Fire Safety Study

Moorebank Logistics Park

Woolworths Limited
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Woolworths Limited

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Rev	Date	Remarks	Prepared By	Reviewed By
A	20th of May 2021	Draft issue for comment	Jason Costa	Renton Parker
0	1st of July, 2021	Issued Final		

Executive Summary

Background

Woolworths Limited (Woolworths), has proposed to develop a distribution centre within the Moorebank Logistics Park, NSW. The project will comprise an automated distribution warehouse which will store and handling materials classified as Dangerous Goods (DGs) which were identified to exceed the thresholds detailed within the State Environmental Planning Policy No. 33 (SEPP 33, Ref. [1]); hence, a Preliminary Hazard Analysis (PHA) was prepared as part of the Development Application (DA).

Following approval of the DA, Conditions of Consent (CoC) were issued requiring the preparation of several studies prior to issuance of a Construction Certificate for the facilities. Specifically, Condition B176B states:

"*B176B. Prior to the commencement of construction, the pre-construction studies set out below must be completed:*

a) A Fire Safety Study for Warehouse JR and/or Warehouse JN, covering the relevant aspects of the Department's Hazardous Industry Planning Advisory Paper No. 2, 'Fire Safety Study Guidelines' and the New South Wales Government's Best Practice Guidelines for Contaminated Water Retention and Treatment Systems. The study must be prepared in consultation with Fire and Rescue NSW.

Construction of Warehouse JR or Warehouse JN, other than of preliminary works that are outside the scope of the hazard studies, must not commence until the relevant study recommendations for the subject warehouse have been considered and, where appropriate, acted upon. The studies must be submitted to the Planning Secretary no later than one month prior to the commencement of construction of relevant warehouse to which they apply (other than preliminary works), or within such further period as the Planning Secretary may agree."

Woolworths has commissioned Riskcon Engineering Pty Ltd (Riskcon) to prepare a FSS for the JN Warehouse. This document represents the FSS of the Woolworths JN Warehouse.

Conclusions

A Fire Safety Study per the HIPAP No. 2 guidelines was prepared for the Woolworths Warehouse JN as required by Condition B174B of the Conditions of Consent. In addition, the FSS assessed all incidents that could occur at the site and was developed in consultation with FRNSW per the minutes in **Appendix G**.

The analysis performed in the FSS was based on the credible fire scenarios to assess whether the protection measures at the site were adequate to combat the hazards associated with the quantities and types of commodities being stored. Based on the assessment, it was concluded that the designs and existing fire protection adequately managed the risks.

Recommendations

Based on the analysis, the following recommendations have been made:

- All site personnel are to be trained in specific site procedures, emergency and first aid procedures and the use of fire extinguishers and hose reels.
- A storm water isolation point (i.e. penstock isolation valve) shall be incorporated into the design. The penstock shall automatically isolate the storm water system upon detection of a fire (smoke

or sprinkler activation) to prevent potentially contaminated liquids from entering the water course.

- A spill kit suitable for the commodities being stored shall be provided for the DG store and a separate spill kit provided for the forklift transport areas.
- The warehouse and/or site boundaries shall be capable of containing 653.4 m^3 which may be contained within the warehouse footprint, site stormwater pipework and any recessed docks or other containment areas that may be present as part of the site design.
- Site management to prepare and maintain operational procedures to minimise the number of hazardous incidents and accidents on site and to mitigate the consequences of incidents regarding the handling of dangerous goods and chemicals.
- An Emergency Response Plan (ERP) shall be developed in accordance with HIPAP No. 1 – Emergency Planning Guidelines.
- An Emergency Services Information Package (ESIP) shall be prepared in accordance with the FRNSW guidelines to accompany the ERP.
- Woolworths shall engage with local FRNSW stations to undertake training and familiarisation of the automated system at a minimum of once (1) per year.
- A hazardous area classification in accordance with AS/NZS 60079.10.1:2009 shall be prepared to identify where hazardous areas may exist.
- Where electrical equipment is installed within a hazardous area, the equipment shall comply with AS/NZS 60079.14:2017.
- DG documentation shall be prepared as required by the Work Health and Safety Regulation 2017 to demonstrate the risks associated with the storage and handling of DGs has been assessed and minimised.
- The DG storages shall be appropriately placarded per the requirements of the Work Health and Safety Regulation 2017.

Implementation Commitment

An implementation commitment from Woolworths has been provided in **Appendix H** committing to adhere to the recommendations made within this Fire Safety Study.

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Abbreviations

Abbreviation	Description
ADG	Australian Dangerous Goods Code
AS	Australian Standard
BLEVE	Boiling Liquid Expanding Vapour Explosion
CBD	Central Business District
CCPS	Centre for Chemical Process Safety
DA	Development Application
DGs	Dangerous Goods
DGS	Dangerous Goods Store
DPE	Department of Planning and Environment
FER	Fire Engineering Report
FRNSW	Fire and Rescue New South Wales
HIPAP	Hazardous Industry Planning Advisory Paper
LPG	Liquefied Petroleum Gas
PHA	Preliminary Hazard Analysis
RDC	Retail Distribution Centre
SEP	Surface Emissive Power
SEPP	State Environmental Planning Policy
SMSS	Storage Mode Sprinkler System
SSC	Spread Sheet Calculator
VF	View Factor

1.0 Introduction

1.1 Background

Woolworths Limited (Woolworths), has proposed to develop a distribution centre within the Moorebank Logistics Park, NSW. The project will comprise an automated distribution warehouse which will store and handling materials classified as Dangerous Goods (DGs) which were identified to exceed the thresholds detailed within the State Environmental Planning Policy No. 33 (SEPP 33, Ref. [1]); hence, a Preliminary Hazard Analysis (PHA) was prepared as part of the Development Application (DA).

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"*B176B. Prior to the commencement of construction, the pre-construction studies set out below must be completed:*

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Construction of Warehouse JR or Warehouse JN, other than of preliminary works that are outside the scope of the hazard studies, must not commence until the relevant study recommendations for the subject warehouse have been considered and, where appropriate, acted upon. The studies must be submitted to the Planning Secretary no later than one month prior to the commencement of construction of relevant warehouse to which they apply (other than preliminary works), or within such further period as the Planning Secretary may agree."

Woolworths has commissioned Riskcon Engineering Pty Ltd (Riskcon) to prepare a FSS for the JN Warehouse. This document represents the FSS of the Woolworths JN Warehouse.

1.2 Objectives

The objectives of the FSS for the JN warehouse are to;

- Review the site operations and DG storages for the potential to initiate or become involved in a fire including flammable materials which may be present at the site.
- Identify heat radiation impacts from potential fire sources at the site and determine the potential impacts on the surrounding areas and fire protection system, and
- Review the proposed fire safety features and determine the adequacy of the fire safety systems based on the postulated fires.

1.3 Scope of Services

The scope of work is for the preparation of an FSS for the facility to assess the potential hazards at the site to ensure the fire protection systems are commensurate with the identified hazards. This document follows the methodology recommended in HIPAP No.2 (Ref. [2]).

The FSS focuses on the storage of commodities associated with the new development at the site in addition to the existing operations at the site as required by HIPAP No. 2. A review of the following components of the FSS are within the scope of work;

- Determination of risk and consequences from fire or explosion scenarios throughout the facility;
- The preparation of a report on fire prevention, fire detection, fire alarm and fire suppression systems for the site;
- Firewater storage capacity for compliance with Australian Standards and Regulations and relevant NFPA standards;
- Hydrant hydraulic design screening calculations for the fire water system including the fire main sizing;
- External fire hydrant configuration and locations; and
- Recommendations based upon the study for implementation in the final design.

2.0 Methodology

2.1 Fire Safety Study Approach

The following methodology was used in the preparation of the FSS for the facility. The methodology is to follow items required by HIPAP No. 2 (Ref. [2]).

- The fire hazards associated with the facility were identified to determine whether there were any fire or explosion hazards that may impact offsite or result in a potential to escalate. Where fire hazards with the potential to impact offsite or escalate were identified, these were carried forward for consequence assessment.
- The heat radiation impacts or overpressure impacts (consequences) from each of the postulated incidents from the proposed equipment were then estimated and potential impacts on surrounding areas assessed.
- Impacts of the fires from the proposed equipment were plotted on a layout plan of the proposed facility, to determine whether heat radiation impacts any critical areas (i.e. adjacent storage areas, fire services, safety systems, etc.) and whether such impact affected the ability of fire fighters to respond to the postulated fire. The heat radiation impact from incidents at adjacent sites on the buildings and structures at the facility were then assessed against the maximum permissible levels in HIPAP No. 4 (Ref. [3]).
- The firefighting strategies were then assessed to determine whether these strategies require update in light of the location of the proposed equipment and storage areas.
- The response times for FRNSW in the immediate vicinity were assessed. In addition, further out lying FRNSW stations were included to provide a 'back-up plan' in the event that the closest fire brigades were unable to attend.
- A report was then developed for submission to the client and the regulatory authority.

2.2 Limitations and Assumptions

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

- The report is specifically limited to the project described in **Section 2.1**.
- The report is based on the information provided.
- The report does not provide guidance in respect of incidents that relate to sabotage or vandalism of fire safety systems.
- The assessment is limited to the objectives of the FSS as provided in the guidelines issued as HIPAP No. 2 (Ref. [2]) and does not consider property damage such as building and contents damage caused by fire, potential increased insurance liability and loss of business continuity.
- Malicious acts or arson with respect to fire ignition and safety systems are limited in nature and are outside the scope of this report. Such acts can potentially overwhelm fire safety systems and therefore further strategies such as security, housekeeping and management procedures may better mitigate such risks.

- This report is prepared in good faith and with due care for information purposes only and should not be relied upon as providing any warranty or guarantee that ignition or a fire will not occur.

3.0 Site Description

3.1 Site Location

The Woolworths warehouse JN is situated within the Moorebank Logistics Park which is located approximately 35 km south west of Sydney Central Business District (CBD). **Figure 3-1** shows the regional location of the site in relation to the Sydney CBD. Provided in **Figure 3-2** is the layout of the site in Moorebank.

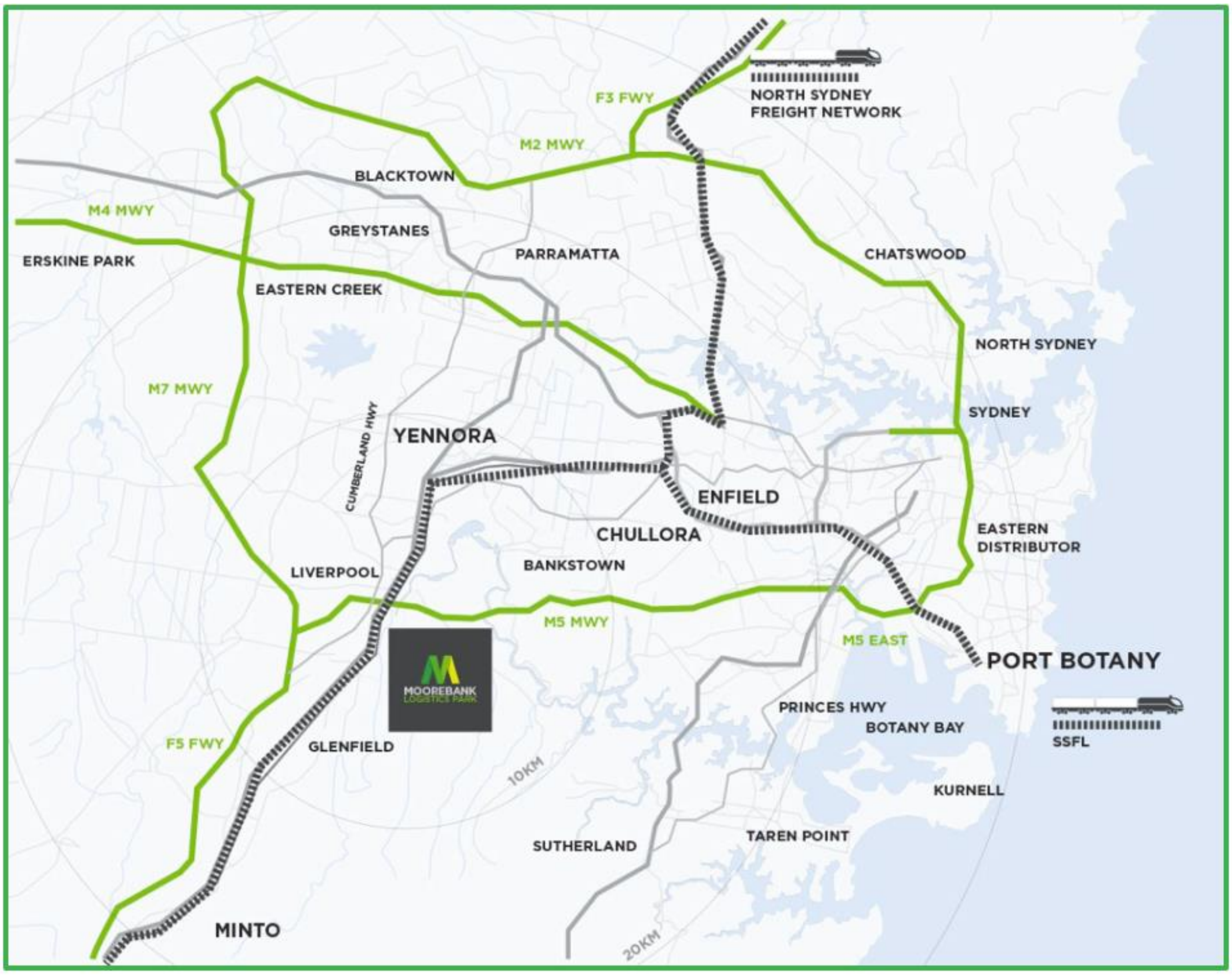

Figure 3-1: Site Location

3.2 Adjacent Land Uses

The land is located in an industrial area surrounded by the following land uses, which are adjacent to the site:

- North – JR Warehouse
- South – Industrial warehousing
- East – Industrial warehousing
- West – Designated reserve area / George's River

3.3 Site Staffing and Operational Hours

The site will have approval for 24-hour operation; however, during operation the warehouse site will be manned over three (3) shifts of 8 hours resulting in an operational time of 24 hours a day, 6 days a week. The site staffing for the JN warehouse has been summarised in **Table 3-1** across the three shifts.

Table 3-1: Shift Hours and Staffing

Shift	JN
Day Shift (06:00 – 14:00	260
Evening Shift (14:00 – 20:00)	240
Night Shift (20:00 – 06:00)	Nil
Total	500

3.4 General Description

The site will consist of the following:

- JN Warehouse
- Carparking (adjacent to JN warehouse)
- LPG tank
- Office areas
- Gate houses
- Weigh bridges

Each item relating to the storage and handling of DGs have been discussed in further detail in the following subsections. An overall site layout of the dual warehouses is shown in **Figure 3-2**. **Figure 3-3** shows the locations where DGs may be stored. A summary of the floor areas for JR and JN has been provided in **Table 3-2**.

Table 3-2: Floor Areas

Items	Area (m^2)
Total Site areas	115,064
Heavy duty paving	37,944
Light duty paving	1,741
Car park	
Ground (include permeable paving)	37,944
Mid-level	6,349
Level 1	4,927

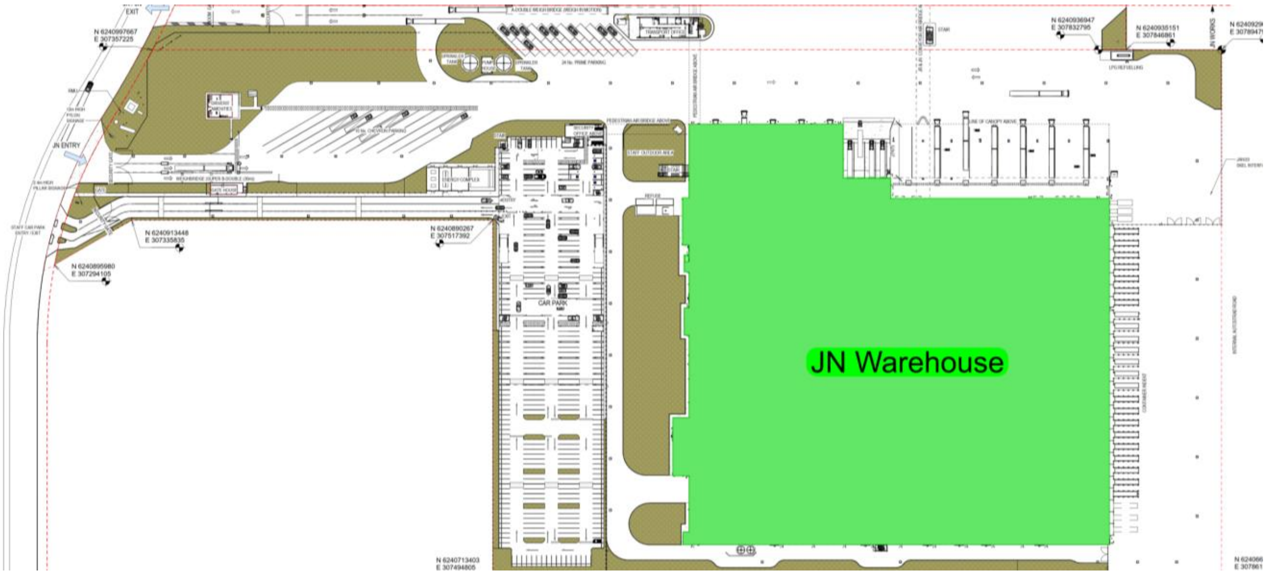

Figure 3-2: Site Layout (JN Warehouses)

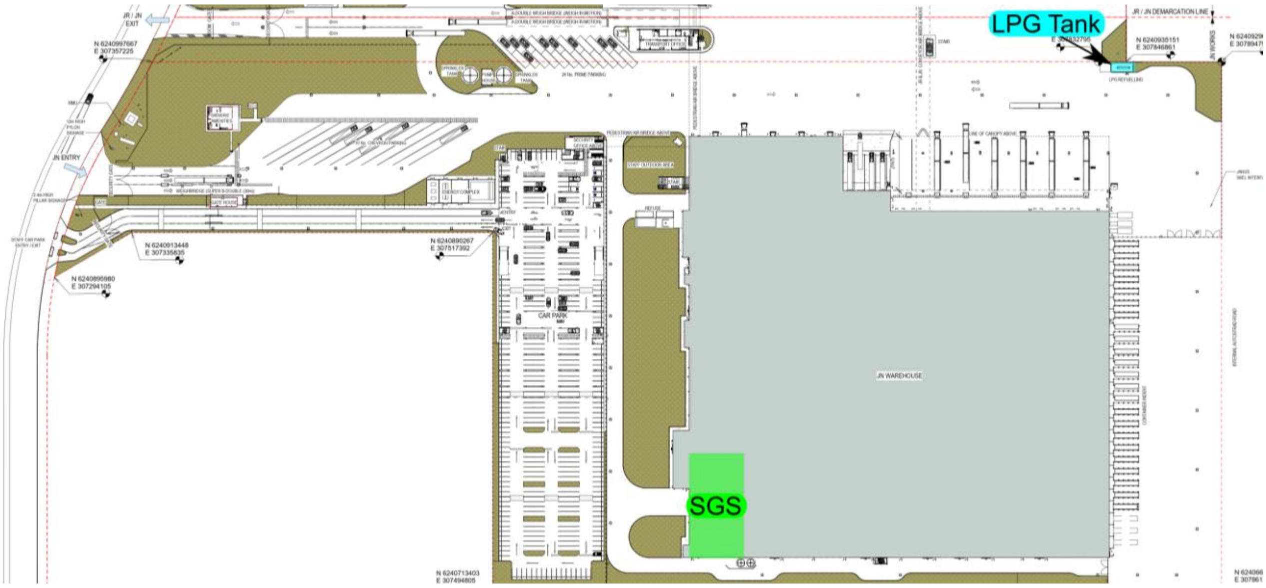

Figure 3-3: Site Layout (DG Locations)

3.5 JN Warehouse

3.5.1 JN Description

The JANUS National (JN) warehouse will have a height of 43.25 m and will be utilised for the distribution of products nationally from the precinct. The warehouse has an approximate footprint area of 45,000 m^2 and comprises a DG store, high bay automated racking system, workshops, receival despatch areas and associated docks, office space, amenities, etc.

The DG store, named the Special Goods Store (SGS), has an area of 1,500 m and is designed to cater for DGs which may not be stored within the automated systems as they cannot be adequately protected within the automated systems.

3.5.2 ErgoPal

The ErgoPal is an automated storage system which stores product within totes which are transported vertically and horizontally through the system to the assigned storage area. Vertical movement occurs at one end of the ErgoPal locating the tote on the correct row where it is then conveyed horizontally on a shuttle before being moved 90º into the allocated location. The totes have dimensions of 600 mm x 400 mm x 200 mm with system reaching approximately 16 m high.

The ErgoPal is a relatively open storage system which looks similar to normal racked storage in that it has space for in-rack sprinklers as shown in **Figure 3-4**. The system has been designed according to FM Global Data Sheet 8-34 (Ref. [4]) which includes in-rack sprinklers along with SMSS located at ceiling height complying with FM Global Data Sheet 8-9 (Ref. [5]). The sprinklers are spaced every three (3) metres vertically with two (2) runs per double row rack.

It is noted that there are no DGs stored within the ErgoPal which reduces the potential for a spill of flammable or combustible liquids which may ignite resulting in a fire.

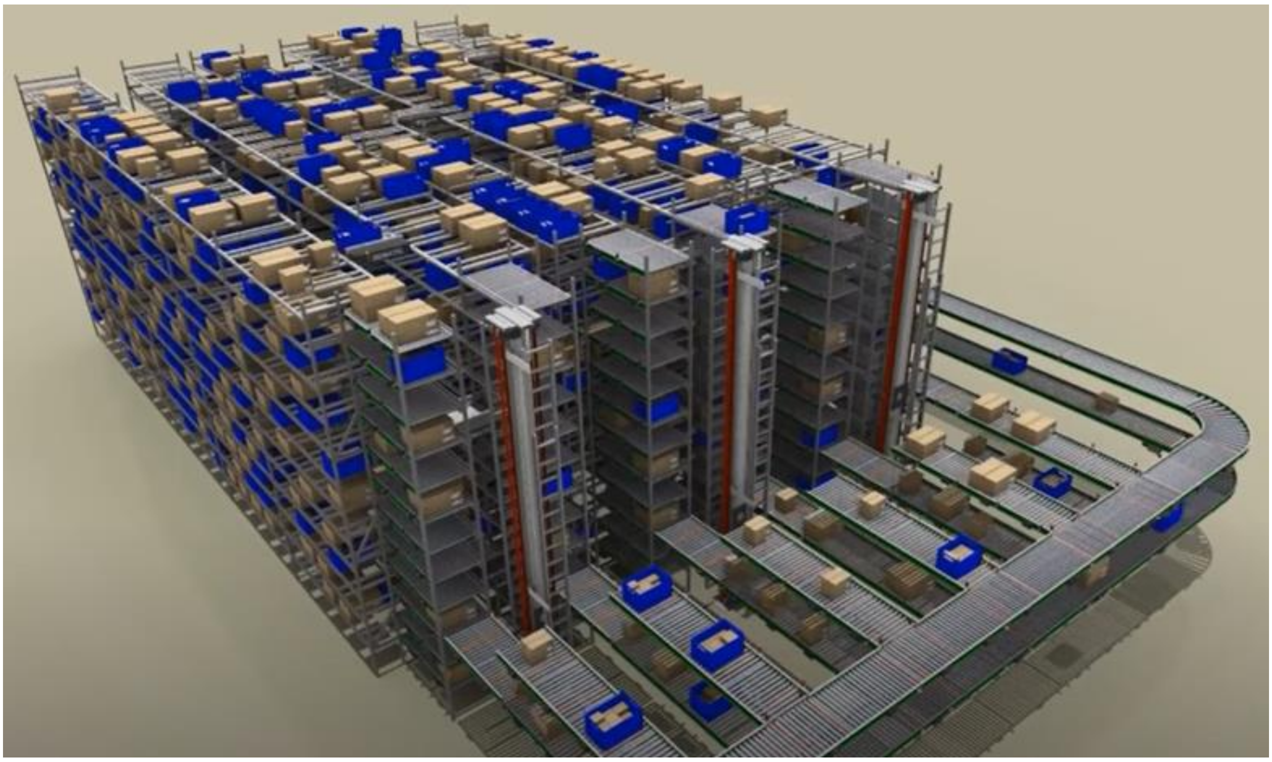

Figure 3-4: ErgoPal Structure

3.5.3 High Bay

The High Bay racking area is an automated system where pallets are transported via cranes through the system and stored per the storage logic. The high bay is approximately 40 m in height and is fitted with in-rack Early Suppression Fast Response (ESFR) sprinklers complying with FM Global Data Sheet 8-9 (Ref. [5]). The in-rack sprinklers are located at heights of 9 – 12 m depending upon the racking spacing. No DG products are proposed to be stored within the High Bay area.

3.5.4 Special Goods Store

The Special Goods Store (SGS) contains the DGs anticipated to be stored within the warehouse. The SGS is a purpose-built DG store which is constructed of walls with an FRL of 240/240/240 which compartmentalises the DGs from the main warehouse. The store has been designed to comply with AS/NZS 3833:2007 (Ref. [6]) including ventilation, bunding, ignition source control, etc. The commodities will be protected by a SMSS complying with FM Global Data Sheet 8-9 (Ref. [5]) and includes environmentally friendly foam making capabilities.

3.5.5 JN DG Quantities

Provided in **Table 3-3** is a summary of the DGs stored within the JN warehouse. **Figure 3-5** shows the location of the DGs listed in **Table 3-3**.

Table 3-3: DG Classes and Quantities Stored in JN

Location	Description	Class	PG	Total (kg)
SGS	Explosives (party poppers)	1.4s	n/a	200
	Flammable Liquids (paint, hand sanitiser, nail polish, etc.)	3	II	39,000
			III	52,500
	Flammable Solids (fire lighters, ethanol wipes)	4.1	II	150
			III	5,000
	Oxidising Agents (hair dyes)	5.1	III	1,300
	Corrosive substances (cleaning products)	8	II	12,000
			III	33,000

Figure 3-5: JN DG Storage Locations

3.6 LPG Tank(s)

3.6.1 LPG Description

There is an Liquefied Petroleum tank (LPG) located in the north eastern corner of the site which will supply LPG for forklift refuelling. Each tank has a volume of 5,880 L resulting in a mass of LPG of 3,250 kg.

3.6.2 LPG DG Quantities

The quantities of LPG proposed to be stored are provided in **Table 3-4**. The location of the LPG storage is shown in **Figure 3-6**.

Table 3-4: LPG Storage Tank Volumes

Location	Description	Class	PG	Total (kg)
LPG Tank 1	Liquefied Petroleum Gas	2.1	n/a	5,880 L / 3,250* kg

*Based upon density of 550 kg/m^3

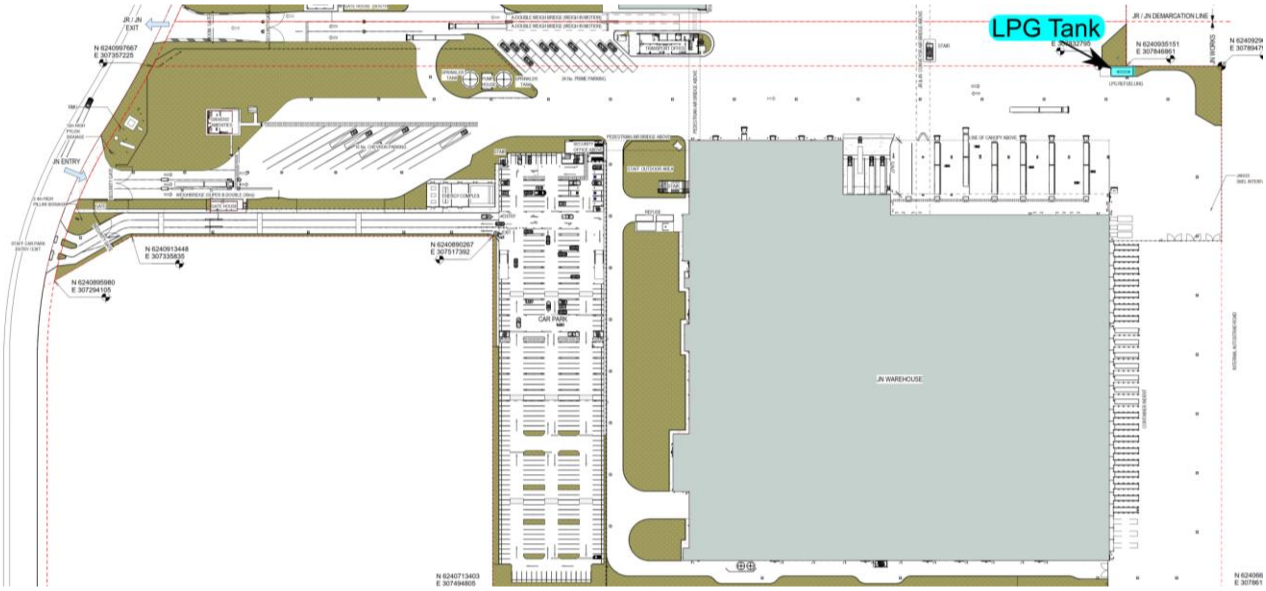

Figure 3-6: Forklift LPG Storage Locations

3.7 Quantities of Dangerous Goods Stored and Handled

Provided in **Table 3-5** is a summary all the DGs proposed to be stored across the whole JN site.

Table 3-5: Dangerous Goods Stored at the Woolworths Distribution Precinct

Area	Description	Class	PG	Total (kg^)
JN	Explosives (party poppers)	1.4s	n/a	200
	Flammable Liquids (paint, hand sanitiser, nail polish, etc.)	3	II	39,000
			III	52,500
	Flammable Solids (fire lighters, ethanol wipes)	4.1	II	150
			III	5,000
	Oxidising Agents (hair dyes)	5.1	III	1,300

Area	Description	Class	PG	Total (kg^)
	Corrosive substances (cleaning products)	8	II	12,000
			III	33,000
LPG Tank 1	Liquefied Petroleum Gas	2.1	n/a	5,880 L / 3,250 kg

^kg unless noted otherwise

3.8 Aggregate Quantity Ratio

Where more than one class of dangerous goods are stored and handled at the site an AQR exists. This ratio is calculated using **Equation 3-1:**

$$AQR = \frac{q_x}{Q_x} + \frac{q_y}{Q_y} + [\ldots] + \frac{q_n}{Q_n}$$

Equation 3-1

Where:

x,y […] and n are the dangerous goods present

q_x, q_y, […] and q_n is the total quantity of dangerous goods x, y, […] and n present.

Q_x, Q_y, […] and Q_n is the individual threshold quantity for each dangerous good of x, y, […] and n

Where the ratio AQR exceeds a value of 1, the site would be considered a Major Hazard Facility (MHF). The threshold quantities for each class have been taken from Schedule 15 of the Work Health and Safety (WHS) Regulation 2017 (Ref. [7]). These are summarised in **Table 3-6** and designated whether the class is subject to MHF assessment.

Table 3-6: Major Hazard Facility Thresholds

Class	Packing Group	Threshold (tonnes)	Storage (tonnes)
1.4s	n/a	Not subject to MHF	n/a
2.1	n/a	200	3.25
3	II & III	50,000	91.0
4.1	II & III	Not subject to MHF	n/a
5.1	III	Not subject to MHF	n/a
8	II & III	Not subject to MHF	n/a
C1	n/a	Not subject to MHF	n/a

A review of the thresholds and the commodities and packing groups listed in **Table 3-6** indicates only Class 2.1 and 3 are assessable against the MHF thresholds. Therefore, substituting the storage masses into **Equation 3-1** the AQR is calculated as follows:

$$AQR = \frac{3.25}{200} + \frac{91.0}{50000} = 0.018$$

The AQR is less than 1; hence, the facility would not be classified as an MHF.

4.0 Hazard Identification

4.1 Introduction

A hazard identification table has been developed and is presented at **Appendix A**. This table has been developed following the recommended approach in Hazardous Industry Planning Advisory Paper No .6, Hazard Analysis Guidelines (Ref. [8]). The Hazard Identification Table provides a summary of the potential hazards, consequences and safeguards at the site. The table has been used to identify the hazards for further assessment in this section of the study. Each hazard is identified in detail and no hazards have been eliminated from assessment by qualitative risk assessment prior to detailed hazard assessment in this section of the study.

In order to determine acceptable impact criteria for incidents that would not be considered for further analysis, due to limited impact offsite, the following approach has been applied:

- *Fire Impacts* - It is noted in Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 (Ref. [3]) that a criterion is provided for the maximum permissible heat radiation at the site boundary (4.7 kW/m^2) above which the risk of injury may occur and therefore the risk must be assessed. Hence, to assist in screening those incidents that do not pose a significant risk, for this study, incidents that result in a heat radiation less that at 4.7 kW/m^2, at the site boundary, are screened from further assessment.

  Those incidents exceeding 4.7 kW/m^2 at the site boundary are carried forward for further assessment (i.e. frequency and risk). This is a conservative approach, as HIPAP No. 4 (Ref. [3]) indicates that values of heat radiation of 4.7 kW/m^2 should not exceed 50 chances per million per year at sensitive land uses (e.g. residential). It is noted that the closest residential area is more than several hundred meters from the site, hence, by selecting 4.7 kW/m^2 as the consequence impact criteria (at the adjacent industrial site boundary) the assessment is considered conservative.

- *Explosion* - It is noted in HIPAP No. 4 (Ref. [3]) that a criterion is provided for the maximum permissible explosion over pressure at the site boundary (7 kPa) above which the risk of injury may occur and therefore the risk must be assessed. Hence, to assist in screening those incidents that do not pose a significant risk, for this study, incidents that result in an explosion overpressure less than 7 kPa, at the site boundary, are screened from further assessment. Those incidents exceeding 7 kPa, at the site boundary, are carried forward for further assessment (i.e. frequency and risk). Similarly, to the heat radiation impact discussed above, this is conservative as the 7 kPa value listed in HIPAP No. 4 relates to residential areas, which are over more than several hundred meters from the site.

- *Toxicity* – No toxic gases have been proposed to be stored at the site; hence, toxicity has not been assessed in this study.

- *Property Damage and Accident Propagation* - It is noted in HIPAP No. 4 (Ref. [3]) that a criterion is provided for the maximum permissible heat radiation/explosion overpressure at the site boundary (23 kW/m^2/14 kPa) above which the risk of property damage and accident propagation to neighbouring sites must be assessed. Hence, to assist in screening those incidents that do not pose a significant risk to incident propagation, for this study, incidents that result in a heat radiation heat radiation less than 23 kW/m^2 and explosion over pressure less than 14 kPa, at the site boundary, are screened from further assessment. Those incidents exceeding 23 kW/m^2 at the site boundary are carried forward for further assessment with respect to incident propagation (i.e. frequency and risk).

- *Societal Risk* – HIPAP No. 4 (Ref. [3]) discusses the application of societal risk to populations surrounding the proposed potentially hazardous facility. It is noted that HIPAP No. 4 indicates that where a development proposal involves a significant intensification of population, in the vicinity of such a facility, the change in societal risk needs to be taken into account. In the case of the facility, there is currently no significant intensification of population around the proposed site; however, the adjacent land has been rezoned residential; hence, there will be housing located more than several hundred meters from the site. Therefore, societal risk has been considered in the assessment.

4.2 Properties of Dangerous Goods

The type of DGs and quantities stored and used at the site has been described in **Section 3**. **Table 4-1** provides a description of the DGs stored and handled at the site, including the Class and the hazardous material properties of the DG Class.

Table 4-1: Properties* of the Dangerous Goods and Materials Stored at the Site

Class	Hazardous Properties
1.4s – Explosives	Class 1.4s are a sub-designation of explosives which covers explosive products which include blasting caps, small arms, ammunition. Essentially, Class 1.4s contains explosives with relatively low risk (compared to other explosives) they are not shock sensitive and are contained within enclosed products. Products likely to be stored at CA include party poppers, sparklers, etc.
2.1 – Flammable Gas	Class 2.1 includes flammable gases which are ignitable when in a mixture of 13 per cent or less by volume with air or have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit. Ignited gas may result in explosion or flash fire. Where gas released under pressure from a hole in a pressurised component is ignited, a jet fire may occur.
3 – Flammable Liquids	Class 3 includes flammable liquids which are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc.) which give off a flammable vapour at temperatures of not more than 60ºC closed-cup test or not more than 65.6ºC open-cup test. Vapours released may mix with air and if ignited, at the right, concentration will burn resulting in pool fires at the liquid surface.
4.1 – Flammable Solids	Flammable solid materials are materials that may burn when exposed to an ignition source, examples of flammable solids include matches and some waxes.
5.1 -Oxidising Agents	Class 5.1 materials will not combust but these materials include substances which can in a fire event, liberate oxygen and could accelerate the burning of other combustible or flammable materials. Releases to the environment may cause damage to sensitive receptors within the environment.
8 – Corrosive Substances	Class 8 substances (corrosive substances) are substances which, by chemical action, could cause damage when in contact with living tissue (i.e. necrosis), or, in case of leakage, may materially damage, or even destroy, other goods which come into contact with the leaked corrosive material. Releases to the environment may cause damage to sensitive receptors within the environment.

* The Australian Code for the Transport of Dangerous Goods by Road and Rail (Ref. [9]

4.3 Hazard Identification

Based on the hazard identification table presented in **Appendix A**, the following hazardous scenarios have been developed:

- JN flammable liquid release, delayed ignition and flash fire or explosion.
- JN flammable material spill, ignition and racking fire.
- JN full warehouse fire and radiant heat.
- JN full warehouse fire and toxic smoke emission.
- JN dangerous goods liquid spill, release and environmental incident.
- JN Warehouse fire, sprinkler activation and potentially contaminated water release.
- LPG release, ignition and pool fire.
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire.
- LPG release and ignition causing flash fire or explosion.
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire and impact on LPG delivery tanker and Boiling Liquid Expanding Vapour Explosion (BLEVE).
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire and impact on LPG tank and BLEVE.
- Fire in ErgoPal or High Bay and propagation between storage areas.

Each identified scenario is discussed in further detail in the following sections.

4.4 JN Flammable Liquid Release, Delayed Ignition and Flash Fire or Explosion

As noted in **Section 3.0**, flammable liquids will be stored at JN. There is potential that a flammable liquid spill could occur in the warehouse area due to an accident (packages dropped from forklift, punctured by forklift tines) or deterioration of packaging. If a flammable liquid spill occurred, the liquid may begin to evaporate (depending on the material flashpoint and ambient temperature). Where materials do evaporate, there is a potential for accumulation of vapours, forming a vapour cloud above the spill.

If the spill is not identified, the cloud may continue to accumulate, eventually contacting an ignition source. If the cloud is confined (i.e. pallet racking and stored products) the vapour cloud may explode if ignited, or, if it is unconfined, it may result in a flash fire which would burn back to the flammable liquid spill, resulting in a pool fire.

A review of the product list to be stored indicates the products are small retail packages as defined by AS/NZS 3833:2007 (Ref. [6]). Therefore, the release from a single flammable liquid container would result in a release <20 L. The associated vapour cloud formed by the release of flammable liquid would be insufficient to result in offsite impacts from ignition.

Packages are inspected for damage upon receipt at the loading dock before they are transported into the warehouse. This minimises the likelihood a damaged package is incorrectly stored. Once stored inside the warehouse, deterioration or damage are unlikely to occur.

To minimise the likelihood a flammable vapour cloud may contact an ignition source, the electrical equipment within the DG store hazardous zone will be installed according to the requirements of AS/NZS 60079.14:2017 (Ref. [10]).

It has been proposed to seek approval to operate the site 24 hours a day 7 days a week however the site will be unlikely to be used for these proposed hours of operation. Therefore, if a spill occurred, it would be identified by personnel working in the warehouse where it could be immediately cleaned up. To ensure appropriate cleaning equipment is available, the following recommendation has been made:

- Multiple spill kits be provided around the DG storage areas to ensure spills can be cleaned up immediately following identification.

Explosives may be stored at the site which will be Class 1.4S which is a subclassification of explosives covering ammunition, blasting caps, etc. These products are finished products that contain small quantities of explosives. In the case of Woolworths, if these are stored they will consist of sparklers and party popper type products. As the products contain only small quantities of explosives a large explosion would not occur. Rather, if exposed to heat (i.e. from a fire) the packaging will burn exposing the explosives which will then ignite resulting in a more aggressive fire. The combustion profile of these products would be similar to ignition of aerosols (i.e. constant flames from combustion of packaging punctuated by the increase burning rate of the LPG when the can ruptures). Nonetheless, combustion of such products would not be expected to result in a pressure wave as there is insufficient explosive mass in a dense form.

Based on the warehouse design (controlled ignition sources, etc.), operation practices and the storage of small packages, the risk of a vapour cloud being generated that is large enough to ignite and impact over the site boundary, by way of a vapour cloud explosion or a flash fire, is considered to be low (if not negligible); hence, this hazard has not been carried forward for further analysis.

4.5 JN Flammable Material Spill, Ignition and Racking Fire

As noted in **Section 4.4**, it is considered that there is a low potential for a package to leak resulting in a flammable material spill and there are several controls in place to minimise the likelihood of a damaged container entering the warehouse and additional controls to minimise the potential that ignition of a flammable material spill could occur.

If a flammable material spill was to occur (e.g. dropped pallet or package during handling) and it was ignited (e.g. by the forklift), the fire would initially be small due to the majority of packages stored being 20 L or less. While a fire would be limited in size, heat generated may impact adjacent packages which may deteriorate and release their contents contributing additional fuel to the fire. As the fire grows Storage Mode Sprinkler System (SMSS) would activate controlling the fire within the sprinkler array and cooling adjacent packages preventing deterioration and reducing the potential for fire growth.

Based on the limited fire size, the design of the warehouse and the installed fire systems, the risks of this incident impacting over the site boundary are considered to be low. Notwithstanding this, this incident has been carried forward for further analysis to demonstrate that the likely impact of an SMSS controlled fire is within the site boundary.

4.6 JN Full Warehouse Fire and Radiant Heat

There is potential that if a fire occurred and the fire protection systems failed to activate, a small fire may escalate as radiant heat impacts adjacent packages resulting in deterioration and release of additional fuel. While it is considered unlikely for a fire to occur simultaneously with the sprinkler system failing to operate there is the potential for this scenario to occur. Therefore, this incident has been carried forward for further analysis.

4.7 JN Full Warehouse Fire and Toxic Smoke Emission

As discussed in **Section 4.6** there is the potential for a full warehouse fire to occur in the event of sprinkler failure. During combustion toxic products of combustion may be generated which will be dispersed in the smoke plume which may impact downwind from the site. Depending on the toxicity of the bi-products, this may result in injury or fatality. Therefore, this incident has been carried forward for further analysis.

4.8 JN Dangerous Goods Liquid Spill, Release and Environmental Incident

There is potential that a spill of the liquid DGs (Class 3, 4.1, 5.1, 8) could occur at the site which if not contained could be released into the public water course resulting in a potential environmental incident.

To prevent spills escaping from the site per the requirements of AS/NZS 3833:2007 (Ref. [6]) the following recommendation has been made:

- The site shall be designed to contain any spills or contaminated water from a fire incident within the boundaries of the site.

The site will also be designed to prevent the release of any spills from the site, including potentially contaminated water. Therefore, the potential for a release is considered unlikely as this is expected to be contained within the footprint of the warehouse. Nonetheless, in the event of a catastrophic scenario and spills are released from the footprint of the warehouse, it will be necessary to prevent this from being released into the public water course. Therefore, the following recommendation has been made:

- A storm water isolation point (i.e. penstock isolation valve) shall be incorporated into the design. The penstock shall automatically isolate the storm water system upon detection of a fire (smoke or sprinkler activation) to prevent potentially contaminated liquids from entering the water course.

As noted, the volumes of the packages are small (< 20 L) and the site will be designed with a drain isolation system, allowing the containment of any spills within the premises; hence, in the event of a release the full volume will be contained within the warehouse area. As a spill would be contained within the bund/site drainage there is no potential for an environmental incident to occur; hence, this incident has not been carried forward for further analysis.

4.9 JN Warehouse Fire, Sprinkler Activation and Potentially Contaminated Water Release

In the event of a fire, the SMSS will activate discharging fire with water to control and suppress the fire. Contact of the fire water with DGs may result in contamination which, if released to the local watercourse, could result in environmental damage. The SMSS system delivers approximately 5 m^3/min of water which, if operated for a long period, may result in overflow of site bunding and potential release. The facility has been designed to be able to contain all DG spills and liquid effluent resulting from the management of an incident (i.e. fire) within the premises.

The site will hold 60 minutes of water storage on site as required by FM Global standards; hence, to allow for additional conservatism, following a risk assessment methodology as outlined by the Department of Planning document "*Best Practice Guidelines for Potentially Contaminated Water Retention and Treatment Systems*" (Ref. [11]), an allowance of 90 minutes of potentially contaminated water has been selected noting this includes all sources of application (i.e. onsite storage and towns mains) thus far exceeding the 60 minute on site storage. In a DG fire scenario, the following protection systems are likely to be discharging:

- SMSS with 12 heads operating at 0.455 m^3/min or 5.46 m^3/min.
- 3 hydrant hoses at 1.8 m^3/min.

The total water discharge would be 7.26 m^3/min. Therefore, operation for 90 minutes would result in a total discharge of 653.4 m^3. The following recommendation has been made:

- The warehouse and/or site boundaries shall be capable of containing 653.4 m^3 which may be contained within the warehouse footprint, site stormwater pipework and any recessed docks or other containment areas that may be present as part of the site design.
- The civil engineers designing the site containment shall demonstrate the design is capable of containing at least 653.4 m^3.

As noted in **Section 4.8**, an automatic isolation valve has been recommended to be incorporated into the design to prevent the release of potentially contaminated water. Therefore, the volume within the stormwater system can also be used in calculation total volume contained.

Based on the design and containment for the premises, there is adequate fire water retention to meet the '*Best Practice Guidelines for Contaminated Water Retention and Treatment Systems*" (Ref. [11]), hence, this incident has not been carried forward for further analysis.

4.10 LPG Release, Ignition and Pool Fire

In the event of a small leak from a vessel or pipework a pool of LPG may form when the rate of evaporation of LPG is less than the flow rate of LPG from the leak. If the pool were to ignite an LPG pool fire would occur which may impact over the site boundary.

A leak sufficient to cause a release that exceeds the evaporation rate to develop a pool large enough to ignite (noting the area is zoned per the requirements of AS/NZS 60079.10.1:2009, (Ref. [12]) and the subsequent fire to impact over the site boundary is very low. This is substantiated by numerous similar sized LPG tanks installed throughout Australia with very low incidences of leaks and fires occurring from such installations.

As the potential for a leak and LPG pool and subsequent ignition to occur is incredibly low, this incident has not been carried forward for further analysis.

4.11 LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire

As the site LPG is depleted, it will be refilled by a delivery tanker at the site. During loading of the tank there is the potential for the hose to rupture which may be the result of a puncture of the hosing or deterioration through general wear and tear. It has been assumed the hoses are inspected monthly and pressure tested annually in accordance with the Australian Dangerous Goods Code (ADG, Ref. [13]).

Notwithstanding this, there is the potential for a hose to become damaged between inspection and test periods which may lead to sufficient deterioration resulting in a hose rupture when transferring pressurised LPG. Excess flow and non-return valves will isolate the flow of LPG; however, if these fail in addition to a hose rupture, LPG will be released resulting in an LPG vapour cloud. The operator may be able to respond and isolate the LPG transfer by activating an emergency stop button located on the tanker.

If the operator is incapacitated or unable to stop the transfer, the LPG will continue to flow developing a substantial cloud which may contact an ignition source and ignite which would result in a flash fire or explosion which would burn back to the release point and subsequent jet fire. It is noted the area is unconfined; hence, an explosion is unlikely to occur and would likely result in a flash fire.

The potential for a fatality to occur as a result of a flash fire is not considered credible as the mechanism for a fatality to occur from a flash fire is via combustion of flammable vapours at head height which results in oxygen within the lungs being consumed as the fuel burns. The impacted person will involuntarily inhale, as low oxygen is detected, resulting in inhalation of hot combustion products which burn the sensitive lining of the lungs. As LPG is a dense gas, any release will spread along at ground level and due to the open nature of the site it will not accumulate to a level where a person offsite will be fully engulfed; hence, a fatality is unlikely to occur.

While a flash fire may not be expected to cause significant harm, the impacts from a jet fire are likely to be substantial and would impact over the site boundary; hence, this incident has been carried forward for further analysis.

4.12 LPG Release and Ignition Causing Flash Fire or Explosion

In the event of an LPG release, LPG will vapourise forming a flammable atmosphere which may ignite. A review of the area indicates the tank will not be stored in an area where confinement will occur; hence, the atmosphere would not ignite as an explosion but would rather result in a flash fire.

As noted in **Section 4.11**, the mechanism for a fatality to occur from a flash fire is inhalation of hot combustion products when a person is fully engulfed in a vapour cloud when ignition occurs. As LPG is a dense gas it will spread out at ground level as there is no confinement to allow the gas to accumulate at height; therefore, it is unlikely that a vapour cloud would form to allow a person to be fully engulfed; hence, a fatality would be unlikely to occur.

Furthermore, AS/NZS 1596:2014 (Ref. [14]) has been developed with reference to the likely impact scenarios from storage of LPG in various tank sizes. Review of Table 6.1 of AS/NZS 1596:2014 (Ref. [14]) indicates for a 5.9 kL tank the separation distance to a protected place is approximately 5.5 m. Therefore, the standard would consider that in open air, events resulting from a release from the tank would be unlikely to significantly impact >5.5 m.

A catastrophic failure of an LPG tank (i.e. rupture and full release of LPG) is considered incredible due to the manufacturing and regular testing of pressure vessels according to AS 1210:2010 (Ref. [15]).

As the area is unconfined and the location of the tank provides adequate separation to the site boundary and protected places it is considered that a fatality would not result from this incident; hence, this incident has not been carried forward for further analysis.

4.13 LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire and Impact on LPG Delivery Tanker and BLEVE

Similarly, to the scenario described in **Section 4.12** the hose may rupture resulting in a jet fire. If this jet fire were aimed at the delivery tanker, the tanker shell would begin to heat, transferring the heat into the LPG within the tank which would begin to vaporise and increase the pressure within the tanker. At the design pressure of the tank, the pressure relief valve will begin to lift to relieve pressure within the tanker.

As the liquid level within the tanker drops, the impact zone of the jet fire may impact the vapour space in the tanker. The vapour will absorb less energy than the liquid which will result in localised heating of the tanker shell at the point of the jet fire impact. This may compromise the structural integrity of the tanker shell which may rupture resulting in a blast overpressure as the vessel fails and formation of an LPG vapour cloud which may also ignite resulting in a vapour cloud explosion known as a Boiling Liquid Expanding Vapour Explosion (BLEVE). This incident has been carried forward to assess the potential impact zone.

4.14 LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire and Impact on LPG Tank and BLEVE

Similarly, to the scenario described in **Section 4.12** the hose may rupture resulting in a jet fire. If this jet fire were aimed at the tank, the tank shell would begin to heat, transferring the heat into the LPG within the tank which would begin to vaporise and increase the pressure within the tank which may result in a BLEVE as described in **Section 4.13**. Hence this incident has been carried forward for further analysis.

4.15 Fire in ErgoPal or High Bay and Propagation Between Storage Areas

Discussion with FRNSW indicates there is the concern that a fire within the ErgoPal (or the High Bay racking) may result in incident propagation between the storage areas. A review of the protection systems indicates that both systems are fitted with in-rack sprinklers sized for the commodities stored. The ErgoPal contains in-rack sprinklers as required by FM Global Data Sheet 8-34 (Ref. [4]) and is also protected by SMSS located at ceiling height in accordance with FM Global Data Sheet 8-9 (Ref. [5]). Similarly, the High Bay area is protected by in-rack sprinklers complying with FM Global Data Sheet 8-9 (Ref. [5]) which are located at heights between 9-12 m within the High Bay system.

It is noted that there are no DGs stored within these systems; hence, the fire risk posed by these storage areas is commensurate with other warehouses storing non-DG products. DGs pose an increased potential for ignition as some classes of DGs are flammable gases or liquids which can create flammable atmospheres which can migrate to an ignition source (i.e. light switch) and ignite flashing back to the point for release and resulting in a fire. As none of the products present within the ErgoPal or High Bay are flammable gases or liquids there potential for migrating flammable atmospheres is eliminated which drastically reduces the potential for ignition. In addition, the products stored, while combustible, are not readily ignited (i.e. by a spark, or static) and required sustained exposure to heat to ignite. Therefore, it is considered that ignition would be unlikely to occur in normal operation and would likely only occur from malicious activities, faulty equipment, or mismanaged hot work.

In addition, the FM Global Standards have been developed based upon empirical testing of sprinkler systems for various configuration of commodities and material types to demonstrate that the sprinkler system can suppress and control a fire adequately. Part of this testing involves the potential for lateral spread from one racked storage area across and aisle into an adjacent storage area. If a fire is able to laterally spread via radiant heat propagation then the system would fail the test and subsequently would not be recommended within the data sheets. Therefore, it would be expected that the potential for incident propagation from the ErgoPal to the High Bay or vice versa would be a low probability event based upon the protection systems installed.

Notwithstanding the above, this incident has been carried forward for further analysis to review the potential for incident propagation between the areas.

5.0 Consequence Analysis

The following incidents were identified to have potential to impact off site:

5.1 Incidents Carried Forward for Consequence Analysis

The following incidents were identified to have potential to impact off site:

- Flammable material spill, ignition and racking fire.
- Full warehouse fire and radiant heat.
- Full warehouse fire and toxic smoke emission.
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire.
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire and impact on LPG delivery tanker and Boiling Liquid Expanding Vapour Explosion (BLEVE).
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire and impact on LPG tank and BLEVE.
- Fire in ErgoPal or High Bay and propagation between storage areas.

Each incident has been assessed in the following sections.

5.2 Flammable Material Spill, Ignition and Racking Fire

There is the potential for a fire to develop involving flammable material stored within the warehouse resulting in a racking fire. As the fire grows the SMSS would activate suppressing and controlling the fire while cooling adjacent packages minimising the potential for lateral spread due to radiant heat. A detailed analysis has been conducted in **Appendix B** and the radiant heat impact distances estimated for this scenario are presented in **Table 5-1**.

Table 5-1: Heat Radiation from a Flammable Liquid Racking Fire

Heat Radiation (kW/m^2)	Distance (m)	
	Base Case	Sensitivity
35	4.6	8.5
23	5.6	10.3
12.6	7.5	13.7
4.7	12.0	22.2
3.0	14.9	27.5

A review of the 23 kW/m^2 impact distance indicates an offsite impact would not occur as neither contour for base case nor sensitivity case impact over the site boundary. Therefore, it is not considered that a propagation risk is present based on the radiant heat levels observed for this fire scenario. In addition, the flammable liquids are contained within an enclosure with a FRL 240/240/240 separating the DG store from the main warehouse; hence, it is considered should a fire occur within the bunker and the sprinkler systems fail to suppress and control the fire, it will not propagate into the main warehouse area.

A review of the 3.0 kW/m^2 contour indicates critical firefighting infrastructure (i.e. hydrants, pump house, boosters, etc.) would be unaffected; hence, would be accessible by FRNSW. As noted, the flammable liquid DGs are held within a fire rated enclosure providing containment of any out of control fire.

Based upon a review of the consequence impacts, it is considered that the fire protection (i.e. in-rack sprinklers, ceiling mounted sprinklers, fire rated enclosure, and hydrant system) provides a high level of protection against fire scenarios originating within the DG bunker.

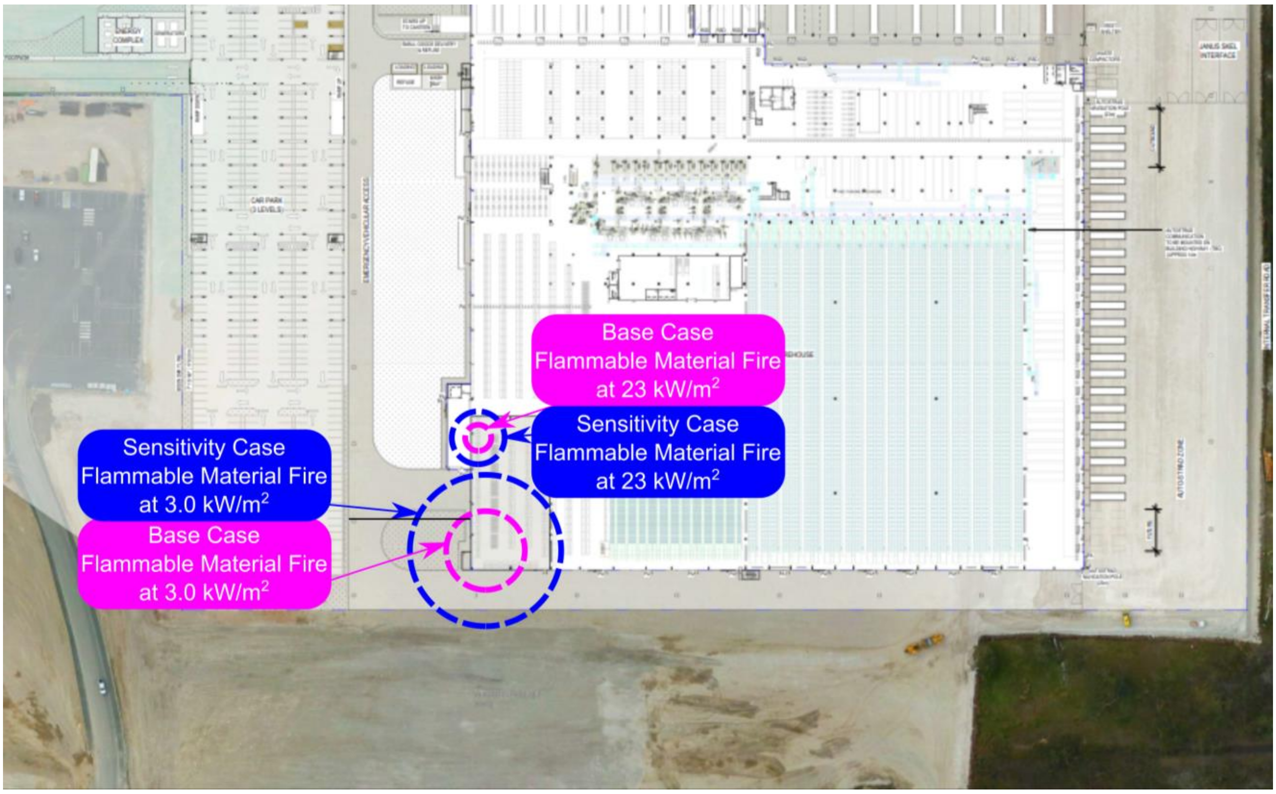

Figure 5-1: Sprinkler Controlled Flammable Material Fire Radiant Heat Contours

5.3 Full Warehouse Fire and Radiant Heat

If a fire occurs within the DG store and the sprinkler systems fail to activate, the fire will spread throughout the warehouse and is unlikely to be contained and would likely consume the entire warehouse. A detailed analysis has been conducted in **Appendix B** and the radiant heat impact distances estimated for this scenario are presented in **Table 5-2**.

Table 5-2: Radiant Heat Impact Distances from a Full Warehouse Fire

Heat Radiation (kW/m^2)	Distance (m)
35	Maximum heat flux is 20*
23	Maximum heat flux is 20*
12.6	38.0
4.7	85.0
3.0	115.0

*Based on the research by Mudan & Croche reported in Lees (Ref. [16]) & Cameron/Raman (Ref. [17])

As shown in **Figure 5-2**, the radiant heat impacts at 3.0 kW/m^2 have an extensive impact from the warehouse; however, it must be noted that the analysis is based upon the full warehouse containing representative DG products with burning rates above those of normal products. It also assumes that the entire footprint is composed of combustible materials; hence, the true impact would likely be less than that shown.

Regardless, a full warehouse fire would likely render all protection systems impacted by a 3.0 kW/m^2 which would prevent FRNSW intervention based upon their accessibility criteria. Nonetheless, the warehouse has been designed using protection systems designed specifically for use in the configuration proposed for this warehouse. Therefore, a full warehouse fire is not expected to occur based upon the reliability of the sprinkler systems installed.

It is noted that due to the fire size there will be considerable smoke emitted which would obscure the flame surface reducing the average surface emissive power (SEP) and subsequently it would not exceed 23 kW/m^2. In addition, the distance to the closest buildings is 23 m which would allow attenuation of radiant heat from luminous spots and would not result in sustained radiant heat such that propagation to adjacent facilities would not occur.

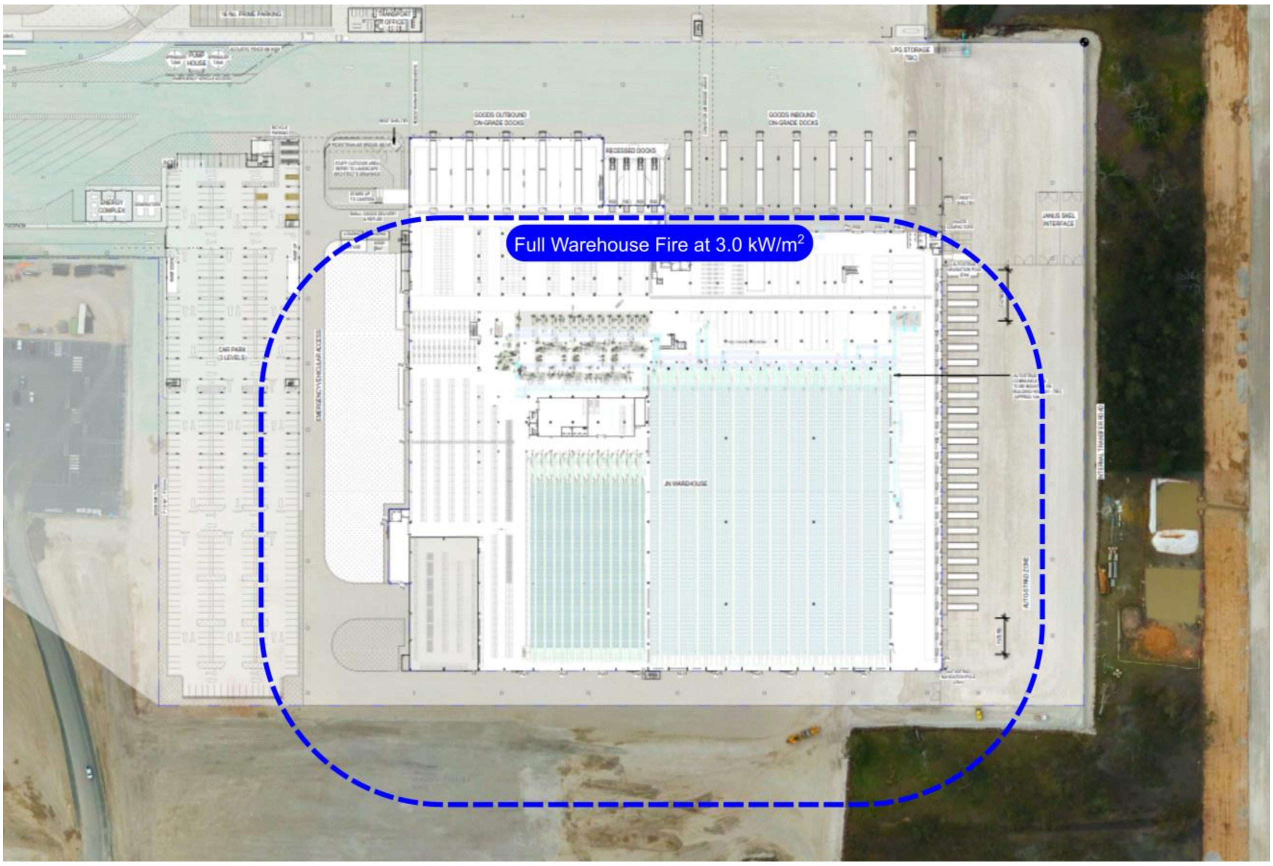

Figure 5-2: Full Warehouse Fire Radiant Heat Contours

5.4 Full Warehouse Fire and Toxic Smoke Emission

A detailed analysis has been performed in **Section B9** of **Appendix B** to estimate the impact of toxic products of combustion on the surrounding area. In addition, it was concluded that due to the relatively low quantity of toxic products that may be stored in the warehouse, and a substantial portion of toxic products involved in a fire will actually be combusted, the results generated from the assessment of toxic bi-products would provide a conservative analysis when applied to uncombusted toxic products.

Provided in **Table 5-3** is a summary of several toxic products of combustion which may be present in the smoke plume and their acceptable concentration of exposure for the Acute Exposure Guideline Levels (AEGL). These levels provide guidance on exposure concentrations for general populations, including susceptible populations over a range of exposure times to assist in the assessment of releases which may result in a toxic exposure.

Provided below is a summary of the AEGL tiers of exposure:

- **AEGL-3** is the airborne concentration, expressed as parts per million (ppm) or milligrams per cubic meter (mg/m^3), of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.
- **AEGL-2** is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- **AEGL-1** is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

Selection for fatality or serious injury is based on an AEGL-3 values with injury values selected as those based on AEGL-2. It is noted the report AEGL values are based on 30-minute exposure.

Table 5-3: Concentrations of Toxic Products of Combustion from a Smoke Plume

Pollutant	Fatality or Serious Injury (ppm)	Injury (ppm)	Concentration (ppm)
Carbon monoxide	600	150	27.9
Nitric Dioxide	25	15	26.1
Hydrogen cyanide	21	10	29.0
Hydrogen chloride	210	43	21.5
Sulphur dioxide	30	0.75	12.2

The analysis indicates all quantities are below the AEGL-3 values. It is noted the analysis conducted is based on the primary toxic bi-product (carbon monoxide) which forms at rates higher than other toxic bi-products. Therefore, application of this result to other components is considered conservative. As these concentrations are taken at the point of release, they will disperse downwind resulting in substantially lower concentrations at the residential areas.

With reference to injury, all values except for hydrogen cyanide and sulphur dioxide are below the AEGL-2 concentration. Similar to the above discussion, the concentrations are likely to disperse substantially prior to impacting the residential populations; hence, an injury is unlikely to occur.

Based on the analysis conducted, it is considered that the concentrations at the residential area are likely to be lower than the fatality and injury concentration levels based on the comparison to the fatality and injury targets at the point of release (i.e. worst-case concentration). Notwithstanding this, as there is the potential for a toxic DG to be involved in the fire, the toxicity impacts may exceed those estimated for the toxic products of combustion analysis. Therefore, this incident has been carried forward for further analysis.

5.5 LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire

There is the potential for a hose to rupture and release high pressure LPG if the excess flow valve on the tanker fails and operator intervention does not occur. If this stream ignited, a jet fire could occur. A detailed analysis has been conducted in **Appendix B9** for this scenario which indicates the jet fire would have an impact of distance of 38 m. The impact distances for this incident are shown in **Figure 5-3**.

There are several protection systems to prevent hose rupture including hose pressure testing and inspections, non-return valves on the tank and vehicle, excess flow valves on the tanker, earthing connections, ignition source controls. Therefore, it is unlikely that a release of LPG would occur and subsequent ignition. In addition, the area has been subject to a hazardous area classification in accordance with AS/NZS 60079.10.1:2009 (Ref. [12]) to ensure ignition sources are controlled within the vicinity to control the risk of ignition.

Based upon the protection systems incorporated into tanker trucks, the ignition source controls within the area, a scenario which escalates into a jet fire scenario from the tanker truck is not expected to occur.

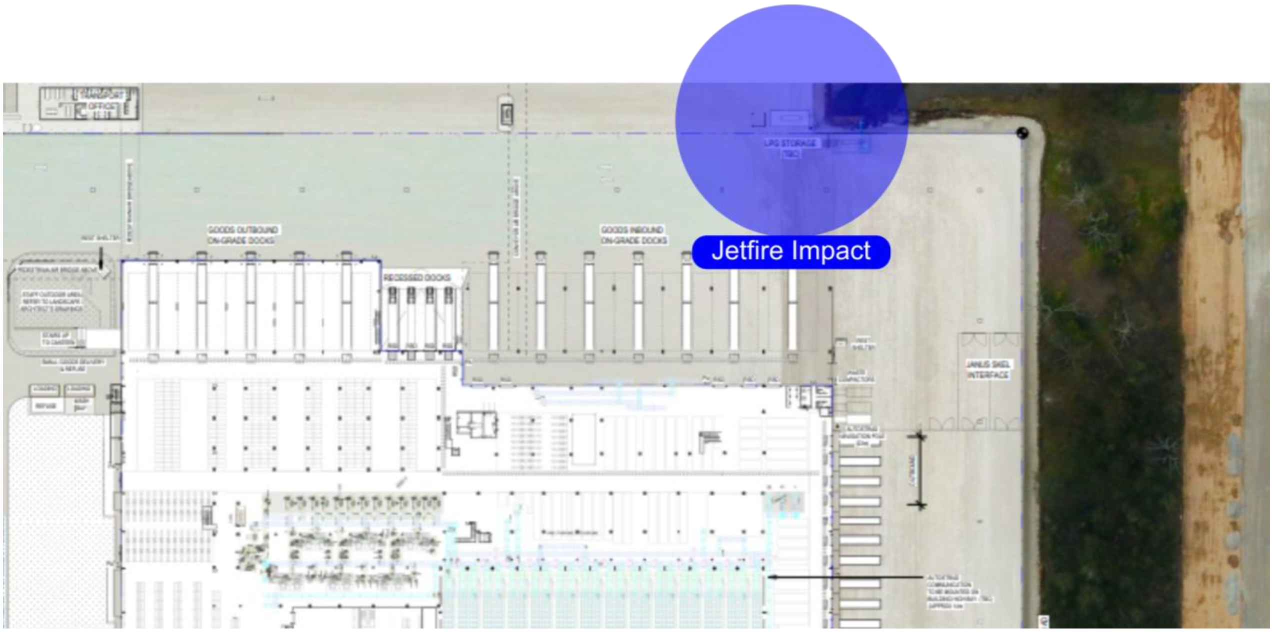

Figure 5-3: Impact from a Jet Fire

5.6 LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire and Impact on LPG Delivery Tanker and BLEVE

In the event of a jet fire and impingement on the delivery tanker there is potential for the LPG in the tanker to boil escalating to a BLEVE if intervention measures fail. A detailed analysis has been conducted in **Appendix B10** which indicates the diameter of the BLEVE would be 63.9 m and would last for 5.0 seconds. The impact distances for this incident are shown in **Figure 5-4**.

Similarly, to the jet fire scenario, several layers of protection are required to fail before the initiating event could occur. In addition, the jet fire would need to be impinged on the tanker before it could BLEVE which takes considerable time as the LPG must boil off such that the liquid level is below the impact point.

It is noted that a BLEVE scenario is a highly unlikely eventuality as it requires a jet fire scenario to occur with the associated impingement of the jet flame onto the tanker. Based upon the protections to prevent a jet fire, escalation to a BLEVE is unlikely. Nonetheless, for the scenario to further escalate where the BLEVE occurs, considerable time must pass which provides substantial potential for intervention which would include cooling of the impinged vessel.

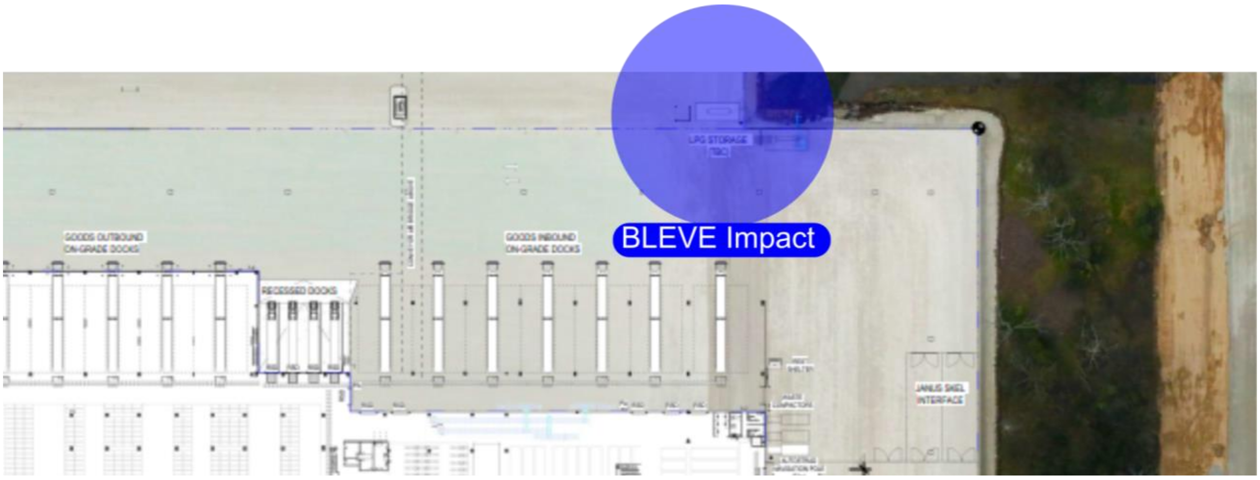

Figure 5-4: BLEVE Impact

5.7 LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire and Impact on LPG Tank and BLEVE

In the event of a jet fire and impingement on the LPG tank there is potential for the LPG in the tank to boil escalating to a BLEVE if intervention measures fail. A detailed analysis has been conducted in **Appendix B11** which indicates the diameter of the BLEVE would be 63.9 m and would last for 5 seconds. The impact distances for this incident are shown in **Figure 5-4** as this has the same fuel profile as the tanker scenario.

The eventuality of this scenario is the same as that analysed in **Section 5.6**, in that the initiating events are unlikely to occur, escalation takes time which allows substantial time for intervention should this unlikely event occur.

5.8 Fire in ErgoPal or High Bay and Propagation Between Storage Areas

In the event a fire occurred within the ErgoPal or the High Bay area it would create sufficient heat to activate the in-rack sprinklers which would control and suppress the fires and minimise propagation by cooling and wetting adjacent packages. Notwithstanding this, it was necessary to assess the potential fire scenarios which could occur within these areas to determine whether incident propagation could occur between the ErgoPal and High Bay and vice versa. A detailed analysis has been conducted in **Appendix B** with the results presented in **Table 5-4**.

Table 5-4: Radiant Heat from Sprinkler Controlled Fires within the ErgoPal & High Bay

Heat Radiation (kW/m^2)	Distance (m)			
	ErgoPal Base Case	ErgoPal Sensitivity	High Bay Base Case	High Bay Sensitivity
35	0.4	1.6	0.9	1.6
23	0.6	2.2	1.3	2.2

Heat Radiation (kW/m^2)	Distance (m)			
	ErgoPal Base Case	ErgoPal Sensitivity	High Bay Base Case	High Bay Sensitivity
12.6	1.0	3.2	1.9	3.2
4.7	1.8	5.6	3.3	5.6
3.0	2.3	7.1	4.2	7.1

Incident propagation would occur at radiant heat values of 23 kW/m^2 which was shown in the worst scenarios identified to occur at 2.2 m from the fire source. The distance between the ErgoPal and High Bay area is an aisle way of 3 m; hence, the radiant heat impacting in either direction would be insufficient to result in incident propagation between the areas.

Furthermore, the analysis does not take into account the reduction of transmissivity which would occur from the sprinklers discharging (i.e. the water spray attenuates radiant heat reducing the radiant heat transmitted through the air). Therefore, it is considered that the analysis provides a very conservative assessment which demonstrate radiant heat propagation would not occur.

In addition, the sprinkler systems have been designed and tested empirically where a successful test only occurs if propagation across an aisle way does not occur. Therefore, the above calculations would support the findings of the sprinkler system design (i.e. it is appropriate for the commodities to prevent incident propagation between the storage areas). As no incident propagation was identified to occur, it is considered that the protection systems are adequate to protect the commodities as required.

Based upon the above, the lateral spread of fire within both the ErgoPal and High Bay storage are controlled by in-rack sprinkler systems. For the ErgoPal the totes are protected by in-rack sprinklers which are provided at 3 m increments vertically. Each column of totes is protected by two (2) heads within each increment as shown in **Appendix D**. Above the ErgoPal are additional ceiling mounted sprinklers which will activate if the in-racks become overwhelmed providing additional cooling and control. Based upon the structure of the ErgoPal, the flow from ceiling mounted sprinklers would be able to penetrate the structure to provide the required cooling.

The High Bay system has four (4) sprinkler heads provided at the corner of each pallet column (i.e. columns stacked up to 9-12 m high have four heads directly above the top pallet immediately below the in-racks). Therefore, activation of the sprinkler heads will form a wall of water around the pallets beneath the sprinkler heads which will control and suppress and cool adjacent pallets to minimise the potential for lateral spread. The system has been designed to have 12 sprinkler heads operating to ensure if lateral spread occurs the system is able to continue to respond. The layout of the sprinklers is provided in **Appendix D**.

6.0 Details of Prevention, Detection, Protection and Mitigation Measures

The fire safety systems at the site can be split into four main categories:

- **Fire Prevention** – systems, installed to prevent the conditions that may result in initiating fire.
- **Fire Detection** – systems installed to detect fire and raise alarm so that emergency response can be affected (both evacuation and firefighting)
- **Fire Protection** – systems installed to protect against the impacts of fire or explosion (e.g. fire walls)
- **Fire Mitigation** – systems installed to minimise the impacts of fire and to reduce the potential damage (e.g. fire water application)

Each category has been reviewed in the following sections, with respect to the existing systems incorporated into the design and those to be provided as part of the recommendations herein.

6.1 Fire Prevention

This section describes the fire prevention strategies and measures that will be undertaken at the site.

6.1.1 Control of Ignition Sources

The control of ignition sources reduces the likelihood of igniting a release of material. The site has a number of controls for ignition sources. These include controls for fixed potential ignition sources and controls for introduced ignition sources.

- A permit to work or clearance system will be used - hot work will be controlled as part of the permit to work system.
- Hazardous area classification for areas containing flammable liquids or combustible dusts per the requirements of AS/NZS 60079.10.1:2009 (Ref. [12]).
- Electrical equipment selected for the classified hazardous area. Equipment is installed per the requirements of AS/NZS 60079.14:2017 (Ref. [18]).
- Designated smoking areas within the site (i.e. external from warehouse areas).

Table 6-1 presents the potential ignition sources and incidents for the facility which may lead to ignition and fire. The table also summarises the controls that will be used to reduce the likelihood of these potential sources of ignition and incidents resulting in a fire.

Table 6-1: Summary of Control of Ignition Sources

Ignition Source	Control
Smoking	No smoking policy for the site (i.e. within the warehouse) including processing and storage areas. Note: A designated smoking area is provided.
Housekeeping	The site will operate a housekeeping procedure to ensure accumulation of dust in delivery and processing areas does not occur. Limiting the accumulation of dust is an important method for minimising the potential for fires or dust dispersions.

Ignition Source	Control
Electrical	Fixed electrical equipment to be designed and installed to AS/NZS 3000:2007 (Ref. [19]). Equipment in hazardous areas installed per AS/NZS 60079.14:2017 (Ref. [18]).
Arson	The site will have a security fence and will be staffed during business hours.
Hot Work	A permit to work system and risk assessment prior to starting work will be provided for each job involving the introduction of ignition sources.

6.1.2 Separation of Incidents

The separation of incidents is used to minimise the impacts of a hazardous incident on the surrounding operations or the generation of potential "domino" effects. The storage locations of products have been designed based upon whether a product can be adequately protected by the fire protection system.

The DG products which pose a higher risk have been separated into a Special Goods Store (SGS) which has walls with an FRL of 240/240/240. Should the protection systems fail to control and suppress an incident, the passive protection of the bunker will prevent escalation of the incident into the main warehouse.

Other areas within the warehouse (i.e. ErgoPal and High Bay) have been separated from each other by an aisle space which has been demonstrated to show incident propagation from radiant heat would be unlikely to occur.

6.1.3 Housekeeping

The risk of fire can be significantly reduced by maintaining high standards of housekeeping. The site shall maintain a high housekeeping standard, ensuring all debris (e.g. waste packaging, etc.) that is released during transport, storage and processing is cleaned up and removed from the areas.

6.1.4 Work Practices

The following work practices will be undertaken to reduce the likelihood of an incident. They include;

- DG identification
- Placarding & signage within the site
- Forms of chemical and DG information
- Availability of Safety Data Sheets
- HAZCHEM code adherence
- Procedures for unlabelled containers
- Procedures for reporting damaged goods/accidents
- Safe work practices adhered to
- Personal Protective Equipment
- Emergency response plan and procedures
- First aid fire equipment

- Personal hygiene requirements
- Security
- Training of personnel
- Compatibility, segregation and safe storage of Dangerous Goods
- Hazardous area dossier (detailing zones, equipment, protection types and certification, etc.)
- Compliance with the Work Health and Safety Regulation 2017 (Ref. [7]).

6.1.5 Emergency Plan

An emergency plan, prepared in accordance with HIPAP No. 1 – Emergency Planning Guidelines (Ref. [20]), will be developed for the site as required by the Work Health and Safety Regulations 2017 (Ref. [7]). The emergency plan will clearly identify potential hazardous fire or explosion incidents and develop fire response procedures. The plan will also include evacuation procedures and emergency contact numbers as well as an onsite emergency response structure with allocated duties to various personnel on site. This will provide readiness response in the unlikely event of an incident at the site.

To ensure the above is captured, the following recommendation has been made:

- An Emergency Response Plan (ERP) shall be developed in accordance with HIPAP No. 1 – Emergency Planning Guidelines.
- An Emergency Services Information Package (ESIP) shall be prepared in accordance with the FRNSW guidelines to accompany the ERP.

6.1.6 Site Security

Maintaining a secure site reduces the likelihood either of a fire being started maliciously by intruders or by accident. Access to the site will be restricted at all times and only authorised personnel will be permitted within the site.

6.2 Detection Procedures and Measures

This section discusses the detection and protection from fires for the hazardous incidents previously identified. These include detection of fire pre-conditions, detection of a fire suppression activated condition and prevention of propagation. This assessment includes identification of the detection and protection systems required.

6.2.1 Detection of Leaks

All products are inspected for damage upon arrival at the site. Where damage is identified, these products are quarantined and not permitted to enter into warehouse storage. Undamaged products once stored are not expected to be damaged as they would be stored within the SGS with damage likely only to occur while an operator is present (i.e. during pallet movements).

Other products stored within the main warehouse (i.e. ErgoPal and High Bay) are non-DG products and so pose less of a risk if a leak were to occur as they are unlikely to ignite in the event of a release as they do not emit flammable vapours.

6.2.2 Smoke Detection

The warehouse and High Bay areas will be fitted with Multi Aspirated Smoke Detection using VESDA which will identify the presence of smoke from combustion early in the fire growth. The detector is linked to the Fire Indicator Panel (FIP) and will notify FRNSW in the event smoke is detected.

6.2.3 Fire Detection

The sprinkler systems are linked to the FIP which, if activated by fire, will notify FRNSW to the presence of a fire within the warehouse. The sprinkler systems are designed to respond quickly due to low temperature sensitivity of the bulbs allowing them to break and activate the system.

6.3 Fire Protection

The required fire protection systems have been outlined in Section 6 of the Fire Engineering Report (FER) produced by Core Engineering. These requirements are summarised below:

6.3.1 Fire Hydrants

A fire hydrant system shall be installed in accordance with Clause E1.3 of the BCA, and the relevant provisions of AS 2419.1:2005 and AS 2419.1:2017, except:

- External hydrant valves are permitted to apply the concession for the radiant heat shields in sprinkler protected buildings as detailed in the Performance Solution and AS 2419.1:2017.
- Dual hydrant valves external to the building envelope but positioned under the awning shall be treated as external hydrants for the purpose of coverage.
- When internal hydrants are required for coverage as per Clause 3.2.3.3 of AS 2419.1:2017 the hydrants shall be positioned to allow progressive movement of fire fighters from at least one entry point. Spacing shall be not more than 50 metres from an external hydrant, and then not more than 25 m to the next hydrant.
- When internal hydrants are provided a localised block plan should be provided at every hydrant pictorially and numerically illustrating the location of the next available additional hydrant. These localised block plans should be at least A4 size and be of all-weather fade resistant construction.

All hydrant valves shall possess a forging symbol and manufacturers mark and shall comply with Fire & Rescue NSW Fire Safety Guideline Technical Information (D15/45534).

6.3.2 Fire Hose Reels

A fire hose reel system shall be installed in accordance with Clause E1.4 of the BCA, and the relevant provisions of AS 2441:2005. However, due to the automated system access to areas with hose reel coverage may be difficult; hence, it has been proposed to use fire extinguisher coverage in lieu of fully compliant hose reel coverage as this is not a prescriptive requirement.

6.3.3 Portable Fire Extinguishers

Portable fire extinguishers shall be installed in accordance with Clause E1.6 of the BCA, and the relevant provisions of AS 2444:2001.

In the warehouse ABE type portable fire extinguishers are to be provided on each forklift or other manually operated piece of picking machinery or equipment.

6.3.4 Fire Sprinkler System

A sprinkler system in accordance with Building Code of Australia (NCC Vol. 1) Clause E1.5 and AS 2118.1:2017. The sprinkler system shall meet the following performance criteria:

- The sprinkler response time index (RTI) is to be no greater than $50m^{0.5}s^{0.5}$.
- Performance solution to use FM Global Data Sheet 8-9 in the High Bay area and Data Sheet 8-34 in the ErgoPal area in lieu of AS 2118.1:2017.

6.3.5 Building Occupant Warning System

A building occupant warning system in accordance with Building Code of Australia (NCC Vol. 1) Clause E2.2 and AS1670.1:2015.

The evacuation signal 1 shall include the words such as “Fire” and “Evacuate” inserted in the time period provided in ISO 8201, or a site-specific voice message as provided for in AS 4428.16.

6.3.6 Smoke Hazard Management

The smoke hazard management system is comprised of an automatic system segmented into two (2) zones for High Bay and remaining ridge portion. The smoke management system shall:

- Incorporate fans designed to operate at 200°C for a period no less than 60-minutes and fire rated cabling; and
- The capacity shall be per Section 5.7 of the FER:
    - High bay: 90,000 L/s
    - Remaining ridge portion: 60,000 L/s
- Shall be initiated by manual controls. The controls together with operating instructions for use by emergency personnel must be provided adjacent to the fire indicator panel in accordance with the requirements of clauses 4.11 and 4.13 of AS/NZS 1668.1; and
- Have fans positioned at natural collection points for the hot smoky gases, having due regard to the ceiling/roof geometry and its effect on the migratory path of the smoke; and
- Make up air for each warehouse is to be provided by permanent openings or by way of louvres or roller shutters that automatically open on fire detection.

6.3.7 Emergency Lighting and Exit Signs

Emergency lighting and exit signs shall be installed in accordance with Clauses E4.2, E4.4, E4.5, E4.6 and E4.8 of the BCA, and the relevant provisions of AS 2293.1:2005.

All drawings associated with the fire protection systems are provided in **Appendix D**.

6.4 Fire Mitigation

6.4.1 Fire Water Supply

The street mains will provide fire water supply to the hydrant ring main and the onsite fire water tanks. The onsite fire water tank is filled directly from the street mains. The sprinkler system will be serviced by an onsite pump set which consists of 2 diesel pumps operating with a primary duty pump and a secondary standby pump. The location of the hydrant main, fire hydrants and hose reels are shown in the drawing package attached to the report submission.

Pumps are started monthly and a complete test of the hydrants, pumps and sprinklers systems is conducted each year and a fire safety statement is to be produced in accordance with Environmental Planning and Assessment Regulation 2000 (Ref. [21]).

7.0 Local Brigade Access and Egress

7.1 Overview

In order to assess the likely fire brigade response times an indicative assessment of fire brigade intervention has been undertaken based on the methods defined in the Fire Brigade Intervention Model (FBIM, Ref. [22]). These are further explored in the Fire Engineering Report (FER) produced by LCI Consultants.

7.2 Assessment

To ensure consistency between the FER and the FSS, the findings of the analysis conducted by LCI Consultants has been reproduced within this report. The analysis by LCI is performed in a spreadsheet which has been reproduced in **Appendix E**.

The analysis assesses the time it takes for the most disadvantage attending brigade (i.e. furthest from the site) to attend the site. The findings indicate it would take 51.4 minutes for the appliance to travel to the site, dismount, firefighters to don equipment, and investigate the fire. It would then take a further 41.1 minutes for the attending firefighters to search the facility and enact a rescue if required. Therefore, to complete the travel, investigation, search, and rescue would take approximately 93 minutes.

8.0 Fire Water Supply & Contaminated Fire Water Retention

8.1 Detailed Fire Water System Assessment

A hydrant system has been designed for the facility to comply with the BCA and also in consultation with FRNSW to ensure all credible scenarios can be combatted in the event of a fire. A detailed pressure loss analysis has been performed in **Appendix C** to ensure the pressure at the most hydraulically disadvantaged hydrant is above the minimum requirements of the BCA and AS 2419.5-2005 (Ref. [23]).

The Worst Credible Case Fire Scenario (WCCFS) was modelled based upon the application of three (3) hydrant hoses operating to combat a fire resulting in a flow of 30 L/s. The site is provided by fire water supplied by the estate which is provided at the entrance at a pressure of 950 kPa. The most disadvantaged hydrant is labelled L2 which is located in the centre of the building by the egress stair (Grid WJ/W10).

The results of the analysis with 30 L/s flowing at this location was an available pressure of 718 kPa. The design limits per AS 2419.1:2017 is for the hydrants to exceed 700 kPa in the WCCFS. As the pressure was identified to be 718 kPa there will be sufficient available pressure for the hydrant to be used.

Therefore, it is considered the hydrant system is compliant with AS 2419-2005 (Ref. [23]) as required based upon the modelling conducted in **Appendix C**.

8.2 Contaminated Water/Fire Water Retention

Where materials are combusted in a fire, they may become toxic (i.e. formation of volatile organic compounds and aromatic hydrocarbons). Hence, when fire water is applied the materials may mix with the water resulting in a contaminated run off. To ensure environmental damage does not occur the facility is designed to contain a volume of liquid discharged from the site.

In a DG fire scenario, the following protection systems are likely to be discharging:

- SMSS with 12 K22 heads operating at 0.455 m^3/min resulting in 5.46 m^3/min for 90 minutes
- 3 hydrant hoses each at 1.8 m^3/min for 90 minutes.

Therefore, the total discharge for all systems is 7.26 m^3/min x 90 = 653.4 m^3. The required water containment will be provided in a combination of recess dock storage, drainage systems and the retaining wall structure drainage. A layout of the proposed containment solution has been provided in **Appendix F**.

9.0 Conclusion and Recommendations

9.1 Conclusions

A Fire Safety Study per the HIPAP No. 2 guidelines was prepared for the Woolworths Warehouse JN as required by Condition B174B of the Conditions of Consent. In addition, the FSS assessed all incidents that could occur at the site and was developed in consultation with FRNSW per the minutes in **Appendix G**.

The analysis performed in the FSS was based on the credible fire scenarios to assess whether the protection measures at the site were adequate to combat the hazards associated with the quantities and types of commodities being stored. Based on the assessment, it was concluded that the designs and existing fire protection adequately managed the risks.

9.2 Recommendations

Based on the analysis, the following recommendations have been made:

- All site personnel are to be trained in specific site procedures, emergency and first aid procedures and the use of fire extinguishers and hose reels.
- A storm water isolation point (i.e. penstock isolation valve) shall be incorporated into the design. The penstock shall automatically isolate the storm water system upon detection of a fire (smoke or sprinkler activation) to prevent potentially contaminated liquids from entering the water course.
- A spill kit suitable for the commodities being stored shall be provided for the DG store and a separate spill kit provided for the forklift transport areas.
- The warehouse and/or site boundaries shall be capable of containing 653.4 m^3 which may be contained within the warehouse footprint, site stormwater pipework and any recessed docks or other containment areas that may be present as part of the site design.
- Site management to prepare and maintain operational procedures to minimise the number of hazardous incidents and accidents on site and to mitigate the consequences of incidents regarding the handling of dangerous goods and chemicals.
- An Emergency Response Plan (ERP) shall be developed in accordance with HIPAP No. 1 – Emergency Planning Guidelines.
- An Emergency Services Information Package (ESIP) shall be prepared in accordance with the FRNSW guidelines to accompany the ERP.
- Woolworths shall engage with local FRNSW stations to undertake training and familiarisation of the automated system at a minimum of once (1) per year.
- A hazardous area classification in accordance with AS/NZS 60079.10.1:2009 shall be prepared to identify where hazardous areas may exist.
- Where electrical equipment is installed within a hazardous area, the equipment shall comply with AS/NZS 60079.14:2017.
- DG documentation shall be prepared as required by the Work Health and Safety Regulation 2017 to demonstrate the risks associated with the storage and handling of DGs has been assessed and minimised.

- The DG storages shall be appropriately placarded per the requirements of the Work Health and Safety Regulation 2017.

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[25] Standards Australia, AS 1940-2017 - Storage and Handling of Flammable and Combustible Liquids, Sydney: Standards Australia, 2017.

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Appendix A

Hazard Identification Table

Appendix A

A1. Hazard Identification Table

ID	Area/Operation	Hazard Cause	Hazard Consequence	Safeguards
1	Warehouse	• Dropped pallet • Damaged packaging (receipt or during storage) • Deterioration of packaging	• Release of Class 2.1, 3, 4.1, 5.1, 6.1, 8s, 9s and other products to the environment	• Small retail sized packages (< 20 L) • Inspection of packages upon delivery to the site. • Trained forklift operators (including spill response training). • Storage of DGs within AS/NZS 3833:2007 compliant store (Ref. [6])
2		• Dropped pallet • Damaged packaging (receipt or during storage) • Deterioration of packaging	• Spill of flammable liquids, evolution of flammable vapour cloud ignition and vapour cloud explosion/flash fire • Spill of flammable liquids, ignition and pool fire/racking fire • Ignition of Class 1.4s materials	• Small retail sized packages (< 20 L) • Inspection of packages upon delivery to the site • Control of ignition sources according to AS/NZS 60079.14:2017 (Ref. [10]) • Automatic fire protection system (in-rack and SMSS) • First attack fire-fighting equipment (e.g. hose reels & extinguishers) • Fire detection systems • Storage of DGs within AS/NZS 3833:2007 compliant store (Ref. [6])
3		• Heating of Class 2.1 from a general warehouse fire	• Rupture, ignition and explosion/rocketing of cylinder within warehouse spreading fire	• Aerosols stored in 240/240/240 FRL bunker • In-rack sprinklers according to FM Global Data Sheet 7-31 (Ref. [24]) • Automatic fire protection system
4	Sprinkler activation	• Fire activates SMSS resulting in fire water release and potential contaminated fire water offsite	• Environmental impact to surrounding areas (e.g. stormwater drainage)	• Dangerous Goods Stores are bunded to contain in excess of the maximum required fire water, per AS/NZS 3833:2007 (Ref. [6])

ID	Area/Operation	Hazard Cause	Hazard Consequence	Safeguards
				• Site drainage to comply with the Best Practice Guide for Potentially Contaminated Water Retention and Treatment Systems (Ref. [11])
5	Pallet Loading/Unloading	• Dropped containers from the pallet • Impact damage to containers on the pallet (collision with racks or other forklifts)	• Spill of flammable liquids, evolution of flammable vapour cloud ignition pool, fire under the pallet • Full pallet fire as a result of fire growth	• Trained & licensed forklift drivers • First attack fire-fighting equipment (hose reels & extinguishers) • SMSS if incident occurs internally • No potential for fire growth beyond the single pallet (limited stock externally)
6	Diesel tank refuelling tank	• Loss of containment of diesel fuel during fuel transfers • Loss of hose connection during fuel transfers • Loss of containment of diesel storage tank • Loss of containment of tanker vehicle • Overfilling of tank • Vehicle collision resulting in damage	• Release of diesel to the environment	• Storage area to comply with AS 1940-2017 (Ref. [25]) • Storage tank to comply with AS 1692-2006 (Ref. [26]) • Spill containment for delivery vehicles • Self-bunded tank • Vehicle impact protection • Delivery area to comply with SC6.28 (Ref. [27]) • Overfill protection
7			• Release of diesel, ignition and fire	• Storage area to comply with AS 1940-2017 (Ref. [25]) • Storage tank to comply with AS 1692-2006 (Ref. [26]) • Spill containment for delivery vehicles • Self-bunded tank • Vehicle impact protection • Overfill protection

ID	Area/Operation	Hazard Cause	Hazard Consequence	Safeguards
				• Low ignition probability due to high flash point of diesel (i.e. flash point above ambient conditions)
8	LPG Tank	• Releases from pipework due to corrosion, flange leaks, hose/pump leaks, weld failure, operator error, maintenance error, mechanical damage (e.g. tanker impact on fill point) etc. • Overfilling of tank due to operator error (incorrect tank reading) • Overfilling of tanker due to equipment fault or procedures not followed (e.g. leaving operation unattended). • Hose failure or coupling failure or coupling not properly engaged during transfers due to mechanical damage or undetected wear and tear or operator error. • Drive away with hoses attached.	• Minor leak (5 mm hole) • Major leak (50 mm hole) • If ignition then: ○ Flash fire, jet fire, pool fire, VCE or BLEVE (tanker), possible explosion if enters drains, and potentially hazardous heat radiation, direct fire involvement, and/or overpressure/ projectiles. • Potential fire propagation to adjacent sites.	• LPG facilities to be designed to comply with AS/NZS 1596:2014 (Ref. [14]) and will be installed by an experienced LPG facility supply company. • Tank and associated pipework/fitting will be pressure tested in accordance with the requirements of the pressure vessels code • Ignition source control including earthing to prevent static sparks. • Hoses tested annually as per AS/NZS 1596:2014 and the ADG (Ref. [13]) • Excess flow valves installed in pipework. • Valves to fill point closed until air connected to truck. • Valves shut on breaking of air connection to truck. • All staff including contract drivers will be trained in the specific transfer operations at the site. • Tanker fitted with Emergency Shut Down • Excess flow valve on tanker • Manual shutdown valve • Non-return valve on delivery line • Emergency Shutdown on delivery line • Manual valve on delivery line • Overfill protection device • Fusible link on tanker and vessel

ID	Area/Operation	Hazard Cause	Hazard Consequence	Safeguards
9	LPG Cylinders	• Damage to cylinders, valves, pipework, etc	• Minor leaks which may result in gas accumulation, ignition, and flash fire or explosions	• Minor storage under AS 4332-2004 (Ref. [28]) • Relatively low volume of gas prevents accumulation to levels which may have offsite impacts • Adequately ventilated • Hazardous area classification per AS/NZS 60079.10.1:2009 (Ref. [12]) • Electrical equipment controlled per AS/NZS 60079.14:2017 (Ref. [10])
10	ErgoPal	• Ignition of packaging / other goods	• Sprinkler controlled fire within ErgoPal and potential for propagation to High Bay storage • Uncontrolled fire in ErgoPal and potential for propagation to High Bay	• In-rack sprinklers throughout ErgoPal • Ceiling mounted sprinklers above ErgoPal • No Dangerous Goods stored within ErgoPal

Appendix B

Consequence Analysis

Appendix B

B1. Incidents Assessed in Detailed Consequence Analysis

The following incidents are assessed for consequence impacts.

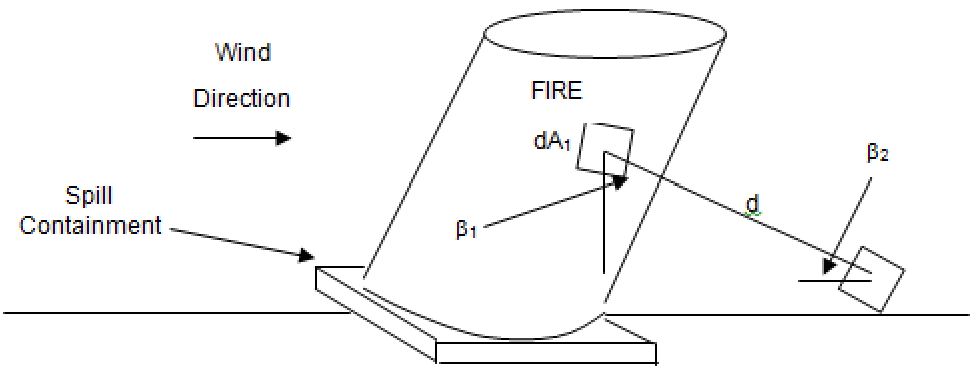
- Flammable material spill, ignition and racking fire.
- Full warehouse fire and radiant heat.
- Full warehouse fire and toxic smoke emission.
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire.
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire and impact on LPG delivery tanker and Boiling Liquid Expanding Vapour Explosion (BLEVE).
- LPG unloading incident, hose rupture, LPG release, ignition and jet fire and impact on LPG tank and BLEVE.
- Fire in ErgoPal or High Bay and propagation between storage areas.

Each incident has been assessed in the sections below.

B2. Spreadsheet Calculator (SSC)

The SSC is designed on the basis of finite elements. The liquid flame area is calculated as if it is a circle to find the radius for input into the SSC model.

The SSC is designed on the basis of finite elements. The liquid flame area is calculated as if it is a circle to find the radius for input into the SSC model. **Appendix Figure B-1** shows a typical pool fire, indicating the target and fire impact details.



Appendix Figure B-1: Heat Radiation on a Target from a Cylindrical Flame

A fire in a bund or at a tank roof will act as a cylinder with the heat from the cylindrical flame radiating to the surrounding area. A number of mathematical models may be used for estimating the heat radiation impacts at various distances from the fire. The point source method is adequate for assessing impacts in the far field; however, a more effective approach is the view factor method, which uses the flame shape to determine the fraction of heat radiated from the flame to a target. The radiated heat is also reduced by the presence of water vapour and the amount of carbon dioxide in air. The formula for estimating the heat radiation impact at a set distance is shown in **Equation B-1** (Ref. [17]).

$$Q = EF\tau \qquad \textbf{Equation B-1}$$

Where:

- Q = incident heat flux at the receiver (kW/m^2)
- E = surface emissive power of the flame (kW/m^2)
- F = view factor between the flame and the receiver
- τ = atmospheric transmissivity

The calculation of the view factor (F) in **Equation B-1** depends upon the shape of the flame and the location of the flame to the receiver. F is calculated using an integral over the surface of the flame, S (Ref. [17]). The formula can be shown as:

$$F = \int\int_S \frac{\cos\beta_1 \cos\beta_2}{\pi d^2}$$ **Equation B-2**

Equation B-2 may be solved using the double integral **or** using a numerical integration method in spread sheet form. This is explained below.

For the assessment of pool fires, a Spread Sheet Calculator (SCC) has been developed, which is designed on the basis of finite elements. The liquid flame area is calculated as if the fire is a vertical cylinder, for which the flame diameter is estimated based on the fire characteristics (e.g. contained within a bund). Once the flame cylindrical diameter is estimated, it is input into the SSC model. The model then estimates the flame height, based on diameter, and develops a flame geometric shape (cylinder) on which is performed the finite element analysis to estimate the view factor of the flame. **Appendix Figure B-1** shows a typical pool fire, indicating the target and fire impact details.

The SSC integrates the element dA_1 by varying the angle theta θ (the angle from the centre of the circle to the element) from zero to 90^o in intervals of 2.5 degrees. Zero degrees represents the straight line joining the centre of the cylinder to the target (x0, x1, x2) while 90^o is the point at the extreme left hand side of the fire base. In this way the fire surface is divided up into elements of the same angular displacement. Note the tangent to the circle in plan. This tangent lies at an angle, gamma, with the line joining the target to where the tangent touches the circle (x4). This angle varies from 90^o at the closest distance between the liquid flame (circle) and the target (x0) and gets progressively smaller as θ increases. As θ increases, the line x4 subtends an angle phi Φ with x0. By similar triangles we see that the angle gamma γ is equal to 90- θ - Φ . This angle is important because the sine of the angle give us the proportion of the projected area of the plane. When γ is 90^o, sin(γ) is 1.0, meaning that the projected area is 100% of the actual area.

Before the value of θ reaches 90^o the line x4 becomes tangential to the circle. The fire cannot be seen from the rear and negative values appear in the view factors to reflect this. The SSC filters out all negative contributions.

For the simple case, where the fire is of unit height, the view factor of an element is simply given by the expression in **Equation B-3** (Derived from **Equation B-2**):

$$VF = \Delta A \frac{\sin\gamma}{\pi \times X4 \times X4}$$ **Equation B-3**

Where ΔA is the area of an individual element at ground level.

Note: the denominator (π. x4. x4) is a term that describes the inverse square law for radiation assumed to be distributed evenly over the surface of a sphere.

Applying the above approach, we see the value of x4 increase as θ increase, and the value of sin(γ) decreases as θ increase. This means that the contribution of the radiation from the edge of the circular fire drops off quite suddenly compared to a view normal to the fire. Note that the SSC adds up the separate contributions of **Equation B-3** for values of θ between zero until x4 makes a tangent to the circle.

It is now necessary to do two things: (i) to regard the actual fire as occurring on top of a fire wall (store) and (ii) to calculate and sum all of the view factors over the surface of the fire from its base to its top. The overall height of the flame is divided into 10 equal segments. The same geometric technique is used. The value of x4 is used as the base of the triangle and the height of the flame, as the height. The hypotenuse is the distance from target to the face of the flame (called X4'). The angle of elevation to the element of the fire (alpha α) is the arctangent of the height over the ground distance. From the cos(α) we get the projected area for radiation. Thus there is a new combined distance and an overall equation becomes in **Equation B-4 ((**Derived from **Equation B-3**):

$$VF = \Delta A \frac{\sin\gamma \times \cos\alpha}{\pi \times X4 \times X4}$$ **Equation B-4**

The SCC now turns three dimensional. The vertical axis represents the variation in θ from 0 to 90º representing half a projected circle. The horizontal axis represents increasing values of flame height in increments of 10%. The average of the extremes is used (e.g. if the fire were 10 m high then the first point would be the average of 0 and 1 i.e. 0.5 m), the next point would be 1.5 m and so on).

Thus the surface of the flame is divided into 360 equal area increments per half cylinder making 720 increments for the whole cylinder. Some of these go negative as described above and are not counted because they are not visible. Negative values are removed automatically.

The sum is taken of the View Factors in **Equation B-3**. Actually the sum is taken without the ∆A term. This sum is then multiplied by ∆A which is constant. The value is then multiplied by 2 to give both sides of the cylinder. This is now the integral of the incremental view factors. It is dimensionless so when we multiply by the emissivity at the "face" of the flame (or surface emissive power, SEP), which occurs at the same diameter as the fire base (pool), we get the radiation flux at the target.

The SEP is calculated using the work by Mudan & Croche (Ref. [16] & Ref. [17]) which uses a weighted value based on the luminous and non-luminous parts of the flame. The weighting is based on the diameter and uses the flame optical thickness ratio where the flame has a propensity to extinguish the radiation within the flame itself. The formula is shown in **Equation B-5**.

$$SEP = E_{max}e^{-sD} + E_s(1 - e^{-sD})$$ **Equation B-5**

Where;

E_{max} = 140

S = 0.12

E_s = 20

D = pool diameter

The only input that is required is the diameter of the pool fire and then estimation for the SEP is produced for input into the SSC.

The flame height is estimated using the Thomas Correlation (Ref. [17]) which is shown in **Equation B-6**.

$$H = 42d_p \left[\frac{\dot{m}}{\rho_a\sqrt{gd_p}}\right]^{0.61}$$ **Equation B-6**

Where;

d_p = pool diameter (m)

ρ_a = density of air (1.2 kg/m^3 at 20°C)

$\dot{m}$ = burning rate (kg/m^2.s)

g = 9.81 m/s^2

The transmissivity is estimated using **Equation B-7** (Ref. [17]).

$$\tau = 1.006 - 0.01171(\log_{10} X(H_2O) - 0.02368(\log_{10}X(H_2O))^2 - 0.03188(\log_{10} X(CO_2) + 0.001164(\log_{10}X(CO_2))^2$$ **Equation B-7**

Where:

- τ = Transmissivity (%)
- X(H_2O) = $\frac{R_H \times L \times S_{mm} \times 2.88651 \times 10^2}{T}$
- X(CO_2) = $\frac{L \times 273}{T}$

and

- R_H = Relative humidity (% expressed as a decimal)
- L = Distance to target (m)
- S_{mm} = saturated water vapour pressure in mm of mercury at temperature (at 25°C S_{mm} = 23.756)
- T = Atmospheric temperature (K)

B3. Jet Fire Modelling

The flow rate of a liquid from a hole may be calculated from **Equation B-8** (Ref. [29]).

$$m = C_d A(2\rho\Delta P)^{0.5}$$ **Equation B-8**

Where:

- m = Mass flow rate (kg/s)
- C_d = Discharge coefficient (0.6 for irregular holes)
- A = area of the orifice (m^2)
- ρ = Density of the material (kg/m^3)
- ΔP = Pressure difference across the orifice (Pa).

The flame length and width, as a result of a release, can be estimated from the empirical formula published by Lees (Ref. [16]). The equations for the length and width are shown in **Equation B-9** and **Equation B-10**.

$$L = 9.1{G_L}^{0.5}$$ **Equation B-9**

Where:

- L = Length (m)
- G_L = Mass flow rate (kg/s)

$$W = 0.25L$$ **Equation B-10**

Where:

- W = Width (m)
- L = Length (m)

B4. BLEVE Modelling

The diameter of the fireball and the duration of the BLEVE may be estimated using the following formulae (Ref. [29]):

$$D = 6.48m^{0.325}$$ **Equation B-11**

$$t = 0.852m^{0.25}$$ **Equation B-12**

Where:

- D = diameter of the fire ball (m)
- m = mass of LPG in the tank (kg)
- t = duration of the BLEVE (seconds)

B5. Radiant Heat Physical Impacts

Appendix Table B-1 provides noteworthy heat radiation values and the corresponding physical effects of an observer exposed to these values (Ref. [3]).

Appendix Table B-1: Heat Radiation and Associated Physical Impacts

Heat Radiation (kW/m^2)	Impact
35	• Cellulosic material will pilot ignite within one minute's exposure • Significant chance of a fatality for people exposed instantaneously
23	• Likely fatality for extended exposure and chance of a fatality for instantaneous exposure • Spontaneous ignition of wood after long exposure • Unprotected steel will reach thermal stress temperatures which can cause failure • Pressure vessel needs to be relieved or failure would occur
12.6	• Significant chance of a fatality for extended exposure. High chance of injury • Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure • Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure
4.7	• Will cause pain in 15-20 seconds and injury after 30 seconds exposure (at least second degree burns will occur)

Heat Radiation (kW/m²)	Impact
2.1	• Minimum to cause pain after 1 minute

B6. Flammable Material Spill, Ignition and Racking Fire

In the event that a flammable liquid package is damaged and flammable liquid is released the volatile component will vaporise which may contact an ignition source resulting in a pool fire. As the fire grows it may accelerate the deterioration of other packages resulting in failure and release of additional flammable material and combustion of packaging.

As heat and smoke is generated from the fire, the in-rack sprinklers and the SMSS will activate. Two sprinkler activation scenarios have been assessed:

- A worst credible (WC) scenario whereby the first row of the SMSS activates and controls the spread of a fire.
- A sensitivity scenario whereby the first row of sprinklers fails to activate and the fire is instead controlled by the second row of the SMSS.

The first row of sprinklers has an approximate diameter of 3 m with the second row having an approximate diameter of 9 m. These diameters are used to estimate the flame height and SEP for the fire scenarios. To estimate the flame height and SEP the following information was substituted into the models:

- Equivalent fire diameter: WC – 3 m, Sensitivity - 9 m
- Burning rate – 0.0667 kg/m^2.s (this value encompasses a large range of flammable liquid burning rates and is considered conservative due to the nature of the flammable liquids stored, Ref. [16])

The selection of a flammable liquid burning rate is considered appropriate and conservative as a the fire will be composed of burning flammable liquids and packaging. The packaging is a solid material that will yield a lower burning rate than selected as it requires an additional phase change prior to combustion reducing the rate at which the product burns.

Furthermore, the analysis is considered incredibly conservative as it assumes a 100% burning area; however, as the subject areas will encompass aisle spaces, which will have no combustible material stored these locations. Therefore, it is considered the results generated from this analysis would substantially overestimate the radiant heat impacts from the identified scenarios.

The results for flame height and SEP for each scenario are summarised in **Appendix Table B-2**.

Appendix Table B-2: Flame Height and SEP for a Flammable Material Sprinkler Controlled Fire

Output	Base Case	Sensitivity
Flame Height (m)	7.7	16.5
SEP (kW/m²)	103.7	60.8

The inputs summarised in **Appendix Table B-2** were input in to the SSC with the results for each scenario shown in **Appendix Table B-3**.

Appendix Table B-3: Heat Radiation from a Flammable Material Sprinkler Controlled Fire

Heat Radiation (kW/m^2)	Distance (m)	
	Base Case	Sensitivity
35	4.6	8.5
23	5.6	10.3
12.6	7.5	13.7
4.7	12.0	22.2
3.0	14.9	27.5

B7. Full Warehouse Fire

To estimate the impact of a full warehouse the area of storage has been used to estimate a diameter of the fire. The DGs are located within the JN warehouse; hence, the storage areas within this facility have been modelled. While it is considered unlikely for a fire to propagate from the SGS into the main warehouse due to the fire walls, this could potentially occur. The area where product is stored within the warehouse has an approximate area of 21,000 m^2. The equivalent diameter for the fire can be calculated by:

$$D = \sqrt{\frac{4 \times 21{,}000}{\pi}} = 163.5\, m$$

Provided in **Appendix Table B-4** is a summary of the DGs which may be stored across JR or JN, the applicable burning rates based on commodities stored and the contribution of each product to the total burning rate. It is considered this methodology is highly conservative as not all products are stored within the one warehouse and that other non-DG products are contained within the warehouse which would result in the average burning rate trending downward.

Appendix Table B-4: Estimation of Average Burning Rate

Class	Quantity (kg)	% of Total Quantity	Burning Rate (kg/m^2.s)	Burning Rate Based on %
2.1	40,000	17%	0.099	0.0167
3	91,500	39%	0.067	0.0259
4.1	5,150	2%	0.022	0.0005
5.1	2,800	1%	0.022	0.0003
8	97,000	41%	0.022	0.0090
Total	**236,450**	**100**	-	**0.0524**

The following information was input into the models;

- Equivalent fire diameter – 163.5 m
- Burning rate – 0.0524 kg/m^2.s
- Fire wall height: no fire wall

The models provided the following information for the warehouse fire;

- SEP – 20 kW/m^2
- Flame Height - 107 m (from model without roof restriction)

Provided in **Appendix Table B-5** are the results generated by the SSC.

Appendix Table B-5: Heat Radiation Impacts from a Full Warehouse Fire

Heat Radiation (kW/m^2)	Distance (m)
35	Maximum heat flux is 20*
23	Maximum heat flux is 20*
12.6	38.0
4.7	85.0
3.0	115.0

* Research conducted in relation to large fires (Ref. [17]) indicates that where a large fire occurs, it is difficult for complete combustion to occur towards the centre of the fire due to the lack of air being unable to reach the centre of the flames. Hence, combustion tends to occur effectively at the fire surface, but poorly towards the centre of the fire. This generates large quantities of black smoke, which shields the flame surface as the smoke from the centre of the fire escapes towards the outer fire surface. The research presented in Lees (Ref. [16]) indicates that fires will generate a SEP within a range of between 20 kW/m^2 for larger fires and 130 kW/m^2 for smaller fires. Hence, a full warehouse fire would be of significant dimensions, generating large quantities of black smoke, shielding the flames at the fire surface. Hence, for the analysis of a full warehouse fire in this study, an SEP value of 20 kW/m^2 has been used.

B8. Full Warehouse Fire and Smoke Emission

During the fire, uncombusted toxic products may be present in the smoke plume or toxic bi-products may be generated which will be dispersed in the smoke plume. It is necessary to assess the associated impacts of the smoke plume downwind of the facility as it may have far reaching impacts on the wider community. When assessing the downwind impacts of the fire plume, the main contributors to the dispersion are:

- The fire size (diameter) and energy released as convective heat
- The atmospheric conditions such as wind speed, relative humidity, atmospheric stability and ambient temperature.

These parameters interact to determine the buoyancy of the smoke plume (vertical rise) which is controlled by the convective energy within the smoke plume in addition to the atmospheric conditions. The atmospheric conditions will vary from stable conditions (generally night time) to unstable conditions (high insolation from solar radiation) which results in substantial vertical mixing which aids in the dispersion. Contributing to this is the impact of wind speed which will limit the vertical rise of a plume but may exacerbate the downwind impact distance.

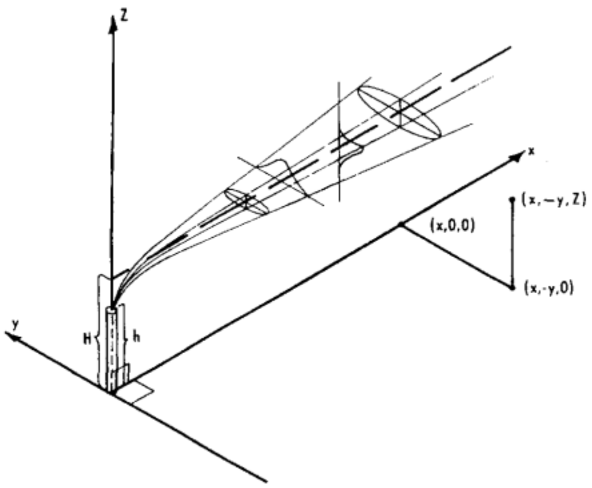
The atmospheric conditions are classified as Pasquill Guifford's Stability categories which are summarised in **Appendix Table B-6** (Ref. [17]).

Appendix Table B-6: Pasquill's Stability Categories

Surface wind speed at 10 m height (m/s)	Insolation			Night	
	Strong	Moderate	Slight	Thinly overcast or ≥50% cloud	<50% cloud.
<2	A	A-B	B	-	-
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

Generally, the most onerous conditions are F conditions which result in stable air masses and typically have inversion characteristics. Inversion characteristics occur when a warm air mass sits above a cold air mass. Typically, hot air will rise due to lower density than the bulk air; however, in an inversion, a warm air mass sits above the cooler denser air; hence, as the warm air rises through the cold mass it hits a 'wall' of warmer air preventing vertical mixing above this point. In a fire scenario, the hot smoke plume will cool as it rises; however, if it encounters an inversion, it will begin to run along this boundary layer preventing vertical mixing and allowing the smoke plume to spread laterally for substantial distances.

A smoke plume is buoyant, and will disperse laterally and vertically as it rises essentially following a Gaussian dispersion as shown in **Appendix Figure B-2** (Ref. [17]).



Appendix Figure B-2: Co-ordinate System for Gas Dispersion

Ian Cameron, professor of Risk Engineering at the University of Queensland, has developed a risk assessment tool known as Risk Assessor produced by DAESIM Technologies. The tool has numerous risk engineering applications; however, the component of interest for this assessment is the smoke plume modelling from fire scenarios. The model has been developed based on a Gaussian dispersion model accounting for modifications to the plume drag coefficients required to model a plume dispersion from a warehouse fire (Ref. [17]).

The model requires several inputs which have been summarised in **Appendix Table B-7** with the associated value input as part of this modelling exercise. As noted, the more onerous conditions occur during stable air conditions which allow far reaching effects with reduced dispersion due to low air velocities and vertical mixing. The industry standard for modelling this scenario is selection of F1.5 (F stability at 1.5 m/s wind velocity) which has been adopted for this assessment.

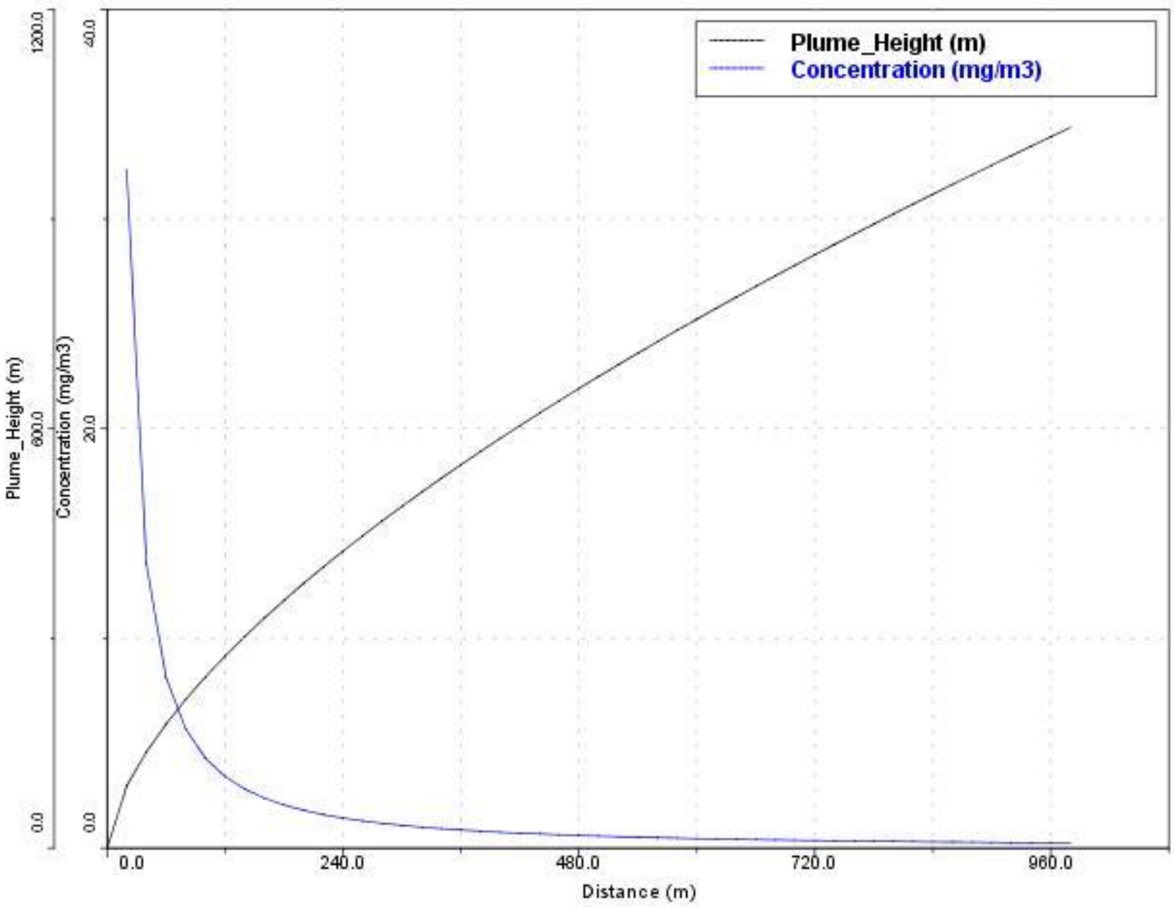
Appendix Table B-7: Input Data for Plume Gaussian Dispersion

Input	Selected Values	Justification
Max burning rate (kg/m^2.s)	0.0524	Taken from full warehouse fire above
Warehouse Area	61,754	Warehouse Area
Heat of combustion (kJ/kg)	21,000	Heat of combustion for combustible liquid (diesel) Ref. [30]
Fraction energy radiated	0.5	Conservative assumption based on high radiant heat blocking which occurs from dense smoke
Pollutant Rate (kg/s)	80,000	Burning rate multiplied by area multiplied 2/3 (amount of space allocated for racking) by 7 (number of racks) multiplied by 6 (number of surfaces on a pallet that can burn)
Wind speed (m/s)	1.5	Industry standard
Stability	F	Industry standard

Provided in **Appendix Figure B-3** is an overlayed plot of plume smoke concentrations and plume height with distance. The analysis is based on the F stability; however, the Gaussian dispersion is unable to model temperature inversions. The response of the smoke plume to an inversion will depend on the height that the plume interacts with the inversion. At low altitudes, the smoke plume will have substantial heat and will ‘punch through’ the inversion and continue a Gaussian dispersion as expected. However, with increasing height, the plume will cool which may equalise at a temperature less than the inverted air mass. Subsequently, the plume will level out at the point of the inversion.

The worst-case concentration occurs in the initial phases of the fire and rapidly decrease with distance from the fire. It has been assumed that an inversion occurs at low level and the plume has insufficient heat to ‘punch through’ the inversion and remains trapped relatively close to the ground. A maximum value of 15 mg/m^3 has been selected per **Appendix Figure B-3** that may impact the surrounding area with regards to potential toxic bi-products of combustion.

Toxic products are a minor quantity of materials stored within the warehouse. Therefore, the mass of other products burning generating toxic bi-products of combustion far exceeds the quantity of toxic products that could be release in the smoke plume considering the majority of the toxic products will be combusted. Therefore, it is considered conservative to apply the toxic bi-products of combustion concentration to any toxic products stored in the warehouse.



Appendix Figure B-3: Plume Concentration and Plume Height vs Distance

Provided in **Appendix Table B-8** is a summary of several toxic products of combustion which may be present in the smoke plume and their acceptable concentration of exposure for the Acute Exposure Guideline Levels (AEGL). These levels provide guidance on exposure concentrations for general populations, including susceptible populations over a range of exposure times to assist in the assessment of releases which may result in a toxic exposure.

Provide below is a summary of the AEGL tiers of exposure:

- **AEGL-3** is the airborne concentration, expressed as parts per million (ppm) or milligrams per cubic meter (mg/m^3), of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.
- **AEGL-2** is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- **AEGL-1** is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

Selection for fatality or serious injury is based on an AEGL-3 values with injury values selected as those based on AEGL-2. It is noted the report AEGL values are based on 30-minute exposure.

Appendix Table B-8: Concentration of Toxic Products of Combustion in Smoke Plume

Pollutant	Fatality or Serious Injury (ppm)	Injury (ppm)	Concentration (ppm)
Carbon monoxide	600	150	27.9
Nitric Dioxide	25	15	26.1
Hydrogen cyanide	21	10	29.0
Hydrogen chloride	210	43	21.5
Sulphur dioxide	30	0.75	12.2

B9. LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire

A hose rupture could occur and ignite which would result in a jet fire. To estimate the dimensions of a jet fire, the flow rate of the liquid from the hose must be estimated. The following data was input into **Equation B-8** to estimate the flow rate through the ruptured hose:

- C_d = Discharge coefficient (0.6 for irregular holes)
- A = 50 mm hose = $\frac{\pi D^2}{4} = \frac{\pi \times 0.050^2}{4} = 0.002\ m^2$
- ρ = 508 kg/m^3
- ΔP = 8.6 bar = 860000 Pa

Substituting the information into **Equation B-8** gives a flow rate of 34.8 kg/s.

$$m = 0.6 \times 0.004 \times (2 \times 508 \times 860000)^{0.5} = 34.8\ \frac{kg}{s}$$

Now, a liquid LPG release would be too fuel dense to ignite as it would be above the LEL so the only portion that could ignite would be the liquid that vapourises upon release. Assuming a flash fraction of 50%, the vapour flow rate from the release would be 0.5 x 34.8 = 17.4 kg/s.

Substituting the mass flow rate of vapour into **Equation B-9** gives a jet fire length of 38 m.

$$L = 9.1 \times 17.4^{0.5} = 38\ m$$

B10. LPG Unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire and Impact on LPG Delivery Tanker and BLEVE

In the event of a jet fire and impingement on the delivery tanker there is potential for the LPG in the tanker to boil escalating to a BLEVE if intervention measures fail. It is assumed that impingement will occur at the 30% fill level of the tanker and that the tanker holds a maximum 7,500 L. A BLEVE will only occur once the liquid level falls below the impingement level; hence, the maximum volume of LPG that could be involved in the BLEVE is 2,250 L. As noted, the density of LPG is 508 kg/m3; therefore, the mass of LPG involved in the BLEVE is 1,143 kg.

Inputting the mass into **Equation B-11** and **Equation B-12** yields an impact diameter of 63.9 m and a resonance time of 5 seconds.

$$D = 6.48 \times 1{,}143^{0.325} = 63.9\ m$$

$$t = 0.852 \times 1{,}143^{0.25} = 5\ s$$

B11. LPG unloading Incident, Hose Rupture, LPG Release, Ignition and Jet Fire and Impact on LPG Tank and BLEVE

In the event of a jet fire and impingement on the above ground tank there is potential for the LPG in the tanker to boil escalating to a BLEVE if intervention measures fail. It is assumed that impingement will occur at the 30% fill level of the tank. The tank holds 7,500 L; hence, at the 30% fill level 2,250 L of LPG is involved in the BLEVE. As noted, the density of LPG is 508 kg/m3; therefore, the mass of LPG involved in the BLEVE is 1,143 kg.

Inputting the mass into **Equation B-11** and **Equation B-12** yields an impact diameter of 63.9 m and a resonance time of 5 seconds.

$$D = 6.48 \times 1{,}143^{0.325} = 63.9\ m$$

$$t = 0.852 \times 1{,}143^{0.25} = 5\ s$$

B12. Fire in ErgoPal or High Bay and Propagation Between Storage Areas

There is the potential for a fire to occur within the ErgoPal or the High Bay area which may result in sufficient radiant heat to impact between the storage areas resulting in incident propagation. The two systems have different protection systems in terms of sprinkler design; hence, there are a range of sprinkler activation scenarios which must be assessed. There are identified as follows:

1. In-rack sprinkler control (ErgoPal base case)
2. Activation of primary array of ceiling mounted sprinklers (ErgoPal sensitivity)
3. Activation of primary array of in-rack sprinklers (High Bay base case)
4. Activation of secondary array of in-rack sprinklers (High Bay sensitivity)

The sprinkler spacing has been used to estimate an equivalent diameter for each fire scenario with the results presented in **Appendix Table B-9**.

Appendix Table B-9: Fire Area Equivalent Diameters

Scenario	Equivalent Diameter (m)
ErgoPal Base Case	0.5
ErgoPal Sensitivity	1.9
High Bay Base Case	1
High Bay Sensitivity	1.9

- Burning rate – 0.022 kg/m^2.s (the burning rate of combustible liquids which is considered conservative for the products stored, Ref. [16]).

Furthermore, the analysis is considered incredibly conservative as it assumes a 100% burning area; however, as the subject areas will encompass aisle spaces, there will be no combustible material stored in these locations. Therefore, it is considered the results generated from this analysis would substantially overestimate the radiant heat impacts from the identified scenarios.

The results for flame height and SEP for each scenario are summarised in **Appendix Table B-10**.

Appendix Table B-10: Flame Height and SEP for Sprinkler Controlled Fires (ErgoPal & High Bay)

Output	ErgoPal Base Case	ErgoPal Sensitivity	High Bay Base Case	High Bay Sensitivity
Flame Height (m)	1	2.9	1.7	2.9
SEP (kW/m^2)	133.7	115.4	127.0	115.4

The inputs summarised in **Appendix Table B-10** were input into the SSC with the results for each scenario shown in **Appendix Table B-11**.

Appendix Table B-11: Heat Radiation from Sprinkler Controlled Scenarios (ErgoPal & High Bay)

Heat Radiation (kW/m^2)	Distance (m)			
	ErgoPal Base Case	ErgoPal Sensitivity	High Bay Base Case	High Bay Sensitivity
35	0.4	1.6	0.9	1.6
23	0.6	2.2	1.3	2.2
12.6	1.0	3.2	1.9	3.2
4.7	1.8	5.6	3.3	5.6
3.0	2.3	7.1	4.2	7.1

Appendix C

Hydraulic Analysis

Appendix C

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North Sydney NSW 2060
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3 May 2021

Woolworths JN Most Remote Hydrants

Design; 3 off attack hydrants at 10L/s each at 700kPa

Total Flow 30L/s

Precinct Input; 30 L/s at 950kPa at the Boundary (RL14) (Input Node 101)

Most remote hydrant; L2, centre of the building by the egress stair (Grid WJ/W10). Modelled as 3 hydrants in this location as a conservative approach.

Output Nodes 120, 121 and 122; 718kPa (RL 28.8)

```
HLehr Consultants International                                                                   DATE 10 MAR 2021
HL1, 80-88 Greville St PRAHRAN VIC 3181                                                           TIME       17:46
H----------------------------------------------------------------------------------------------------
xTHE ACADS-BSG PROGRAM
yHYENA
xVERSION 6.10.2A
z
z ACADS BSG advises that the program HYENA is intended to be used only
z by persons who are proficient in its use and application and that these
z results should be verified independently. The results must not be used
z without acceptance of the ACADS-BSG"s License Agreement for this program.

xDESIGN PROGRAM FOR SPRINKLER, HOSE REEL AND HYDRANT SYSTEMS
zCopyright (C) 2000 ACADS-BSG Pty Ltd
 Calculation build number 6.10.2A
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mInput Data

 LABL1=Authourising Company
 TEXT1=
 LABL2=Certification Number
 TEXT2=
 OCC=
 DENS=
 AREA=
 ORIF=
 COVER=
 NOPLOT
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 \ Fitting Type =Comm
 \ Defaults for Elbows=SE
 \ Defaults for Tees=TT
 \
 \ Pipes
 \ Pipes Mtr and Coef: Defaults= MCASAM HW120
 P  101 101 102 17 200      AP16140 1SE 1TT
 P  102 102 103 3 -203      ASAM120 2SE  GV
 P  103 103 104 251 200      AP16140 1SE  4HE
 P  104 104 105 285 150      AP16140 1SE  3GV
 P  105 105 106 599 150      AP16140 2SE  2GV
 P  106 106 104 67 150      AP16140  1TT GV
 P  107 106 107 37 150      AP16140 1SE 1TT GV
 P  108 105 108 4 150      AP16140 1SE 1TT GV
 P  110 107 111 163 150      ASAM120 8SE
 P  111 108 111 231 150      ASAM120 7SE 1TT
 P  112 111 112 10 100      ASAM120 3SE 1TT
 P  120 112 120 1 65      ASAM120  1TT NV
 PS 120 121 112 121
 PS 120 122 112 122
 \Discharges Default=
 \
 \ Fixed Discharge
 R  120     28.8    600
 R  121     28.8    600
 R  122     28.8    600
 \
 \ Reference Points
```

```
\Reference Point Default= ED16.5
R  102      16.5
R  103      16.5
R  104      16.5
R  105      16.5
R  106      16.5
R  107      16.5
R  108      16.5
R  111        23
R  112        23
\
\ InputPoints
IF 101 14 950
END

                   LENGTH   DIAMETER    FLOW      HEAD   ELEVATION  PRESSURE
UNITS BEING USED:  METERS      MM      l/m         CM      METERS      KPA

ITERATION STOPS WHEN GREATEST FLOW CHANGE IS 0.180 IN ANY PIPE

THERE ARE    0 SPRINKLERS AND    0 BOOSTER PUMPS

THERE ARE   14 PIPES AND   12 REFERENCE POINTS

THE NUMBER OF INPUT POINTS IN SYSTEM IS    1

NODE   NO. OF PUMPS    PUMP      INPUT      PUMP PARAMETERS
 NO.   IN PARALLEL   ELEVATION  FRACTION    OR X-Y COORDINATES
 101         1         14.00       1.00    950.00  0.0000E+00  0.0000E+00  0.0000E+00

Initial estimate of demand on the system is 1800.00

d     NET UNBALANCED DEMAND ON THE SYSTEM IS 0
```

```
mLOOP INFORMATION
     LOOP         PIPES
       1          110  111  108  105  107
       2          104  105  106


           BANDWIDTH =    2
```

---

d Designer : LCI   DATE :10 MAR 2021
d Client : Woolies   TIME : 17:46
d Project : JN - Most Remote Test Hydrant

---

d Maximum unbalanced head loss is = 0.00000 kPa
Maximum node unbalanced flow is = 0.00012 l/m and occurs at node 104
Maximum loop unbalanced flow is = 0.01277 l/m and occurs in Pipe Loop 2

Fittings Specified as AS2118

Hazen-Williams formula used

Number of Fixed Discharges : 3
Total water flow for Discharges : 1800 l/m

d Actual Flow & Pressure, Input Node 101 : 1800 l/m at 950 kPa

Calculated Total Pipe Volume is : 34221 Litres

Authourising Company :
Certification Number :

Input data file name : C:\HYENA6102\DATA\JN MOST REMOTE FH.DAT
Results file name : C:\HYENA6102\DATA\JN MOST REMOTE FH.OUT

mPIPE CHARACTERISTICS

d Designer : LCI DATE :10 MAR 2021
d Client : Woolies TIME : 17:46
d Project : JN - Most Remote Test Hydrant

d Pipe No.	Pipe node Numbers		Flow (l/m)	Pipe diam. Nom (mm)	Pipe diam. Actual (mm)	Pipe & Ftg. CODE #	Pipe & Ftg. Length (m)	TOTAL Length (m)	Loss Per m (KPa)	Loss Over pipe (KPa)	Static Loss (KPa)	TOTAL Loss (KPa)	H&W Co-eff	Water Vel. (m/s)	Vel. Press (KPa)
101	101	102	1800.00	200	202	AP16	17.0	38.6	0.0405	1.561	24.488	26.050	140	0.93	0.436
				200		1SE	7.3								
				200		1TT	14.2								
102	102	103	1800.00		203	ASAM	3.0	15.3	0.0528	0.808	0.000	0.808	120	0.93	0.429
				200		2SE	11.1								
				200		1GV	1.2								
103	103	104	1800.00	200	202	AP16	251.0	272.7	0.0405	11.043	0.000	11.043	140	0.93	0.436
				200		1SE	7.3								
				200		4HE	14.4								
104	104	105	647.54	150	152	AP16	285.0	294.3	0.0246	7.228	0.000	7.228	140	0.60	0.177
				150		1SE	5.7								
				150		3GV	3.6								
105	106	105	185.91	150	152	AP16	599.0	612.8	0.00244	1.493	0.000	1.493	140	0.17	0.0146
				150		2SE	11.4								
				150		2GV	2.4								
106	104	106	1152.46	150	152	AP16	67.0	80.3	0.0714	5.735	0.000	5.735	140	1.06	0.561
				150		1TT	12.1								
				150		1GV	1.2								
107	106	107	966.55	150	152	AP16	37.0	56.0	0.0516	2.889	0.000	2.889	140	0.89	0.395
				150		1SE	5.7								
				150		1TT	12.1								
				150		1GV	1.2								
108	105	108	833.45	150	152	AP16	4.0	23.0	0.0392	0.902	0.000	0.902	140	0.77	0.293
				150		1SE	5.7								
				150		1TT	12.1								
				150		1GV	1.2								
110	107	111	966.55	150	155	ASAM	163.0	197.4	0.0620	12.237	63.670	75.907	120	0.85	0.363
				150		8SE	34.4								
111	108	111	833.45	150	155	ASAM	231.0	270.2	0.0471	12.730	63.670	76.400	120	0.74	0.270
				150		7SE	30.1								
				150		1TT	9.1								
112	111	112	1800.00	100	105	ASAM	10.0	25.1	1.304	32.731	0.000	32.731	120	3.46	5.970
				100		3SE	9.0								
				100		1TT	6.1								
120	112	120	600.00	65	69	ASAM	1.0	14.5	1.342	19.398	56.813	76.212	120	2.69	3.611
				65		1TT	3.7								
				65		1NV	9.8								
121	112	121	600.00	65	69	ASAM	1.0	14.5	1.342	19.398	56.813	76.212	120	2.69	3.611

				65		1TT	3.7								
				65		1NV	9.8								
122	112	122	600.00	65	69	ASAM	1.0	14.5	1.342	19.398	56.813	76.212	120	2.69	3.611
				65		1TT	3.7								
				65		1NV	9.8								

LEGEND - Fittings and Pipe Materials used in this run

SE = 90 Degree Elbow　　HE = 45 Degree Elbow　　TT = Tee Branch

GV = Gate Valve　　NV = Angle Valve

ASAM = Medium Steel Tube to AS1074 -1989 & BS 1387

AP16 = UPVC Class 16 CI Compatible to AS2977 (Blue Brute)

d Maximum unbalanced head loss is = 0.00000 kPa

Maximum loop unbalanced flow is = 0.01277 l/m and occurs in Pipe Loop 2

Maximum node unbalanced flow is = 0.00012 l/m mNODE CHARACTERISTICS

d Designer : LCI
d Client : Woolies
d Project : JN - Most Remote Test Hydrant

DATE :10 MAR 2021
TIME : 17:46

d SPRINKLER/NOZZLE(N) POINTS			REFERENCE POINTS			INPUT POINTS			Node Elevation	Entered Discharge	K-Factor l/m &
d No.	Dischg. l/m	kPa	No.	Dischg. l/m	kPa	No.	Demand l/m	kPa	(m)	(l/m)	kPa
						101	1800.00	950.000	14.000		
			102		923.950				16.500		
			103		923.143				16.500		
			104		912.100				16.500		
			105		904.872				16.500		
			106		906.365				16.500		
			107		903.476				16.500		
			108		903.970				16.500		
			111		827.570				23.000		
			112		794.838				23.000		
			120	600.00	718.627				28.800	600.00	
			121	600.00	718.627				28.800	600.00	
			122	600.00	718.627				28.800	600.00	

mADDITIONAL PRESSURE INFORMATION

d Designer : LCI — DATE :10 MAR 2021
d Client : Woolies — TIME : 17:46
d Project : JN - Most Remote Test Hydrant

d Pipe No.	Pipe Node Numbers		Flow (l/min)	Pipe Diam. Nom (mm)	Actual (mm)	Pipe & Ftg. Code #	Length (m.)	TOTAL Length (m.)	Loss Per m. (kPa)	Loss For Pipe (kPa)	Static Loss (kPa)	TOTAL Loss (kPa)	Pressure 1st Node (kPa)	2nd Node (kPa)
101	101	102	1800.00	200	202	AP16	17.0	38.6	0.0405	1.561	24.488	26.050	950.000	923.950
				200		1SE	7.3							
				200		1TT	14.2							
102	102	103	1800.00		203	ASAM	3.0	15.3	0.0528	0.808	0.000	0.808	923.950	923.143
				200		2SE	11.1							
				200		1GV	1.2							
103	103	104	1800.00	200	202	AP16	251.0	272.7	0.0405	11.043	0.000	11.043	923.143	912.100
				200		1SE	7.3							
				200		4HE	14.4							
104	104	105	647.54	150	152	AP16	285.0	294.3	0.0246	7.228	0.000	7.228	912.100	904.872
				150		1SE	5.7							
				150		3GV	3.6							
105	106	105	185.91	150	152	AP16	599.0	612.8	0.00244	1.493	0.000	1.493	906.365	904.872
				150		2SE	11.4							
				150		2GV	2.4							
106	104	106	1152.46	150	152	AP16	67.0	80.3	0.0714	5.735	0.000	5.735	912.100	906.365
				150		1TT	12.1							
				150		1GV	1.2							
107	106	107	966.55	150	152	AP16	37.0	56.0	0.0516	2.889	0.000	2.889	906.365	903.476
				150		1SE	5.7							
				150		1TT	12.1							
				150		1GV	1.2							
108	105	108	833.45	150	152	AP16	4.0	23.0	0.0392	0.902	0.000	0.902	904.872	903.970
				150		1SE	5.7							
				150		1TT	12.1							
				150		1GV	1.2							
110	107	111	966.55	150	155	ASAM	163.0	197.4	0.0620	12.237	63.670	75.907	903.476	827.570
				150		8SE	34.4							
111	108	111	833.45	150	155	ASAM	231.0	270.2	0.0471	12.730	63.670	76.400	903.970	827.570
				150		7SE	30.1							
				150		1TT	9.1							
112	111	112	1800.00	100	105	ASAM	10.0	25.1	1.304	32.731	0.000	32.731	827.570	794.838
				100		3SE	9.0							
				100		1TT	6.1							
120	112	120	600.00	65	69	ASAM	1.0	14.5	1.342	19.398	56.813	76.212	794.838	718.627
				65		1TT	3.7							
				65		1NV	9.8							
121	112	121	600.00	65	69	ASAM	1.0	14.5	1.342	19.398	56.813	76.212	794.838	718.627

				65		1TT	3.7							
				65		1NV	9.8							
122	112	122	600.00	65	69	ASAM	1.0	14.5	1.342	19.398	56.813	76.212	794.838	718.627
				65		1TT	3.7							
				65		1NV	9.8							

LEGEND - Fittings and Pipe Materials used in this run

SE = 90 Degree Elbow   HE = 45 Degree Elbow   TT = Tee Branch

GV = Gate Valve   NV = Angle Valve

ASAM = Medium Steel Tube to AS1074 -1989 & BS 1387

AP16 = UPVC Class 16 CI Compatible to AS2977 (Blue Brute)

```
m FITTING EQUIVALENT PIPE LENGTHS IN METERS      Diameter in mm
d    15   20   25   32   40    50    65    80    90   100   125   150   200   225   250   300   350   375   400   450
d-------------------------------------------------------------------------------------------------------------------
cAS2118 Screwed Fittings up to 80mm AS1074 Med Steel, >80mm Schedule 40 Steel  C=120
 SE  .00  .60  .60  .90 1.20  1.50  1.80  2.10  2.40  3.00  3.70  4.30  5.50  6.10  6.70  8.20   .00   .00   .00   .00
 HE  .00  .30  .30  .30  .60   .60   .90   .90   .90  1.20  1.50  2.10  2.70  3.05  3.40  4.00   .00   .00   .00   .00
 LE  .00  .30  .60  .60  .60   .90  1.20  1.50  1.50  1.80  2.40  2.70  4.00  4.45  4.90  5.50   .00   .00   .00   .00
 TT  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 TN  .00  .00  .00  .00  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 TR  .00  .00  .00  .00  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
d-------------------------------------------------------------------------------------------------------------------
cAS2118 Valves, etc. - up to 80mm AS1074 Med Steel, >80mm Schedule 40 Steel    C=120
 GV  .00  .30  .30  .30  .30   .30   .30   .30   .30   .60   .60   .90  1.20  1.35  1.50  1.80   .00   .00   .00   .00
 CV  .00  .00 1.50 2.10 2.70  3.40  4.30  4.90  5.80  6.70  8.20  9.80 13.70   .00 16.80 19.80   .00   .00   .00   .00
 LV  4.9  6.1  7.6 10.4 12.5  16.2  18.6  24.4  27.4  30.8  36.6  48.8  64.0  76.2  88.4 103.6    .0    .0    .0    .0
 NV 2.44 3.35 3.96 5.49 6.40  8.23  9.75 12.19 14.33 16.76 18.29 24.99 32.00 38.10 44.20 51.82   .00   .00   .00   .00
 BV  .00  .00  .00  .00  .00  1.80  2.10  3.00  3.35  3.70  2.70  3.00  3.70  4.75  5.80  6.40   .00   .00   .00   .00
 AV  .00  .00 1.50 2.10 2.70  3.40  4.30  4.90  5.80  6.70  8.20  9.80 13.70   .00 16.80 19.80   .00   .00   .00   .00
 MV  .00  .00  .00  .00  .00   .00   .00   .00   .00 18.00   .00 30.00 45.00   .00 60.00   .00   .00   .00   .00   .00
 DV  .00  .00  .03  .06  .15   .46  1.07  3.05  3.66  5.49  6.10  9.14   .00   .00   .00   .00   .00   .00   .00   .00
 SR  .00  .00  .03  .12  .23   .76  1.83  5.18  6.10  9.14 10.70 12.20 21.30   .00   .00   .00   .00   .00   .00   .00
d-------------------------------------------------------------------------------------------------------------------
c  Flanged or Socketed Fittings - unlined Cast or Ductile Iron                 C=100
 E1  .00  .60  .60  .90 1.20  1.50  1.80  2.10  2.40  3.00  3.70  4.30  5.50  6.10  6.70  8.20   .00   .00   .00   .00
 E2  .00  .30  .30  .30  .60   .60   .90   .90   .90  1.20  1.50  2.10  2.70  3.05  3.40  4.00   .00   .00   .00   .00
 T1  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 T2  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 T3  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 T4  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 C1  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 C2  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 C3  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
 C4  .00  .90 1.50 1.80 2.40  3.00  3.70  4.60  5.20  6.10  7.60  9.10 10.70 11.95 15.20 18.30   .00   .00   .00   .00
d-------------------------------------------------------------------------------------------------------------------
c  CPVC Fittings up to 80mm and PVC Fittings 100mm and above                   C=150
 PE  .30  .40  .50  .77  .81  1.15  1.39  1.59   .00  2.30  2.84  3.37  4.23   .00  5.24  6.45  7.46   .00  8.67 10.69
 PH  .16  .22  .28  .36  .42   .52   .63   .81   .00  1.03  1.33  1.61  2.14   .00  2.72  3.13  3.63   .00  4.03  4.64
 P2  .77  .99 1.21 1.47 1.69  2.42  2.96  3.31   .00  4.44  5.52  6.59  9.88   .00 11.49 13.51 15.73   .00 17.74 21.57
 P3  .20  .28  .34  .46  .54   .81   .99  1.23   .00  1.59  2.04  2.48  2.82   .00  3.53  4.03  5.04   .00  5.44  6.45
d-------------------------------------------------------------------------------------------------------------------
c  AS2118 - Domestic Fittings for Steel and Copper
 ME  .00 2.00 2.00 2.00 3.00  3.00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MT  .00 2.00 2.00 2.00 3.00  3.00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MG  .00  .30  .30  .30  .30   .30   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MC  .00 1.00 1.20 1.50 1.80  2.40   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MB  .00  .00  .00  .00  .00  1.80   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MS  .00  .00  .00  .10  .20   .80   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MW  .0023.0031.0066.0035.00 55.00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
d-------------------------------------------------------------------------------------------------------------------
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d	15	20	25	32	40	50	65	80	90	100	125	150	200	225	250	300	350	375	400	450

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m FITTING EQUIVALENT PIPE LENGTHS IN METERS      Diameter in mm
d    500   550   600   650   700   750   800   850   900   950  1000  1050  1100  1150  1200
d---------------------------------------------------------------------------------------------
cAS2118 Screwed Fittings up to 80mm AS1074 Med Steel, >80mm Schedule 40 Steel  C=120
 SE   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 HE   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 LE   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 TT   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 TN   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 TR   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
d---------------------------------------------------------------------------------------------
cAS2118 Valves, etc. - up to 80mm AS1074 Med Steel, >80mm Schedule 40 Steel    C=120
 GV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 CV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 LV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 NV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 BV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 AV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 DV   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 SR   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
d---------------------------------------------------------------------------------------------
c  Flanged or Socketed Fittings - unlined Cast or Ductile Iron                 C=100
 E1   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 E2   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 T1   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 T2   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 T3   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 T4   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 C1   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 C2   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 C3   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 C4   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
d---------------------------------------------------------------------------------------------
c  CPVC Fittings up to 80mm and PVC Fittings 100mm and above                   C=150
 PE 11.69   .00 13.51   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 PH  5.04   .00  6.05   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 P2 23.79   .00 27.62   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 P3  7.06   .00  8.47   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
d---------------------------------------------------------------------------------------------
c  AS2118 - Domestic Fittings for Steel and Copper
 ME   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MT   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MG   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MC   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MB   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MS   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 MW   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
d---------------------------------------------------------------------------------------------
```

d	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200

mQUANTITIES FOR COSTING
dPIPES and FITTINGS

d Material	Diameter (mm)		Ftgs	Length No.off	Units	Rate	Totals
ASAM							
	65			3.0	m		
			TT	3	off		
			NV	3	off		
	100			10.0	m		
			SE	3	off		
			TT	1	off		
	150			394.0	m		
			SE	15	off		
			TT	1	off		
	200		SE	2	off		
	200		GV	1	off		
	203	(F)		3.0	m		
AP16							
	150			992.0	m		
			SE	5	off		
			TT	3	off		
			GV	8	off		
	200			268.0	m		
			SE	2	off		
			HE	4	off		
			TT	1	off		

Note 1: The (F) denotes a user fixed diameter.

Note 4: Fittings have not been included at the sprinkler connection points unless extra fittings have been added to the Ranges and Trees.

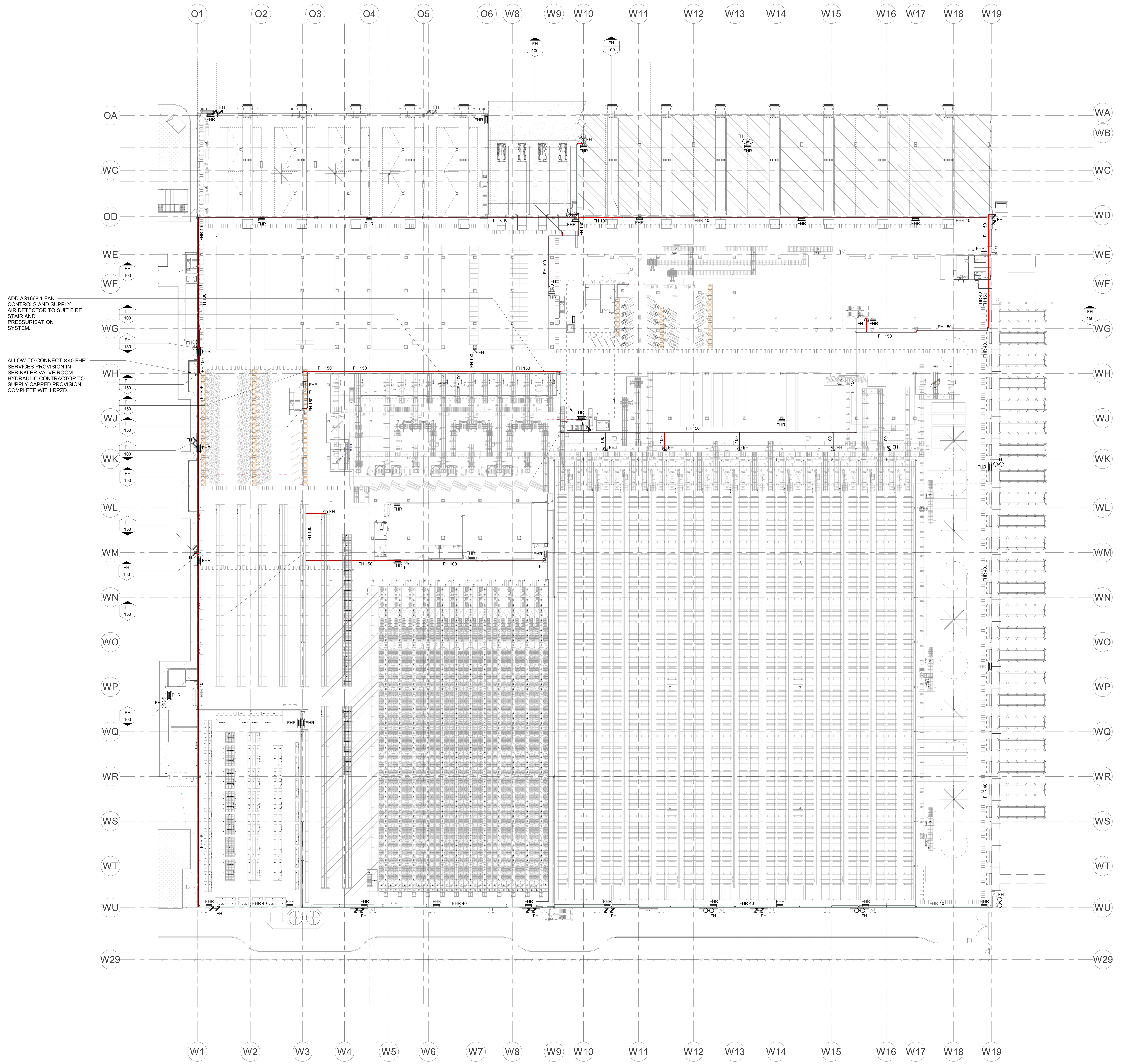
Appendix D

Fire System Drawings

Appendix D

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR 32mm CONNECTION TO EACH FIRE HOSE REEL FROM DEDICATED FHR SERVICE.
3. REFER TO ARCHITECTURAL & DEMATIC DRAWINGS FOR FINAL LOCATION OF INTERNAL FIRE HYDRANTS & FIRE HOSE REELS.



CONSTRUCTION

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 19/04/2021 15:49:30

ISSUE	DATE	DESCRIPTION	ISSUED BY
CC1	19.04.21	ISSUED FOR CC1 APPROVAL	
T3	28.02.21	UPDATED TENDER ISSUE	
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Richard Crookes Construction
4 Broadcast Way, Artarmon NSW 2064
P 02 9902 4700

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

RICHARD CROOKES CONSTRUCTIONS

Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

Woolworths

LCI

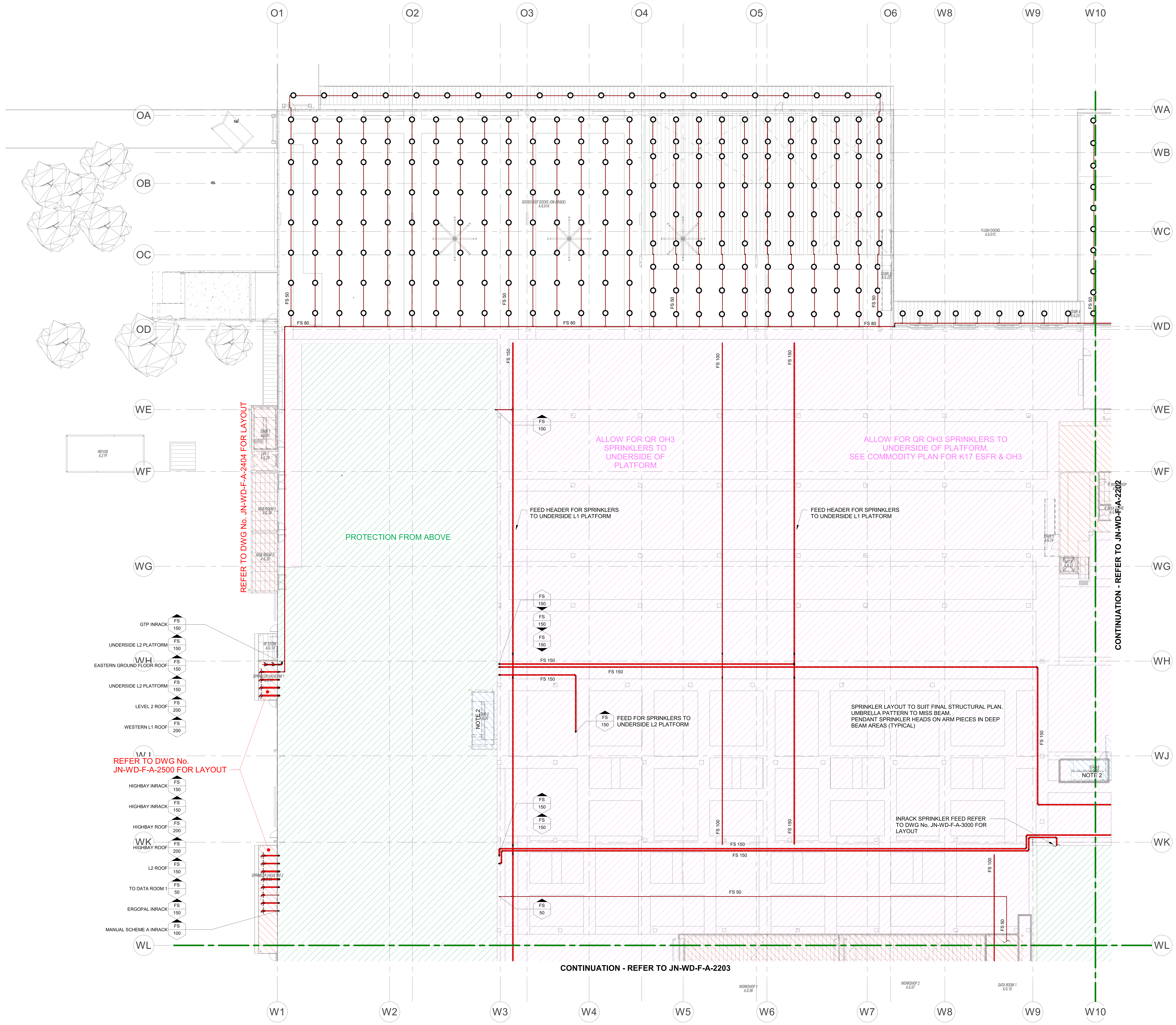
KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE				DRAWING TITLE		
JN DISTRIBUTION CENTRE				FIRE SERVICES GROUND LEVEL - OVERALL FH & FHR LAYOUT		
SCALE BAR 0m 1m 2m 3m 4m 5m						
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 400	MJK	SLH	JN-WD-F-A-2100	C	CC1

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 9/03/2021 12:26:48

ISSUE	DATE	DESCRIPTION	ISSUED BY
1	09.03.21	CLARIFIED SPRINKLER PROTECTION	
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

NOTES:
1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLERS TO STAIRS.
3. QQQQQQQ
4. WWWWWW
5. EEEEEEE
6. RRRRR

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

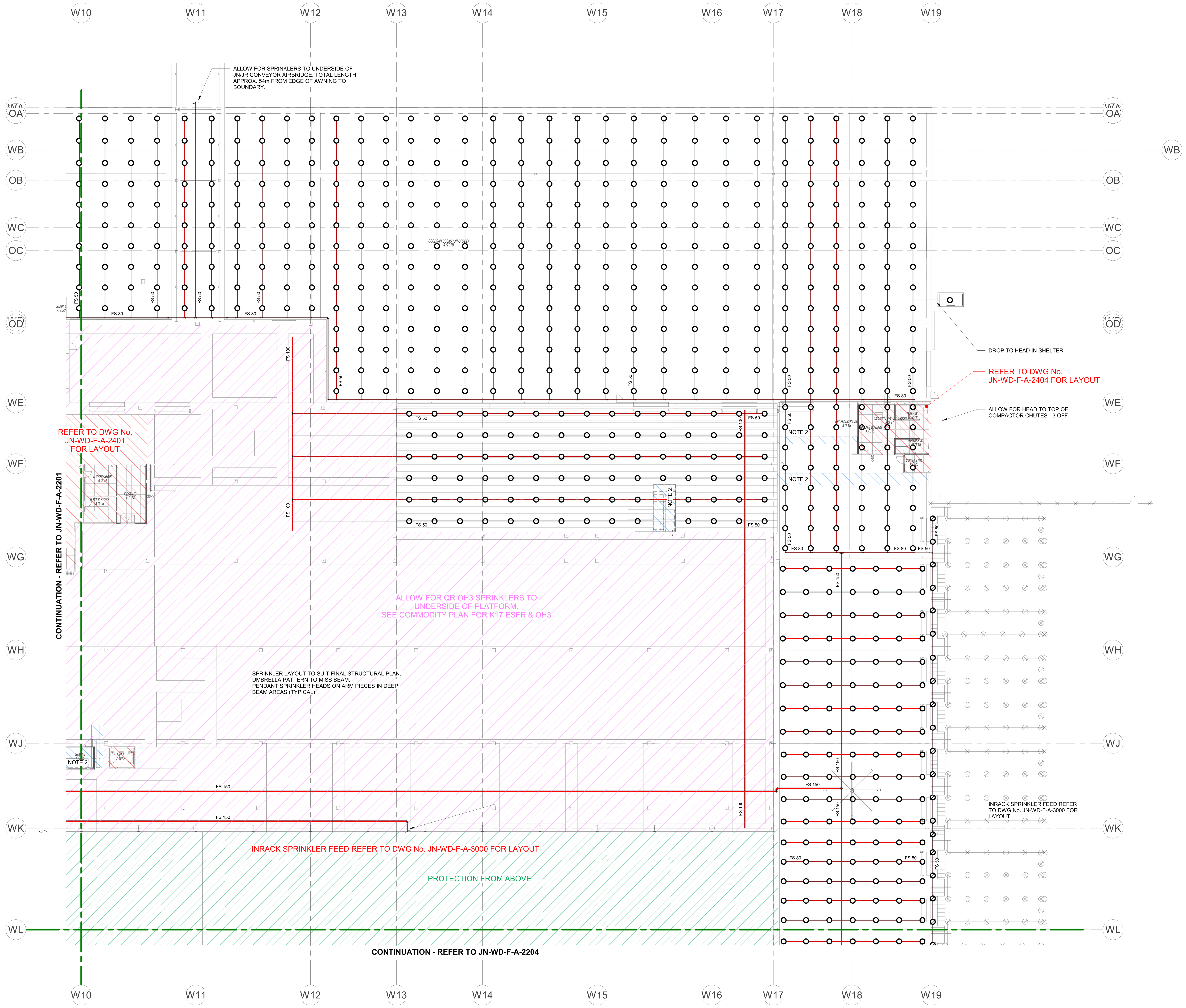
SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE
FIRE SERVICES
GROUND LEVEL - ZONE 1
SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2201	T	1

<u>NOTES:</u>

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 9/03/2021 12:27:09

ISSUE	DATE	DESCRIPTION	ISSUED BY
1	09.03.21	CLARIFIED SPRINKLER PROTECTION	
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

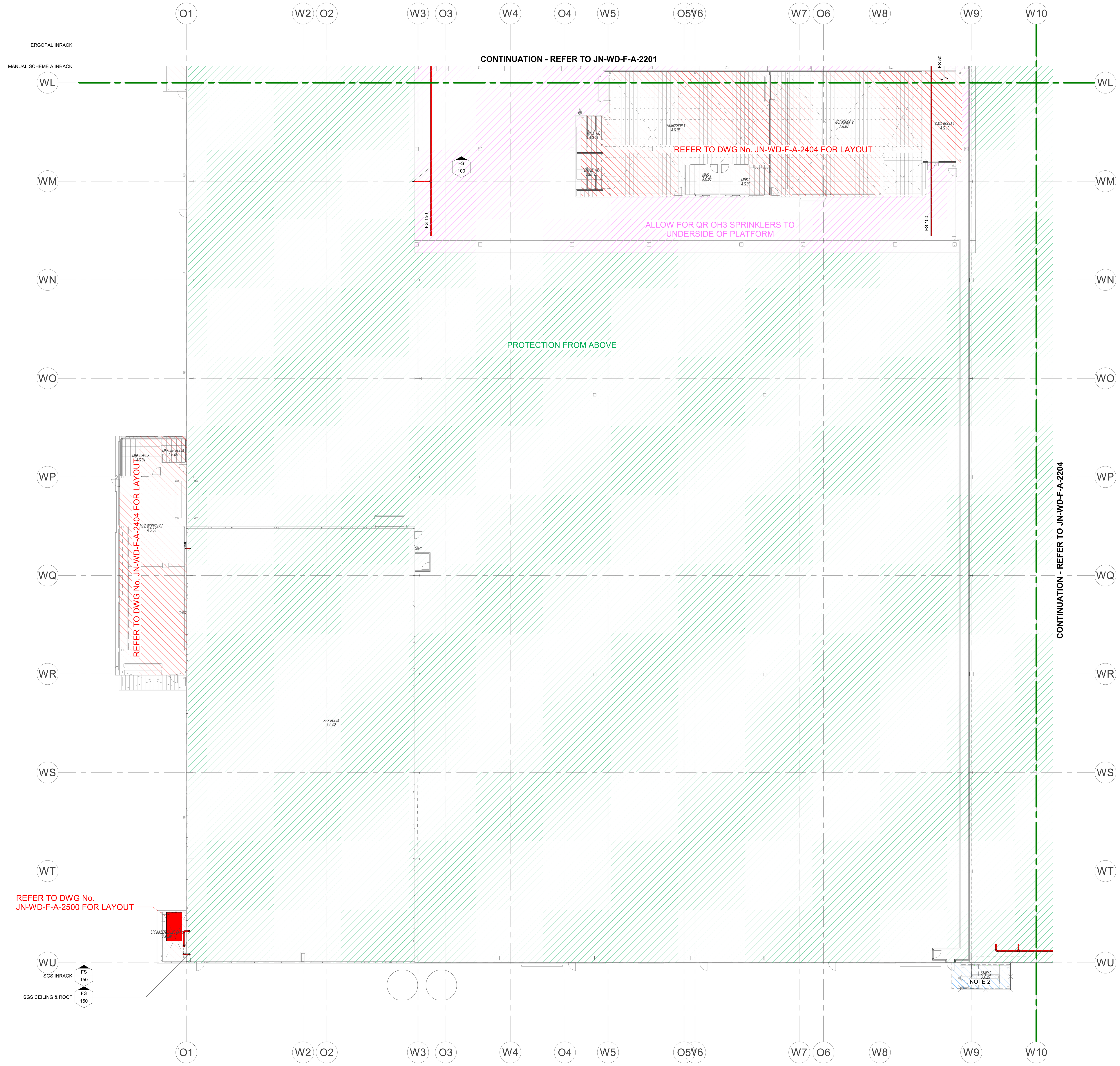
SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE
FIRE SERVICES
GROUND LEVEL - ZONE 2
SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2202	T	1

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 9/03/2021 12:27:23

ISSUE	DATE	DESCRIPTION	ISSUED BY
1	09.03.21	CLARIFIED SPRINKLER PROTECTION	
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE: JN DISTRIBUTION CENTRE

SCALE BAR 0m 4m 8m 12m 16m 20m

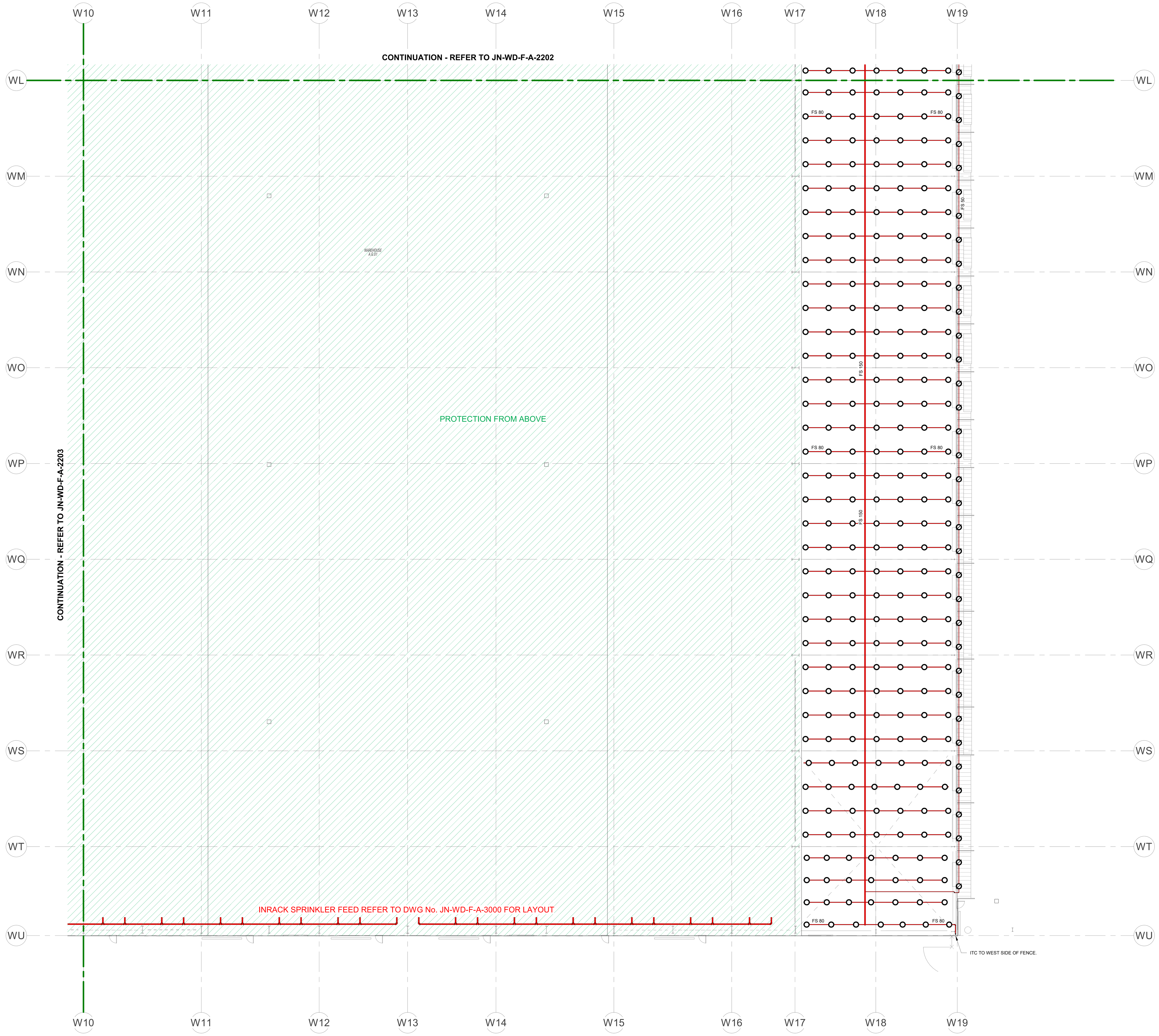
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY
190852	1 : 200	MJK	SLH

DRAWING TITLE
FIRE SERVICES
GROUND LEVEL - ZONE 3
SPRINKLER LAYOUT

DRAWING NO	STATUS	REVISION
JN-WD-F-A-2203	T	1

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 18:48:42

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

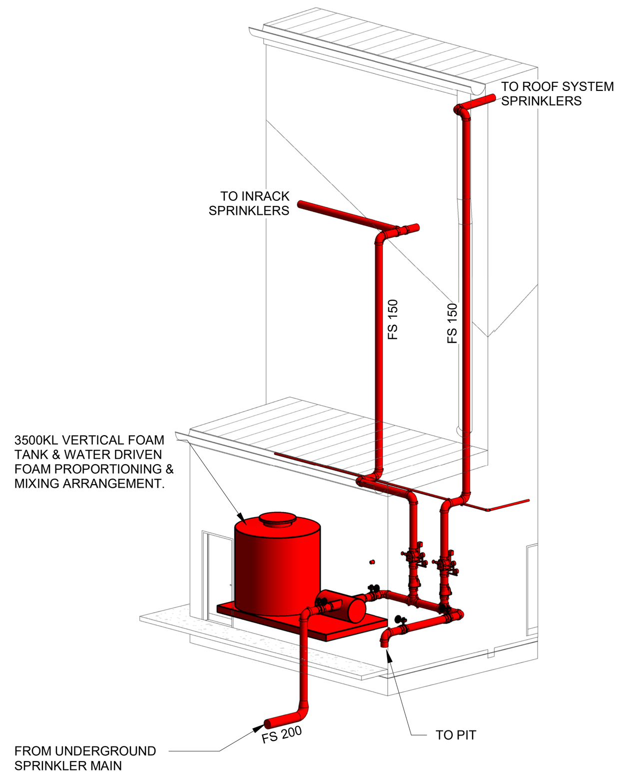
KEY PLAN

ORIENTATION
TRUE NORTH

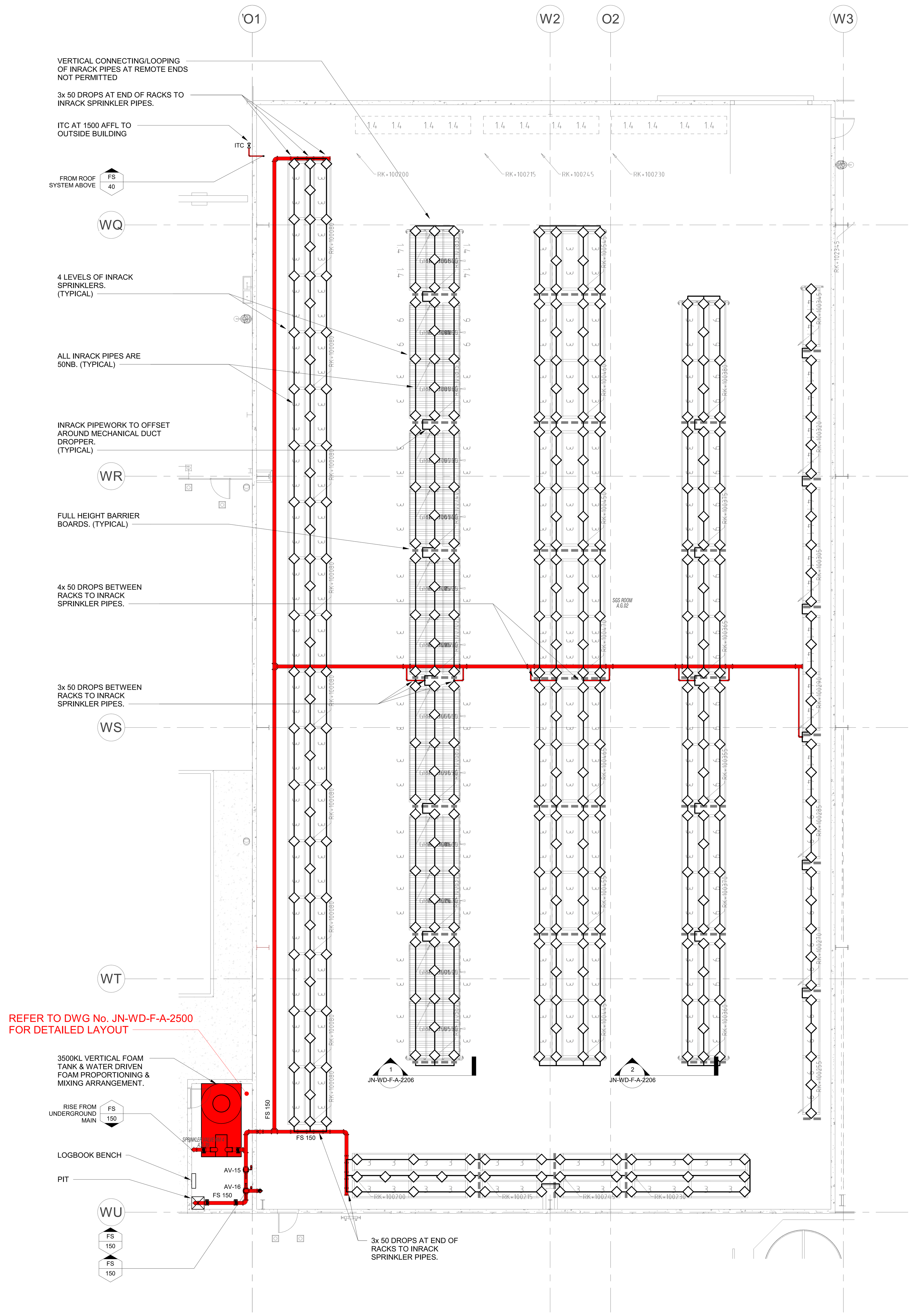
JOB TITLE				DRAWING TITLE		
JN DISTRIBUTION CENTRE				FIRE SERVICES GROUND LEVEL - ZONE 4 SPRINKLER LAYOUT		
SCALE BAR 0m 4m 8m 12m 16m 20m						
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2204	T	T2

NOTES:

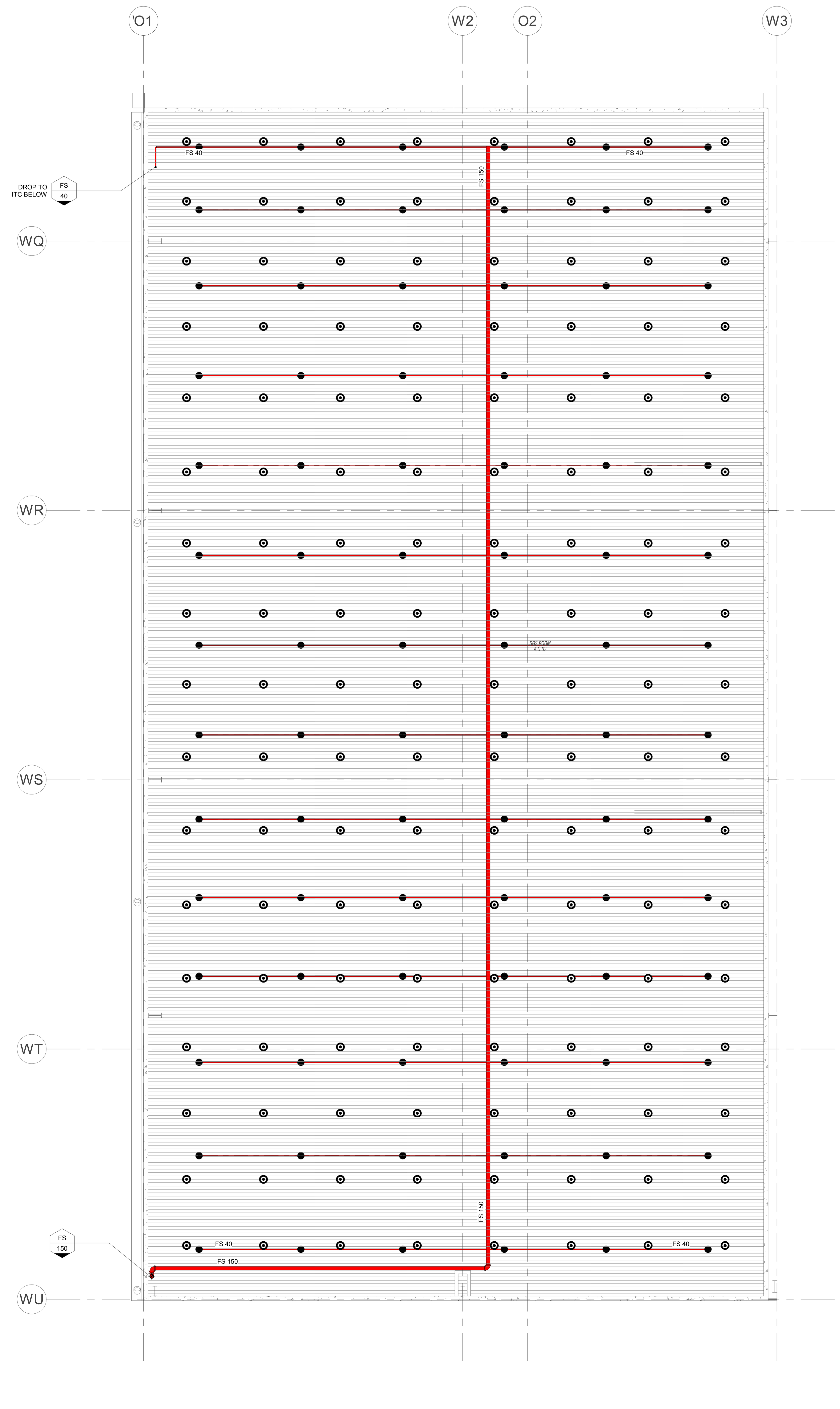
1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



3 FP_SGS 3D View



1 BELOW CEILING
1 : 100



2 ABOVE CEILING
1 : 100

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 18:58:37

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

Woolworths

LCI

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

SCALE BAR 0m 2m 4m 6m 8m 10m

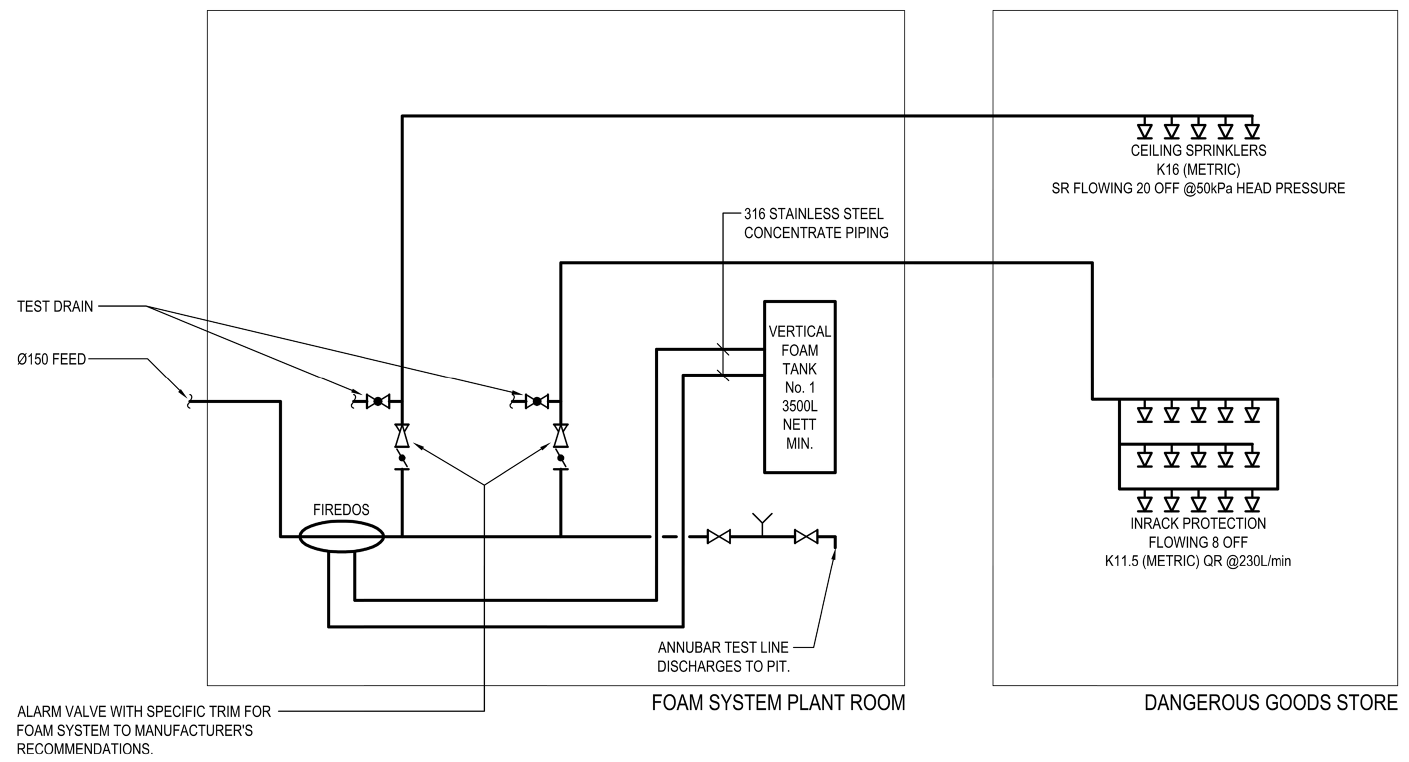
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY
190852	1 : 100	MJK	SLH

DRAWING TITLE
FIRE SERVICES
SGS ROOM SPRINKLER LAYOUT

DRAWING NO	STATUS	REVISION
JN-WD-F-A-2205	T	T2

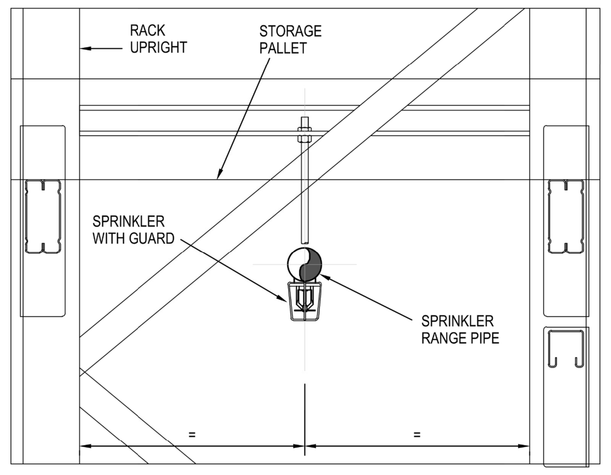
NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.

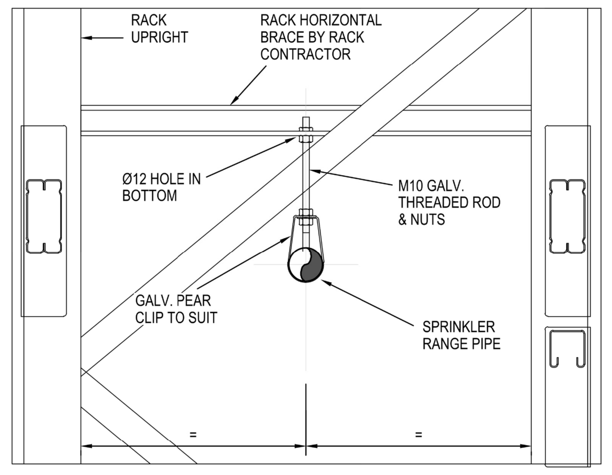


FOAM SYSTEM:

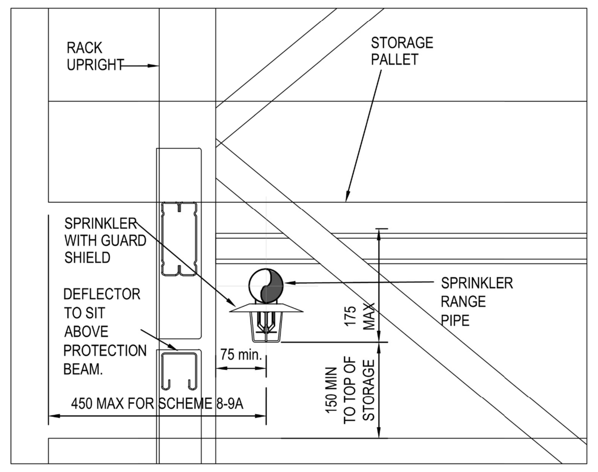
1. FOAM SYSTEM IN COMPLIANCE WITH AS2118.7-17 SECTION 13.
2. FOAM SYSTEM PROPORTIONING METHOD VIA WATER DRIVEN FOAM PROPORTIONING & MIXING ARRANGEMENT FOR STAINLESS STEEL ATMOSPHERIC TANK. WATER DRIVEN SHALL BE OF FIREDOS MANUFACTURE.
3. FOAM TYPE 3% AR C6 PURE TYPE FOR A 3% EXPANSION RATIO.
4. FOAM TANK STORAGE BASED ON SYSTEM DEMAND AT 20 MINUTES WITH 3% FOAM MIX AT SYSTEM CLOSEST AREA OF OPERATION.
5. SYSTEM DESIGN:
   CEILING: K16 (METRIC) SR FLOWING 20 OFF @50kPa HEAD PRESSURE
   MAXIMUM SPACING $9m^2$
   HOSE STREAM 1900L/min
   INRACK: K11.5 (METRIC) QR 8 HEADS @230L/min PER HEAD
6. SCHEMATIC IN INDICATIVE ONLY & DOES NOT INCLUDE ALL ITEMS FOR A WORKING SYSTEM.



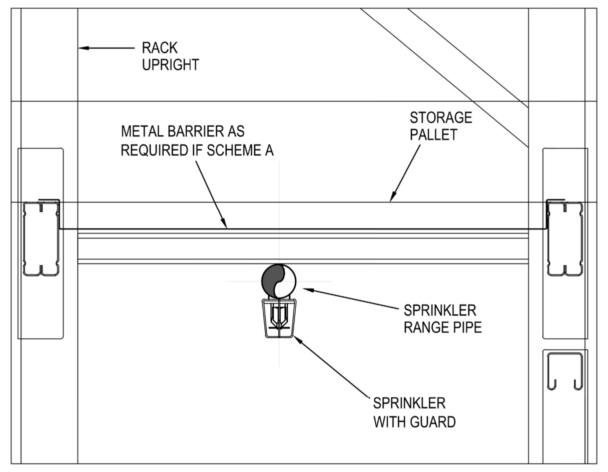
TYPICAL SINGLE RACK SPRINKLER DETAIL



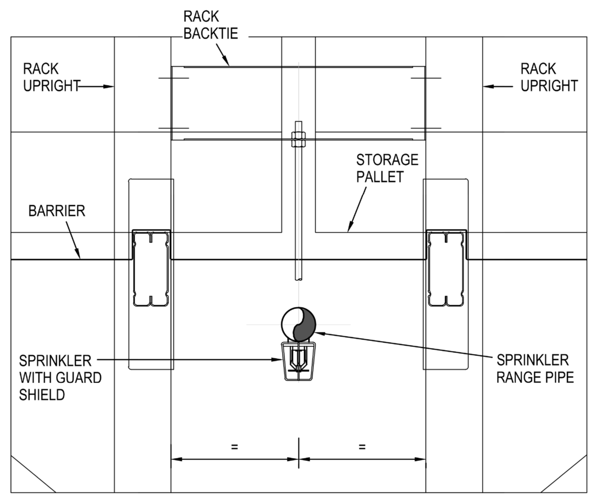
TYPICAL SINGLE RACK RANGE SUPPORT 'SR4'



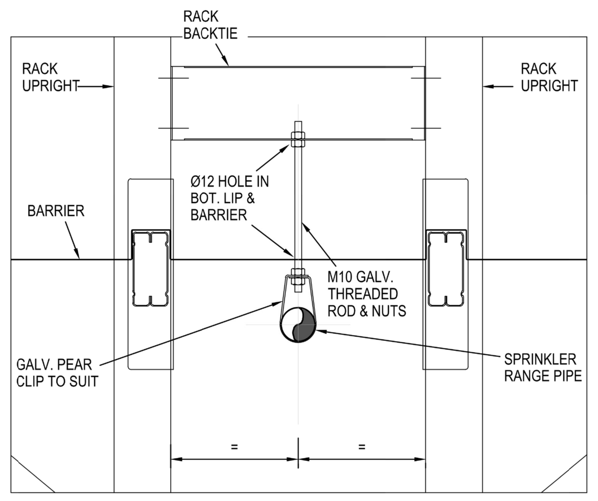
TYPICAL DOUBLE RACK FACE SPRINKLER DETAIL



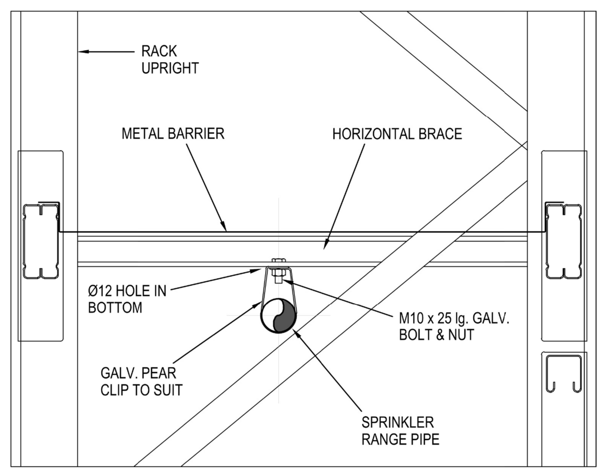
TYPICAL SINGLE RACK SPRINKLER DETAIL RELOCATED AROUND BRACING



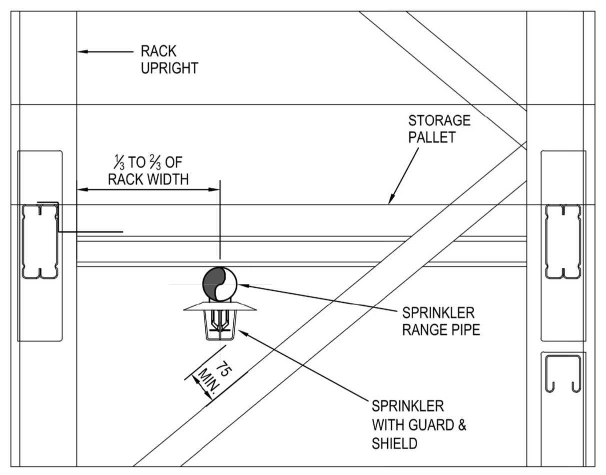
TYPICAL FLUE SPACE DOUBLE RACK INTERMEDIATE SPRINKLER DETAIL



TYPICAL FLUE SPACE DOUBLE RACK INTERMEDIATE RANGE SUPPORT 'SR5'



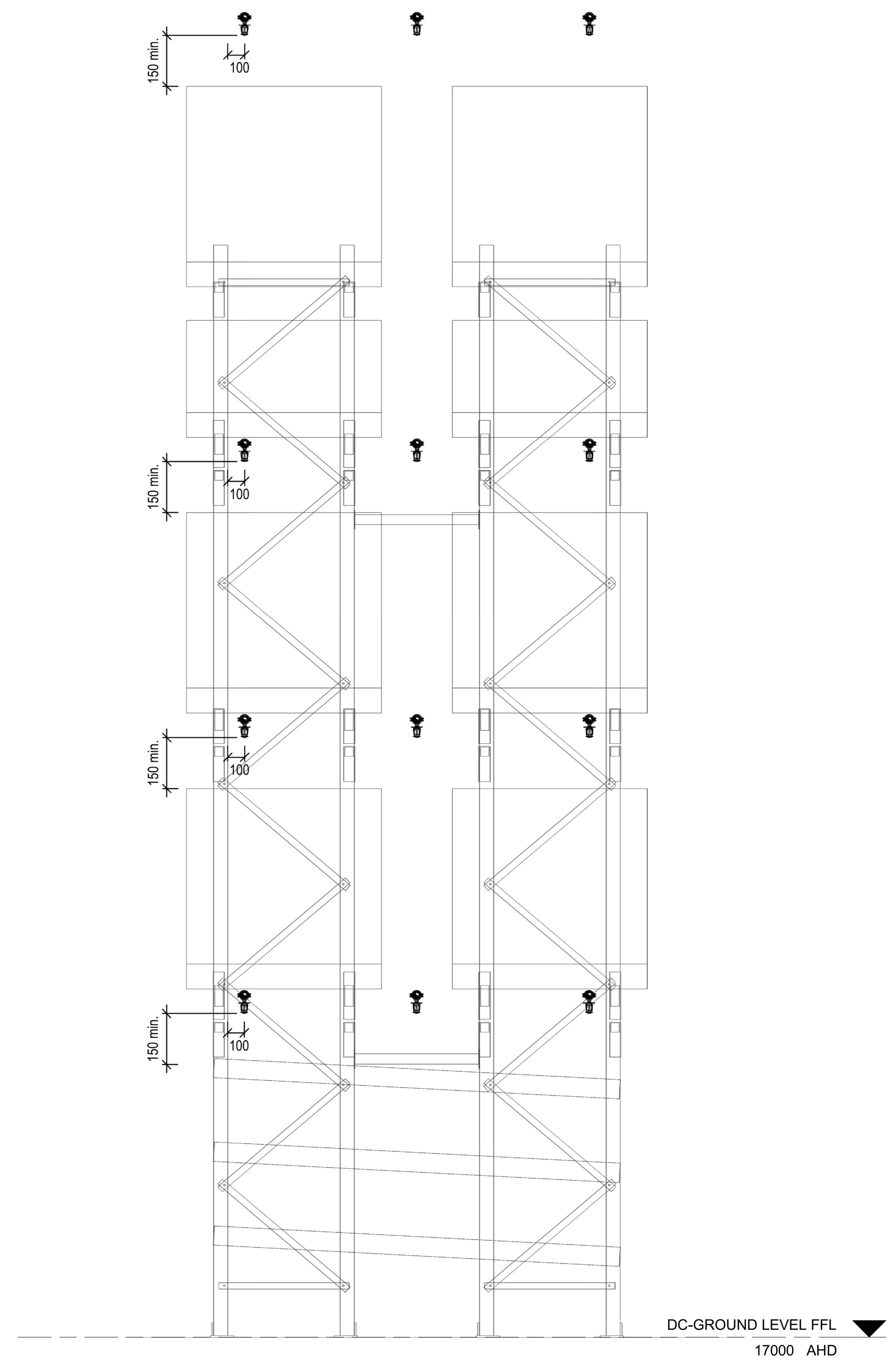
TYPICAL DOUBLE RACK FACE SPRINKLER & SINGLE RACK SPRINKLER RANGE SUPPORT 'SR6'



TYPICAL SINGLE RACK SPRINKLER DETAIL RELOCATED AROUND BRACING

NOTES:

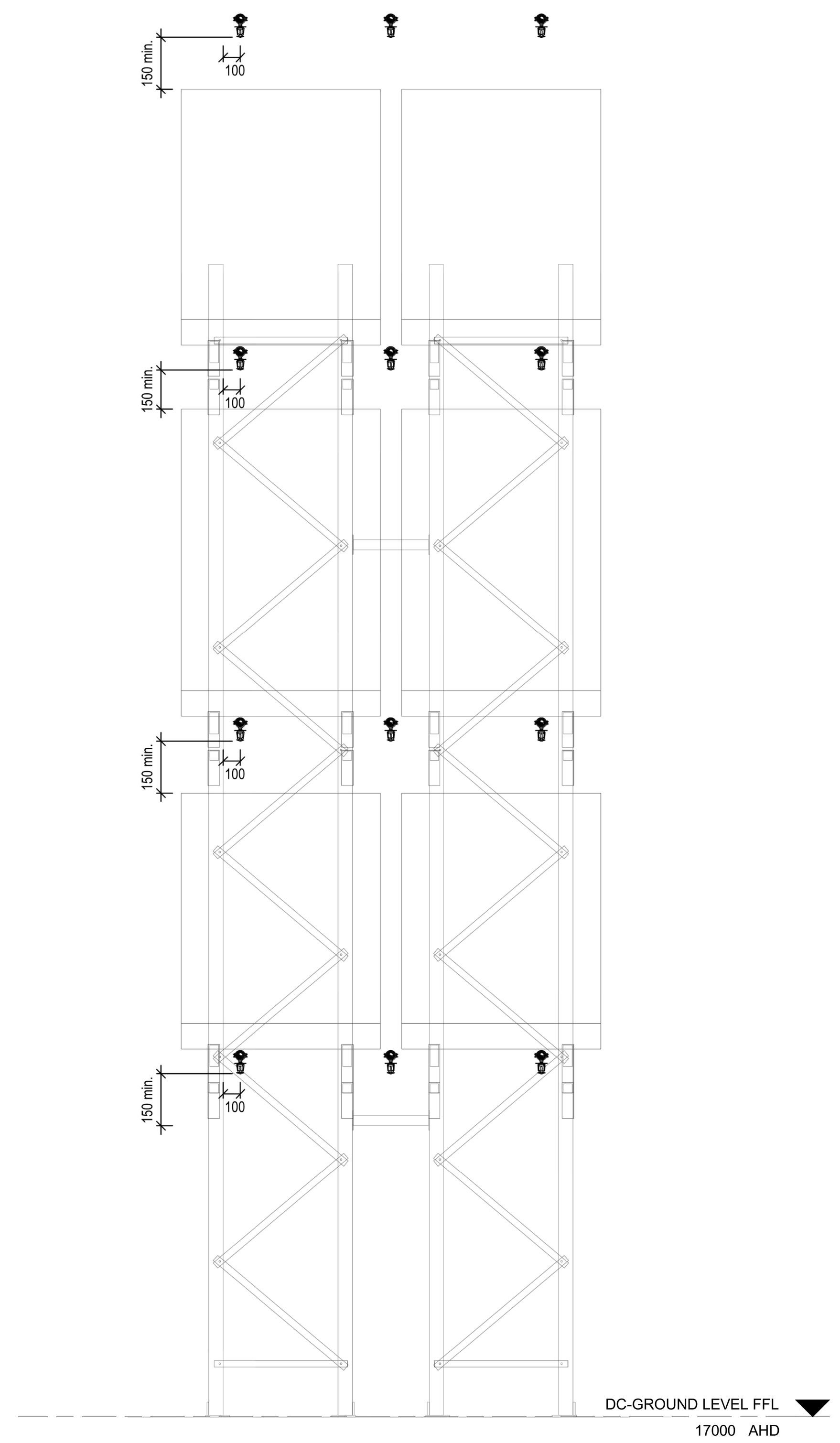
- NO HOLES TO BE SITE DRILLED INTO RACKS. WHERE HOLES IN RACKS ARE NOT AVAILABLE PROVIDE BEAM CLIPS.
- DIMENSIONS ARE INDICATIVE ADJUST TO SUIT SITE AND CODE.
- ALL DROPPERS TO BE CONCEALED TOTALLY BEHIND RACK UPRIGHTS.
- IN-RACK SPRINKLERS TO BE WITHIN 75mm OF TRANSVERSE FLUE. LOCATE BEHIND UPRIGHTS WHERE POSSIBLE.
- BRACING TO BE MINIMUM OF 75mm CLEAR OF SPRINKLER HEAD DEFLECTOR (BASED ON A HEMISPHERICAL PATTERN BELOW SPRINKLER DEFLECTOR.
- MINIMUM 150mm CLEAR FROM SPRINKLER DEFLECTOR TO TOP OF STOCK FOR INRACK SPRINKLERS.



1 TYPICAL CLS RACK SECTION

1 : 25

HORIZONTAL BARRIER BOARDS ABOVE EACH LEVEL OF INRACK SPRINKLERS BY RACKING CONTRACTOR



2 TYPICAL RACK SECTION

1 : 25

HORIZONTAL BARRIER BOARDS ABOVE EACH LEVEL OF INRACK SPRINKLERS BY RACKING CONTRACTOR

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 13:20:28

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

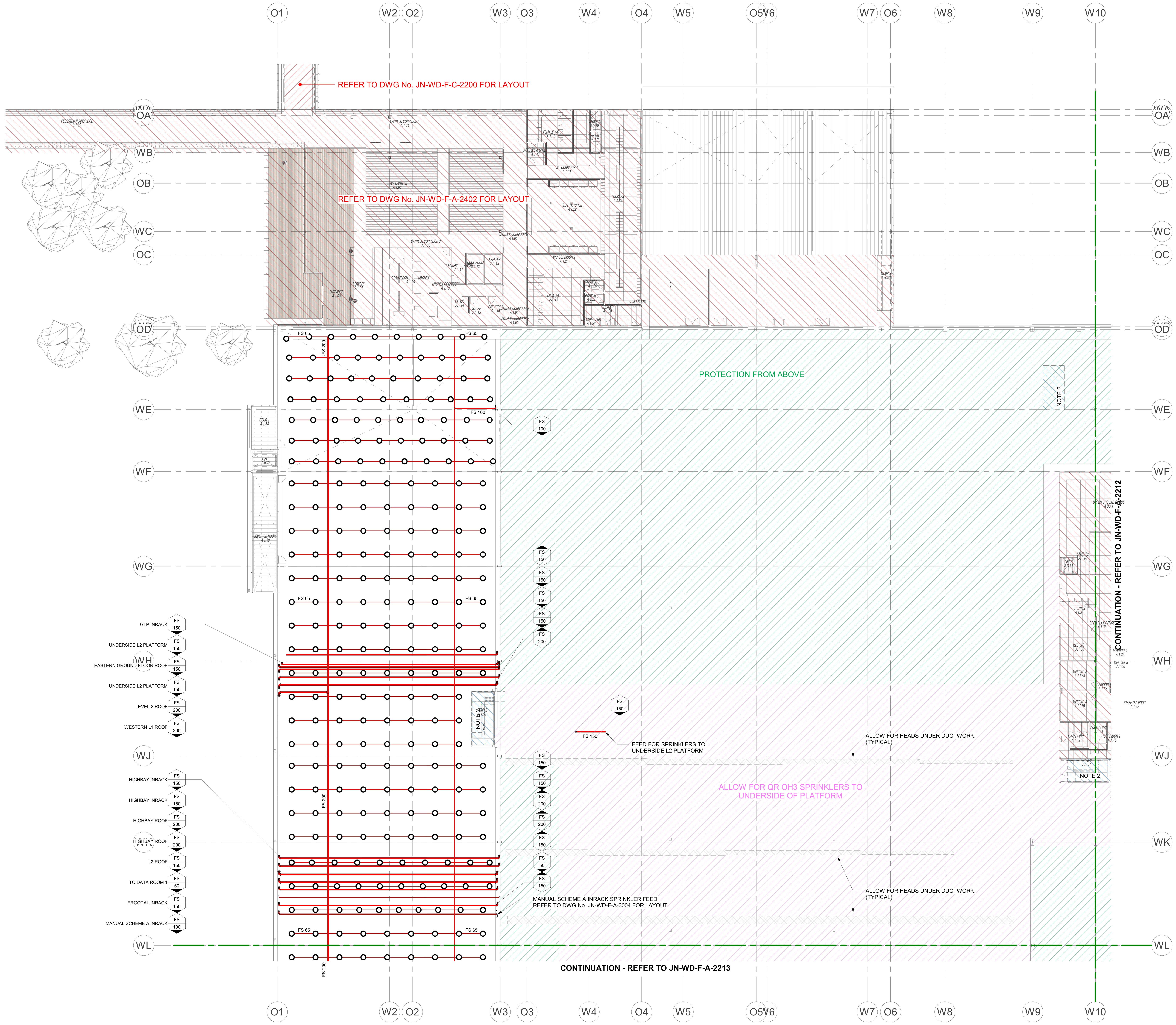
KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE				DRAWING TITLE		
JN DISTRIBUTION CENTRE				FIRE SERVICES SGS ROOM DETAILS		
SCALE BAR						
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 25	MJK	SLH	JN-WD-F-A-2206	T	T2

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 9/03/2021 12:27:44

ISSUE	DATE	DESCRIPTION	ISSUED BY
1	09.03.21	CLARIFIED SPRINKLER PROTECTION	
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE: JN DISTRIBUTION CENTRE

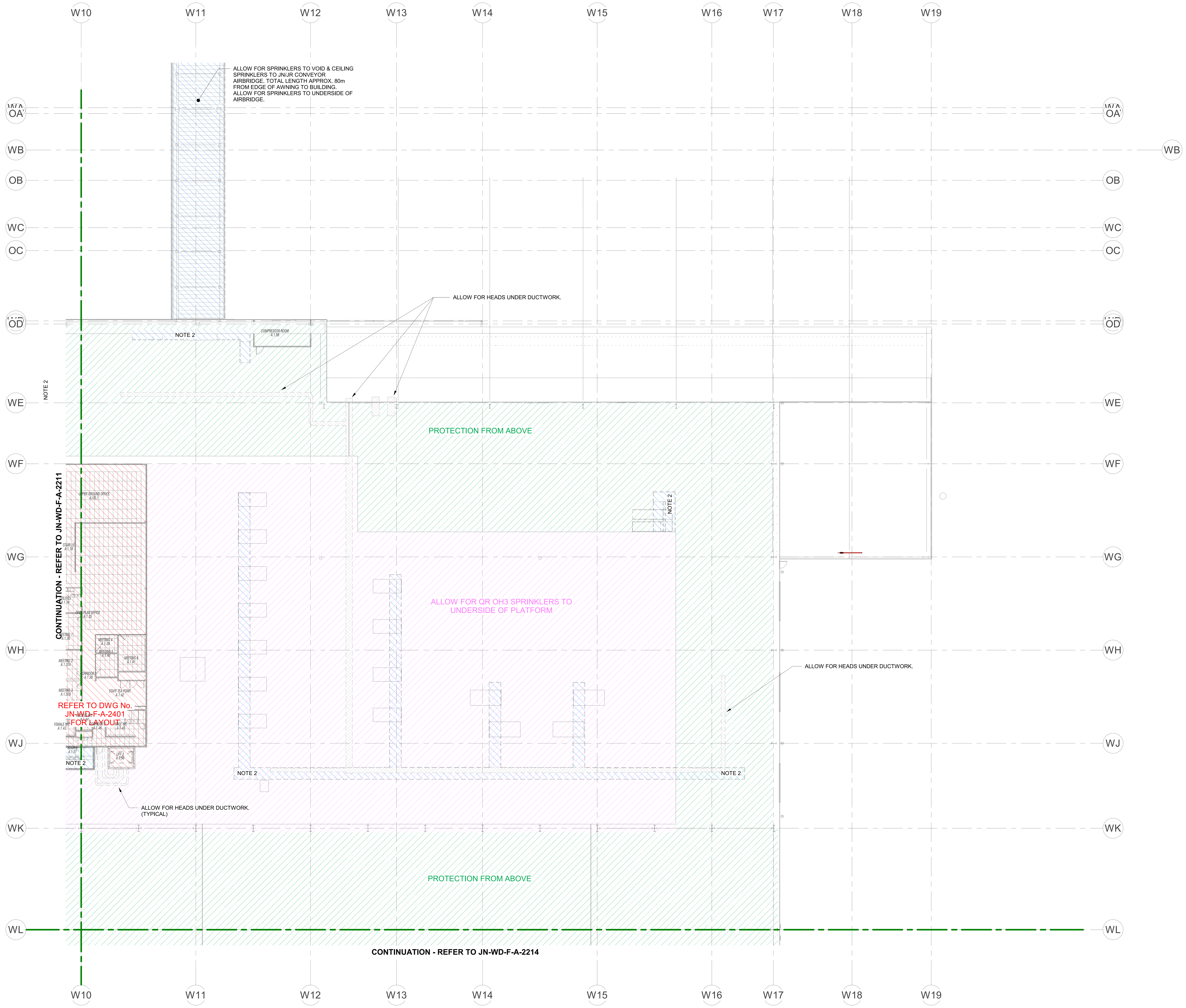
SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE: FIRE SERVICES LEVEL 1 - ZONE 1 SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2211	T	1

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 9/03/2021 12:28:02

ISSUE	DATE	DESCRIPTION	ISSUED BY
1	09.03.21	CLARIFIED SPRINKLER PROTECTION	
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE: JN DISTRIBUTION CENTRE

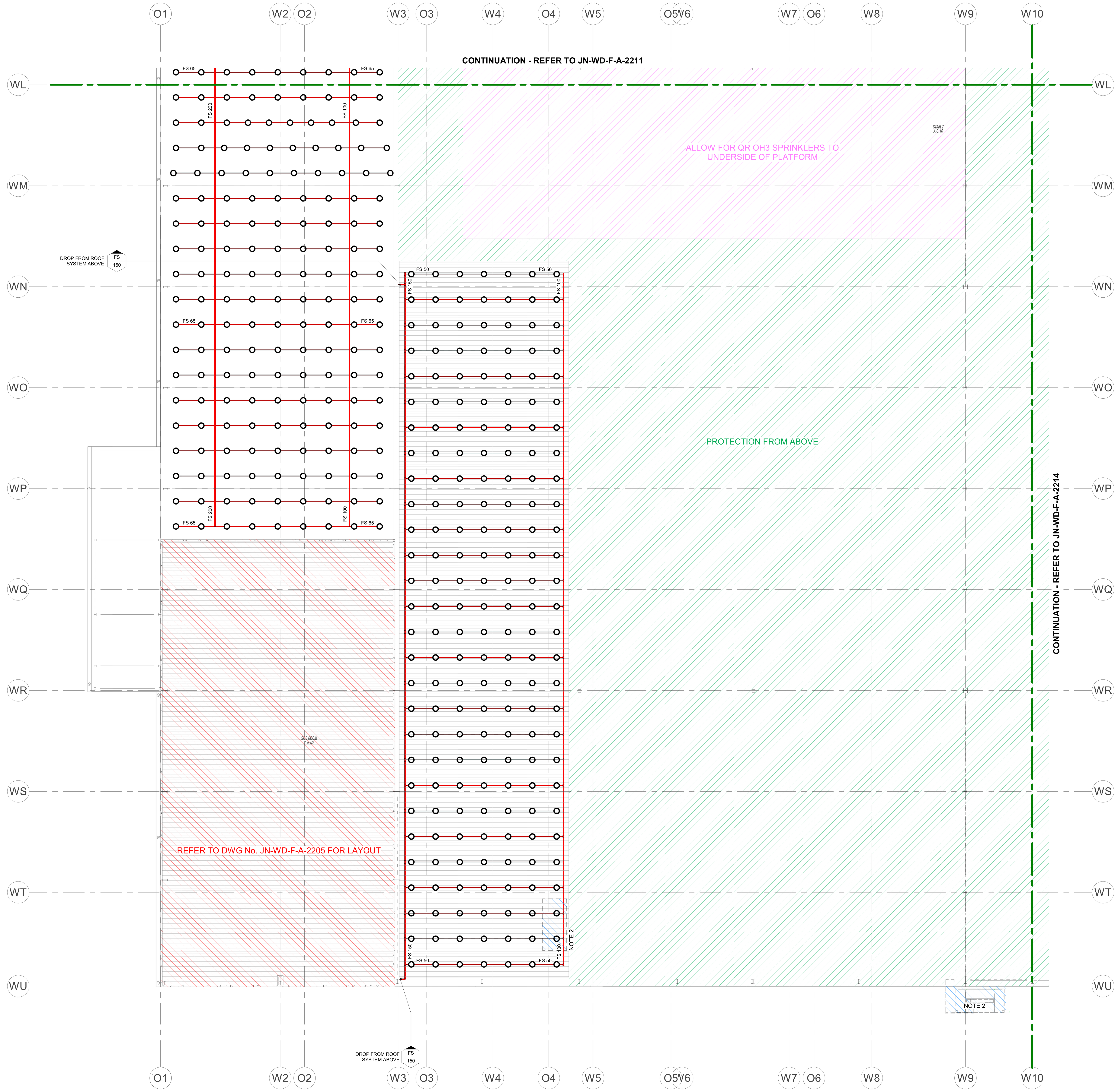
SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE: FIRE SERVICES LEVEL 1 - ZONE 2 SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2212	T	1

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 18:59:26

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE: JN DISTRIBUTION CENTRE

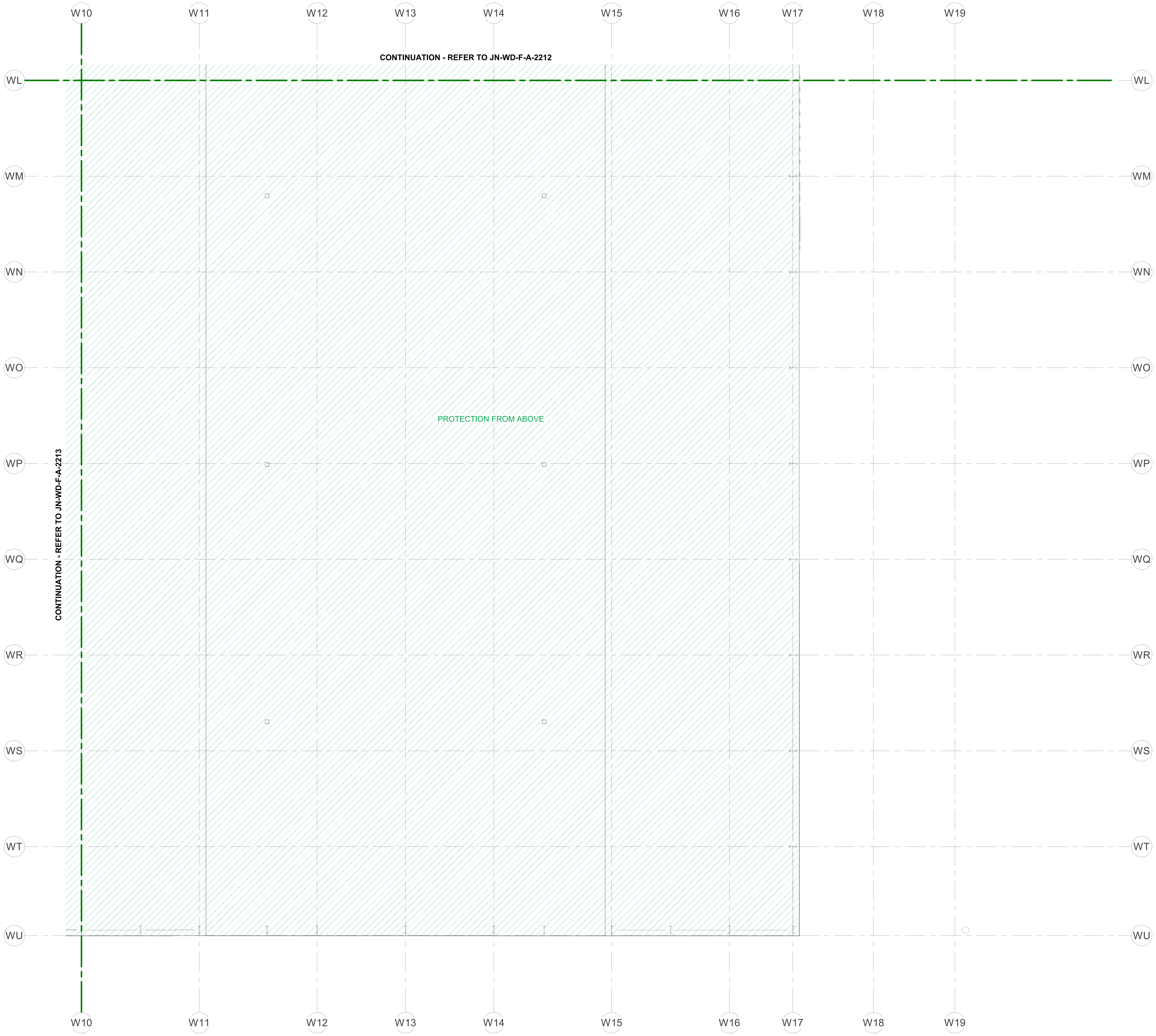
SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE: FIRE SERVICES LEVEL 1 - ZONE 3 SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2213	T	T2

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 18:59:39

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

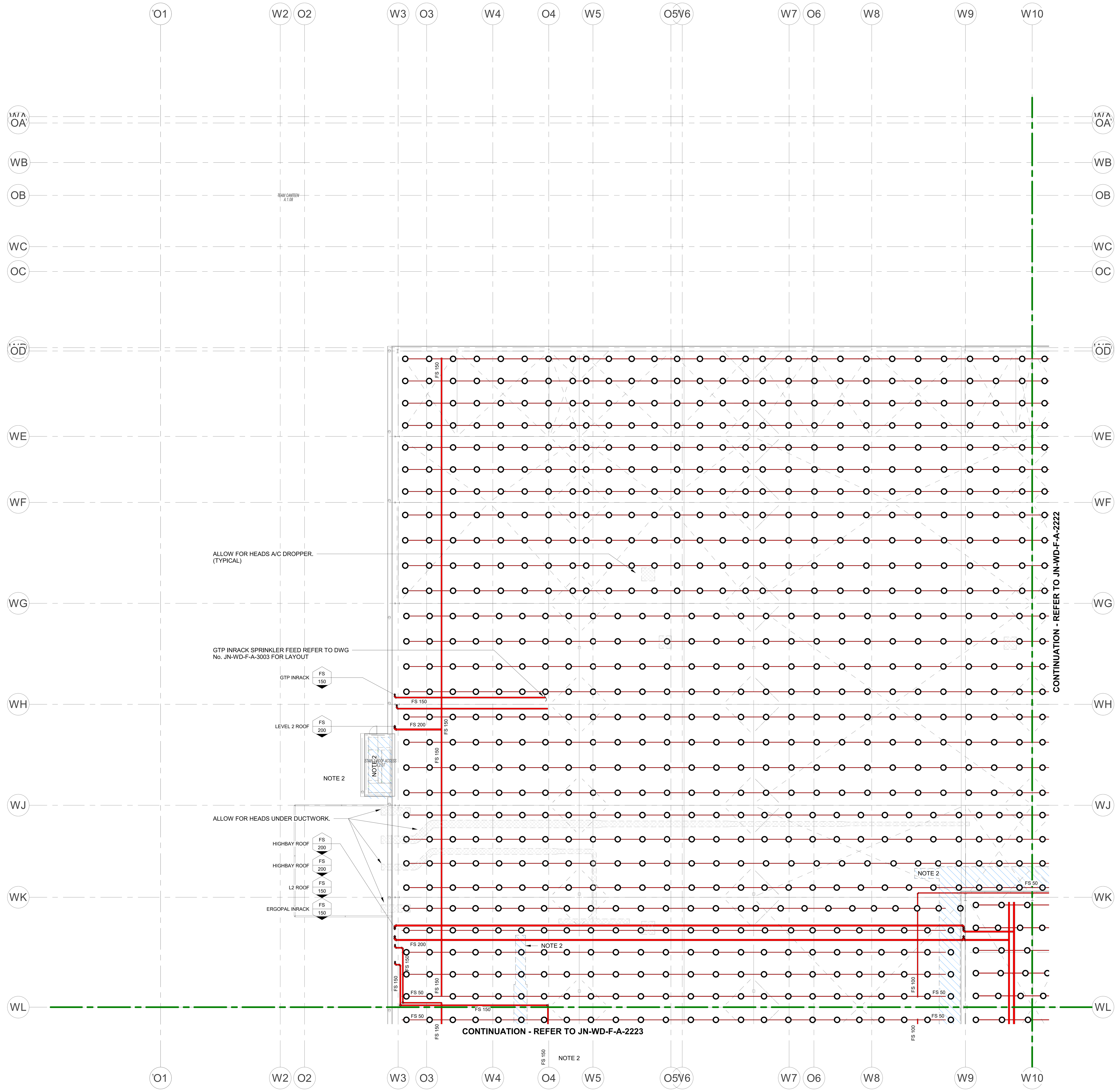
SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE
FIRE SERVICES
LEVEL 1 - ZONE 4 SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2214	T	T2

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 18:59:55

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE: JN DISTRIBUTION CENTRE

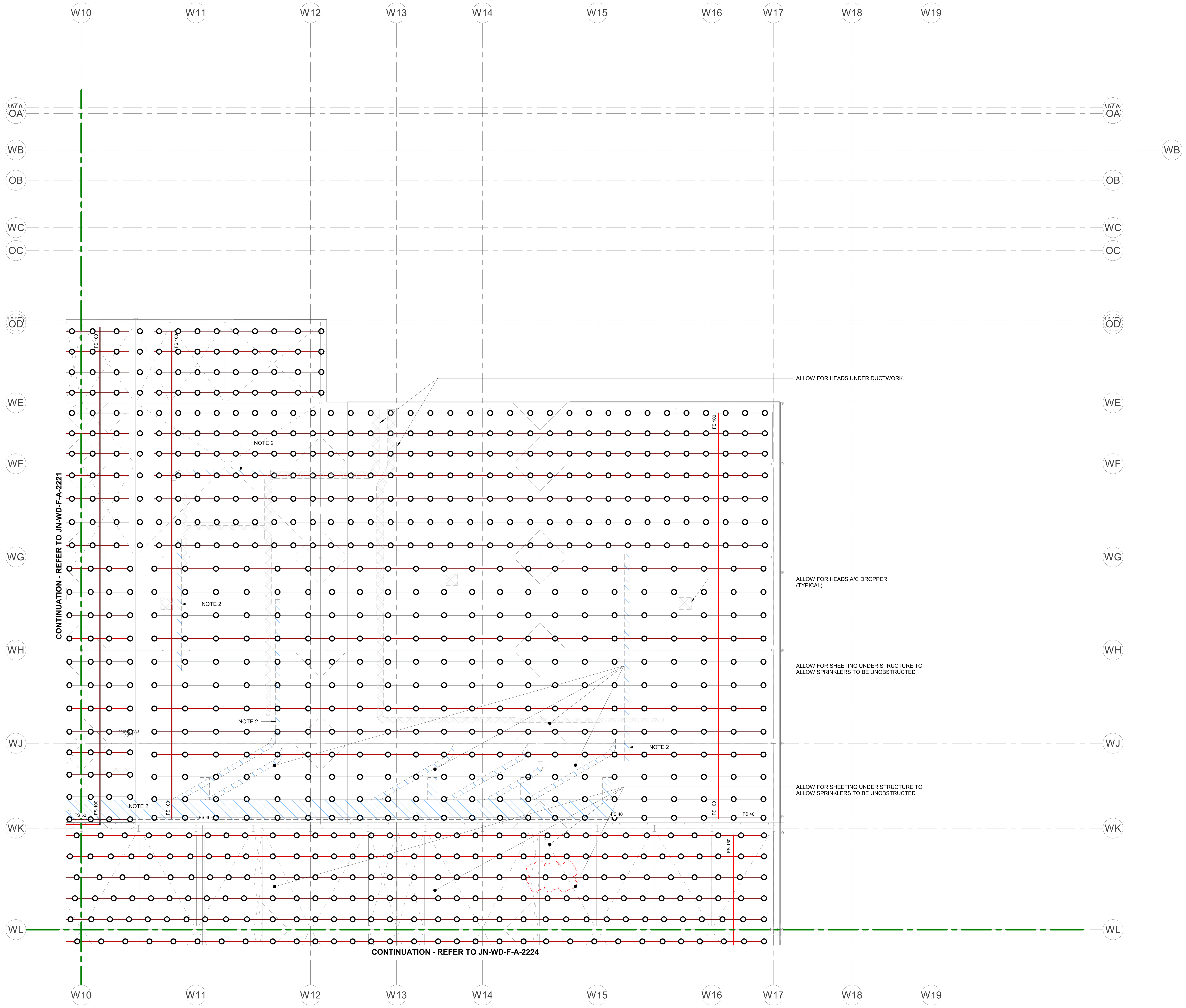
SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE: FIRE SERVICES LEVEL 2 - ZONE 1 SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2221	T	T2

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 19:00:11

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

Woolworths

LCI

KEY PLAN

ORIENTATION

TRUE NORTH

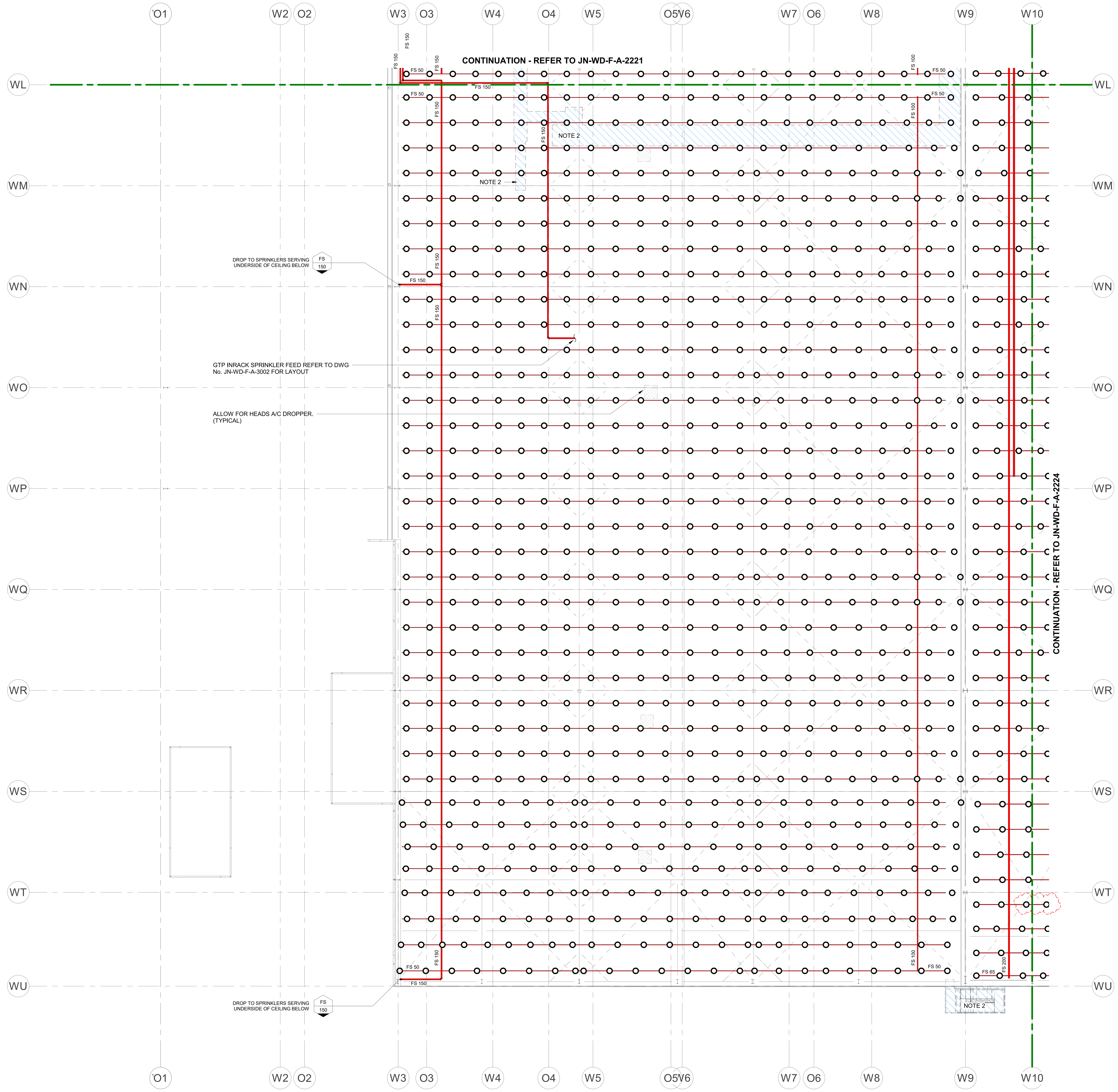
JOB TITLE	DRAWING TITLE
JN DISTRIBUTION CENTRE	FIRE SERVICES LEVEL 2 - ZONE 2 SPRINKLER LAYOUT

SCALE BAR 0m 4m 8m 12m 16m 20m

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2222	T	T2

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.



70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 19:00:28

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE
FIRE SERVICES
LEVEL 2 - ZONE 3 SPRINKLER LAYOUT

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2223	T	T2

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS, PLATFORMS & CONVEYORS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 19:00:44

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

Woolworths
LCI

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

SCALE BAR 0m 4m 8m 12m 16m 20m

DRAWING TITLE
FIRE SERVICES
LEVEL 2 - ZONE 4 SPRINKLER LAYOUT

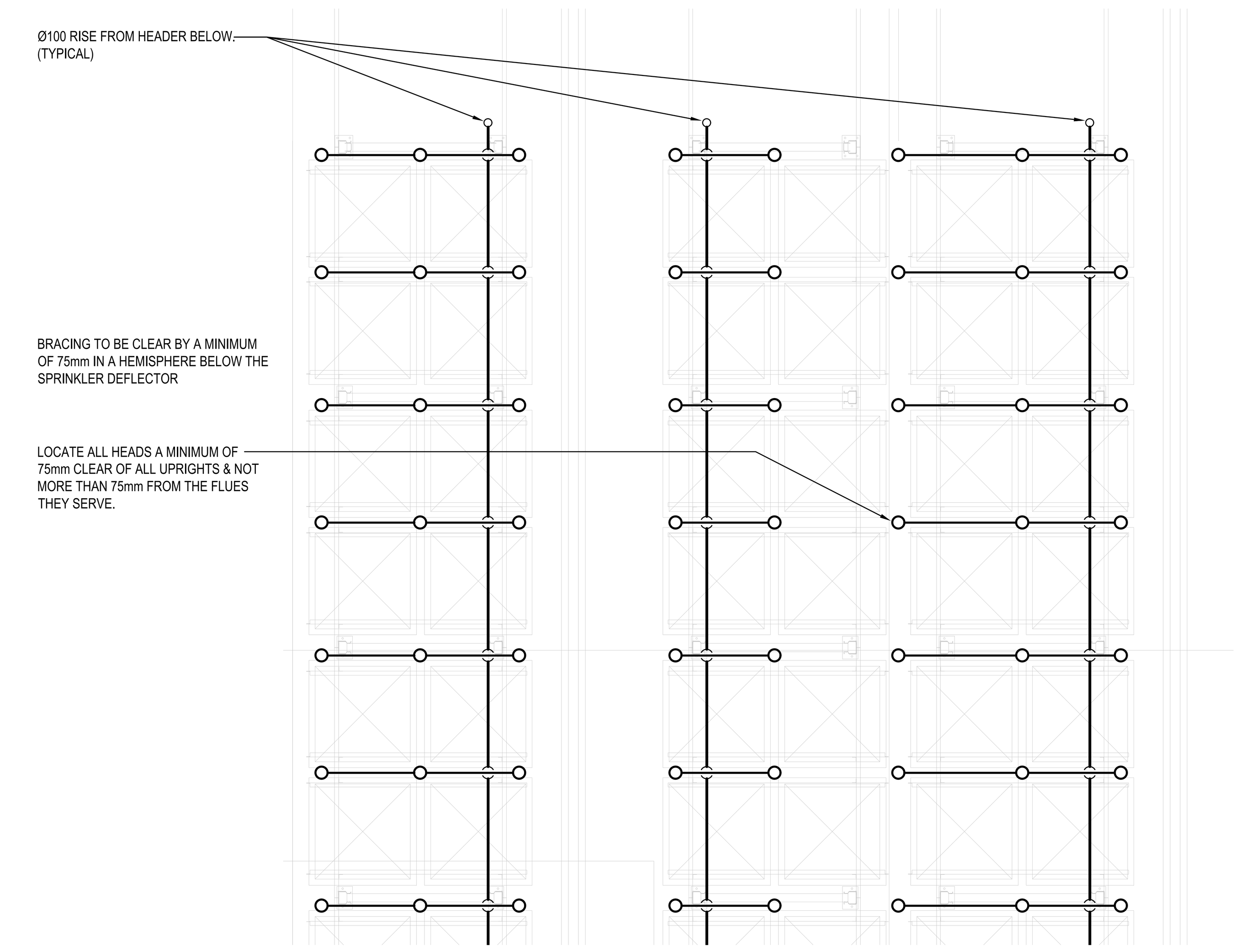
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 200	MJK	SLH	JN-WD-F-A-2224	T	T2

NOTES:

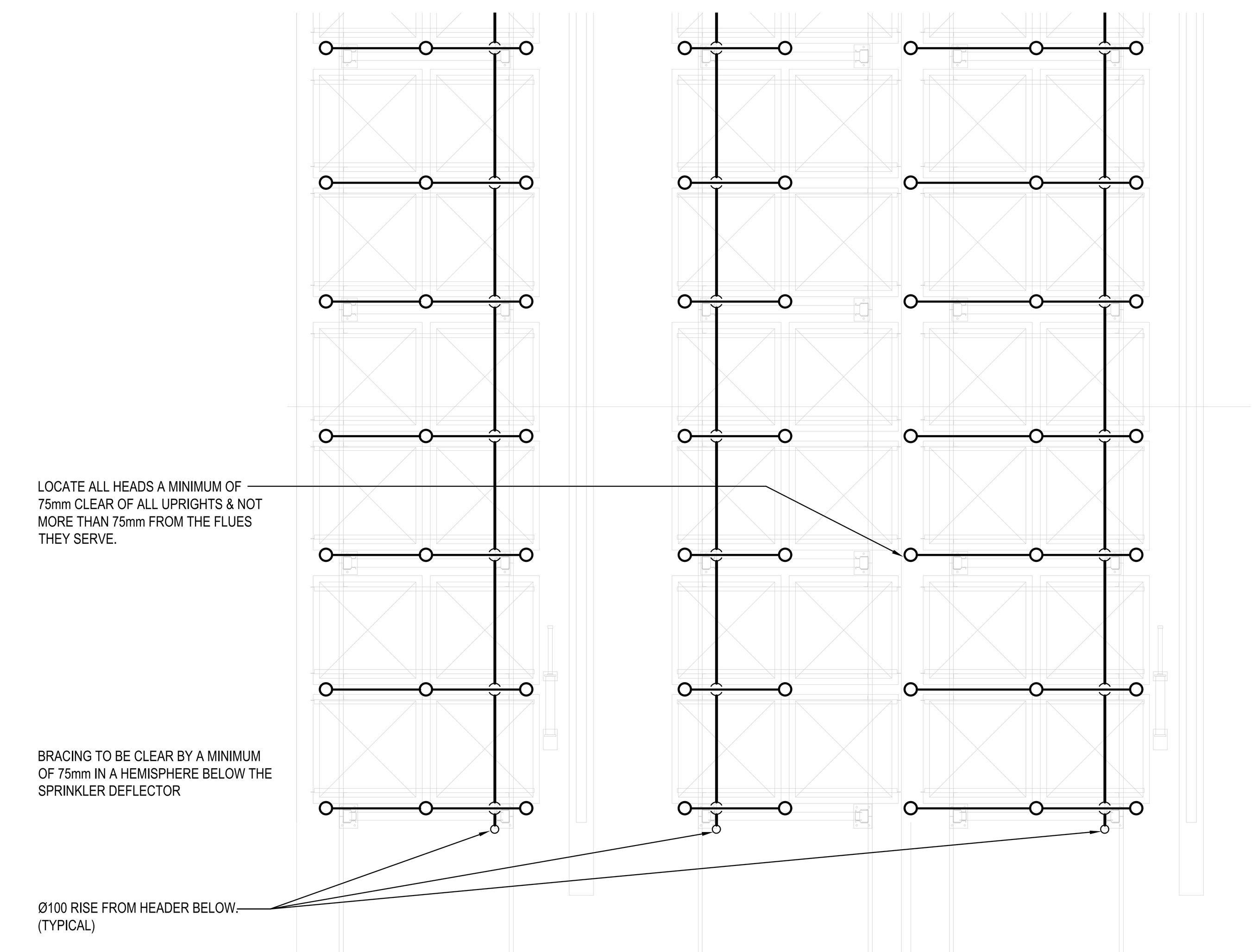
1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.

PIPE DIA NB (mm)	kg/m
200	65
150	48
100	25
80	16
65	12.5
50	8.5
40	6.5

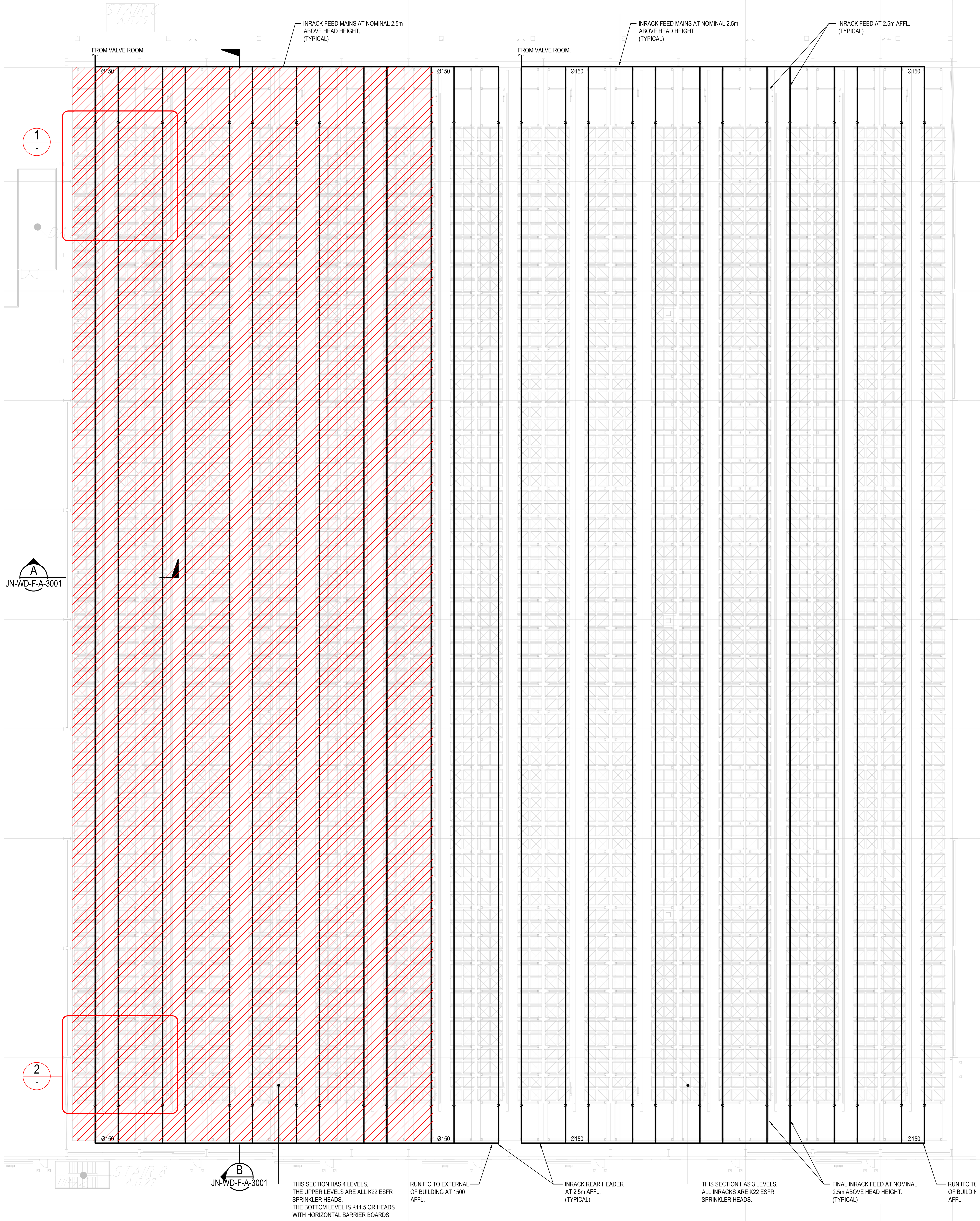
TABLE OF WATER FILLED PIPE WEIGHTS



DETAIL 1
SCALE 1:50



DETAIL 2
SCALE 1:50



INRACK SPRINKLER MAINS
SCALE 1:200

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 13:27:41

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

SCALE BAR

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY
190852		MJK	SLH

DRAWING TITLE
FIRE SERVICES
IN-RACK SPRINKLERS HIGH BAY
SHEET 1

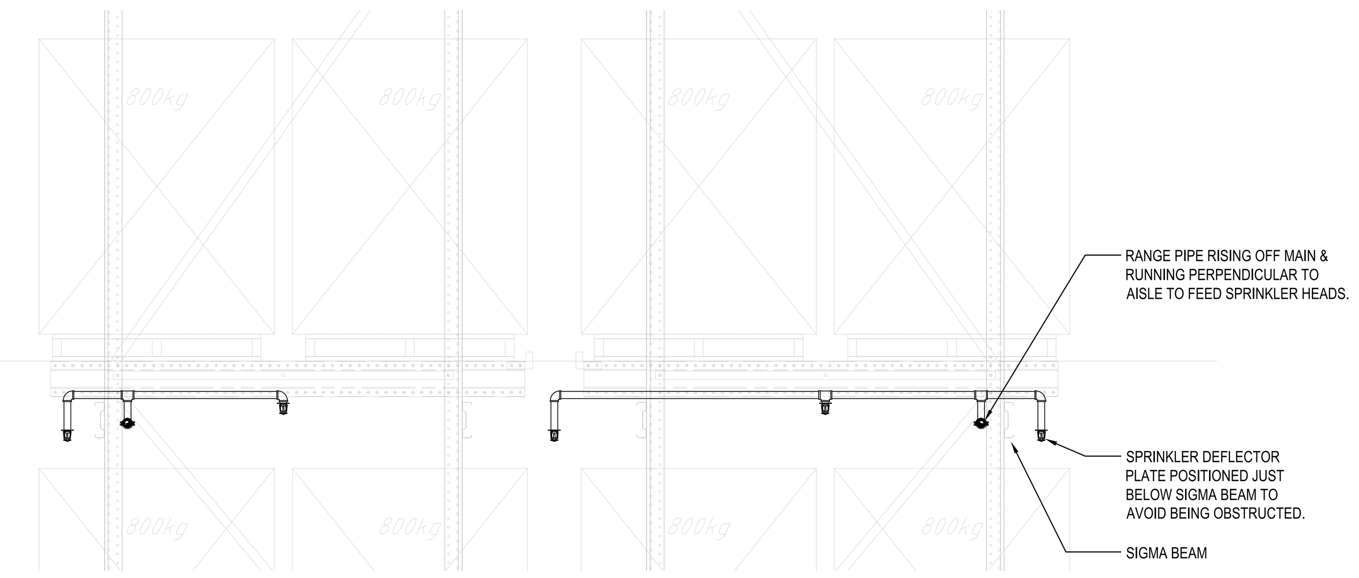
DRAWING NO	STATUS	REVISION
JN-WD-F-A-3000	T	T2

NOTES:

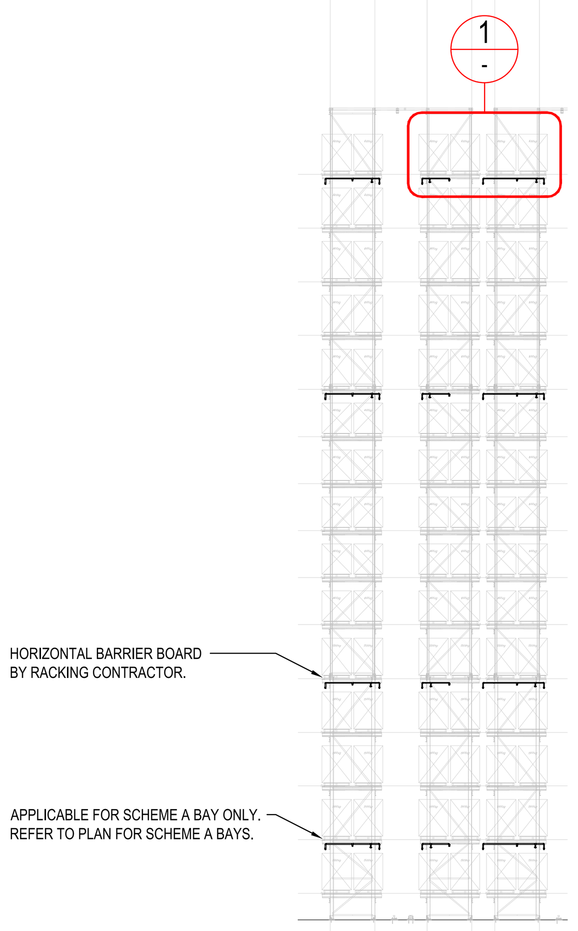
1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.

PIPE DIA NB (mm)	kg/m
200	65
150	48
100	25
80	16
65	12.5
50	8.5
40	6.5

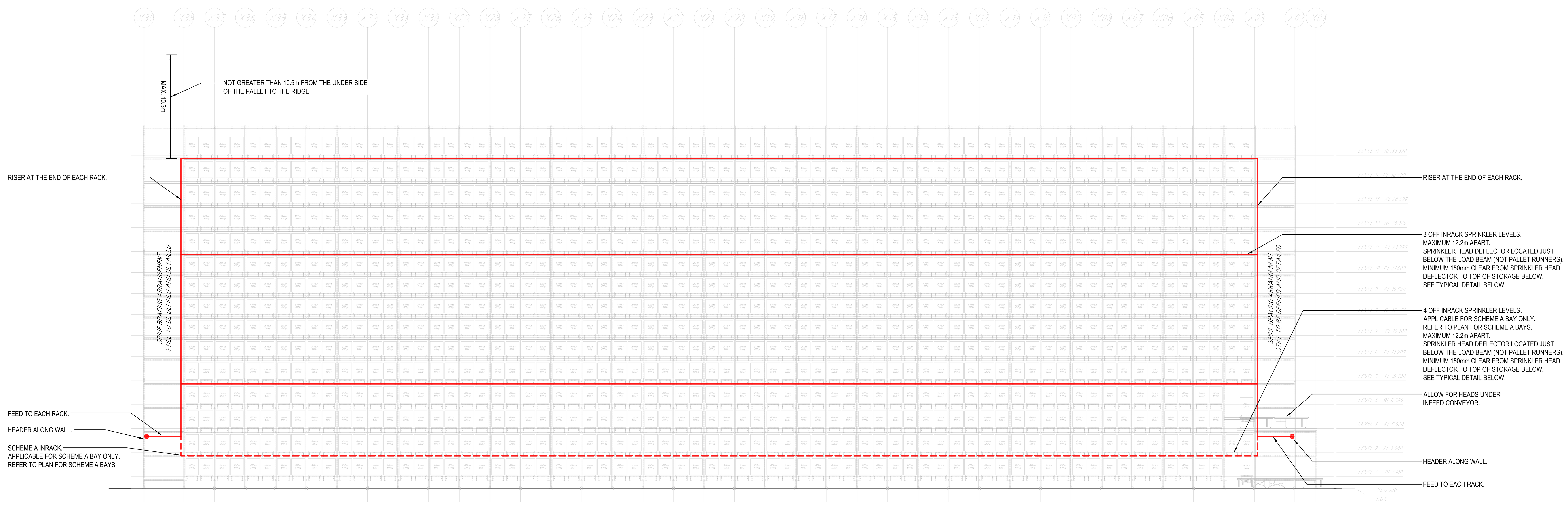
TABLE OF WATER FILLED PIPE WEIGHTS



DETAIL A
SCALE 1:25



SECTION A
SCALE 1:200 JN-WD-F-A-3000



SECTION B
SCALE 1:200 JN-WD-F-A-3000

CARTONED UNEXPANDED PLASTIC ASSUMED AS THE MAXIMUM COMMODITY CLASSIFICATION
(ie NO OILS, NO AEROSOLS, NO FLAMMABLE DG LIQUIDS, NO PLASTIC OR IDLE PALLETS EXCEPT IN SCHEME A IN PARTS OF LOWEST PALLET POSITION.)

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 13:27:42

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

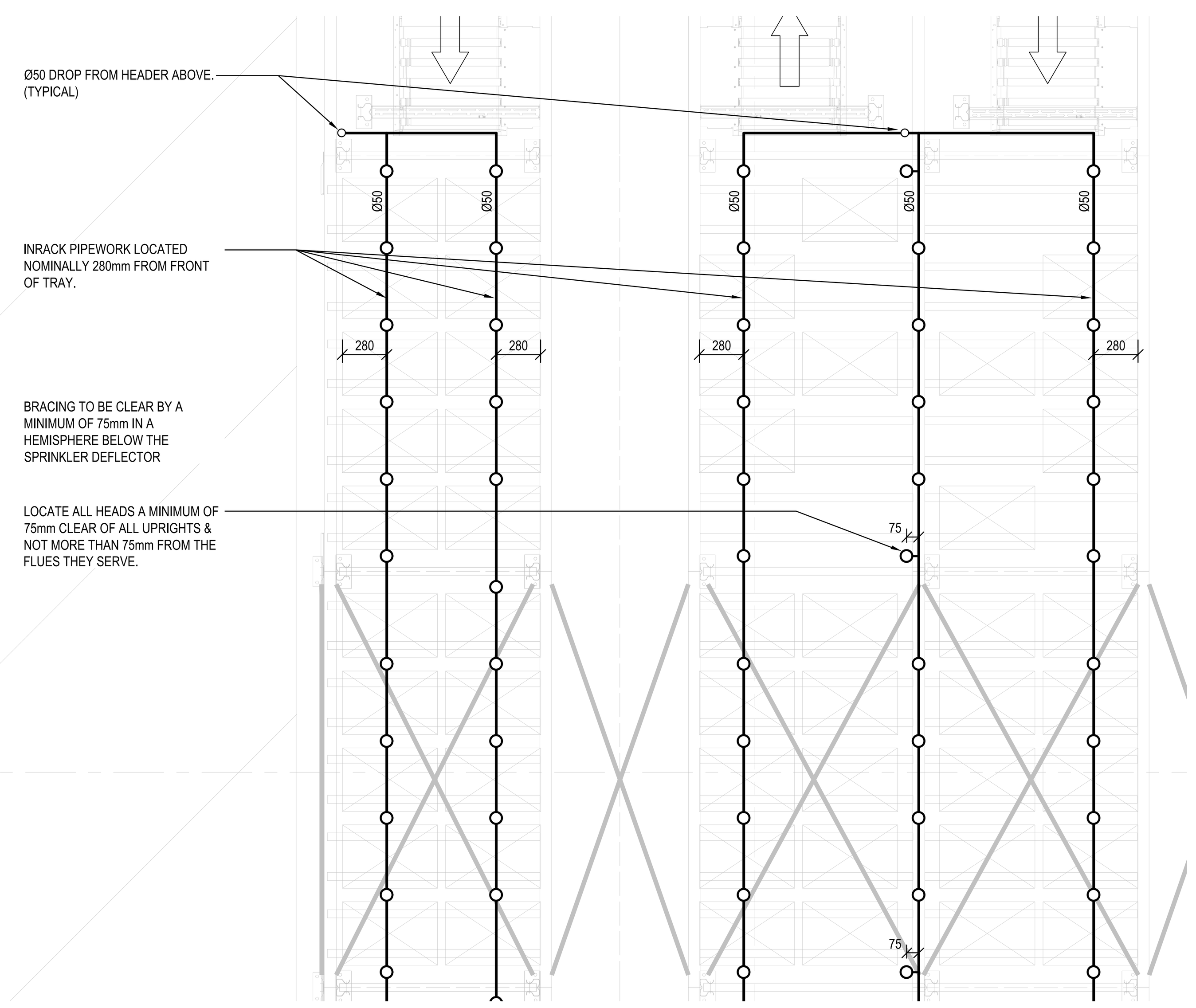
SCALE BAR 0m 0m 0m 0m 0m 0m

DRAWING TITLE
FIRE SERVICES
IN-RACK SPRINKLERS HIGH BAY
SHEET 2

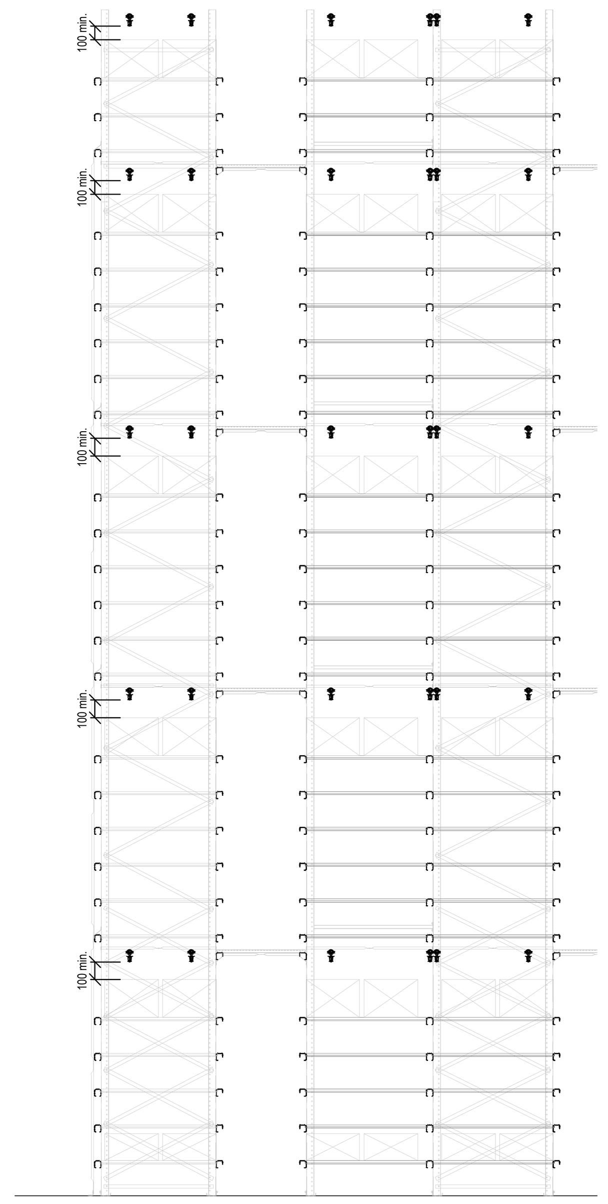
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852		MJK	SLH	JN-WD-F-A-3001	T	T2

NOTES:

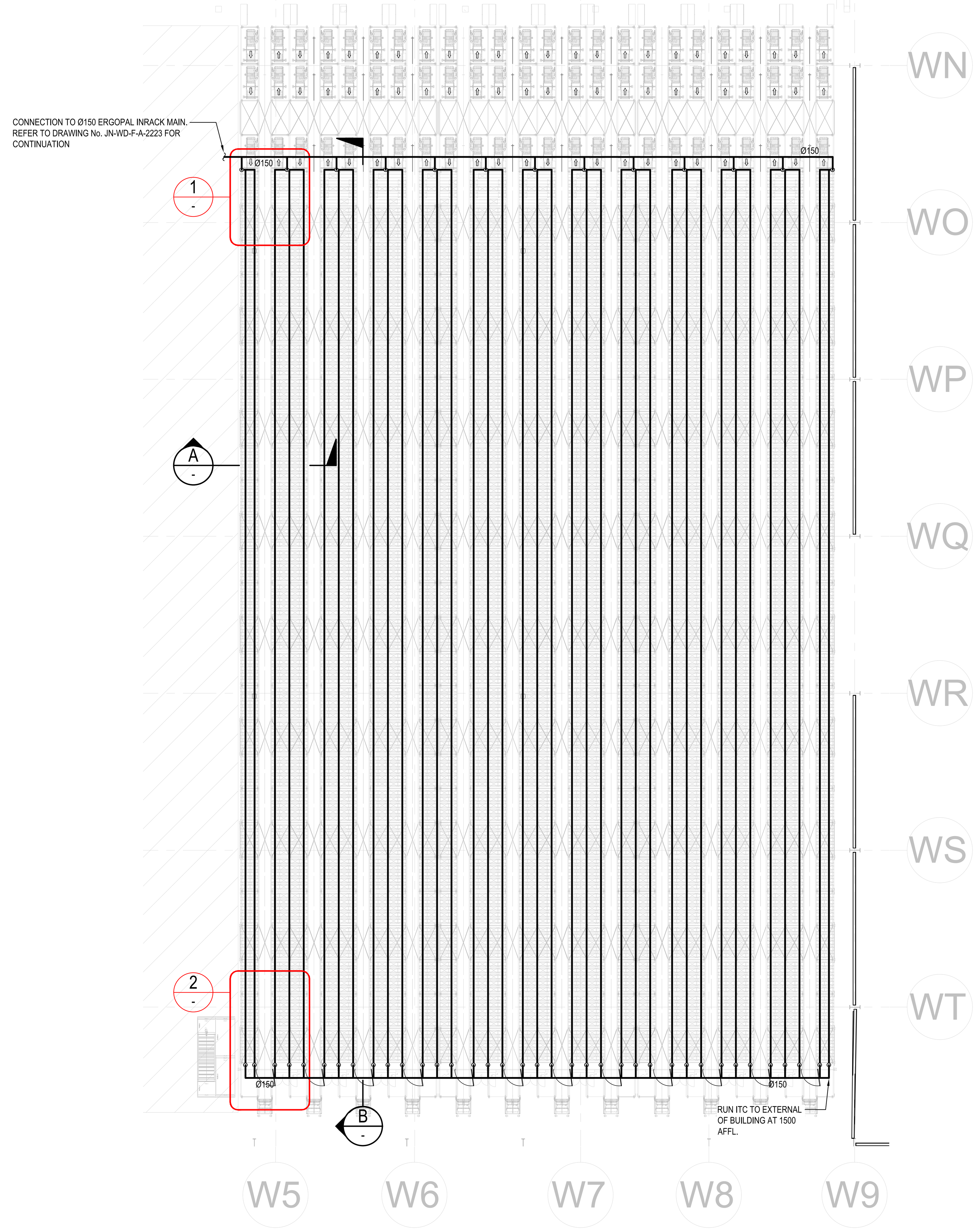
1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.



DETAIL 1
SCALE 1:25



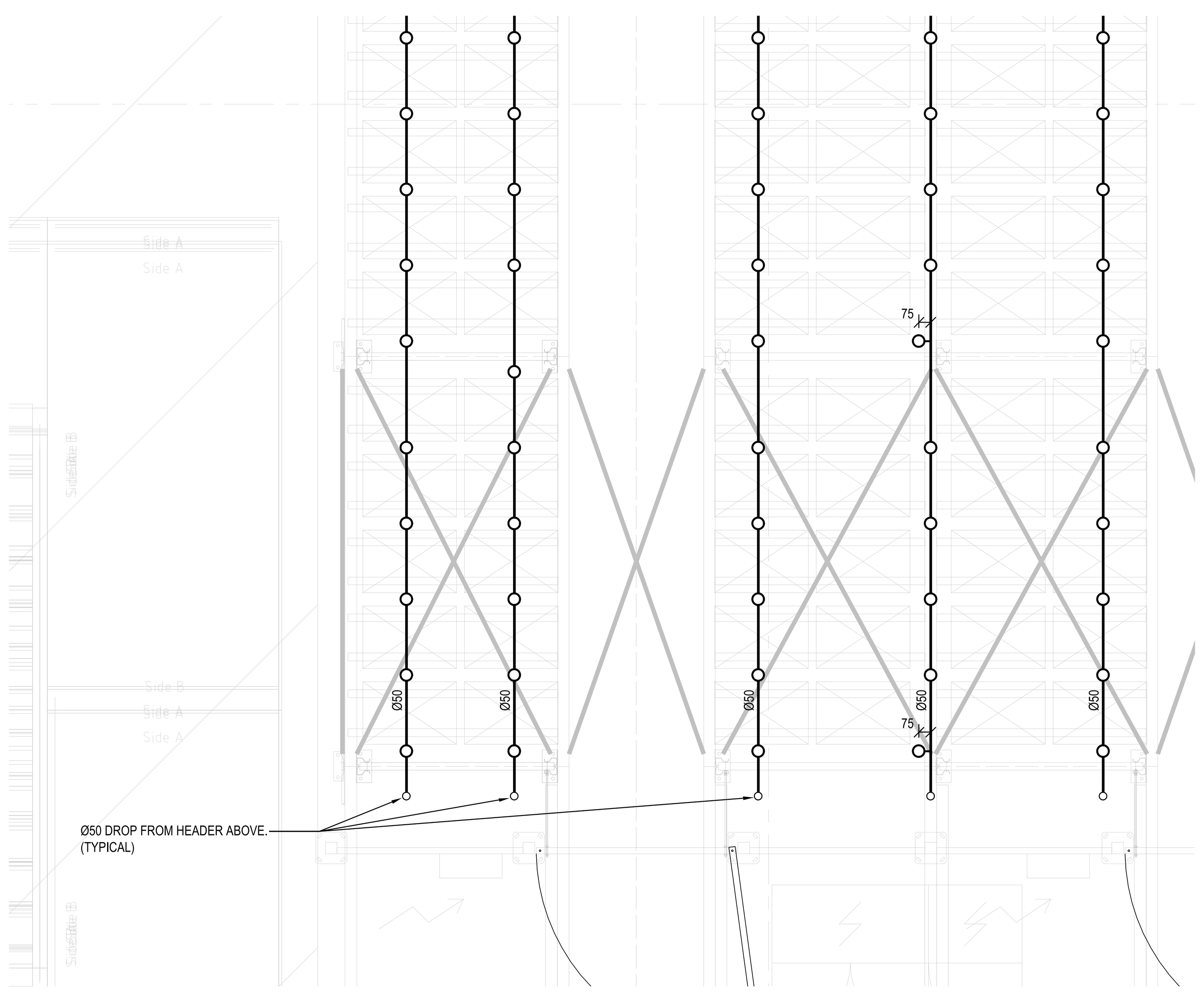
SECTION A
SCALE 1:50



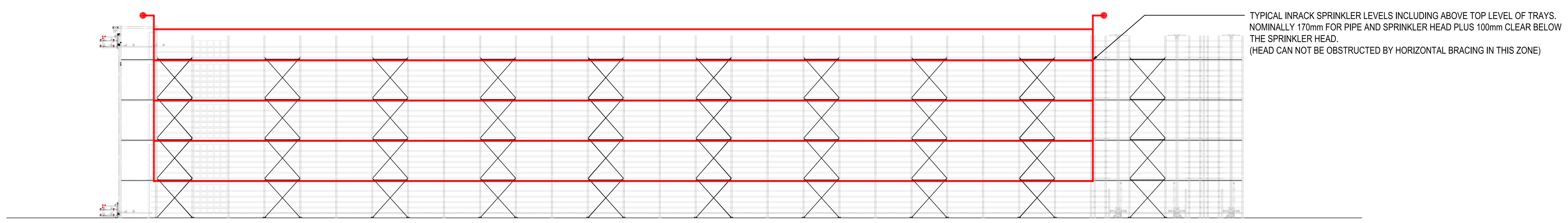
INRACK SPRINKLER MAINS
SCALE 1:200

PIPE DIA NB (mm)	kg/m
200	65
150	48
100	25
80	16
65	12.5
50	8.5
40	6.5

TABLE OF WATER FILLED PIPE WEIGHTS



DETAIL 2
SCALE 1:25



SECTION B
SCALE 1:200

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 13:27:43

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

Woolworths
LCI

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

SCALE BAR

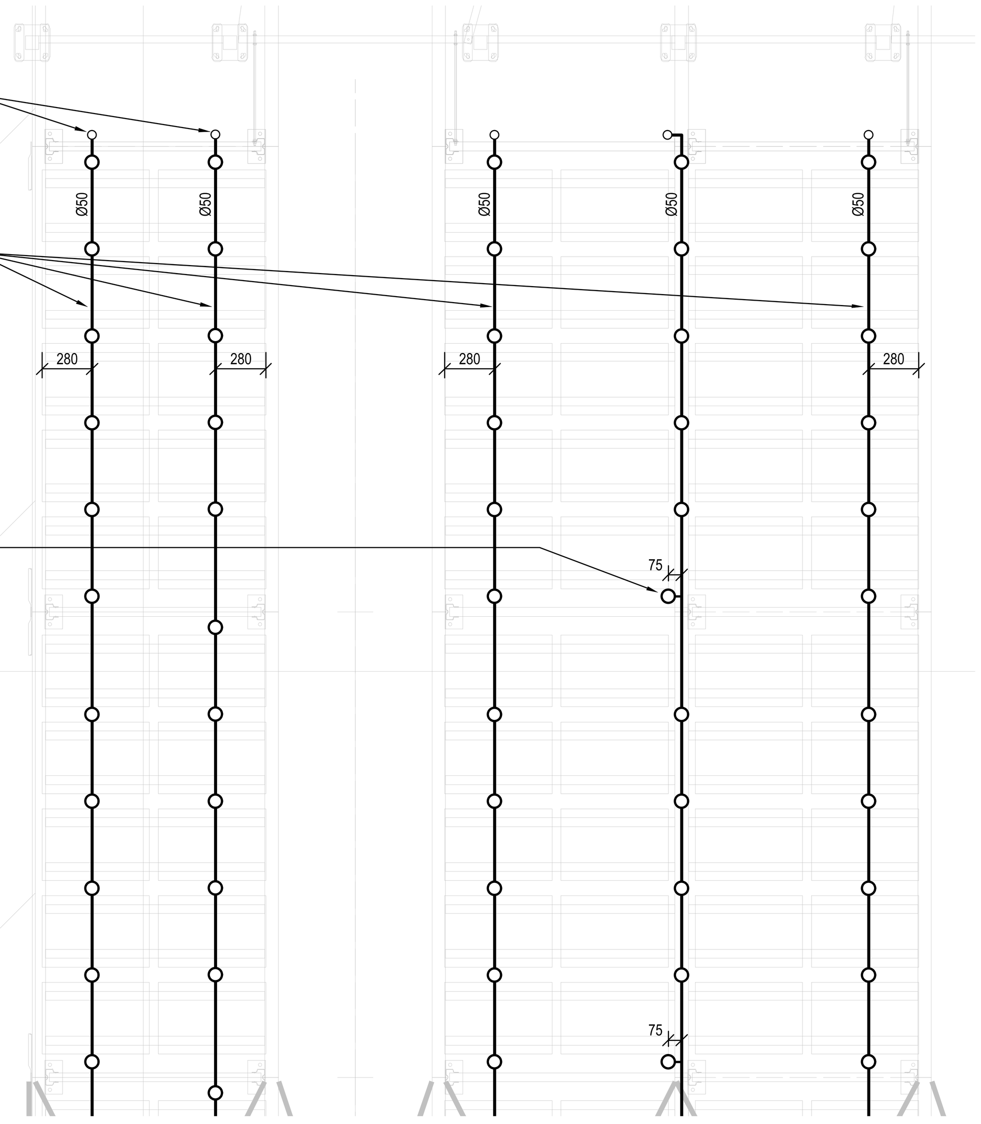
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY
190852		MJK	SLH

DRAWING TITLE
FIRE SERVICES
IN-RACK SPRINKLERS ERGOPAL
CASE BUFFER

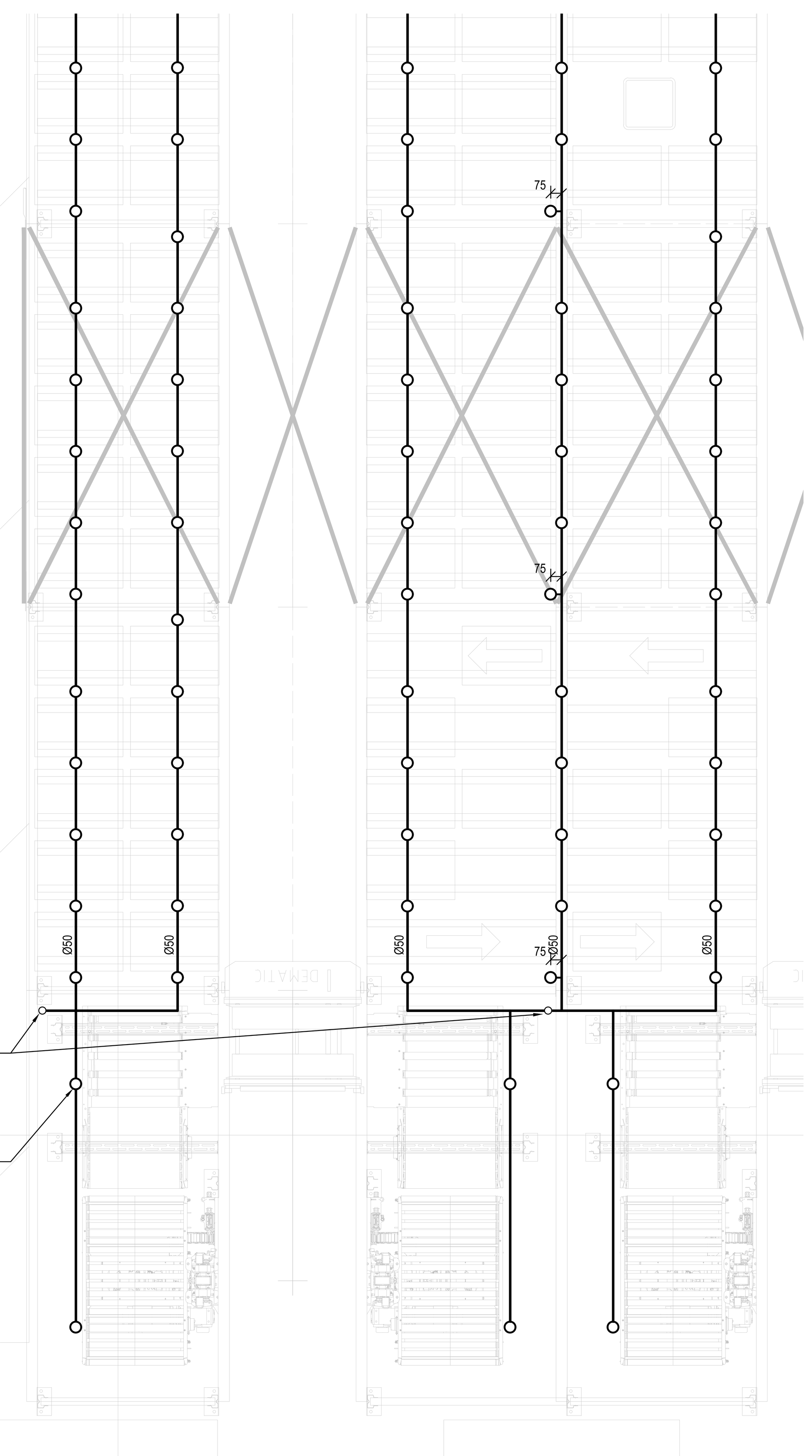
DRAWING NO	STATUS	REVISION
JN-WD-F-A-3002	T	T2

NOTES:

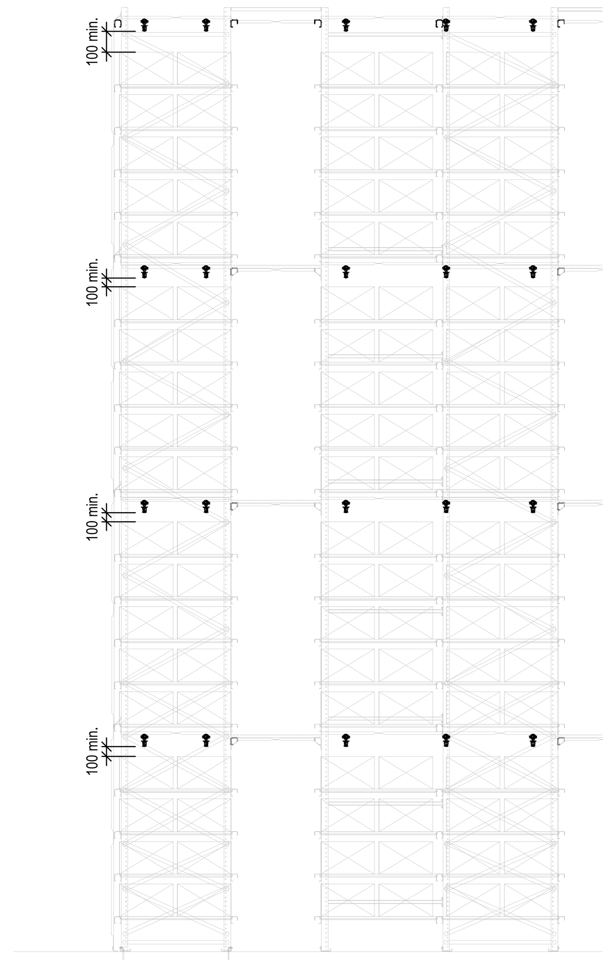
1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.



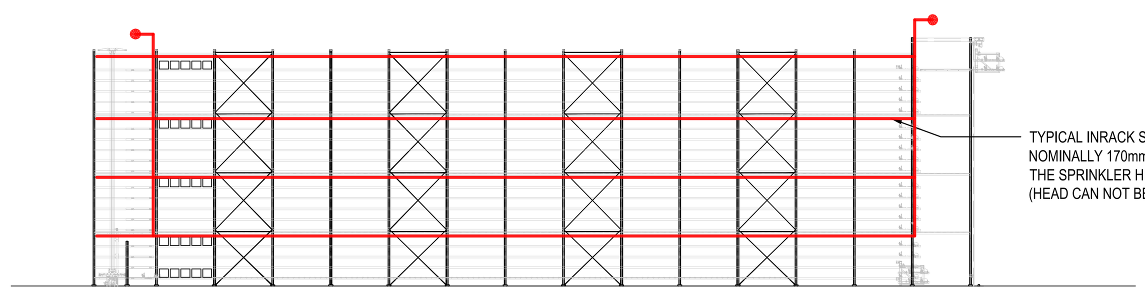
DETAIL 1 -
SCALE 1:25



DETAIL 2 -
SCALE 1:25



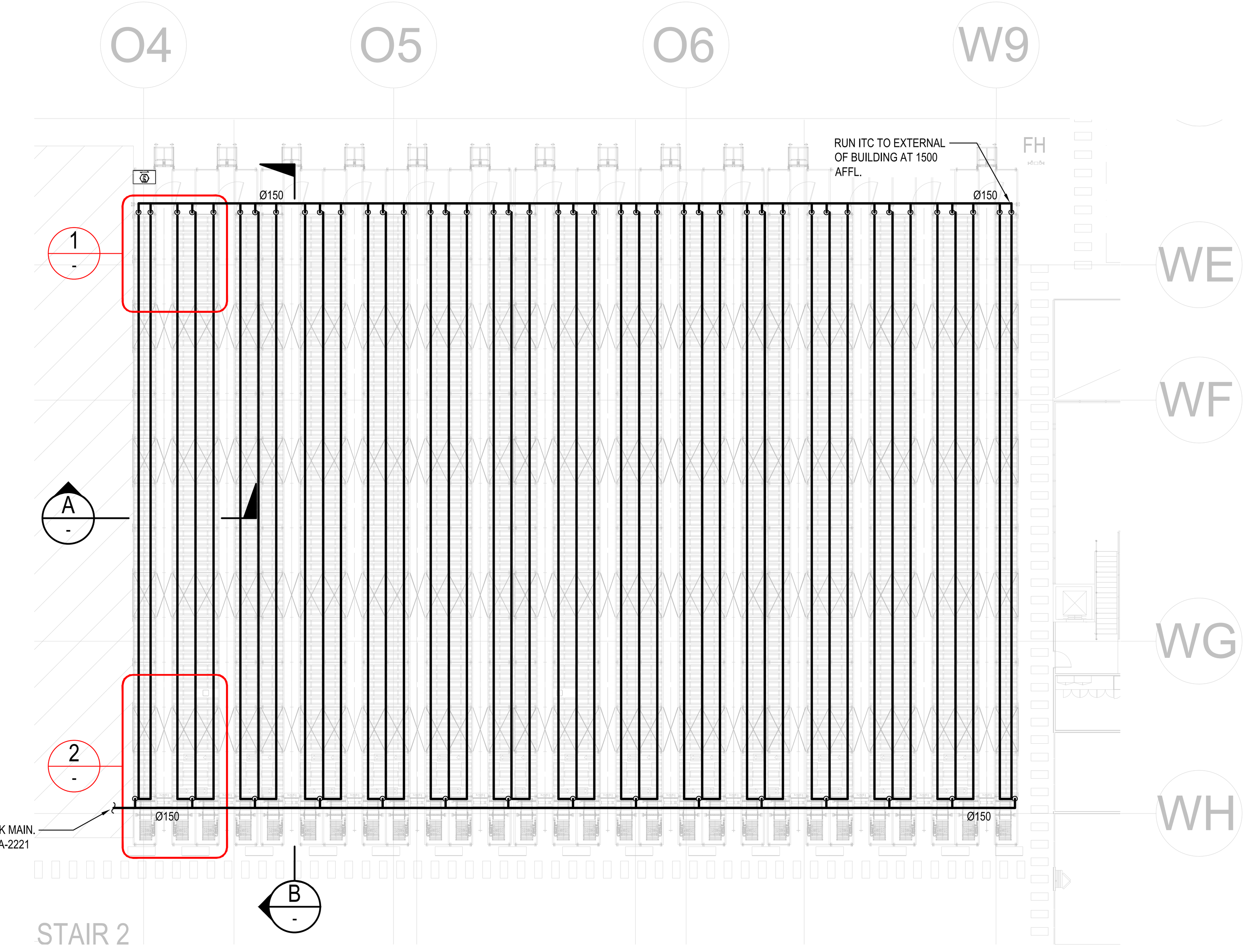
SECTION A -
SCALE 1:50



SECTION B -
SCALE 1:200

PIPE DIA NB (mm)	kg/m
200	65
150	48
100	25
80	16
65	12.5
50	8.5
40	6.5

TABLE OF WATER FILLED PIPE WEIGHTS



INRACK SPRINKLER MAINS
SCALE 1:200

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 13:27:44

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

KEY PLAN

ORIENTATION
TRUE NORTH

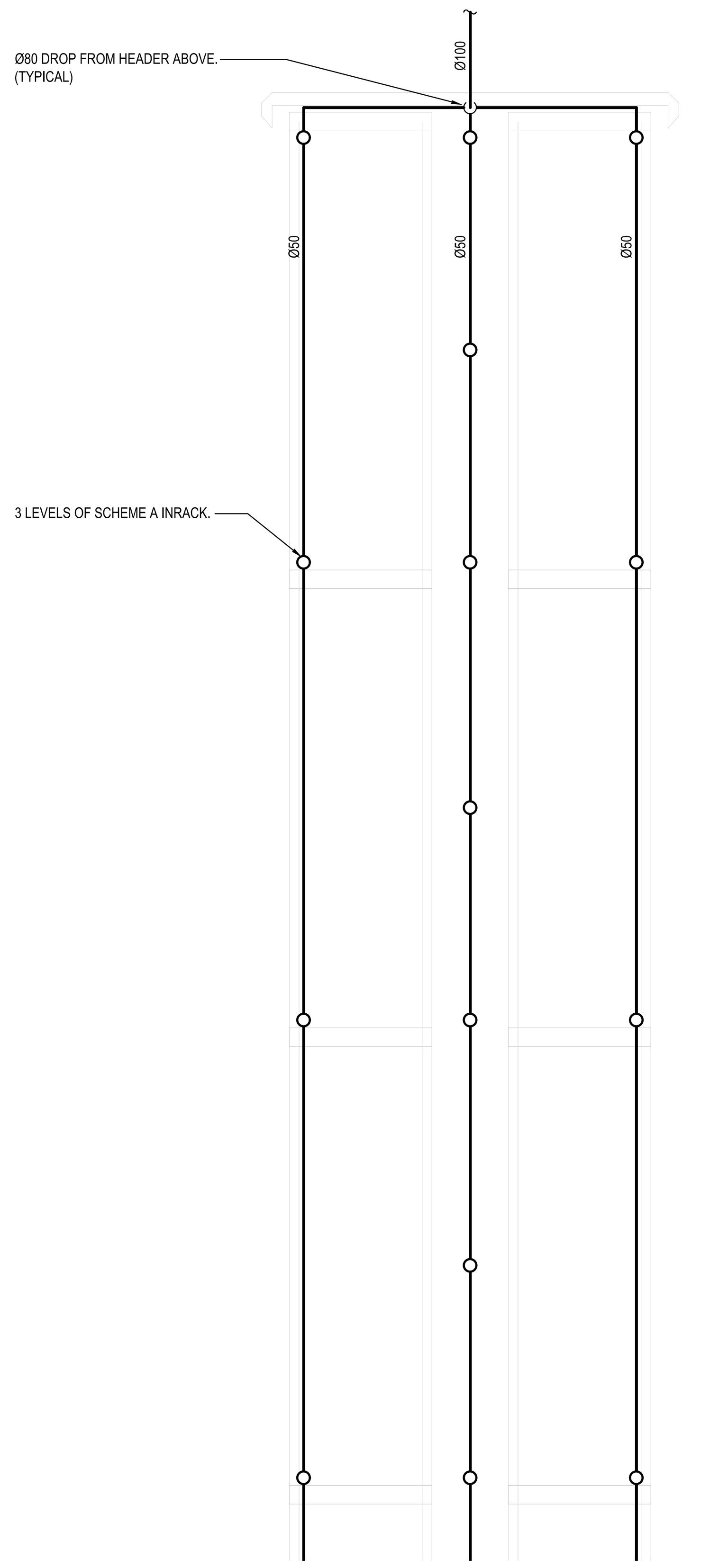
JOB TITLE
JN DISTRIBUTION CENTRE

SCALE BAR

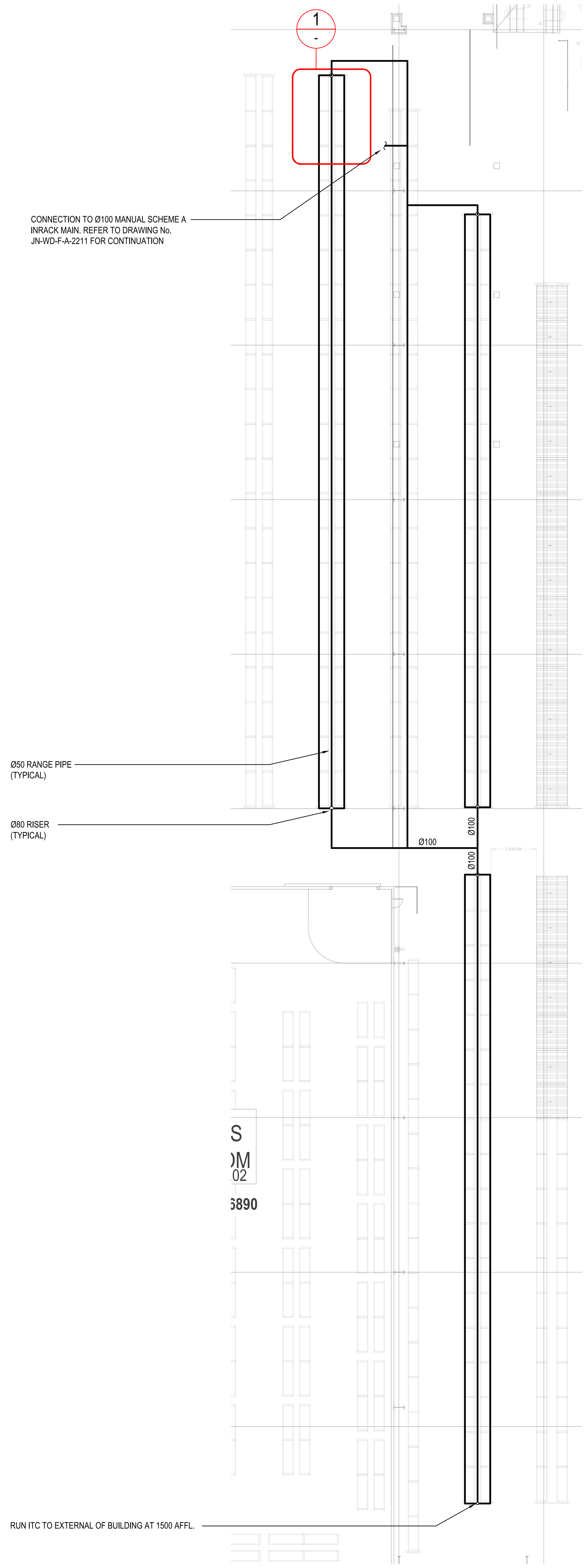
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY
190852		MJK	SLH

DRAWING TITLE
FIRE SERVICES
IN-RACK SPRINKLERS GTP
CASE BUFFER

DRAWING NO	STATUS	REVISION
JN-WD-F-A-3003	T	T2



DETAIL 1 -
SCALE 1:25



INRACK SPRINKLER MAINS
SCALE 1:200

PIPE DIA NB (mm)	kg/m
200	65
150	48
100	25
80	16
65	12.5
50	8.5
40	6.5

TABLE OF WATER FILLED PIPE WEIGHTS

70% TENDER

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 16/12/2020 13:27:45

ISSUE	DATE	DESCRIPTION	ISSUED BY
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

Woolworths
LCI

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE
JN DISTRIBUTION CENTRE

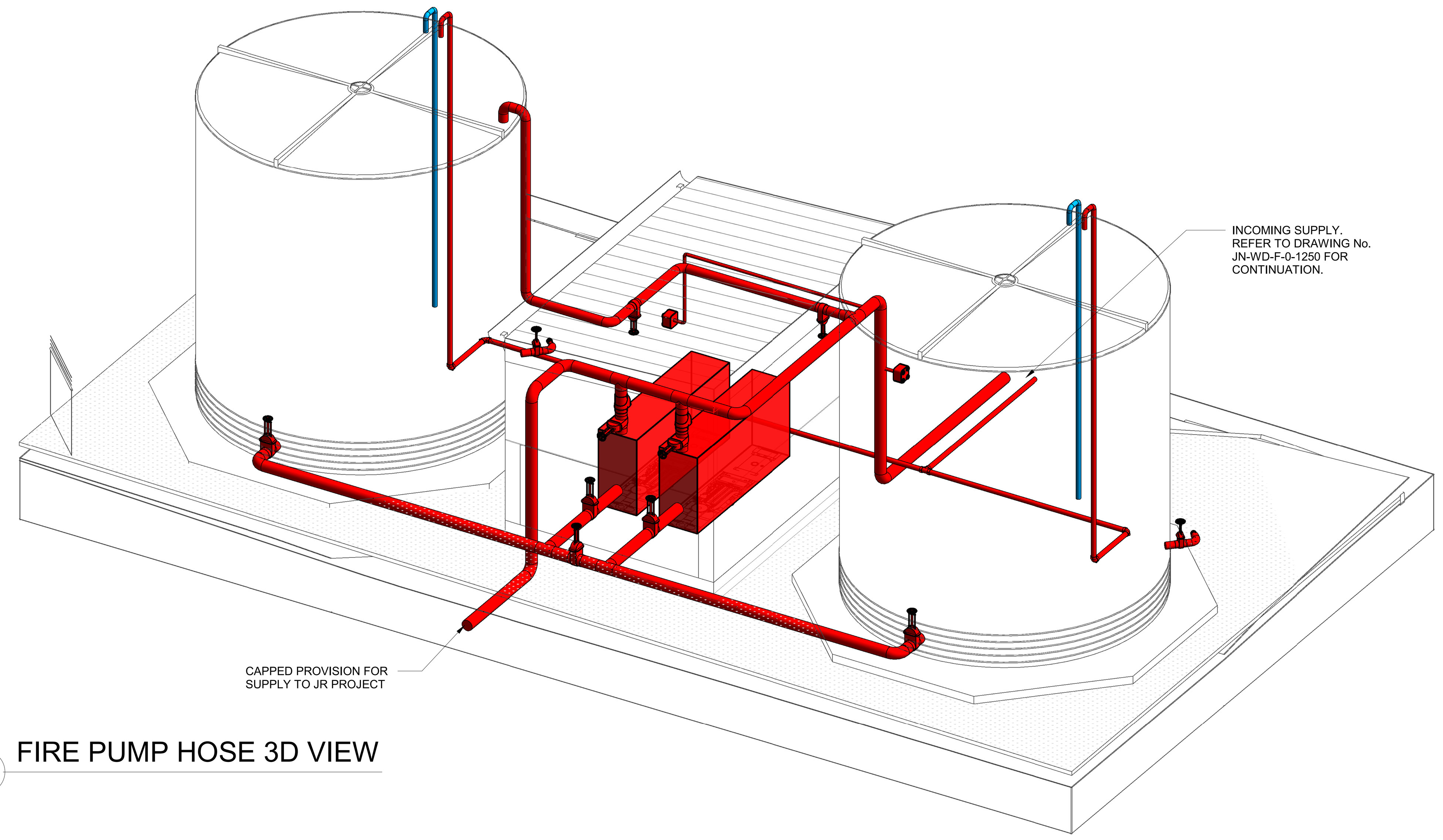
SCALE BAR

DRAWING TITLE
FIRE SERVICES
IN-RACK SPRINKLERS MANUAL
SCHEME A

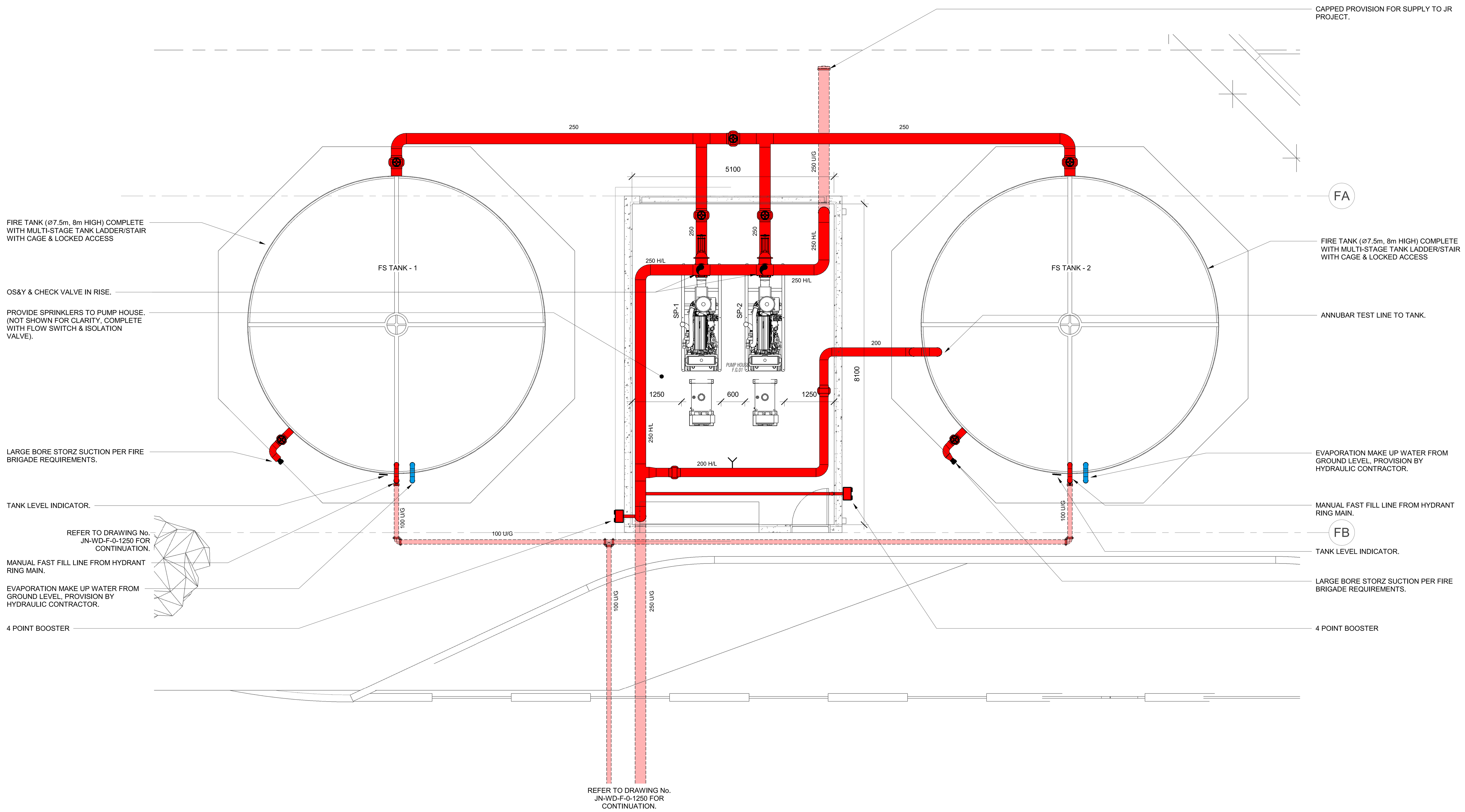
JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852		Author	Checker	JN-WD-F-A-3004	T	T2

NOTES:

1. REFER TO JN-WD-F-00-0002 FOR LEGEND & GENERAL NOTES.
2. ALLOW FOR SPRINKLER HEADS TO UNDERSIDE OF STAIRS.
3. ALLOW FOR ITC PER SPRINKLER SYSTEM. ITC TO RUN TO 1500AFFL EXTERNAL TO BUILDING.
4. ALLOW FOR SPRINKLERS HEADS TO UNDERSIDE OF MECHANICAL DUCTWORK EXCEEDING 600mm WIDE.
5. ALLOW FOR VOID SPRINKLER HEADS PER CODE TO CONCEALED SPACES.
6. ALLOW FOR MASD DETECTION TO ALL LIFT SHAFTS.



1 FIRE PUMP HOSE 3D VIEW



CONSTRUCTION

BIM 360://Woolworths Distribution Centre - Janus National (JN)/JN-Woolworths DC-F-LC-DD.rvt 19/04/2021 15:49:38

ISSUE	DATE	DESCRIPTION	ISSUED BY
CC1	19.04.21	ISSUED FOR CC1 APPROVAL	
T2	16.12.20	UPDATED TENDER ISSUE	
T1	23.10.20	70% TENDER ISSUE	

CLIENT
Richard Crookes Construction
4 Broadcast Way, Artarmon NSW 2064
P 02 9902 4700

FIRE PROTECTION SERVICES
LCI Consultants (Australia) Pty Ltd
Level 4, 73 Walker Street, North Sydney NSW 2060. P 02 9157 0570

Woolworths Group
1 Woolworths Way Bella Vista NSW 2153
P 02 8885 0000

KEY PLAN

ORIENTATION
TRUE NORTH

JOB TITLE	DRAWING TITLE
JN DISTRIBUTION CENTRE	FIRE SERVICES FIRE TANK & PUMP HOUSE FIRE LAYOUT

SCALE BAR 0m 1m 2m 3m 4m 5m

JOB NO	DRAWING SCALE @ A0	DRAWN BY	CHK BY	DRAWING NO	STATUS	REVISION
190852	1 : 50	MJK	SLH	JN-WD-F-F-2200	C	CC1

Appendix E

Fire Brigade Intervention Model Assessment

Appendix E

Activity	Unit & Rate		No.Units	Activity Time (s)	Elapsed Time (s)	Details
1. Time for Fire Brigade Notifaction						
Activation of smoke detection system	-	-	-	83	83	Obtained from CFD model
FIP verification and monitoring system notification	-	-	-	20	103	Table B - Time delay for alarm verification
2. Time to Dispatch Resources						
Time to relay dispatch information	-	-	-	0	103	Table D - Time to relay dispatch information by fully electronic CAD syst
3. Time for Firefighters to Respond to Dispatch Call						
Time to dress, assimilate information and leave station	-	-	-	90	193	Table E - Time to dress, assimilate information and depart
4. Time to Reach Fire Scene (Kerb Side)						
Travel time - Macquarie Field Fire Station (Second Closest fire Station)	11	mins	1	660	853	Table F - Time Travel For Brigade Appliances
5. Time for Initial Determination of Fire Location						
Time to travel through site (distance to gate from kerb side)	39	s	1	39	892	
Time for any security procedure	60	s	1	60	952	60 s - nominal value
Time to communicate with fire warden	90	s	1	90	1042	Table H - Time to communicate with warden
6. Time to travel to Set up at Fire Location						
Time to travel to set up area	315	s	1	315	1357	700 m - nominal distance (worst case)
Time to don safety equipment	1089	s	1	1089	2446	Chart 6
Time to gain entry	180	s	1	180	2626	Forced Entry
Time for Horziontal Travel	116.25	s	1	116.3	2742	Furthest distance
Time for Vertical Travel	73.3	s	1	73.3	2816	Worst case distance
Time taken to connect and charge hoses from on site hydrants to fire area	266	s	1	266	3082	Table V - V series graph
Time for furthest appliance to arrive, dismount and don equipment and investigate				**51.4**	**Minutes**	
7. Search and Rescue						
Time taken to search area	1.4	m/s	852	609	609	Table Y - Full Perimeter Search (852 m) - Worst case
Time to rescue person	0.05	m/s	93	1860	2468.571	Table Y - Furthest Distance
Time for search and rescue operations				**41.1**	**Minutes**	

Maximum Time
93

Table F - Google Maps used

Building Address	Appropriate / Agreed Fire Station Address	Distance	Day of the week	Time of Day	Time Range
Moorebank ave, Moorebank 2170	Macquarie Fields Fire Station	6.4 km	Tuesday	8:30	8-14 mins
				12:00	7-10 mins
				17:00	7-10 mins
				23:00	8 mins
			Friday	8:30	7-12 mins
				12:00	7-10 mins
				17:00	7-10 mins
				23:00	8 mins
			Saturday	8:30	7-10 mins
				12:00	7-10 mins
				17:00	7-10 mins
				23:00	7-9 mins

Appendix F

Potentially Contaminated Water Retention Solution

Appendix F

STORMWATER DRAINAGE PLAN - SHEET 2
1:300 SCALE

3m 0 5 10 15 20 25 30m
SCALE 1:300 AT A0 SIZE SHEET

FOR CONSTRUCTION

AMENDMENTS	DATE	ISSUE
ISSUED FOR CONSTRUCTION	08.04.21	C1
ISSUED FOR CONSTRUCTION CERTIFICATE	24.02.21	CC1
ISSUED FOR TENDER	16.12.20	T2
ISSUED FOR TENDER	23.10.20	T1
ISSUED FOR TENDER	15.10.20	B
PRELIMINARY ISSUE ONLY	04.09.20	A

AMENDMENTS	DATE	ISSUE
REVISED AS CLOUDED	25.06.21	C2

DEVELOPER: MOOREBANK LOGISTICS PARK

ARCHITECT: BELL

CLIENT: RICHARD CROOKES CONSTRUCTIONS

PROJECT: JANUS NATIONAL MOOREBANK PRECINCT WEST
MOOREBANK, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
DS	DS	NOV '19	MW	A0	AS SHOWN	JN-WD-C-0-0402

CONSULT AUSTRALIA

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Costin Roe Consulting
PRECISION | COMMUNICATION | ACCOUNTABILITY

DRAWING TITLE: STORMWATER DRAINAGE PLAN SHEET 2

DRAWING No: JN-WD-C-0-0402 ISSUE: C2

Appendix G

FRNSW Minutes

Appendix G

Riskcon Engineering Pty Ltd
Unit 618 / 159 Ross Street
Forest Lodge NSW 2037
ABN 74 626 753 820
www.Riskcon-eng.com

Consultants Advice Notice

Project:	JN Warehouse	**Ref No.:**	RCE-21050
From:	Renton Parker	**Date:**	18th of May, 2021
		Revision:	0

	Attention	Company	Email
To:	John Hawes	FRNSW	John.hawes@fire.nsw.gov.au
	Nathan Everett	FNRSW	Nathan.everett@fire.nsw.gov.au
	Mark Hughes	Tactical Group	mhughes@tacticalgroup.com.au
	Stephen Hall	LCI Consultants	Stephen.hall@lciconsultants.com.au

Re: FRNSW Meeting Minutes for Woolworths JN Warehouse

1.0 Introduction

1.1 Background

Woolworths is in the process of developing a warehouse within the Moorebank Logistics Park located in Moorebank. The facility will store materials classified as Dangerous Goods (DGs) in quantities exceeding the State Environmental Planning Policy No. 33 (SEPP 33). As SEPP 33 is exceeded several conditions of consent relating to the hazards and risks associated with these materials were issued as part of the State Significant Development Application (SSDA) approval. One of these conditions relates to the requirement to prepare a Fire Safety Study (FSS) in accordance with the Hazardous Industry planning Advisory Paper No. 2 (HIPAP No. 2). Specifically the condition states:

"*B176B. Prior to the commencement of construction, the pre-construction studies set out below must be completed:*

a) A Fire Safety Study for Warehouse JR and/or Warehouse JN, covering the relevant aspects of the Department's Hazardous Industry Planning Advisory Paper No. 2, 'Fire Safety Study Guidelines' and the New South Wales Government's Best Practice Guidelines for Contaminated Water Retention and Treatment Systems. The study must be prepared in consultation with Fire and Rescue NSW.

Construction of Warehouse JR or Warehouse JN, other than of preliminary works that are outside the scope of the hazard studies, must not commence until the relevant study recommendations for the subject warehouse have been considered and, where appropriate, acted upon. The studies must be submitted to the Planning Secretary no later than one month prior to the commencement of construction of relevant warehouse to which they apply (other than preliminary works), or within such further period as the Planning Secretary may agree."

As part of the development of the FSS and to ensure consultation with FRNSW occurs, a meeting was schedule with FRNSW on the 12th of May, 2021 at 1000 via virtual link (i.e., Microsoft Teams). It is noted that while the Condition covers both JR and JN warehouses, this particular meeting was only covering JN warehouse for which the FSS is being prepared. A separate FSS will be prepared for the JR warehouse with accompanying consultation occurring for that project.

2.0 Meeting Details

2.1 Time, Date and Attendees

The meeting occurred at 1000 on the 12th of May, 2021 via a virtual link (i.e. Microsoft Teams) with the attendees listed in **Table 2-1**.

Table 2-1: Meeting Attendees

Name	Organisation	Role
John Hawes	FRNSW	Team Lead
Nathan Everett	FRNSW	Engineer
Mark Hughes	Tactical Group	Project Manager
Stephen Hall	LCI Consultants	Fire Engineer
Renton Parker	Riskcon Engineering	Risk Engineer
Lucy Jimenez	Riskcon Engineering	Risk Engineer / Minutes

2.2 Minutes

Provided in **Table 2-2** is a summary of the minutes recorded during the meeting.

Table 2-2: Meeting Minutes

ID	Minute	Action Item	Location in Report
1	General description of the site / project and storage areas: ErgoPall 1. High density racking – stores goods in totes, 600 mm x 400 mm x 200 mm with system reaching 15-16 m high. 2. Fully automated system 3. Maintenance access ways 500 mm wide. 4. In-rack sprinkler system every 3 m vertically, 2 runs per double row rack 5. ESFR system above at roof system. High Bay Racking 1. Automated racking system 40 m high 2. ESFR sprinklers provided at 9-12 m increments General Site 1. 4 hour fire rated, enclosed evacuation tunnel between ErgoPall and High Bay Racking Special Goods Store 1. 4 hour fire rated enclosure 2. ESFR sprinkler system with foam making capabilities	• Include description of ErgoPall system into FSS and associated fire protection systems. • Include description of High Bay Racking system into FSS and associated fire protection systems.	• Section 3.5.2 • Section 3.5.3
2	• Separation between ErgoPall autopick area and High Bay Racking and the potential for fire spread.	• Assess and include the potential for fire spread from ErgoPall to High Bay area or vice versa.	• Section 4.15 • Section 5.8

ID	Minute	Action Item	Location in Report
		• Assess how lateral and smouldering fires are controlled within the ErgoPall due to the highly confined nature.	
3	• ErgoPall autopick store – considered a solid block of fuel, FRNSW does not consider sprinkler system effective for suppressing spread of fire. • ErgoPall designed in accordance with FM Global Data Sheet 8-34 • ErgoPall system is not as densely packed as previous projects FRNSW are familiar with (video of system available: https://www.youtube.com/watch?v=DQq_S4RoSKM)	• Discuss combustible fuel load within ErgoPall and High Bay Area.	• Section 3.5.2 • Section 3.5.3 • Section 4.15
4	• FRNSW have concern for ignition sources within the automated systems and potential for fire to occur	• Discuss protection systems to minimise potential for ignition.	• Section 6.1.1
5	• General sprinkler systems requirements • It was noted that there is the potential for duplication errors between FEBQ and FSS. Where overlapping items between FEBQ and FSS occur, a summary will be provided in the FSS with reference made to the FER to minimise errors.	• Include sprinkler system design and arrangements within the FSS for ErgoPall, High Bay Racking, SGS.	• Section 3.5.2 • Section 3.5.3 • Appendix D
6	• Access (to ErgoPall or High Bay Racking). FRNSW would not send personnel into either system after fire due to inability to determine structural stability post exposure to a fire.	• Discuss how fires will be controlled by fire protection system	• Section 4.15

ID	Minute	Action Item	Location in Report
7	• Potentially contaminated fire water	• Include assessment and details of how potentially contaminated fire water is to be contained at the site.	• Section 8.2 • Appendix F
8	• Further discussions with Nathan Everett post meeting indicated there were some original points discussed at the meeting (i.e. final extinguishment) which Nathan considered to be surplus to the requirements of HIPAP No. 2 and would therefore not be required to be included within the FSS.	• Final extinguishment not to be assessed in FSS.	• Not required to be assessed.

Riskcon Engineering Pty Ltd

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Renton Parker
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Appendix H

Implementation Commitment

WOOLWORTHS GROUP

22 June 2021

Renton Parker
Director
Riskcon Engineering Pty Ltd
618/159 Ross Street
Forest Lodge NSW 2037

RE: Woolworths Warehouse JN Fire Safety Study

Woolworths Group Ltd acknowledges receipt of the Fire Safety Study Report for Warehouse JN within the Moorebank Logistics Park, Moorebank, NSW.

We feel comfortable with the recommendations made and the business intention is to ensure the customer implements the recommendations as outlined in the study. In addition, we commit to comply with the Prevention, Detection, Protection and Mitigation measures as detailed throughout the Fire Safety Study; specifically, the ongoing commitment to the findings and recommendations of the Fire Safety Study.

Yours sincerely

Trevor Lee

Trevor Lee
Regional Development Manager
Authorised agent of Woolworths Group Ltd

A Woolworths Group
1 Woolworths Way
Bella Vista, NSW 2153

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Woolworths Limited
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