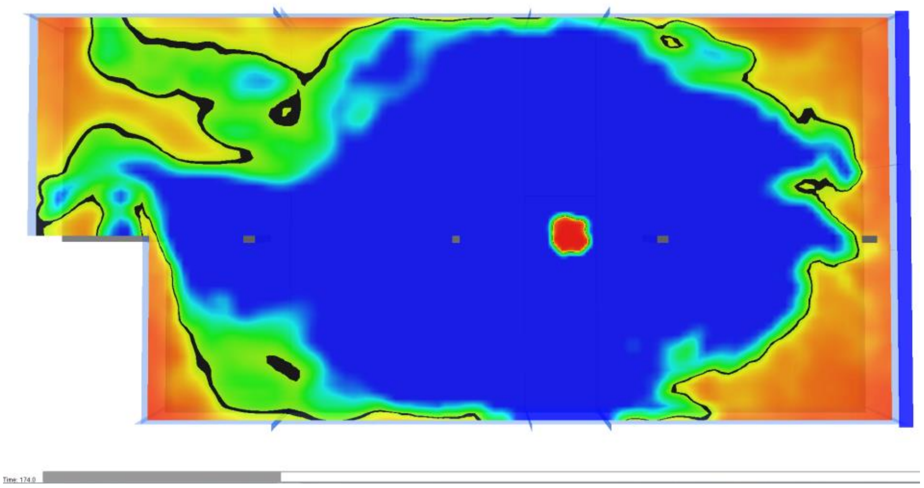
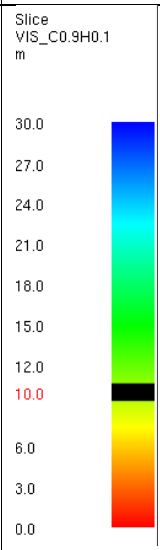
Scenario	Heat Release Rate (kW)
1	
2	

A 3.3.2 Visibility

Table 34 below shows the visibility slice files from the simulations. The slices have been taken to show the visibility distances in the models from several timesteps throughout the model runtime. The slices below demonstrates various stages in fire development and resulting smoke spread for both scenarios, Scenario1 is shown in Table 33 and the Scenario 2 is shown in Table 34.

Table 33: Visibility Slice Files Scenario 1

Event	Slice	Legend

Event	Slice	Legend
Queuing	 Time: 80 seconds	
First Exit Path Blocked	 Time: 174 seconds	

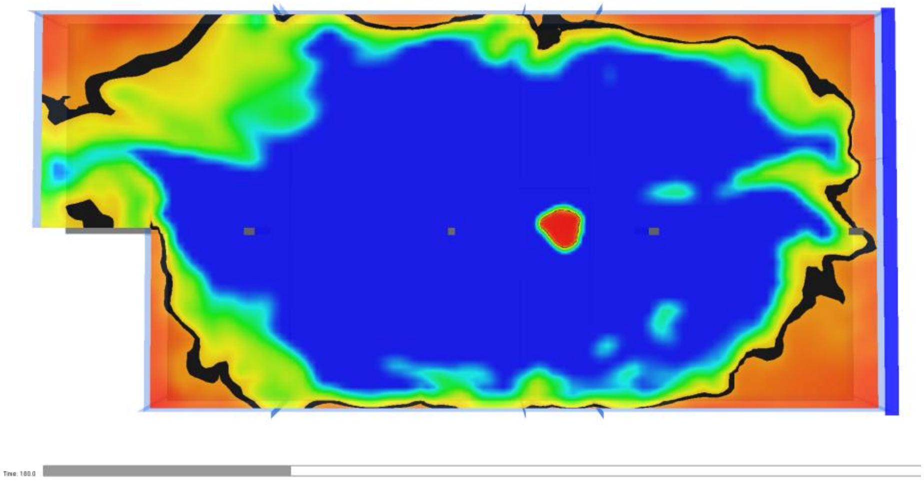
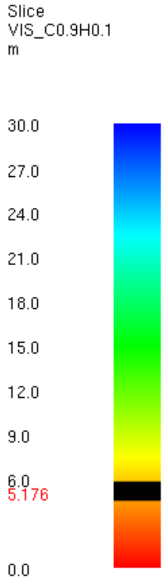
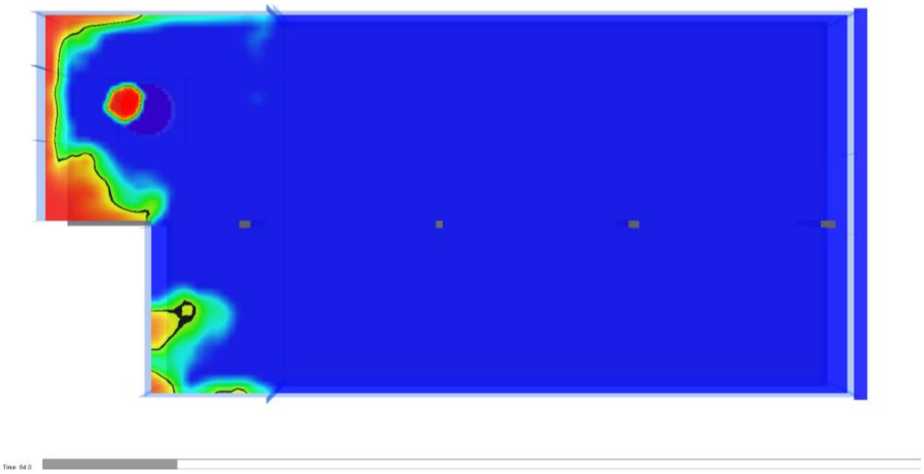
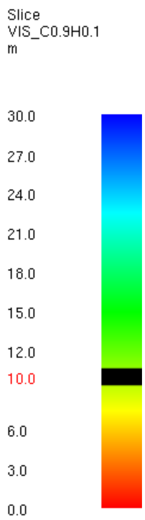
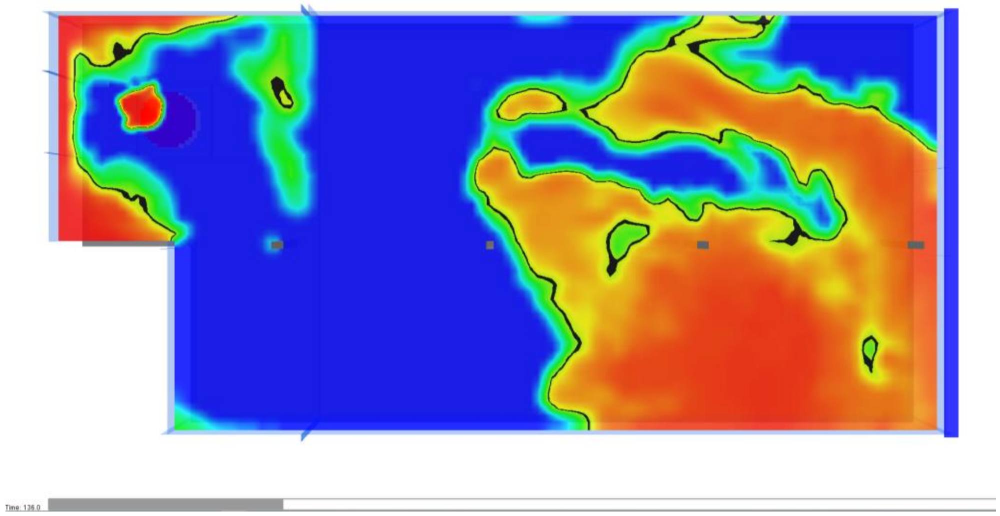
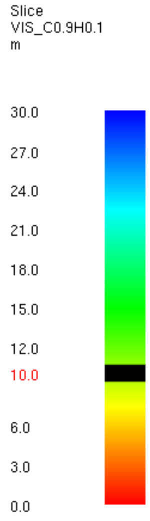
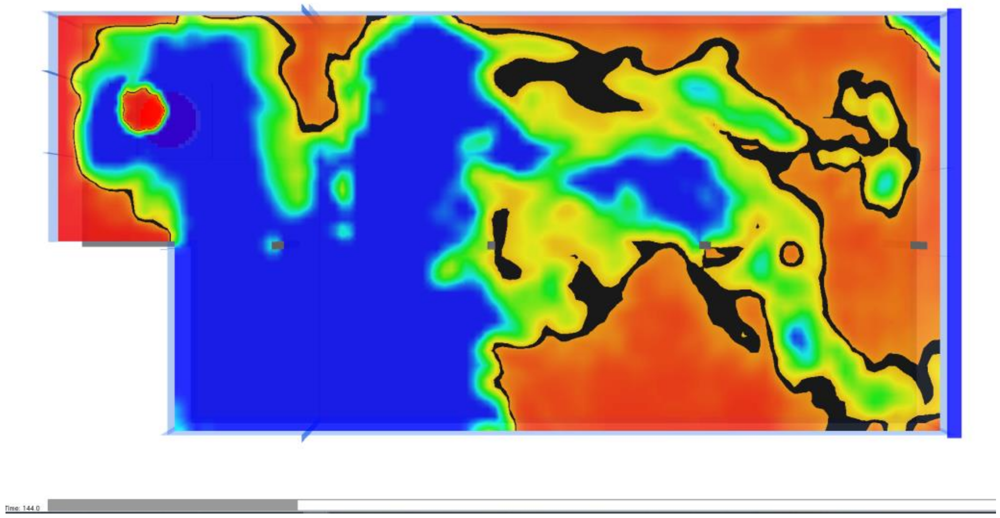
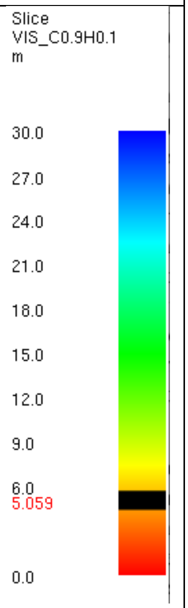
Event	Slice	Legend
All exits are blocked*	 Time: 180 seconds	
Note: * The 5 m visibilty data clip is shown in leiu of 10 m		

Table 34: Visibility Slice Files Scenario 2

Event	Slice	Legend
Queuing	 Time: 84 seconds	

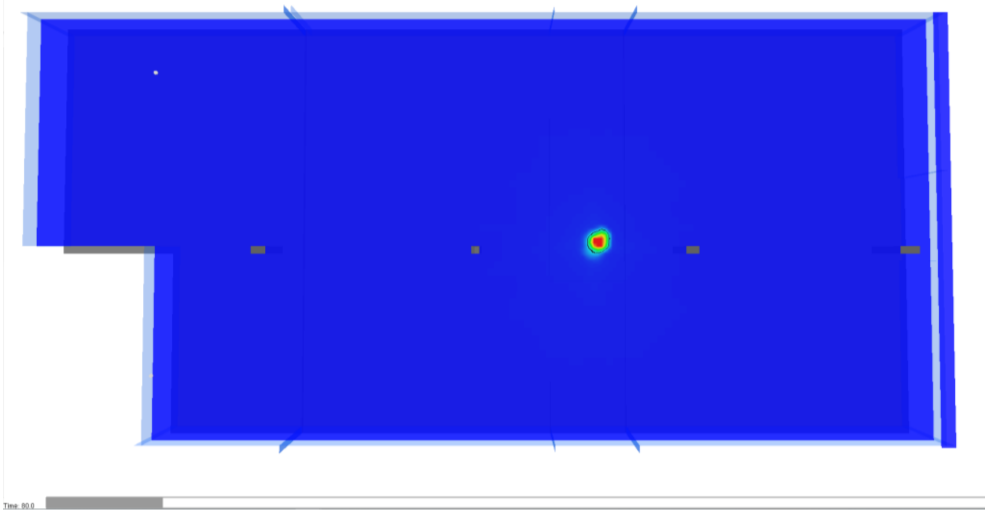
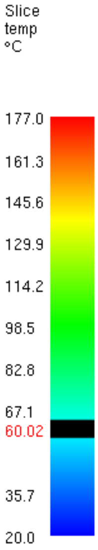
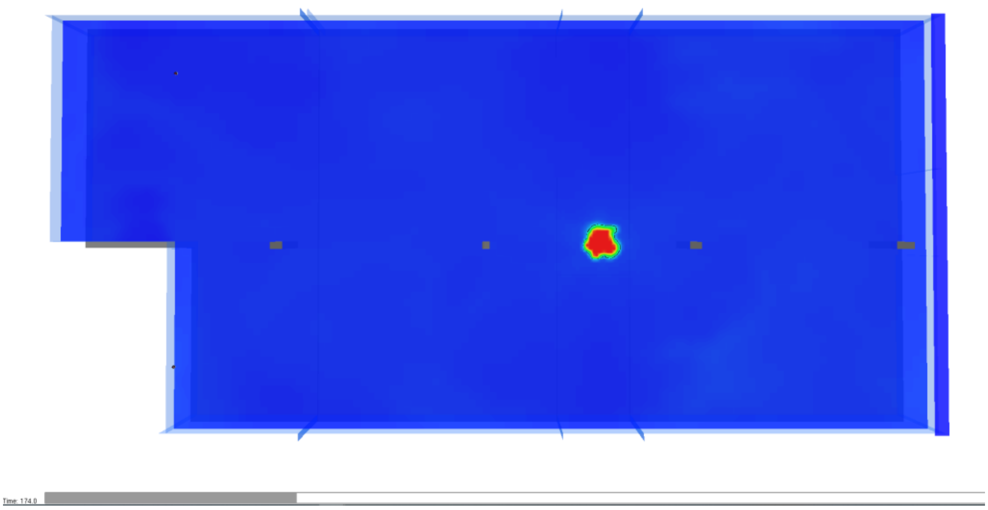
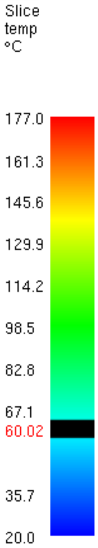
Event	Slice	Legend
First Exit Path Blocked	 Time: 136 seconds	
All exits are blocked*	 Time: 144 seconds	
Note: * The 5 m visibilty data clip is shown in leiu of 10 m		

A 3.3.3 Temperature

Table 36 and Table 35 below shows the temperature slice files from the simulation. The slices have been taken at the time corresponding to the where the visibility slice results presented in the section above. These temperature results demonstrate that the visibility results are the limiting factor in determining the ASET.

Table 35: Temperature Slice Files Scenario 1

Event	Slice	Legend

<table>
<tr><th>Event</th><th>Slice</th><th>Legend</th></tr>
<tr><td>Queuing</td><td>
Time: 80 seconds</td><td></td></tr>
<tr><td>First Exit Path Blocked</td><td>
Time: 174 seconds</td><td></td></tr>
</table>

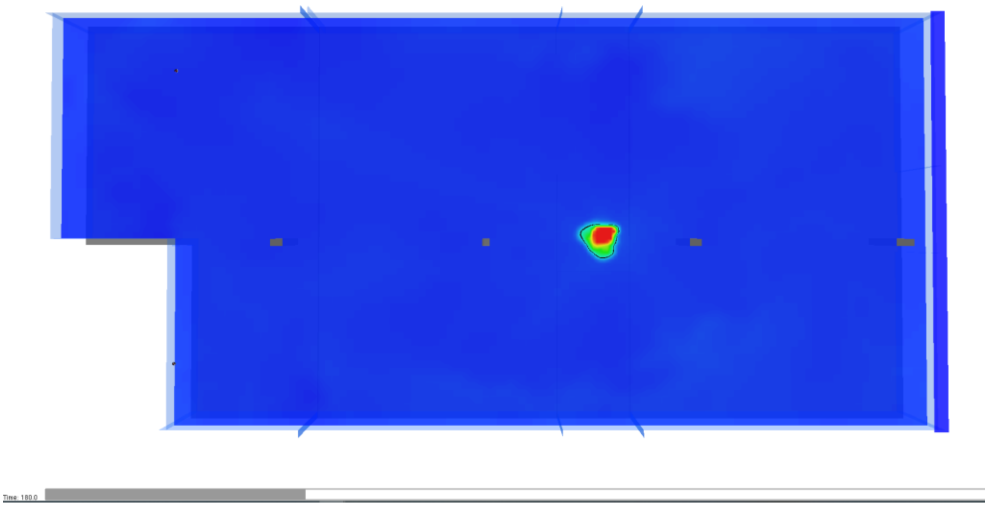
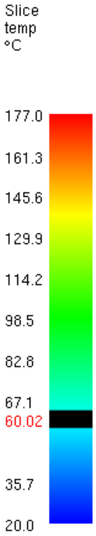
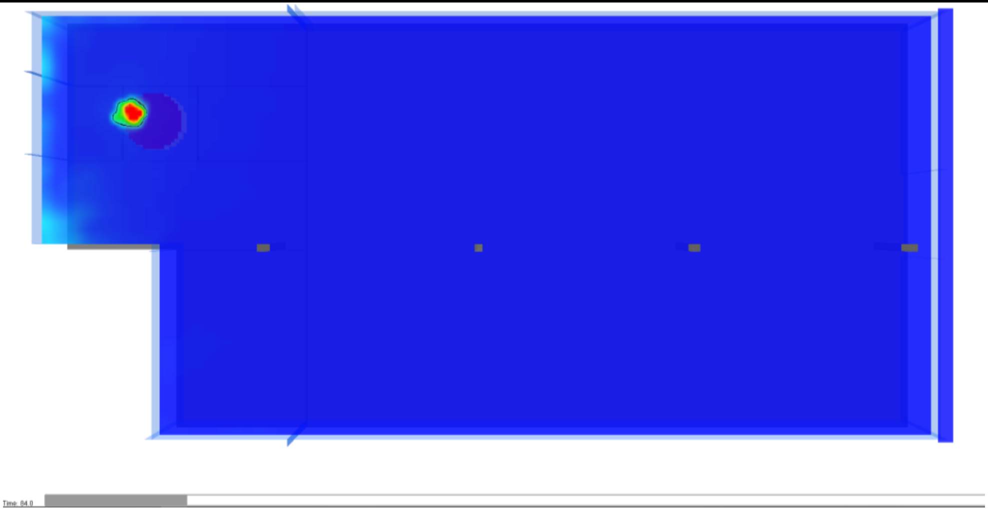
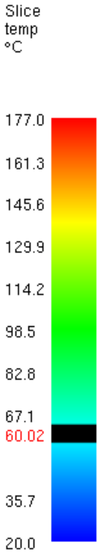
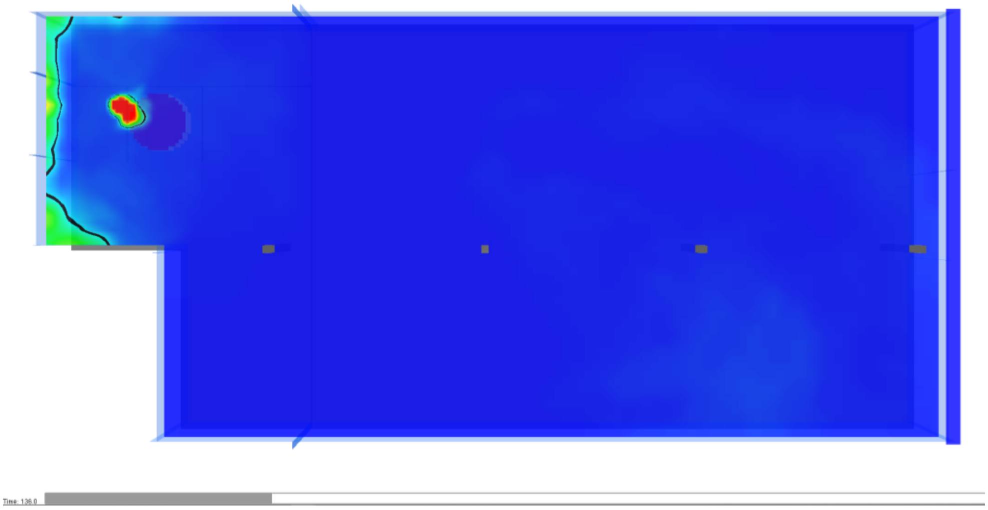
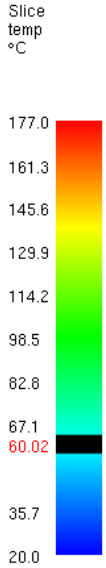
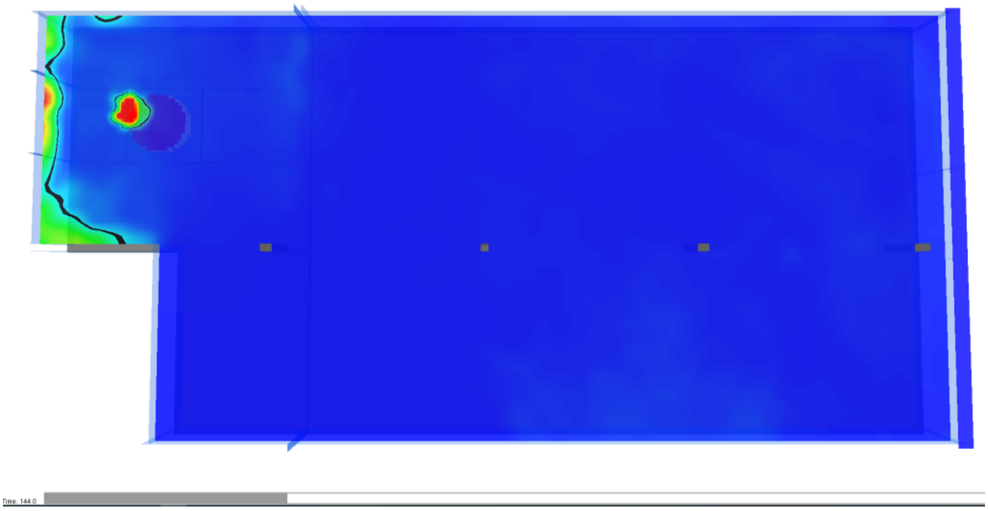
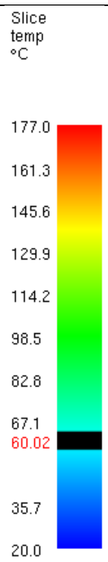
Event	Slice	Legend
All exits are blocked	 Time: 180 seconds	

Table 36: Temperature Slice Files Scenario 2

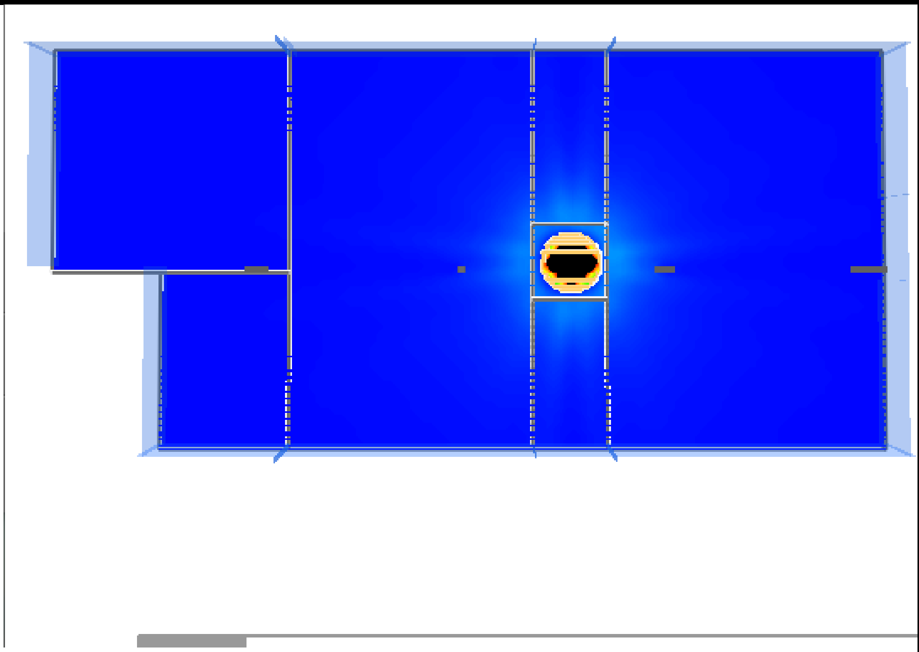
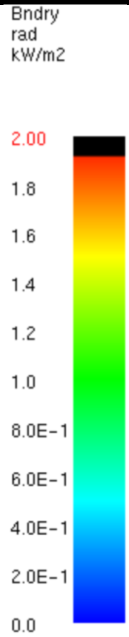
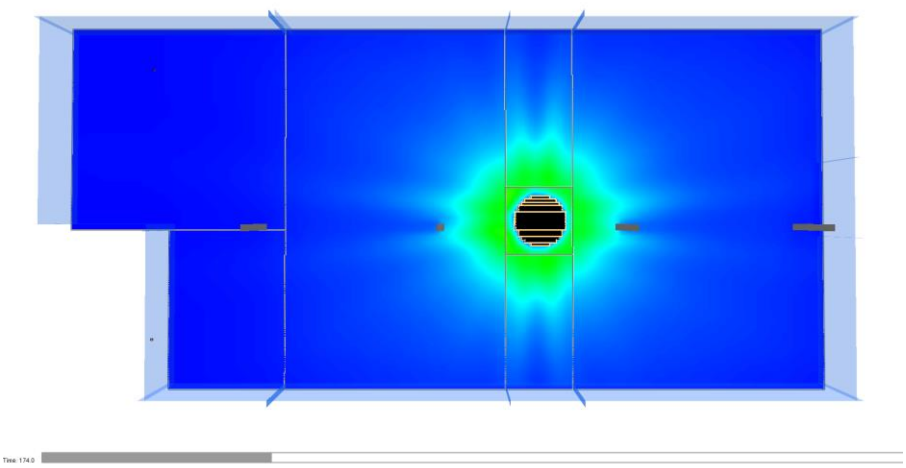
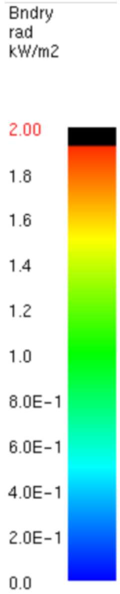
Event	Slice	Legend
Queuing	 Time: 84 seconds	

<table>
<tr><th>Event</th><th>Slice</th><th>Legend</th></tr>
<tr><td>First Exit Path Blocked</td><td>
Time: 136 seconds</td><td>
</td></tr>
<tr><td>All exits are blocked</td><td>
Time: 144 seconds</td><td>
</td></tr>
</table>

A 3.3.4 Critical Heat Flux

Table 38 and Table 39 below, shows radiant heat flux along the gym floor at ASET and at steady state conditions, respectively. To demonstrate whether the 2.0 kW/m^2 threshold is reached the upper bound is limited to this limit. It is demonstrated that this limit is only reached to a localised extent around the fire source feature as such fire spread is not considered to be facilitated. These heat flux results demonstrate that the visibility results are the limiting factor in determining the ASET.

Table 37: Receiving Radiant Heat Flux Scenario 1

Event	Boundary Quantity	Legend
Queuing	 Time: 80 seconds	
First Exit Path Blocked	 Time: 174 seconds	

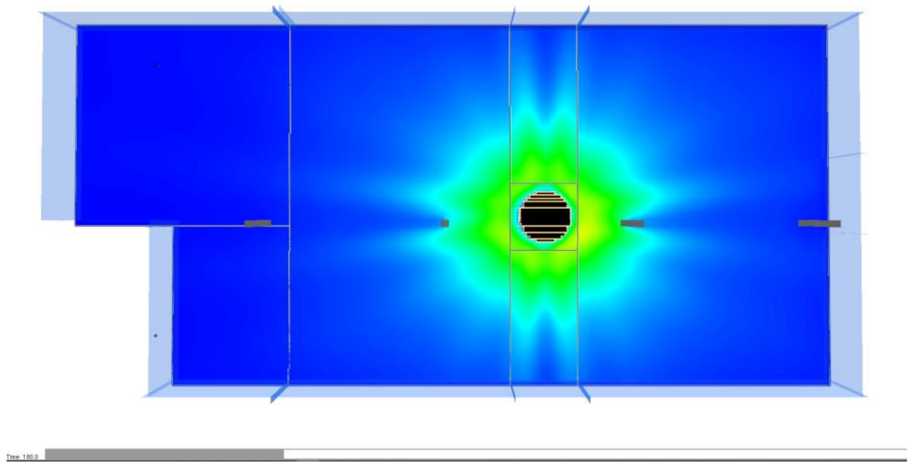
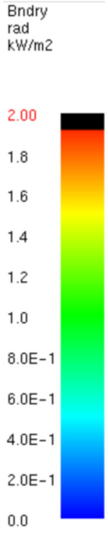
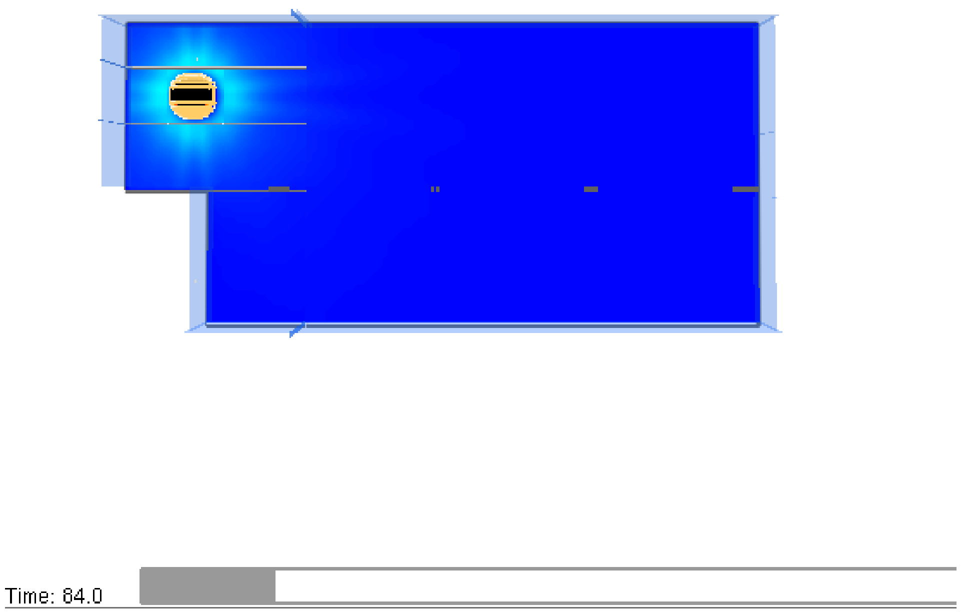
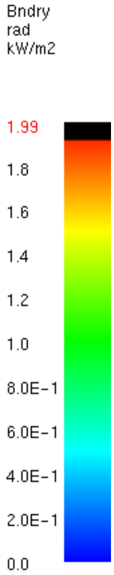
Event	Boundary Quantity	Legend
All exits are blocked	 Time: 180 seconds	

Table 38: Receiving Radiant Heat Flux Scenario 2

Event	Boundary Quantity	Legend
Queuing	 Time: 84 seconds	

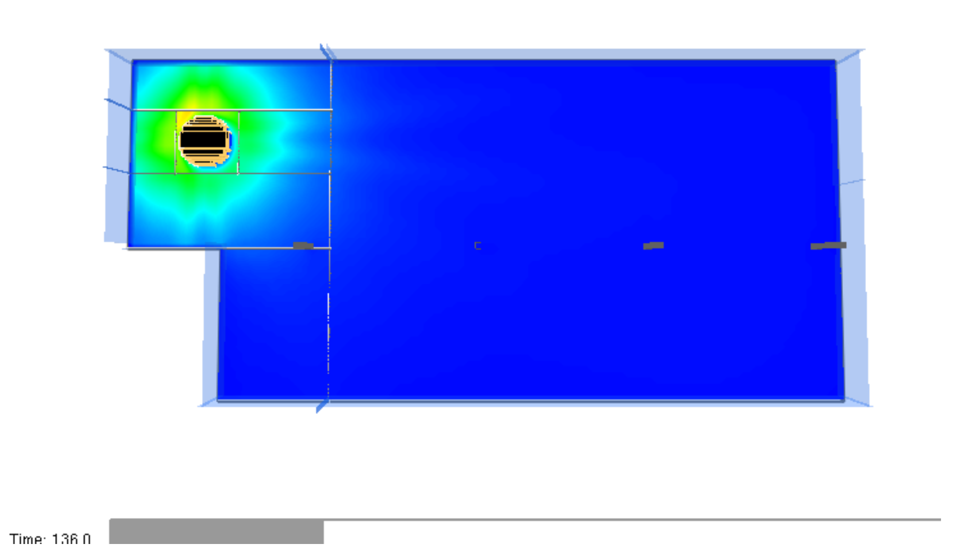
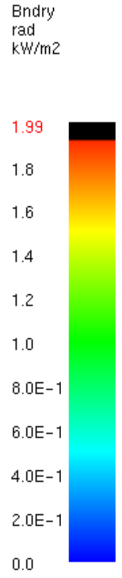
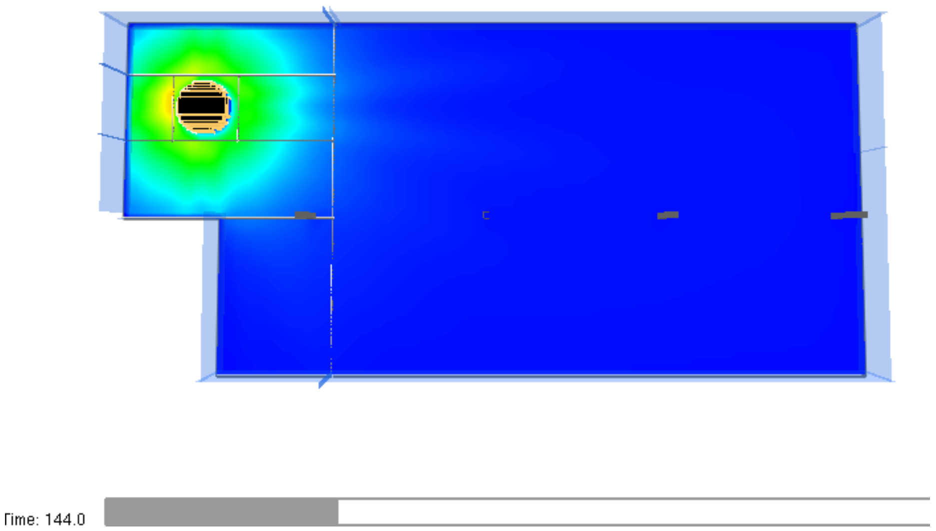
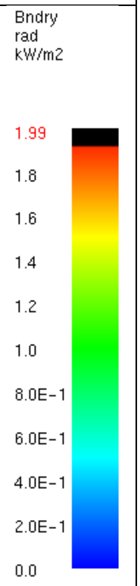
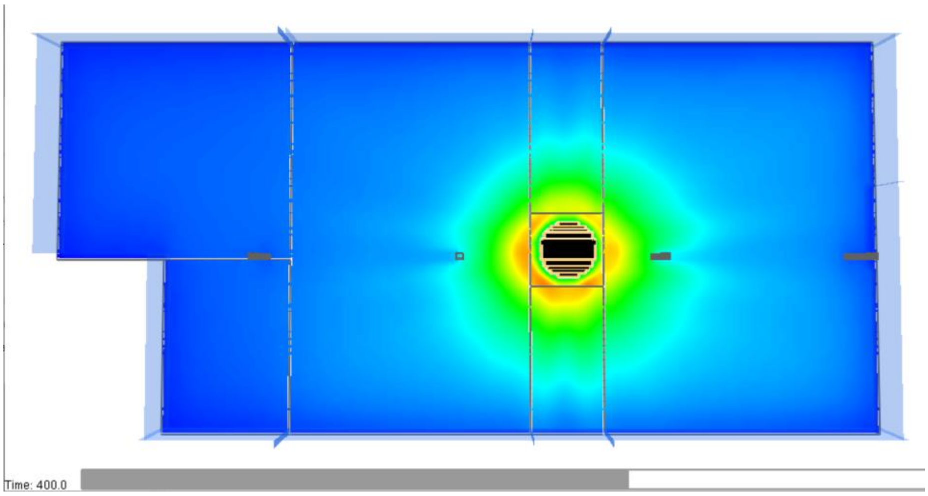
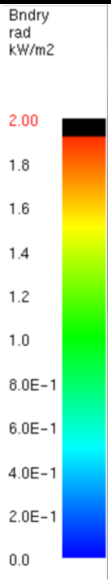
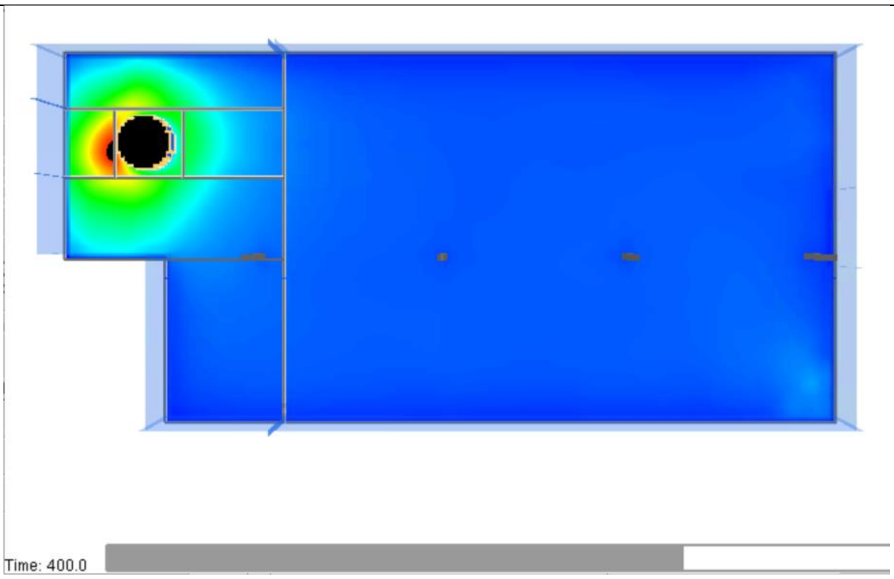
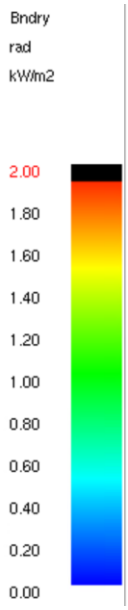
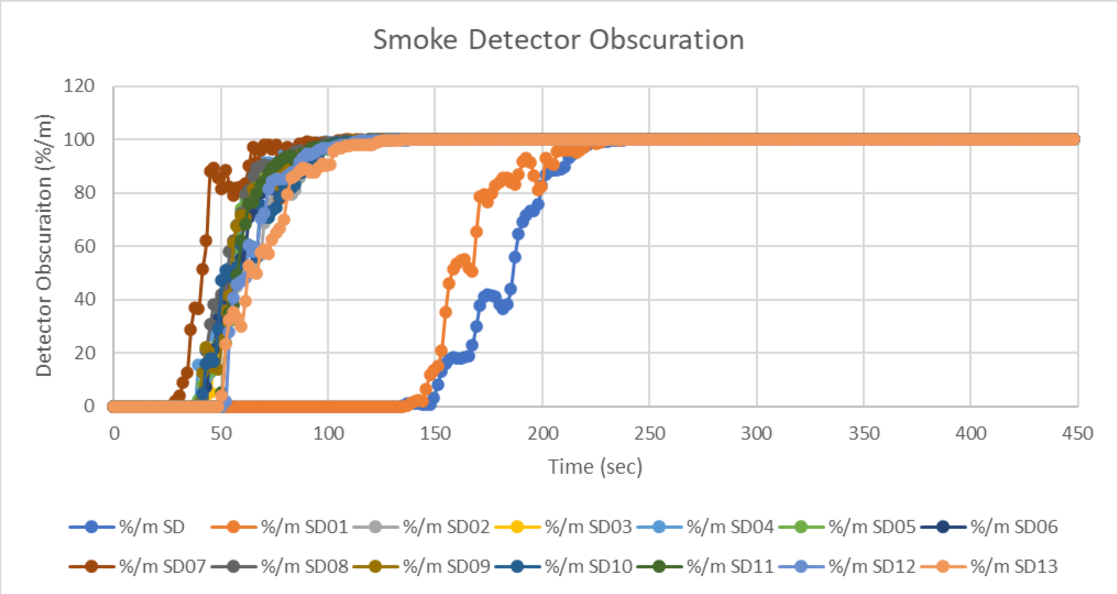
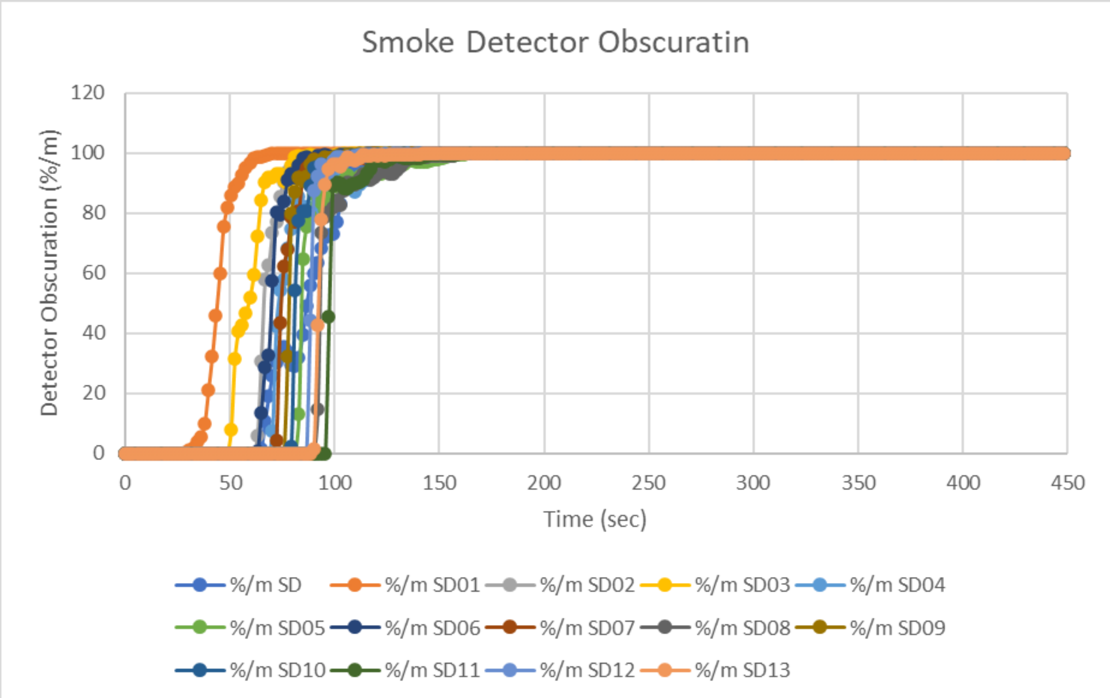
Event	Boundary Quantity	Legend
First Exit Path Blocked	 Time: 136 seconds	
All exits are blocked	 Time: 144 seconds	

Table 39: Receiving Radiant Heat Flux (Steady State)

Scenario	Boundary Quantity	Legend
1	 Time: 400 Seconds (Steady State)	
2	 Time: 400 Seconds (Steady State)	

A 3.3.5 Device Activation

This section covers the activation of the smoke detectors which indicate the time at which alarm activation occurs.

Scenario	Detector Obscuration (%/m)
1	
2	

A 3.4 Conclusion

The assessment for the non-compliant floor material within the gym space has been conducted. The results of the assessment indicate that the ASET for the space is summarised in Table 40.

Table 40: Summary of ASET

Scenario	ASET (seconds)
Scenario 1	180
Scenario 2	144

Appendix 4 Evacuation Assessment

A 4.1 Introduction

The goal of this section is to successfully model the evacuation times using the 3D pedestrian evacuation tool, Pathfinder.

The analysis documented herein details the evacuation period for the space, based on a considered fire scenario and the proposed active, passive Fire Safety systems, and the phase evacuation process adopted in the building, as outlined in Appendix 2.

The results of the analysis allow the determination of the Required Safe Egress Time (RSET).

A 4.1.1 Method of Analysis Used

Pathfinder is an emergency egress simulator that includes an integrated user interface and 3D results visualization. Pathfinder uses agent-based artificial intelligence. Each occupant has individual traits, goals, and perceptions. This allows groups of occupants to organize themselves into natural flow patterns. As a result, occupant motion looks smooth and realistic.

Rather than modelling occupants on a grid or as particles in a flow field, Pathfinder moves occupants in continuous 3D space. At each time step, every agent examines the surrounding environment and acts based on their own conditions and goals.

A 4.2 Description of Analysis

A 4.2.1 Methodology

An analysis of the total time to evacuate the building will be conducted. This analysis is based on the identification and quantification of the individual time elements, which contribute to the overall escape time. These elements include time periods related to the Fire Safety systems (e.g., time to detection and alarm), occupant pre-movement time (e.g., recognition and response time), and the time taken to actually travel out of the building. These are represented in the timeline shown in Figure 44 below.

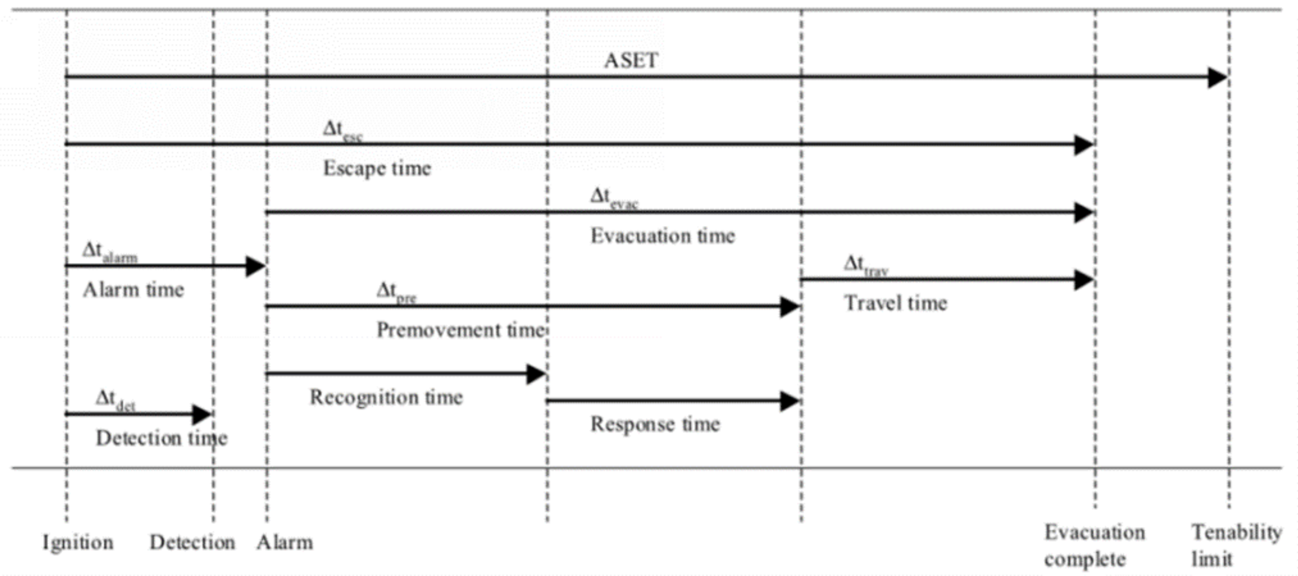


Figure 44: Required Safe Egress Time (PD7974-6, 2004)

A 4.2.2 Scenarios

Pathfinder is used to model occupant evacuation for Performance Solution 4. The purposes of modelling occupant evacuation are summarised below for each solution.

A summary of the evacuation modelling is outlined in Table 41 below alongside a summary of the RSET components used for the analysis in Table 42.

Table 41: Summary of Evacuation Modelling

Performance Solution	Description of Solution	Description of Analysis
4	It is proposed to permit the use of non-compliant, PLAE floor material.	An ASET/RSET comparison is conducted to demonstrate that tenable egress conditions are maintained within the gymnasium space during the evacuation period.

In each fire scenario a case considers where occupants are able to evacuate via all available gym exits and a case which considers a blocked exit scenario whereby the location of a fire obstructs one of the available exits.

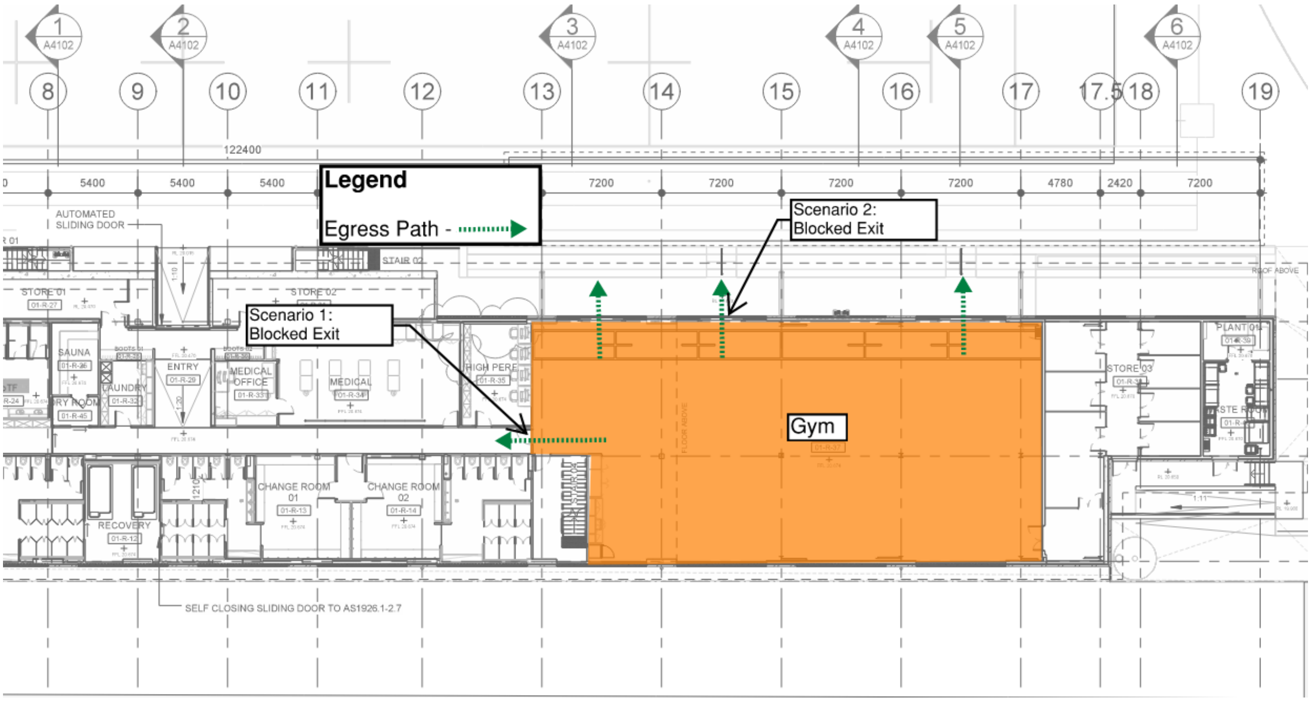


Figure 45: Egress paths serving the gym space

Table 42: Summary of RSET Components Used in the Analysis

Description	Duration (sec) Scenario 1 Non-Blocked Exit	Duration (sec) Scenario 1 Blocked Exit	Duration (sec) Scenario 2 Non-Blocked Exit	Duration (sec) Scenario 2 Blocked Exit	Discussion
Detector/Alarm activation (seconds)	35		39		Period of time it takes for the smoke detectors to activate and trigger the alarm
Time to Recognition and Response (Pre-movement time) (seconds)	30				Additional period of time it takes for occupants to recognise the alarm and begin evacuation

Description	Duration (sec)				Discussion
	Scenario 1		Scenario 2		
Time to Travel (seconds)	24.5	24.3	24.5	24.3	Additional period of time it takes for occupants to completely evacuate from the gym space.
Total (seconds)	**89.5**	**89.3**	**93.5**	**93.3**	**Total time it takes for occupants to completely evacuate from the gym space.**

A 4.2.3 Extent of Modelled Space

Figure 46 and Figure 47 shows the extent of the modelled space and should be viewed in conjunction with the architectural drawings.

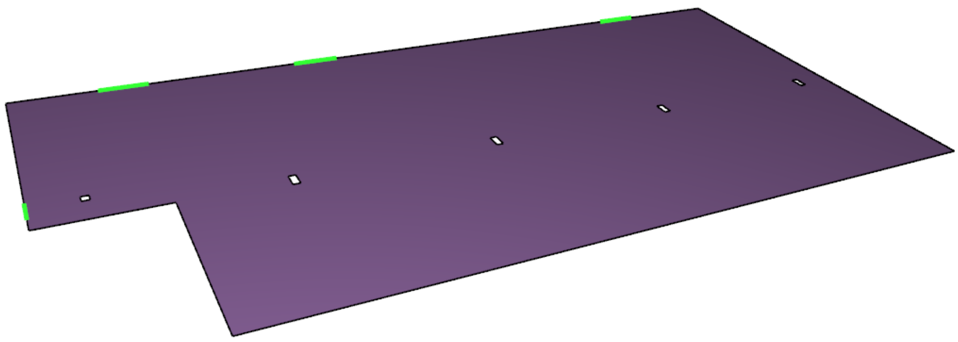


Figure 46: Extent of Modelled Space Pathfinder (Scenario 1 and 2)

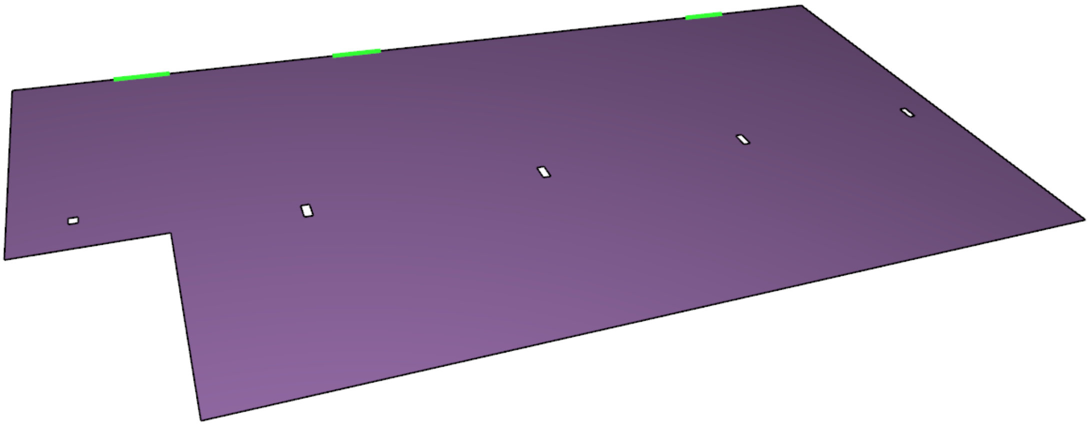


Figure 47: Extent of Modelled Space Pathfinder (Blocked Exit Scenario 1)

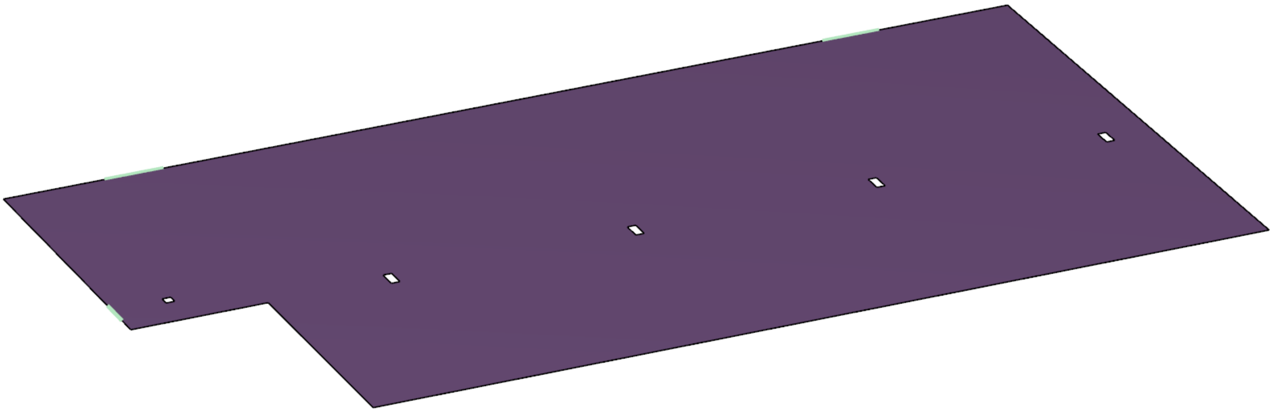


Figure 48: Extent of Modelled Space Pathfinder (Blocked Exit Scenario 2)

A 4.2.4 Inputs

It is proposed to use the default SFPE settings in Pathfinder program for the analysis undertaken, with the exception of the occupant's evacuation speed is assumed to be 0.8 m/s which is approximately 25% smaller than the stated SFPE value of 1.19 m/s. Although the occupants within the gymnasium space are considered able bodied and alert, this reduced evacuation speed ensures that the assessment is onerous.

Based on the occupancy numbers confirmed by NSW Rugby Union the gym space maximum capacity is 90 occupants, it is noted that the subject gymnasium is expected to be occupied by authorised sport's team members (40 NSW Rugby Players) and support staff (10 coaching support staff) under typical occupancy conditions. To ensure the assessment is onerous, the maximum of 90 occupants is considered within evacuation modelling. Confirmation of this occupant size is provided in Appendix 6.

A 4.3 Results and Discussion

The results of the evacuation modelling are detailed in Table 43 to Table 44.

Table 43: Results of Evacuation Modelling (Scenario 1 and 2)

Cumulative Time (sec)	Snapshot
Time to Detection & Alarm + Pre-movement Time + 0 sec.	

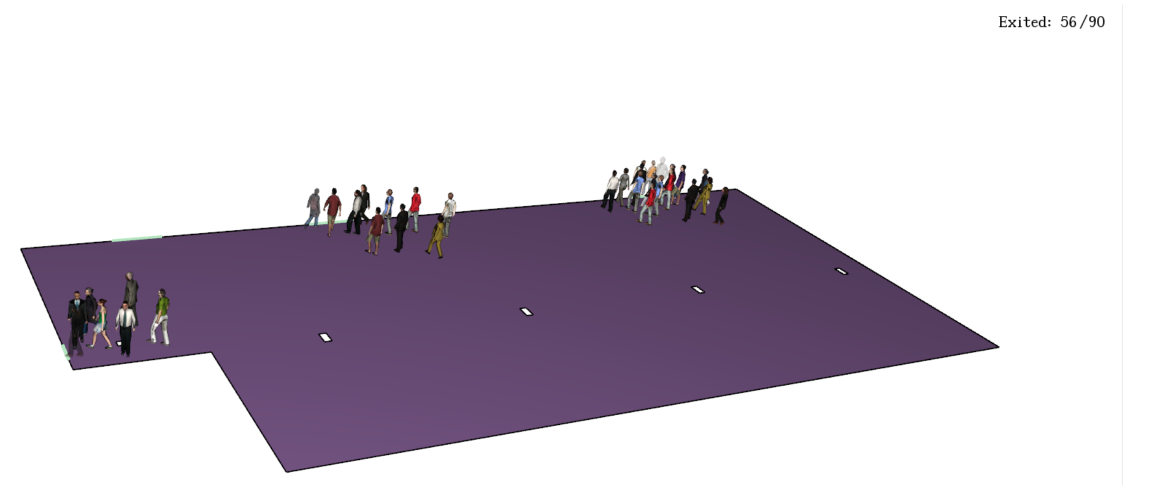
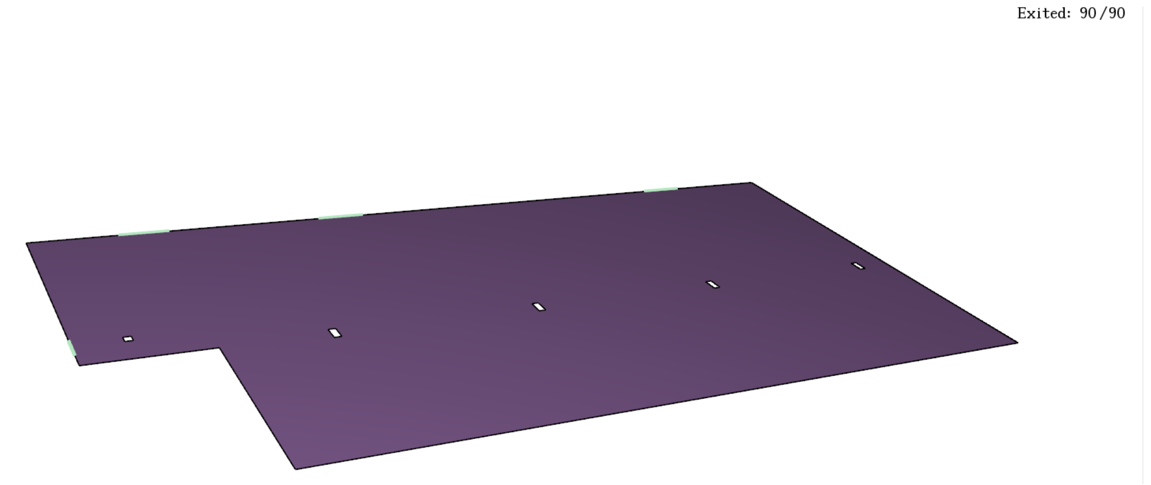
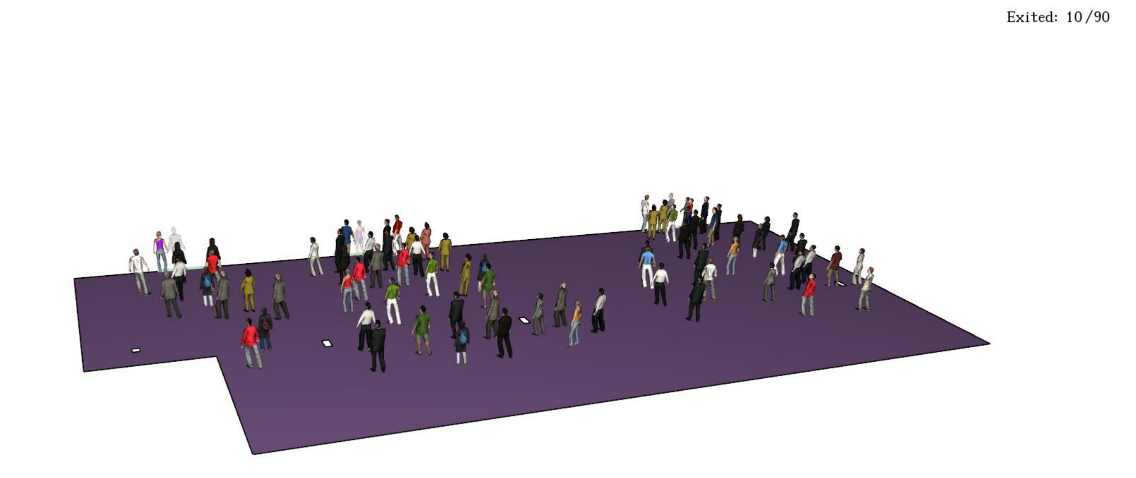
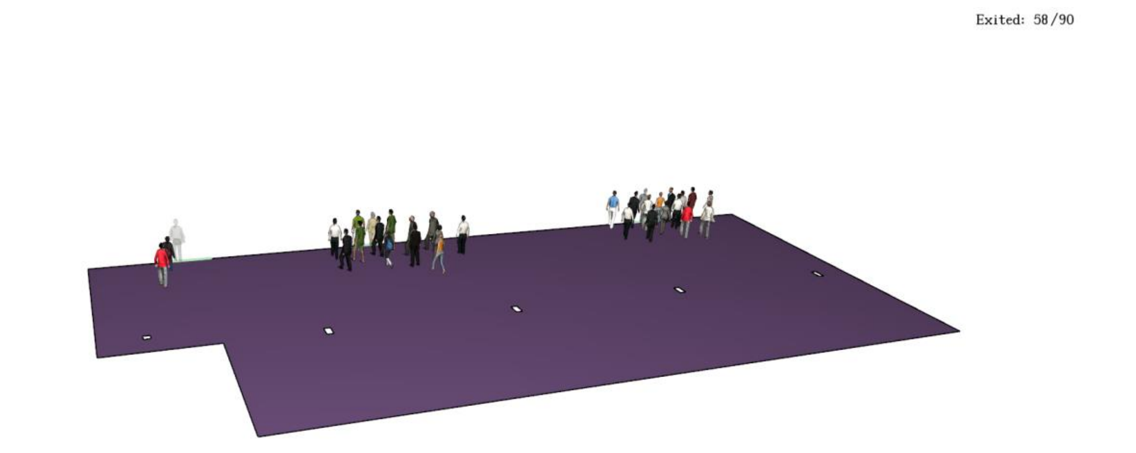
Cumulative Time (sec)	Snapshot
Time to Detection & Alarm + Pre-movement Time + 5 sec.	
Time to Detection & Alarm + Pre-movement Time + 15 sec.	
Time to Detection & Alarm + Pre-movement Time + 24.5 sec.	

Table 44: Results of Evacuation Modelling (Scenario 1 Blocked Exit)

Cumulative Time (sec)	Snapshot

Cumulative Time (sec)	Snapshot
Time to Detection & Alarm + Pre-movement Time + 0 sec.	
Time to Detection & Alarm + Pre-movement Time + 5 sec.	
Time to Detection & Alarm + Pre-movement Time + 15 sec.	

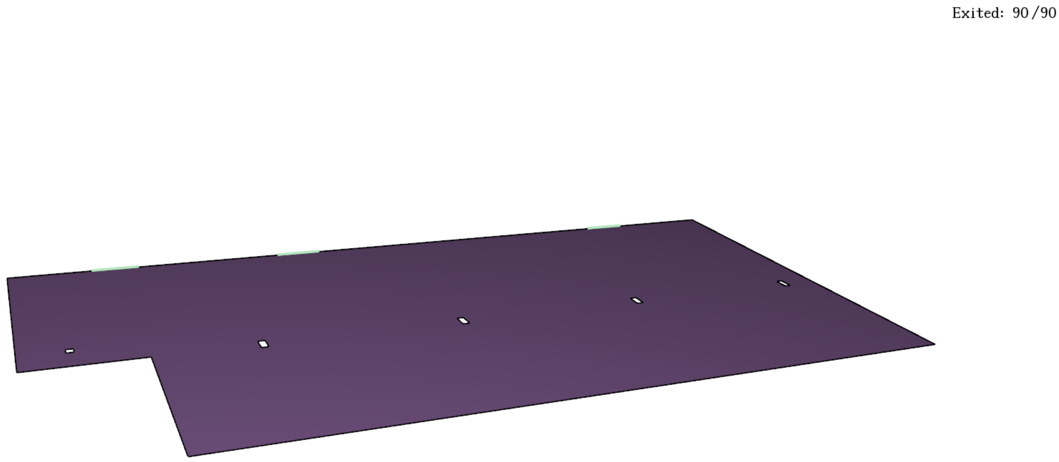
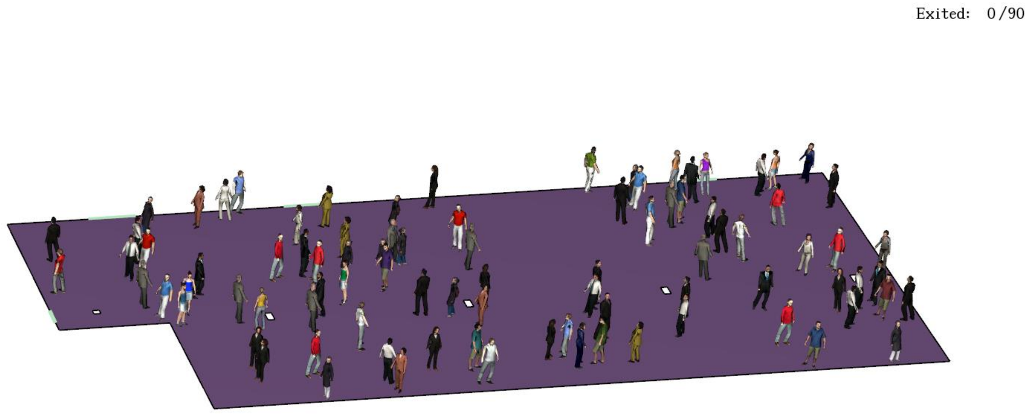
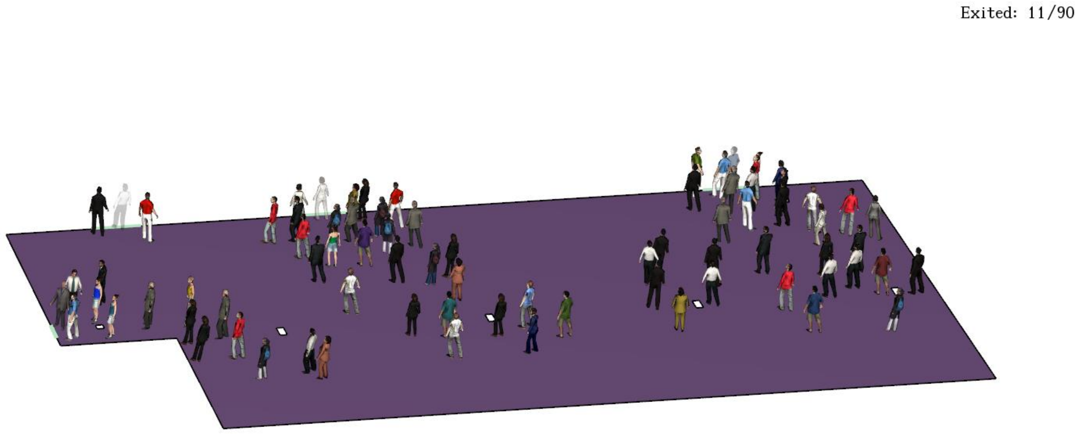
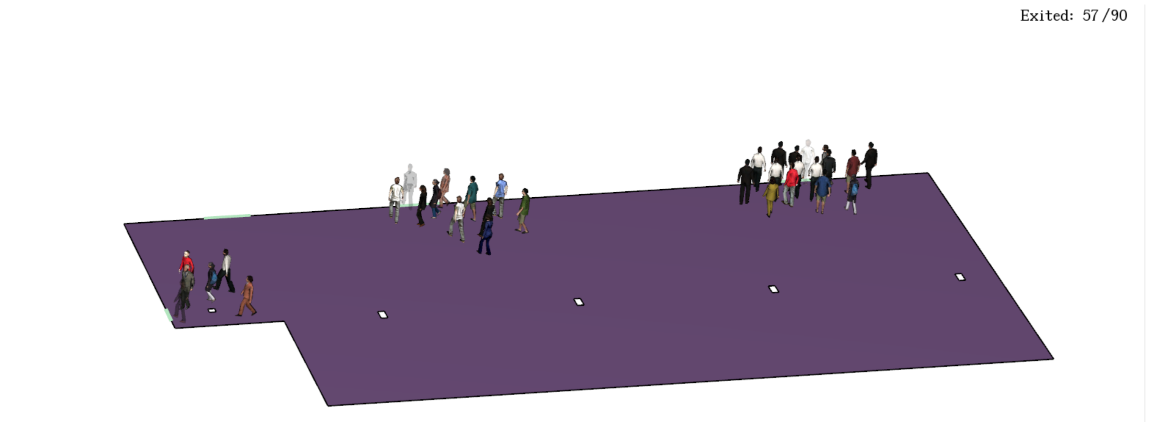
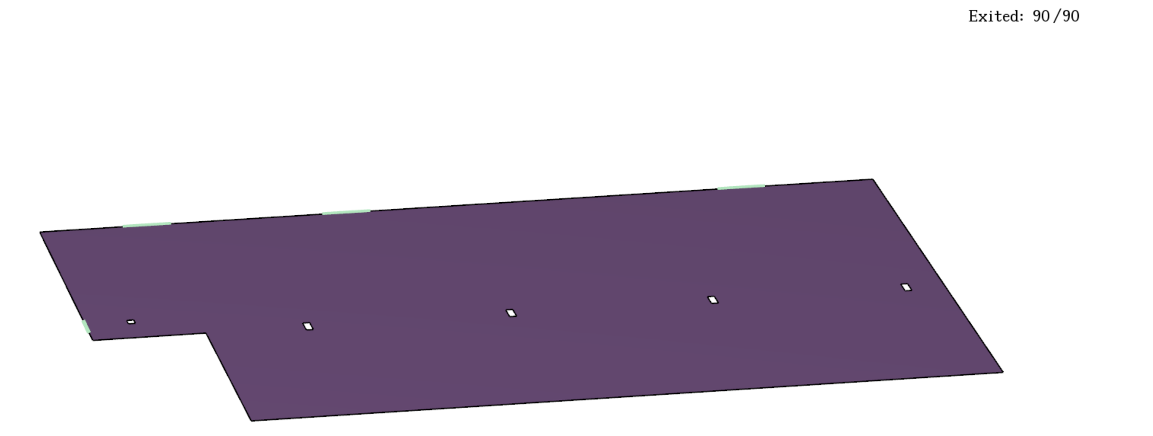
Cumulative Time (sec)	Snapshot
Time to Detection & Alarm + Pre-movement Time + 24.3 sec.	

Table 45: Results of Evacuation Modelling (Scenario 2 Blocked exit)

Cumulative Time (sec)	Snapshot
Time to Detection & Alarm + Pre-movement Time + 0 sec.	
Time to Detection & Alarm + Pre-movement Time + 5 sec.	

Cumulative Time (sec)	Snapshot
Time to Detection & Alarm + Pre-movement Time + 15 sec.	
Time to Detection & Alarm + Pre-movement Time + 24.3 sec.	

The RSET results demonstrate that the blocked exit scenario is slightly less than where all exits are available, it is noted this is counter-intuitive, however, due to the number and location of available exits and travel distances the queue time in the blocked exit scenarios is marginally less than the travel time and queue time to the additional available exit in the non-blocked exit scenario. The difference between the travel time of the blocked exit and non-blocked exit scenarios is minor due to sufficient exits, compliant travel distances and long queuing is not expected to occur.

A 4.4 Conclusion

A summary of the results is detailed in Table 46 below

Table 46: Summary of RSET

Description	Duration (sec)				Discussion
	Scenario 1		Scenario 2		
	Non-Blocked Exit	Blocked Exit	Non-Blocked Exit	Blocked Exit	
Detector/Alarm activation	35		39		Period of time it takes for the smoke detectors to activate and trigger the alarm
Time to Recognition and Response (Pre-movement time)	30				Additional period of time it takes for occupants to recognise the alarm and begin evacuation

Description	Duration (sec)				Discussion
	Scenario 1		Scenario 2		
	Non-Blocked Exit	Blocked Exit	Non-Blocked Exit	Blocked Exit	
(seconds)					
Time to Travel (seconds)	24.5	24.3	24.5	24.3	Additional period of time it takes for occupants to travel through the space and complete evacuation
Total (seconds)	**89.5**	**89.3**	**93.5**	**93.3**	**Total time it takes for occupants to completely evacuate from the gym space.**

Appendix 5 Test Reports

AWTA PRODUCT TESTING

Australian Wool Testing Authority Ltd - trading as AWTA Product Testing
A.B.N 43 006 014 106
1st Floor, 191 Racecourse Road, Flemington, Victoria 3031
P.O Box 240, North Melbourne, Victoria 3051
Phone (03) 9371 2400 Fax (03) 9371 2499

TEST REPORT

Client :	PLAE 17 Cashew Court Upper Coomera QLD 4209	**Test Number** **Issue Date** **Print Date**	: : :	18-003942 14/08/2018 14/08/2018

Sample Description

Clients Ref : "Achieve"
Rubber matting
Colour : Grey
Nominal Composition : Rubber
Nominal Mass per Unit Area/Density : Approx. 11.4kg/m2
Nominal Thickness : 8mm

AS/ISO 9239.1-2003 **Reaction to Fire Tests for Floorings. Determination of the Burning Behaviour using a Radiant Heat Source**

Date of Sample Arrival	11/07/2018
Date Tested	13/08/2018

	1	2	3	Mean	
CHF Value Non Directional	2.5	2.2	2.1	2.3	kW/m²
HF-30 Value Non Directional	3.4	3.0	3.1	3.2	kW/m²
Smoke Value Non Directional	861	1289	1665	1272	%.min

Penetration of flame through to substrate	Yes
Smouldering	Yes

Accredited for compliance with ISO/IEC 17025 - Testing

- Chemical Testing	: Accreditation No.	983
- Mechanical Testing	: Accreditation No.	985
- Performance & Approvals Testing	: Accreditation No.	1356

[redacted]

APPROVED SIGNATORY

[redacted]

MICHAEL A. JACKSON B.Sc.(Hons)
MANAGING DIRECTOR

0204/11/06

AWTA PRODUCT TESTING

Australian Wool Testing Authority Ltd - trading as AWTA Product Testing
A.B.N 43 006 014 106
1st Floor, 191 Racecourse Road, Flemington, Victoria 3031
P.O Box 240, North Melbourne, Victoria 3051
Phone (03) 9371 2400 Fax (03) 9371 2499

TEST REPORT

Client :	PLAE	**Test Number**	:	18-003942
	17 Cashew Court	**Issue Date**	:	14/08/2018
	Upper Coomera QLD 4209	**Print Date**	:	14/08/2018

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test, they are not intended to be sole criterion for assessing the potential fire hazard of the product in use.

Sample was conditioned in accordance with BSEN 13238:2010 at a temperature of 23±2°C and relative humidity of 50±5% for a minimum of 48 hours prior to testing.

Each specimen was adhered to a substrate of 6mm thick fibre reinforced cement board using Roberts 656 adhesive and clamped prior to testing.

Accredited for compliance with ISO/IEC 17025 - Testing

- Chemical Testing	: Accreditation No.	983
- Mechanical Testing	: Accreditation No.	985
- Performance & Approvals Testing	: Accreditation No.	1356

[redacted]

APPROVED SIGNATORY

[redacted]

MICHAEL A. JACKSON B.Sc.(Hons)
MANAGING DIRECTOR

0204/11/06

Appendix 6 Management Statements

NSW Rugby Union Pty Ltd
ABN 70 000 222 711

Locked Bag 1222
Paddington NSW 2021
David Phillips Sports Complex
Banks Avenue, Daceyville
NSW 2032

T 61 2 9323 3300
enquiries@nsw.rugby
nsw.rugby

25 August 2022

Christopher Chau
Project Manager
2 John Street,
Waterloo, NSW, 2017

cchau@kane.com.au

Dear Christopher,

NSW Rugby Union Centre of Excellence

The gym space as part of the ground floor will be served by a warden for that floor or otherwise a warden present if only the gym is in operation.

Yours sincerely,

[redacted]

Paul Doorn
Chief Executive Officer
New South Wales Rugby Union Ltd

NSW Rugby Union Pty Ltd
ABN 70 000 222 711

Locked Bag 1222
Paddington NSW 2021
David Phillips Sports Complex
Banks Avenue, Daceyville
NSW 2032

T 61 2 9323 3300
waratahs.enquiries@nsw.rugby
nsw.rugby

3 August 2021

Aaron Redfern
Senior Building Surveyor
Blackett Maguire and Goldsmith
PO Box 167
Broadway, NSW 2007

aaron@bmplusg.com.au

Dear Aaron,

On behalf of New South Wales Rugby Union Ltd, I would like to confirm the capacities for the following spaces:

Multipurpose – 96 people
This is in line with the number of seats on A2110 (96 seats).

Gym – 90 People
While the above is maximum capacity, the space will be used by 40 NSW Rugby Players and 10 Coaching Support Staff majority of the time.

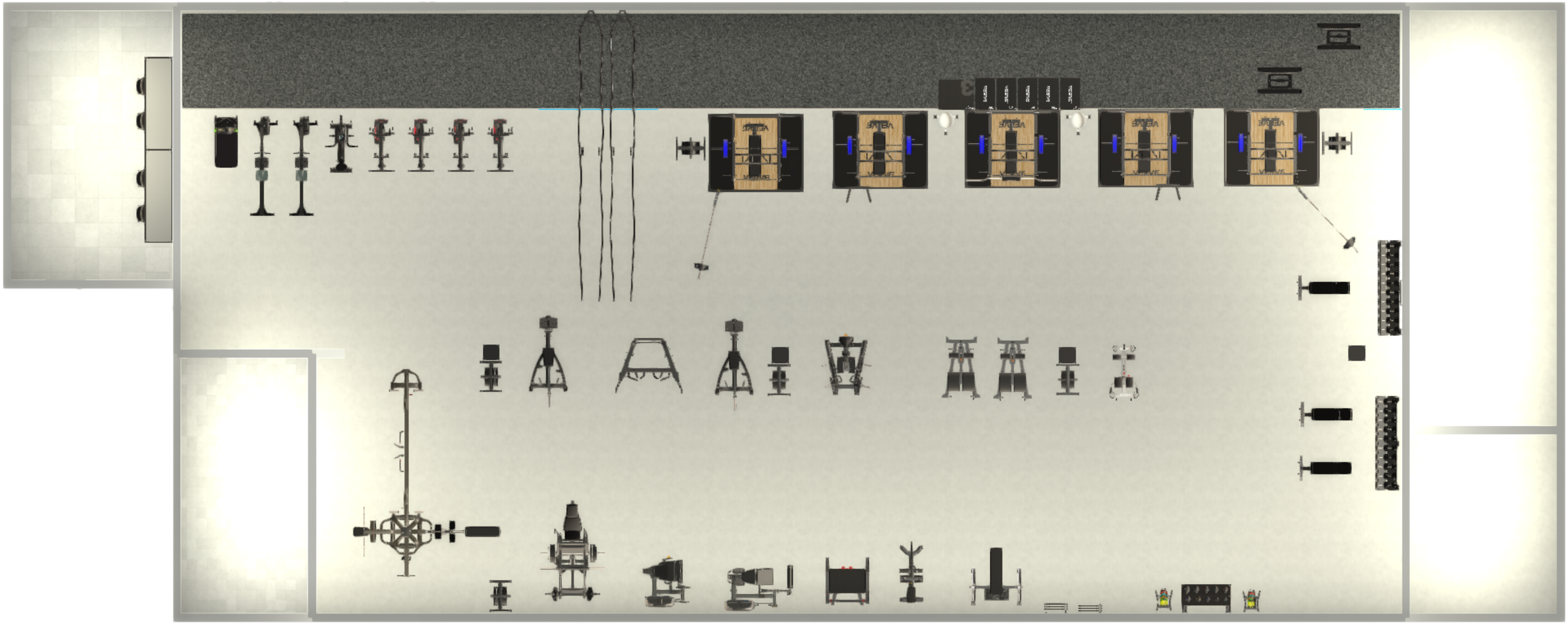
Terrace/Grandstand – 240 People
Includes up to 144 grandstand seats and 96 person Terrace. Players will use amenities provided in change rooms.

Yours sincerely,

[redacted]

Paul Doorn
Chief Executive Officer, NSW Rugby Union

Appendix 7 Indicative Equipment Layout



APPROXIMATION OF FLOOR AND PLANNING AREA

Floor Plan measurements are approximate and are for illustrative purposes only. While we do not doubt the floor plans accuracy, we make no guarantee, warranty or representation as to the accuracy and completeness of the floor plan. You or your advisors should conduct a careful, independent investigation of the property to determine to your satisfaction as to the suitability of the property for your space requirements.

APPROXIMATION OF FLOOR AND PLANNING AREA

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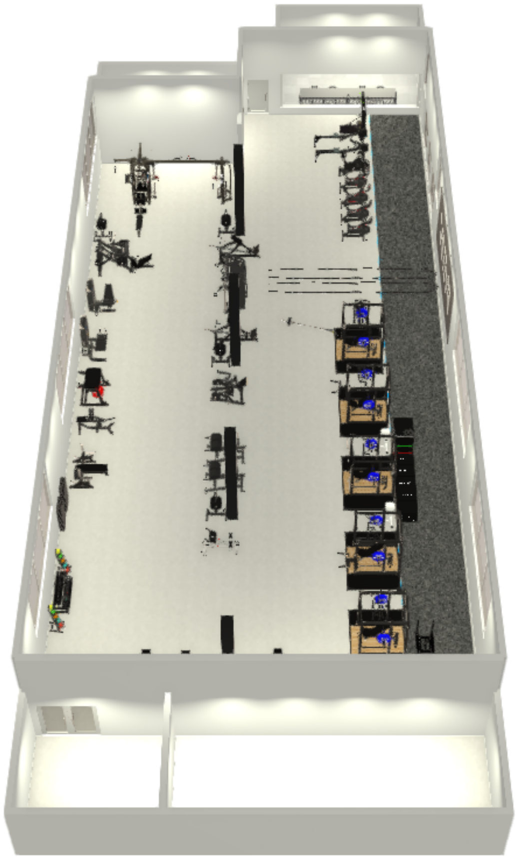

APPROXIMATION OF FLOOR AND PLANNING AREA

Floor Plan measurements are approximate and are for illustrative purposes only. While we do not doubt the floor plans accuracy, we make no guarantee, warranty or representation as to the accuracy and completeness of the floor plan. You or your advisors should conduct a careful, independent investigation of the property to determine to your satisfaction as to the suitability of the property for your space requirements.

Design with
community in mind

Level 6, Building B
207 Pacific Highway
St Leonards NSW 2065
Tel +61 +61 2 8484 7000

For more information please visit
www.stantec.com

Appendix C – Flood Risk Management Plan

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney NSW 2000

Tel: +61 432 477 036
www.grchydro.com.au

Date: 6 September 2022
Ontoit
Level 5, 4-6 Bligh Street
Sydney NSW 2000

Re: 35 Banks Avenue, Daceyville Floodplain Risk Management Plan

Dear Christian,

A Flood Risk Management Plan has been prepared for 35 Banks Avenue, Daceyville as part of development at the site. The Plan was included in the report "Flood Study – 35 Banks Avenue, Daceyville – Rugby Club of Excellence" (GRC Hydro, August 2021). The Plan has since been slightly amended based on information on the operation of the facility, please find below.

Yours Sincerely

[redacted]

Felix Taaffe
Senior Engineer

Email: felix@grchydro.com.au
Tel: +61 422 224 754

1. FLOOD RISK MANAGEMENT PLAN

35 Banks Avenue, Daceyville is subject to flooding. Relevant flood, ground and floor levels for the Rugby Centre of Excellence site are:

- 1% AEP Flood Level = 20.17 mAHD
- Probable Maximum Flood = 21.68 mAHD
- Finished Floor Level = 20.67 mAHD
- Second Floor Level = 24.05 mAHD
- Front Boundary Level = 19.80 mAHD
- Lowest Ground Level = 19.80 mAHD

The above levels give an indication of how the various floods will impact this property and what level of protection is provided. Finished floor levels are designed to be a minimum of 0.5 m above the 1% AEP Flood Level and with the building's second floor providing protection for all flood up to and including the Probable Maximum Flood which is the largest event which can occur at this location.

A Flood Management Plan for the site is detailed below with a consolidated, single page plan, suitable for display provided at the end of this document. The plan covers the range of possible flooding including the 1% AEP event and the PMF. The plan is to be used as part of operation of the site as a sports facility. Based on information provided on past and future events, the total number of attendees is typically between 100 and 400 people.

1.1 Preparedness

Preparations for flooding are to be incorporated into the management of the site. These measures are the responsibility of the centre's management staff and are to ensure the centre is prepared for a flood when it occurs. The preparatory measures are as follows:

- Keep a hard copy and digital version of this Flood Management Plan;
- Brief relevant staff of its contents on an annual basis, or more frequently if staff turnover is high. There should always be at least one employee familiar with the Plan on duty whilst the centre is open.
- During a public sports event such as a rugby match, one staff member is to be designated as being the flood warden. They are to ensure the weather forecast is checked, and if there are any warnings issued by the Bureau of Meteorology for potential flooding for the time of the event, then either:
    - The match is postponed or cancelled or,
    - If the total attendance will be able to safely evacuate to the second storey of the building in the event that a flood occurs, the match can be held. The attendance and available floor area is to be determined by the flood warden. The flood warden should then monitor weather warnings as they are updated, and monitor for flooding on Banks Avenue. If flooding begins, move to the During a Flood section of the plan.

  The Warden must monitor the weather and if raining, potential flooding, even if no warnings are issued. Flooding may occur without warning.

- Design temporary warning signage (see examples below) to marshal site occupants during a flood, including:
    - Temporary warning signs stating the car park is currently flooding and to remain within the centre;
    - Temporary warning signs to stop cars entering the carpark from surrounding roads are NOT to be used due to the risk posed to staff responsible for erecting signage.
- Maintain a loudspeaker system inside the centre that can be used for announcements during a flood. A flood warning message should be prepared for dissemination to occupants during times of flood. The message should contain information about of the dangers of flood waters and advising people remain within the centre until an all-clear message is announced.

1.2 During a Flood

The main responsibilities during a flood are to notify emergency services, to marshal site occupants into areas of safety, and to assist those impacted by floodwaters. The greatest risks are estimated to be to those entering areas of flooding in the car park. The actions to be taken by the site's management, in chronological order, are to:

1. Call the State Emergency Service and advise that the centre site is flooding, and that assistance may be required.
2. Erect temporary warning signs at each building exit, stating the car park is currently flooding and to remain within the centre.
3. If floodwaters appear to be likely to enter the building, turn off the buildings power to reduce the risk of electrocution.
4. Announce (over the loudspeaker and in-person) to occupants of the building that flooding is occurring outside, and to remain calm and stay within the building until the flooding passes. The centre should not be evacuated during the flood event as the greatest flood risk is experienced in the carpark and surrounding areas.
5. Check outside if any vehicles or pedestrians have been caught in floodwaters or injured. Assist them if safe to do so (fast moving or deep floodwaters should be avoided) and if injuries are noted, call an ambulance.
6. If floodwaters enter the building, announce to building occupants that they must evacuate to the second story of the building which is above the level of the Probable Maximum Flood.
7. Assist the elderly or those with children in finding a safe area to wait within the building.

There are three categories of time when the flood event can occur. These are:

(1) Late night/early morning when the site is completely unoccupied;

(2) During site's normal day to day operation; and
(3) During a sports match at the site with public attendance.

No actions are required for (1), however (2) and (3) both require the same actions listed previously.

1.3 Recovery

Once the floodwaters subside, announce that it is safe to now leave the building and the car park, and take down the signage. Attend to occupants that are injured or show symptoms of shock. Call Emergency 000 for assistance if required. If electrical or gas services have been inundated do not turn these appliances on until they have been checked by a qualified electrician or gas fitter.

Following the flood event, the centre management should assess the consequences of the flood event, including where repairs are required. This plan should then be reviewed and updated if necessary, with any lessons learned. Damages to the building, car park or other assets will be dealt with following the flood and they are not the focus of this plan.

A Flood Management Plan for the site is detailed below with a consolidated, single page plan, suitable for display provided below.

FLOOD MANAGEMENT PLAN

Rugby Centre of Excellence
35 Banks Avenue, Daceyville, NSW 2032

Preparedness

Remain vigilant for flood risk:

- Keep a hard copy and digital version of this Flood Management Plan.
- Brief relevant staff of its contents on an annual basis. There should always be at least one employee familiar with the Plan on duty whilst the centre is open.
- A staff member is to be designated as the Flood Warden during any sporting events held with public attendance. The Warden has responsibility for monitoring for flooding. Any events with large attendance may need to be postponed if flood warnings are present.
- Design and maintain temporary warning signage to advise that car park is flooded.
- Maintain a loudspeaker system inside the centre to advise of flood risk.

Response

During a flood the actions to be taken by the site's management are:

1. Call the State Emergency Service and advise that the centre site is in flood.
2. Erect temporary warning signs at each building exit, stating the car park is currently flooding and to remain within the centre.
3. If floodwaters appear to be likely to enter the building, turn off the buildings power.
4. Announce (over the loudspeaker and in-person) to occupants of the building that flooding is occurring outside, and to remain within the building. Do not evacuate.
5. Check outside if any vehicles or pedestrians have been caught in floodwaters or injured. Assist them if safe to do so and if injuries are noted, call an ambulance.
6. If floodwaters enter the building, announce to building occupants that they must evacuate to the second story of the building which is above the level of the Probable Maximum Flood.
7. Assist the elderly or those with children in moving to the second floor if required.

Recovery

Once the floodwaters subside, announce that it is safe to now leave the building and the car park, and take down the signage. Attend to occupants that are injured or show symptoms of shock. Call Emergency 000 for assistance if required. If electrical or gas services have been inundated do not turn these appliances on until they have been checked by a qualified electrician or gas fitter.

Important phones numbers

NSW State Emergency Service:	Emergency – 132 500	General enquiries – 4251 6111
Police, Fire, Ambulance:	Emergency – 000	
Bureau of Meteorology:	Website: http://www.bom.gov.au/nsw/warnings/ , p:1300 659 218	