



# **WATERLOO METRO QUARTER OVER STATION DEVELOPMENT**

## **Environmental Impact Statement Appendix RR - Natural Cross Ventilation Assessment**

### **SSD-10437 Southern Precinct**

Detailed State Significant Development  
Development Application

Prepared for **Waterloo Developer Pty Ltd**

30 September 2020

Reference	Description
Applicable SSD Applications	SSD-10437 Southern Precinct
Author	RWDI Anemos Ltd. Kevin Peddie, Michael Pieterse
Reviewed	Waterloo Developer Pty Ltd Simon Joseph
Document Number	WMQ-BLD4-RWDII-WR-RPT-0002
Status	Draft
Version	2
Date of Issue	30 July 2020
© Waterloo Developer Pty Ltd 2020	

## Table of Contents

<b>1. Glossary and abbreviations .....</b>	<b>5</b>
<b>2. Executive summary.....</b>	<b>8</b>
<b>3. Introduction.....</b>	<b>9</b>
<b>4. The site .....</b>	<b>11</b>
<b>5. Background.....</b>	<b>14</b>
5.1 About Sydney Metro .....	14
5.1.1 Sydney Metro North West.....	14
5.1.2 Sydney Metro City & Southwest.....	14
5.1.3 Sydney Metro West .....	14
5.1.4 Sydney Metro Greater West .....	14
5.2 Sydney Metro CSSI Approval (SSI 7400).....	15
5.3 Concept Approval (SSD 9393) .....	16
<b>6. Proposed development.....</b>	<b>17</b>
6.1 Waterloo Metro Quarter Development.....	17
6.1.1 Southern Precinct [Subject DA].....	17
6.1.2 Basement Car Park .....	17
6.1.3 Central Precinct.....	18
6.1.4 Northern Precinct .....	18
<b>7. Methodology .....</b>	<b>19</b>
7.1 Natural Ventilation Criteria – Apartment Design Guide.....	19
7.1.1 Section 4B-1: All Habitable rooms are naturally ventilated.....	19
7.1.2 Section 4B-3: Number of Apartments with natural cross ventilation is maximized to create a comfortable indoor environment for residences. ....	19
7.1.3 Section 4J: Noise and Pollution .....	19
7.2 Natural Ventilation Strategies .....	20
7.2.1 Height Consideration and Exposure.....	21
7.2.2 Plenum and Light Wells .....	21
7.3 Meteorological Data.....	21
<b>8. Assessment and findings.....</b>	<b>23</b>
8.1 Natural Ventilation for Noise Affected Apartments.....	23
8.2 Natural Cross Ventilation .....	23
8.3 Cumulative impacts .....	30
<b>9. Conclusion .....</b>	<b>31</b>
<b>10. Applicability of Results.....</b>	<b>32</b>

## List of Figures

Figure 1 - Aerial image of the site.....	12
Figure 2 - Waterloo Metro Quarter site, with sub-precincts identified.....	13
Figure 3 - Waterloo Metro Quarter site, with sub-precincts identified.....	13
Figure 4 - Sydney Metro alignment map.....	15
Figure 5 - CSSI Approval scope of works.....	16
Figure 6 – Pressure Driven Natural Ventilation .....	20
Figure 7 – Pressure Distribution around a building for a given wind direction, plan (left) section (right).....	20
Figure 8 – Directional Distribution of Winds Approaching Sydney International Airport from 1995 to 2019 .....	22
Figure 9 – Natural Cross Ventilation Floor Plan – Level 1.....	27
Figure 10 – Natural Cross Ventilation Floor Plan – Level 2.....	28
Figure 11 – Natural Cross Ventilation Floor Plan – Levels 3 to 7 .....	28
Figure 12 – Natural Cross Ventilation Floor Plan – Level 8.....	29
Figure 13 – Natural Cross Ventilation Floor Plan – Level 9.....	29

## List of Tables

Table 1 - SEARs requirements.....	9
Table 2 - Conditions of Concept Approval.....	10
Table 3 – Natural Cross Ventilation Summary of the first 9 Levels.....	27

## 1. Glossary and abbreviations

Reference	Description
ACHAR	Aboriginal Cultural Heritage Assessment Report
ADG	Apartment Design Guide
AHD	Australian height datum
AQIA	Air Quality Impact Assessment
BC Act	Biodiversity Conservation Act 2016
BCA	Building Code of Australia
BC Reg	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
CEEC	critically endangered ecological community
CIV	capital investment value
CMP	Construction Management Plan
Concept DA	A concept DA is a staged application often referred to as a 'Stage 1' DA. The subject application constitutes a detailed subsequent stage application to an approved concept DA (SSD 9393) lodged under section 4.22 of the EP&A Act.
Council	City of Sydney Council
CPTED	Crime Prevention Through Environmental Design
CSSI approval	critical State significant infrastructure approval
CTMP	Construction Traffic Management Plan
DA	development application
DPIE	NSW Department of Planning, Industry and Environment
DRP	Design Review Panel
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPA Regulation	Environmental Planning and Assessment Regulation 2000
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	ecologically sustainable design

Reference	Description
GANSW	NSW Government Architect's Office
GFA	gross floor area
HIA	Heritage Impact Assessment
IAP	Interchange Access Plan
LGA	Local Government Area
NCC	National Construction Code
OSD	over station development
PIR	Preferred Infrastructure Report
POM	Plan of Management
PSI	Preliminary Site Investigation
RMS	Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 55	State Environmental Planning Policy No 55—Remediation of Land
SEPP 65	State Environmental Planning Policy No. 65 – Design Quality of Residential Apartment Development
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2009
SREP Sydney Harbour	State Regional Environmental Plan (Sydney Harbour Catchment) 2005
SSD	State significant development
SSD DA	State significant development application
SLEP	Sydney Local Environmental Plan 2012
Transport for NSW	Transport for New South Wales
TIA	Traffic Impact Assessment
The proposal	The proposed development which is the subject of the detailed SSD DA
The site	The site which is the subject of the detailed SSD DA
VIA	Visual Impact Assessment

Reference	Description
WMQ	Waterloo Metro Quarter
WMP	Waste Management Plan
WSUD	water sensitive urban design

## 2. Executive summary

This Natural Cross Ventilation Assessment of Building 4 has been prepared by RWDI Anemos Ltd. to accompany a detailed State significant development (SSD) development application (DA) for the Southern Precinct over station development (OSD) at the Waterloo Metro Quarter site.

This report has been prepared to address the relevant conditions of the concept SSD DA (SSD 9393) and the Secretary's Environmental Assessment Requirements (SEARs) issued for the detailed SSD DA (SSD 10437).

The assessment has been completed for Building 4 where 60.0% (42/70) of the residential apartments on the 9 residential levels are considered naturally cross ventilated according to the ADG. The performance of each apartment has been summarised within the report, including consideration for the noted flow paths during the prevailing wind events based on the external opening pressures.

Given these findings, the development is considered to achieve the required level of natural cross ventilation in accordance with the intent of the ADG and as such the Southern Precinct OSD warrants approval.



### 3. Introduction

This report has been prepared to accompany a detailed State significant development (SSD) development application (DA) for the Southern Precinct over station development (OSD) at the Waterloo Metro Quarter site. The detailed SSD DA is consistent with the concept approval (SSD 9393) granted for the maximum building envelope on the site, as proposed to be modified.

The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning, Industry and Environment (DPIE) for assessment.

The detailed SSD DA seeks development consent for the design, construction and operation of:

Southern Precinct

- 25-storey residential building (Building 3) comprising student accommodation, to be delivered as a mixture of studio and twin apartments with approximate capacity of 474 students
- 9-storey residential building (Building 4) above the southern station box to accommodate 70 social housing dwellings
- ground level retail tenancies including Makerspace and gymnasium lobby, and loading facilities
- level 1 and level 2 gymnasium and student accommodation communal facilities
- landscaping and private and communal open space at podium and roof top levels to support the residential accommodation
- new public open space including the delivery of the Cope Street Plaza, including vehicle access to the site via a shared way from Cope Street, expanded footpaths on Botany and Wellington streets and public domain upgrades
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 8 April 2020 and issued for the detailed SSD DA. Specifically, this report has been prepared to respond to the SEARs requirements summarised below.

Item	Description of requirement	Section reference (this report)
n/a	n/a	

*Table 1 - SEARs requirements*

This report has also been prepared in response to the following conditions of consent issued for the concept SSD DA (SSD 9393) for the OSD as summarised in the table below.

Item	Description of requirement	Section reference (this report)
A14	<p>Waterloo Metro Quarter – Design and Amenity Guidelines</p> <p>Part 3, Section 3K “Built Form above the Podium”:</p> <p>Design Criteria 4: <b>Design of residential mid-rise buildings and towers will need to be in accordance with the Apartment Design Guide</b></p>	7, 8, 9, 10, 11

*Table 2 - Conditions of Concept Approval*

## 4. The site

The site is located within the City of Sydney Local Government Area (LGA). The site is situated about 3.3 kilometres south of Sydney CBD and eight kilometres northeast of Sydney International Airport within the suburb of Waterloo.

The Waterloo Metro Quarter site comprises land to the west of Cope Street, east of Botany Road, south of Raglan Street and north of Wellington Street (refer to Figure 1). The heritage-listed Waterloo Congregational Church at 103–105 Botany Road is within this street block but does not form a part of the Waterloo Metro Quarter site boundaries.

The Waterloo Metro Quarter site is a rectangular shaped allotment with an overall site area of approximately 1.287 hectares.

The Waterloo Metro Quarter site comprises the following allotments and legal description at the date of this report. Following consolidation by Sydney Metro (the Principal) the land will be set out in deposited plan DP1257150.

- 1368 Raglan Street (Lot 4 DP 215751)
- 59 Botany Road (Lot 5 DP 215751)
- 65 Botany Road (Lot 1 DP 814205)
- 67 Botany Road (Lot 1 DP 228641)
- 124-128 Cope Street (Lot 2 DP 228641)
- 69-83 Botany Road (Lot 1, DP 1084919)
- 130-134 Cope Street (Lot 12 DP 399757)
- 136-144 Cope Street (Lots A-E DP 108312)
- 85 Botany Road (Lot 1 DP 27454)
- 87 Botany Road (Lot 2 DP 27454)
- 89-91 Botany Road (Lot 1 DP 996765)
- 93-101 Botany Road (Lot 1 DP 433969 and Lot 1 DP 738891)
- 119 Botany Road (Lot 1 DP 205942 and Lot 1 DP 436831)
- 156-160 Cope Street (Lot 31 DP 805384)
- 107-117A Botany Road (Lot 32 DP 805384 and Lot A DP 408116)
- 170-174 Cope Street (Lot 2 DP 205942).

The detailed SSD DA applies to the Southern Precinct (the site) of the Waterloo Metro Quarter site. The site has an area of approximately 4830sqm. The subject site comprises the following allotments and legal description at the date of this report.

### Southern Precinct DA

- 130–134 Cope Street (Lot 12 DP 399757) (Part)
- 136–144 Cope Street (Lots A-E DP 108312) (Part)
- 93–101 Botany Road (Lot 1 DP 433969 and Lot 1 DP 738891) (Part)
- 156–160 Cope Street (Lot 31 DP 805384)
- 107–117A Botany Road (Lot 32 DP 805384 and Lot A DP 408116)



- 119 Botany Road (Lot 1 DP 205942 and Lot 1 DP 436831)
- 170–174 Cope Street (Lot 2 DP 205942).

The boundaries of the overall site are identified at Figure 1, and the subject site of the detailed SSD DA is identified at Figures 2 and 3. The site is reasonably flat with a slight fall to the south.

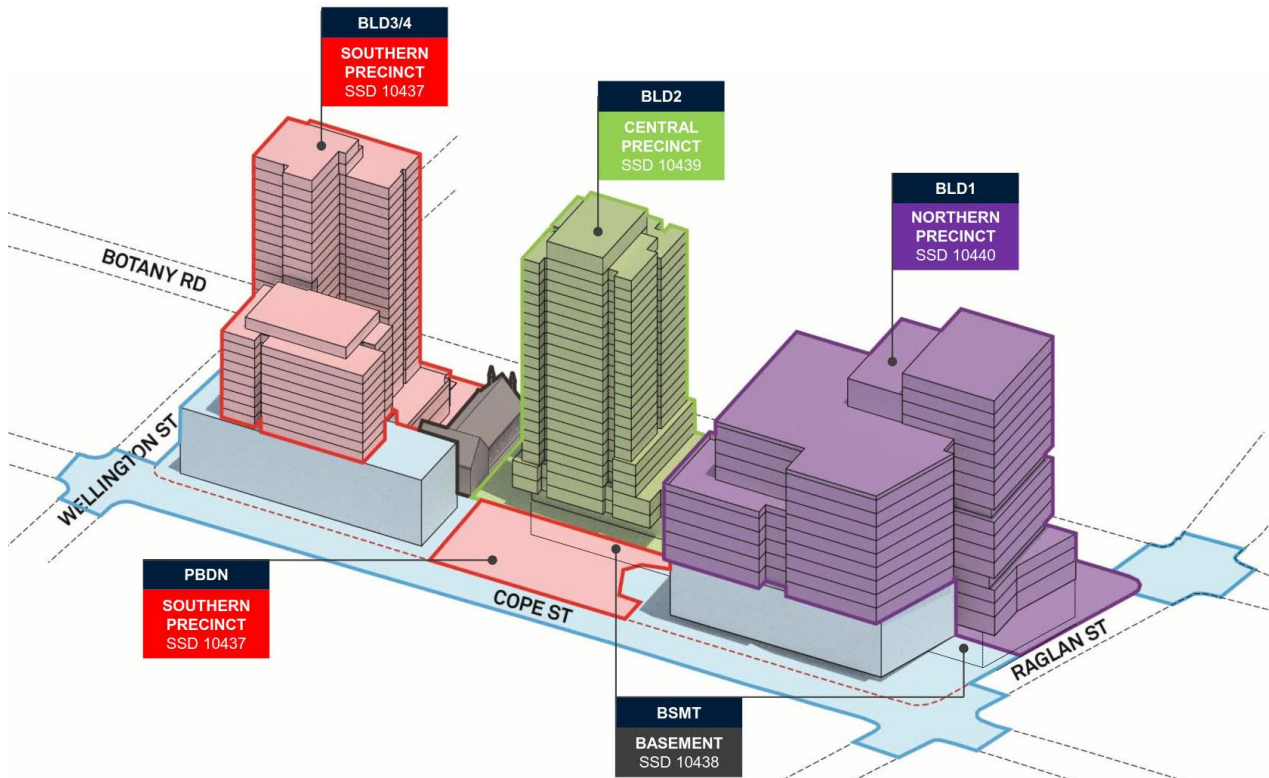
The site previously included three to five storey commercial, light industrial and shop top housing buildings. All previous structures except for an office building at the corner of Botany Road and Wellington Street have been demolished to facilitate construction of the new Sydney Metro Waterloo station. As such the existing site is predominately vacant and being used as a construction site. Construction of the Sydney metro is currently underway on site in accordance with critical State significant infrastructure approval (CSSI 7400).



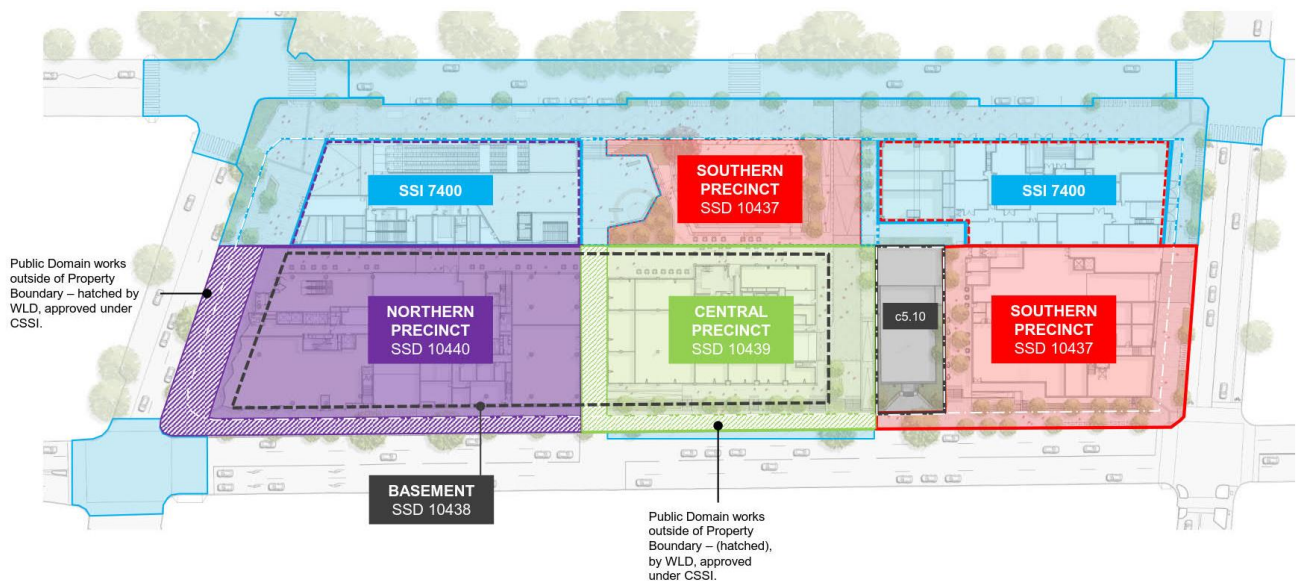
**Figure 1 - Aerial image of the site**  
Source: Urbis



The area surrounding the site consists of commercial premises to the north, light industrial and mixed-use development to the south, residential development to the east and predominantly commercial and light industry uses to the west.



**Figure 2 - Waterloo Metro Quarter site, with sub-precincts identified**  
**Source: HASSELL**



**Figure 3 - Waterloo Metro Quarter site, with sub-precincts identified**  
**Source: Waterloo Developer Pty Ltd**

## 5. Background

### 5.1 About Sydney Metro

Sydney Metro is Australia's biggest public transport project. Services started in May 2019 in the city's North West with a train every four minutes in the peak. A new standalone railway, this 21st century network will revolutionise the way Sydney travels.

There are four core components:

#### 5.1.1 Sydney Metro North West

This project is now complete and passenger services commenced in May 2019 between Rouse Hill and Chatswood, with a metro train every four minutes in the peak. The project was delivered on time and \$1 billion under budget.

#### 5.1.2 Sydney Metro City & Southwest

Sydney Metro City & Southwest project includes a new 30km metro line extending metro rail from the end of Metro Northwest at Chatswood, under Sydney Harbour, through new CBD stations and southwest to Bankstown. It is due to open in 2024 with the ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney Metro City & Southwest will deliver new metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and new underground metro platforms at Central Station. In addition, it will upgrade and convert all 11 stations between Sydenham and Bankstown to metro standards.

#### 5.1.3 Sydney Metro West

Sydney Metro West is a new underground railway connecting Greater Parramatta and the Sydney CBD. This once-in-a-century infrastructure investment will transform Sydney for generations to come, doubling rail capacity between these two areas, linking new communities to rail services and supporting employment growth and housing supply between the two CBDs.

The locations of seven proposed metro stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays.

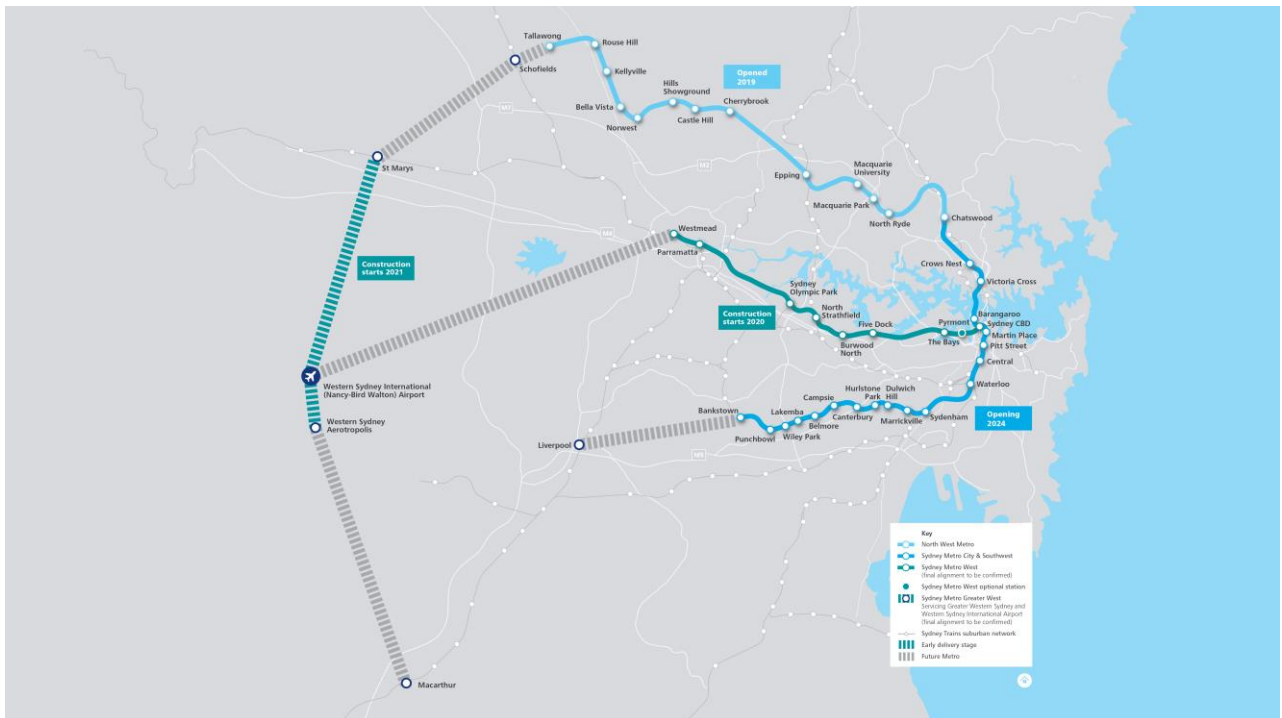
The NSW Government is assessing an optional station at Pyrmont and further planning is underway to determine the location of a new metro station in the Sydney CBD.

#### 5.1.4 Sydney Metro Greater West

Metro rail will also service Greater Western Sydney and the new Western Sydney International (Nancy Bird Walton) Airport. The new railway line will become the transport spine for the Western Parkland City's growth for generations to come, connecting communities and travellers with the rest of Sydney's public transport system with a fast, safe and easy metro service.

The Australian and NSW governments are equal partners in the delivery of this new railway.

The Sydney Metro project is illustrated below.



**Figure 4 - Sydney Metro alignment map**  
Source: Sydney Metro

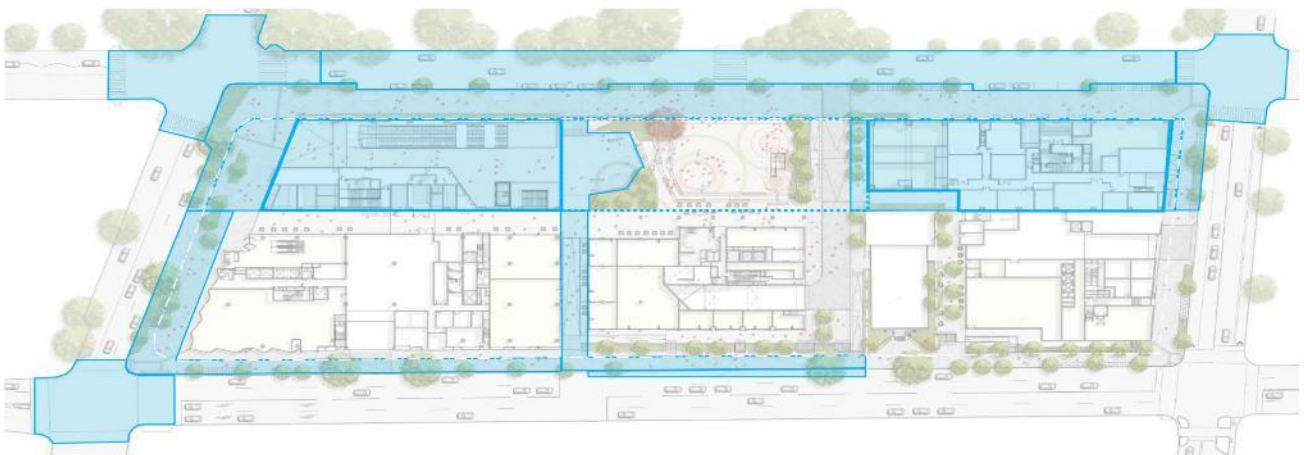
## 5.2 Sydney Metro CSSI Approval (SSI 7400)

On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham project as a critical State significant infrastructure (CSSI) project (reference SSI 7400) (CSSI approval). The terms of the CSSI approval includes all works required to construct the Sydney Metro Waterloo Station. The CSSI approval also includes the construction of below and above ground works within the metro station structure for appropriate integration with the OSD.

With regards to CSSI related works, any changes to the 'metro station box' envelope and public domain will be pursued in satisfaction of the CSSI conditions of approval and do not form part of the scope of the concept SSD DA or detailed SSD DA for the OSD.

Except to the extent described in the EIS or Preferred Infrastructure Report (PIR) submitted with the CSSI application, any OSD buildings and uses do not form part of the CSSI approval and will be subject to the relevant assessment pathway prescribed by the EP&A Act.

The delineation between the approved Sydney Metro works, generally described as within the two 'metro station boxes' and surrounding public domain works, and the OSD elements are illustrated in Figure 5.



**Figure 5 - CSSI Approval scope of works**  
**Source: WL Developer Pty Ltd**

### 5.3 Concept Approval (SSD 9393)

As per the requirements of clause 7.20 of the *Sydney Local Environmental Plan 2012* (SLEP), as the OSD exceeds a height of 25 metres above ground level (among other triggers), development consent is first required to be issued in a concept DA (formerly known as Stage 1 DA).

Development consent was granted on 10 December 2019 for the concept SSD DA (SSD 9393) for the Waterloo Metro Quarter OSD including:

- a maximum building envelope for podium, mid-rise and tower buildings
- a maximum gross floor area of 68,750sqm, excluding station floor space
- conceptual land use for non-residential and residential floor space
- minimum 12,000sqm of non-residential gross floor area including a minimum of 2,000sqm of community facilities
- minimum 5% residential gross floor area as affordable housing dwellings
- 70 social housing dwellings
- basement car parking, motorcycle parking, bicycle parking, and service vehicle spaces.

The detailed SSD DA seeks development consent for the OSD located within the Southern Precinct of the site, consistent with the parameters of this concept approval. Separate SSD DAs have been prepared and will be submitted for the Central Precinct and Northern Precinct and Basement Car Park proposed across the Waterloo Metro Quarter site.

A concurrent amending concept SSD DA has been prepared and submitted to the DPIE which proposed to make modifications to the approved building envelopes at the northern precinct and central building. This amending concept SSD DA does not impact the proposed development within the southern precinct.



## 6. Proposed development

### 6.1 Waterloo Metro Quarter Development

The Waterloo Metro Quarter OSD comprises four separate buildings, a basement carpark and public domain works adjacent to the Waterloo Metro station.

Separate SSD DAs will be submitted concurrently for the design, construction and operation of each building in the precinct;

- Southern precinct SSD-10437,
- Basement Car Park SSD-10438,
- Central precinct SSD-10439, and
- Northern precinct-SSD-10440.

An overview of the Development is included below for context. This detailed SSD DA seeks development consent for the design, construction and operation of the Southern Precinct:

#### 6.1.1 Southern Precinct [Subject DA]

The Southern Precinct comprises:

- 25-storey residential building (Building 3) comprising student accommodation, to be delivered as a mixture of studio and twin apartments with approximate capacity of 474 students
- 9 storey residential building (Building 4) above the southern station box to accommodate 70 social housing dwellings
- ground level retail tenancies including Makerspace and gymnasium lobby, and loading facilities
- level 1 and level 2 gymnasium and student accommodation communal facilities
- landscaping and private and communal open space at podium and roof top levels to support the residential accommodation
- new public open space including the delivery of the Cope Street Plaza, including vehicle access to the site via a shared way from Cope Street, expanded footpaths on Botany and Wellington Streets and public domain upgrades
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

#### 6.1.2 Basement Car Park

The Basement Car Park comprises:

- 2-storey shared basement car park and associated excavation comprising
- Ground level structure
- Carparking for the Commercial Building 1, Residential Building 2, social housing Building 4, Waterloo Congregational Church and Sydney Metro
- Service vehicle bays
- commercial end of trip and bicycle storage facilities

- Retail end of trip and bicycle storage facilities
- residential storage facilities
- shared plant and services.

### 6.1.3 Central Precinct

The Central Precinct comprises:

- 24-storey residential building (Building 2) comprising approximately 126 market residential and 24 affordable housing apartments, to be delivered as a mixture of 1 bedroom, 2 bedroom and 3 bedroom apartments
- Ground level retail tenancies, community hub, precinct retail amenities and basement car park entry
- level 1 and level 2 community facilities (as defined in the SLEP) intended to be operated as a childcare centre
- landscaping and private and communal open space at roof top levels to support the residential accommodation
- new public open space including the delivery of the Church Square, including vehicle access to the basement via a shared way from Cope Street, expanded footpaths and public domain upgrades on Botany Road
- external licensed seating areas
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

### 6.1.4 Northern Precinct

The Northern Precinct comprises:

- 17-storey commercial building (Building 1) comprising Commercial floor space, with an approximate capacity of 4000 workers
- ground level retail tenancies, loading dock facilities serving the northern and central precinct including Waterloo metro station
- landscaping and private open space at podium and roof top levels to support the commercial tenants
- new public open space including the delivery of the Raglan Street Plaza, Raglan Walk and expanded footpaths on Raglan Street and Botany Road and public domain upgrades
- external licensed seating areas
- signage zone locations
- utilities and service provision
- stratum subdivision (staged).

## 7. Methodology

This section provides guidance to support natural ventilation. The Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020) outlines consideration for residential amenity in Part 3L. This notes in Item 3 of the Design Criteria that the “*residential apartments are to fully comply with the requirements of the NSW Apartment Design Guide for natural ventilation,...*”.

The requirements for natural ventilation as detailed in the Apartment Design Guide are discussed in further detailed below and form part of the basis of the assessment.

### 7.1 Natural Ventilation Criteria – Apartment Design Guide

Section 4B of the Apartment Design Guide (ADG) states that “natural cross ventilation is achieved by apartments having more than one aspect with direct exposure to the prevailing winds, or windows located in significantly different pressure regions, rather than relying on purely wind driven air.”

The ADG guidance focuses on two key aspects for natural ventilation in apartment developments. This is noted in the following sections.

#### 7.1.1 Section 4B-1: All Habitable rooms are naturally ventilated.

Section 4B-1 provides guidance to support natural ventilation. The main guidance provided is that an area of unobstructed window opening be provided for each habitable room of 5% of the floor area served. Furthermore that the building’s orientation should be such that it maximises the capture and use of the prevailing breezes.

#### 7.1.2 Section 4B-3: Number of Apartments with natural cross ventilation is maximized to create a comfortable indoor environment for residences.

Section 4B-3 details design criteria for natural cross ventilation in the first 9 storeys of the building being assessed, specifically that at least 60% of the apartments on these levels are required to be cross ventilated. Apartments located on Level 10 and above are deemed to be considered naturally cross ventilated, only if any enclosure of the balconies at these levels allows adequate natural ventilation and cannot be fully enclosed.

Furthermore the depth of cross-over or cross-through apartments should not be more than 18m from glass line to glass line.

Noting that the ADG is a guide, it does not provide specific metrics detailing what constitutes adequate ventilation. It therefore falls to the wind consultant to recommend an appropriate metric.

#### 7.1.3 Section 4J: Noise and Pollution

Section 4J of the Apartment Design Guide recognises that properties located adjacent to major roads, rail lines and flight paths can be exposed to poor noise and air quality levels which need to be addressed, this includes Natural Cross Ventilation as noted in Objective 4J-1. It notes that developments that are unable to achieve the design criteria for natural cross ventilation can consider alternatives. Part 4J notes that SEPP 65 must have regard to the NSW Government’s Development near Rail Corridors and Busy Roads – Interim Guideline, as called up by the State Environment Planning Policy (Infrastructure) 2007. This document notes in Section 4.4.1 Ventilation of Indoor Areas,

that internal ventilation options whereby windows must be kept closed due to noise limitations design options can include:

- Natural Ventilation – windows open to provide adequate ventilation
- Passive Acoustic Ventilation – ventilators designed and fitted to provide adequate air movements
- Mechanical Ventilation – operating to provide suitable air exchange rates.

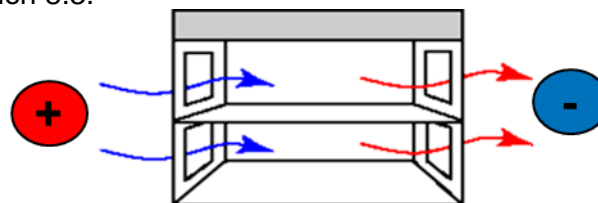
As part of the natural ventilation assessment in noisy environments, consideration should also be made with regards to the draft City of Sydney: Alternative natural ventilation of apartments in noisy environments - Performance Pathway Guideline (Performance Pathway Guideline). While it is noted that this document has been identified by the SEARs, and hence may be relevant to the proposal, it has currently not yet been endorsed by Council. Therefore the ADG guideline takes precedence, but it has been considered as a reference document for mechanical ventilation strategy.

## 7.2 Natural Ventilation Strategies

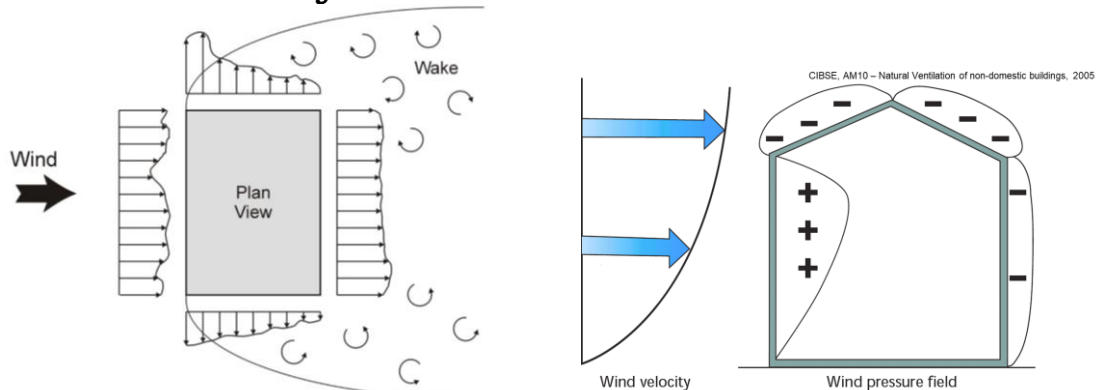
The ability of the site to harness natural ventilation will be dependent on the exposure of the external openings on the building's façade to the prevailing winds, as well as the type of natural ventilation strategy employed.

Wind driven natural ventilation takes advantage of the local wind conditions to drive air through the internal spaces of residences. The internal air flow is driven by a pressure differential across the openings, with air moving from high pressure to low pressure openings, as noted in Figure 6. Therefore it is important to understand the pressure distribution around a built form to assist in the positioning of opening locations to ensure wind driven natural ventilation will be achieved in accordance with the Apartment Design Guide. Figure 7 provides a simplified plan and section view of a wind pressure field around a built form for a given wind direction.

Note that thermal driven buoyancy ventilation would act in addition to this wind driven flow path. Furthermore, it is important to also consider the prevailing wind directions for the region, hence is discussed in Section 8.3.



**Figure 6 – Pressure Driven Natural Ventilation**



**Figure 7 – Pressure Distribution around a building for a given wind direction, plan (left) section (right)**

### 7.2.1 Height Consideration and Exposure

The Apartment Design Guide notes that apartments located on Storey 10 and above can be considered to be naturally cross ventilated due to their elevated position providing sufficient exposure to wind pressures at opening locations. This includes single aspect apartments as well as developments located in built-up (shielded) environments. For the Waterloo Metro Quarter site, consideration has therefore been made with regards to the elevated nature of the apartment floor plates, as well as the current and future exposure of the site to the prevailing winds for the region. Building 4 is noted to start above the Southern Metro Station Box at RL 35.760. As such the apartment levels will be positioned as a more elevated position and hence increased exposure to the prevailing winds.

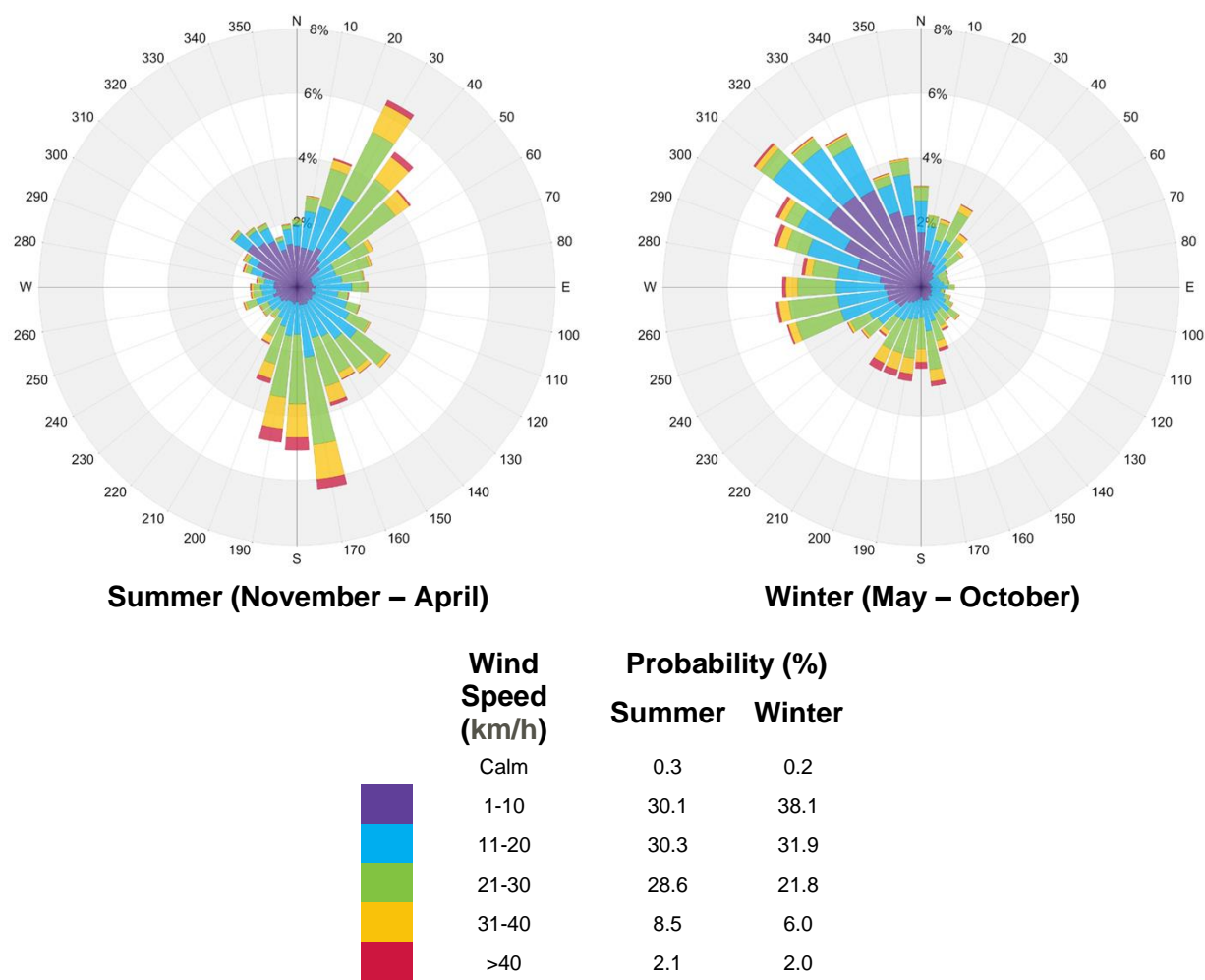
### 7.2.2 Plenum and Light Wells

With Building 4 being located atop the Southern Metro Station box, there is restriction in how apartments can achieve natural cross ventilation. This is further noted by the need for lift access to be obtained via Building 3 to the west preventing the ability for traditional “corner” apartments or inclusion of cross-over apartments. As such, consideration has been made for alternative means to achieve cross ventilation, which is supported by the ADG. Objective 4B-2 of the Apartment Design Guide notes that natural ventilation for single aspect apartments can have primary windows augmented with plenums and light wells. This can be utilised to facilitate natural cross ventilation where required and site constraints exist, but not as the main approach. Noting the limitations for Building 4 as discussed above, is a suitable candidate for this approach to be considered. Discussion has been outlined in the results section on how this has been approached and development for select apartments.

## 7.3 Meteorological Data

Wind statistics recorded at Sydney International Airport between 1995 and 2019, inclusive, were analysed for the Summer (November through April) and Winter (May through October) seasons. Figure 8 graphically depicts the directional distributions of wind frequencies and speeds for these two seasons. Winds from the northeast, south-southeast and south are predominant in the summer season, and winds from the west and northwest directions are predominant in the winter season as indicated by the wind roses. Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) occur for 10.6% and 8% of the time during the summer and winter seasons, respectively, and are predominantly from the southern directions in both seasons. Strong winds from the northeast are also common in the summer.

These prevailing wind directions are important to consider for natural ventilation performance. This includes opening locations to generate pressure differential as well as seasonal variance of the prevailing wind directions throughout the year.



**Figure 8 – Directional Distribution of Winds Approaching Sydney International Airport from 1995 to 2019**



## 8. Assessment and findings

### 8.1 Natural Ventilation for Noise Affected Apartments

An assessment has been undertaken by Stantec to determine the noise affected locations on Building 4 which affect the ability for the apartments to achieve simultaneously both the natural ventilation requirements as well as the acoustic requirements as outlined in the NCC. The Noise and Vibration Impact Assessment report has discussed this in further detail and hence has not been addressed as part of this report.

### 8.2 Natural Cross Ventilation

An assessment has been undertaken of the residential apartments located on the first 9 storeys of Building 4 of the Southern Precinct with consideration for their ability to have access to natural cross ventilation and amenity.

Building 4 is located atop the Southern Metro Station box and hence starts at RL 35.760. As such the apartment levels will be positioned as a more elevated position and hence exposure to the prevailing winds, this includes the adjacent buildings on the southern side of Wellington Street. The assessment has been based on all 9 Levels of the residential building to assess for 60% compliance with natural cross ventilation in accordance with the Apartment Design Guide.

A summary of the natural ventilation conditions associated with the design of the development are noted below and detailed in Table 3:

- 60.0% (42/70) of the residential apartments on the 9 Levels of Building 4 are considered naturally cross ventilated according to the ADG. This has been summarised in Table 3 below with supporting diagrams in Figures 9 to 13 which note the flow direction for the north-easterly (blue) southerly (green) and westerly (red) wind direction based on pressure differential at the openings.
- 2 apartments (Apartments 609 and 709) will utilise a ventilation plenum above the internal corridor to connect the northern aspect of the façade to the apartment. This is indicated in Figure 11 and also the Design Report for the building.
- 7 apartments (201, 301, 401, 501, 601, 701 and 801) will achieve natural cross ventilation via a ventilated corridor to the northern aspect. This is due to the limited potential for natural cross ventilation due to the complexity of access being required via Building 3 with the Metro Station Box below.
- 25 of the 70 apartments of Building 4 are noted in the Noise and Vibration Impact Assessment report by Stantec to be noise affected apartments. 20 of these apartments are also noted as being naturally cross ventilated.

The assessment is based on the criteria and guidance in the ADG and the Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020). This report is based on a qualitative assessment of the development and the amenity provided in terms of natural cross ventilation for the residents.

Consideration has been made for the use of plenums to enable natural cross ventilation for some apartments as noted in Table 3 and detailed in Figures 10 and 11 in accordance with Objective 4B-2 of the Apartment Design Guide due to the built form and site constraints.

Apartment Number	Naturally Cross Ventilated	Naturally Ventilated (5% Openable Area) <sup>3</sup>
Level 1		
101	No	Yes
102	Yes	Yes
103	No	Yes
104	No	Yes
105	Yes	Yes <sup>4</sup>
106	Yes	Yes <sup>4</sup>
Level 2		
201	Yes <sup>1</sup>	Yes
202	Yes	Yes
203	Yes	Yes
204	No	Yes
205	No	Yes
206	No	Yes
207	Yes	Yes <sup>4</sup>
208	Yes	Yes <sup>4</sup>
209	No	Yes <sup>4</sup>
Level 3		
301	Yes <sup>1</sup>	Yes
302	Yes	Yes
303	Yes	Yes
304	No	Yes
305	No	Yes
306	No	Yes
307	Yes	Yes <sup>4</sup>
308	Yes	Yes <sup>4</sup>



Apartment Number	Naturally Cross Ventilated	Naturally Ventilated (5% Openable Area) <sup>3</sup>
309	No	Yes <sup>4</sup>
Level 4		
401	Yes <sup>1</sup>	Yes
402	Yes	Yes
403	Yes	Yes
404	No	Yes
405	No	Yes
406	No	Yes
407	Yes	Yes <sup>4</sup>
408	Yes	Yes <sup>4</sup>
409	No	Yes <sup>4</sup>
Level 5		
501	Yes <sup>1</sup>	Yes
502	Yes	Yes
503	Yes	Yes
504	No	Yes
505	No	Yes
506	No	Yes
507	Yes	Yes <sup>4</sup>
508	Yes	Yes <sup>4</sup>
509	No	Yes <sup>4</sup>
Level 6		
601	Yes <sup>1</sup>	Yes
602	Yes	Yes
603	Yes	Yes
604	No	Yes

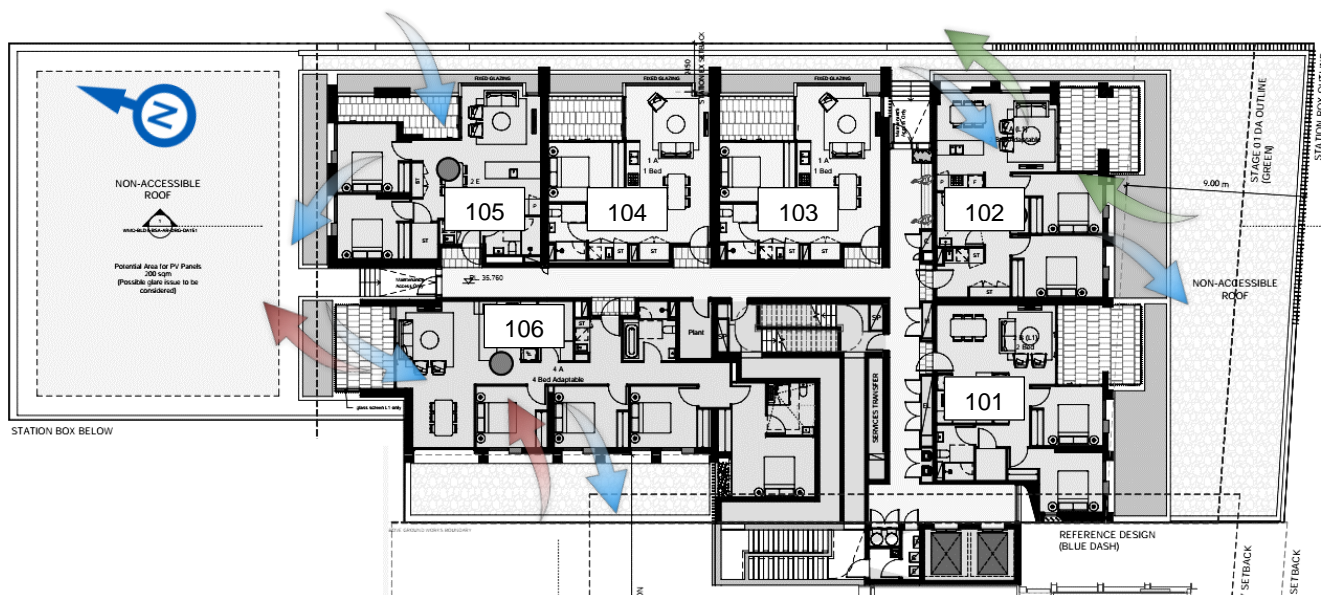
Apartment Number	Naturally Cross Ventilated	Naturally Ventilated (5% Openable Area) <sup>3</sup>
605	No	Yes
606	No	Yes
607	Yes	Yes <sup>4</sup>
608	Yes	Yes <sup>4</sup>
609	Yes <sup>2</sup>	Yes <sup>4</sup>
Level 7		
701	Yes <sup>1</sup>	Yes
702	Yes	Yes
703	Yes	Yes
704	No	Yes
705	No	Yes
706	No	Yes
707	Yes	Yes <sup>4</sup>
708	Yes	Yes <sup>4</sup>
709	Yes <sup>2</sup>	Yes <sup>4</sup>
Level 8		
801	Yes <sup>1</sup>	Yes
802	Yes	Yes
803	Yes	Yes
804	No	Yes
805	No	Yes
806	Yes	Yes <sup>4</sup>
807	Yes	Yes <sup>4</sup>
808	No	Yes <sup>4</sup>
Level 9		
901	Yes	Yes <sup>4</sup>

Apartment Number	Naturally Cross Ventilated	Naturally Ventilated (5% Openable Area) <sup>3</sup>
902	Yes	Yes <sup>4</sup>

**Table 3 – Natural Cross Ventilation Summary of the first 9 Levels**

**Notes:**

- 1 Cross ventilation flow path via open lift lobby corridor as noted in below figures.
- 2 Cross ventilation flow path via ventilation ducting to northern aspect on Level 6 and 7 as indicated in Figures 11 and discussed in Section 8.2.2.
- 3 External openings for occupiable room of the building is noted to be at least 5% of the associated floor plan area. This will be verified during the detailed design phase.
- 4 Noise Affected Apartment, refer to the Noise and Vibration Impact Assessment report by Stantec for further details.



**Figure 9 – Natural Cross Ventilation Floor Plan – Level 1**



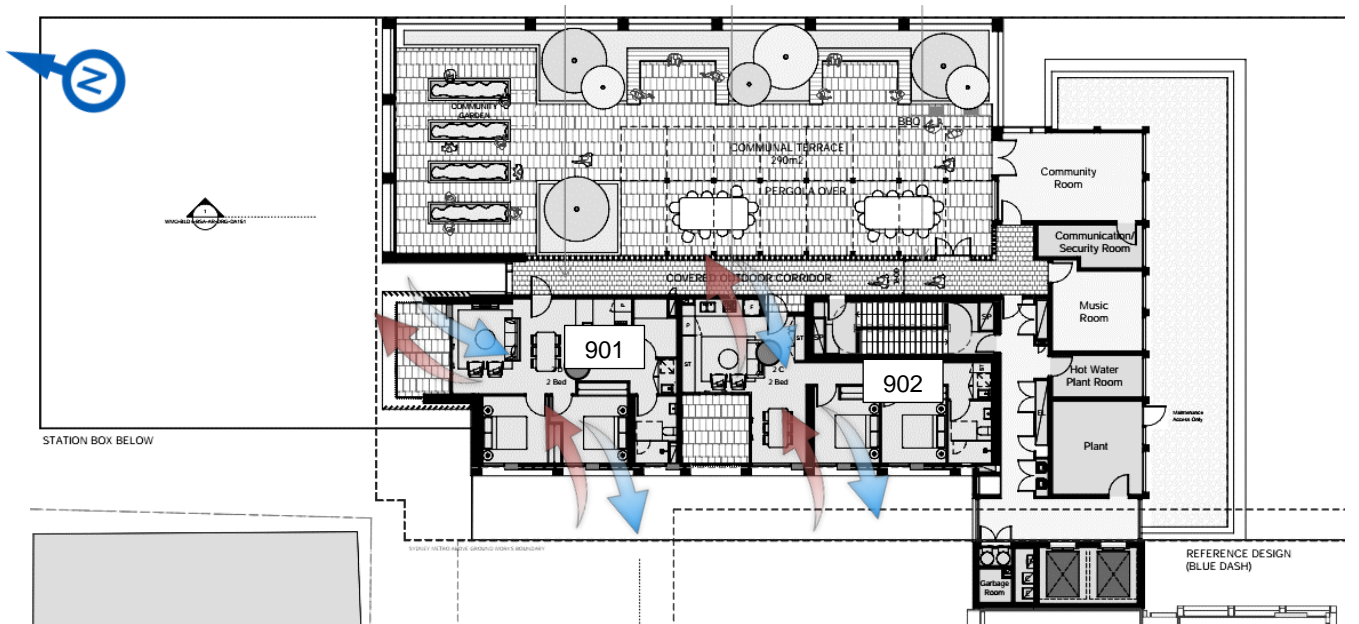
**Figure 10 – Natural Cross Ventilation Floor Plan – Level 2**



**Figure 11 – Natural Cross Ventilation Floor Plan – Levels 3 to 7**



**Figure 12 – Natural Cross Ventilation Floor Plan – Level 8**



**Figure 13 – Natural Cross Ventilation Floor Plan – Level 9**

### 8.3 Cumulative impacts

The assessment for the natural ventilation performance of the apartments in Building 4 has been undertaken with consideration for the cumulative building for of the Waterloo Metro Quarter. Due to Building 4 being located atop the Metro Box hence access via Building 3 which abuts the building, in accordance with the reference massing scheme, this limits the ability for traditional corner and cross over apartments as would apply for a typical development.

The design has subsequently been developed to address these limitations for the precinct to comply with the ADG and the requirements outlined in the Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020).



## 9. Conclusion

On review of the proposed design of Building 4 apartments of the Waterloo Metro Quarter development in Sydney, it is noted that 60.0% (42/70) of the residential apartments over the 9 Levels of Building 4 satisfy the requirements of the Apartment Design Guide to be considered Naturally Cross Ventilated.

25 of the apartments noted in the Noise and Vibration Impact Assessment by Stantec will require consideration for noise impacts from Botany Road and the Metro Station. More detailed wind tunnel measurements and CFD analysis can be undertaken by RWDI during the design development phase to verify these airflow patterns.

The design of the ventilation plenum for Apartments 609 and 709 has been developed with the mechanical engineer to ensure suitable airflow rates can be achieved while accounting for opening louvres, acoustic treatment and fire dampers. More detailed wind tunnel measurements and CFD analysis can be undertaken by RWDI during the design development phase to verify these airflow rates.

## 10. Applicability of Results

The drawings and information listed below were received from Woods Bagot, Hassell, and Bates Smart. The findings presented in this report pertain to the proposed design as detailed in the architectural design drawings listed in the table below. Should there be any design changes that deviate from this list of drawings, the predictions presented may change. Therefore, if changes in the design are made, it is recommended that RWDI be contacted.

File Name	File Type	Date Received (dd/mm/yyyy)
Building 1 (Woods Bagot)		
WMQ-SITE-HAS-UD-MDL-0005	DWG	12/06/2020
WMQ-BLD1-WBG-AR-DRG-DA001-dwg[B]	DWG	28/07/2020
WMQ-BLD1-WBG-AR-DRG-DA002-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA003-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA091-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA092-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA100-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA100M-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA101-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA102-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA103-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA104-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA105-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA108-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA109-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA110-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA113-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA114-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA115-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA116-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA117-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA121-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA122-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA123-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA124-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA131-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA132-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA133-dwg[B]		



File Name	File Type	Date Received (dd/mm/yyyy)
WMQ-BLD1-WBG-AR-DRG-DA134-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA141-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA142-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA143-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA144-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA145-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA146-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA147-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA148-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA149-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA190-dwg[B]		
WMQ-BLD1-WBG-AR-DRG-DA191-dwg[B]		
Building 2 (Hassell)		
WMQ-SITE-HAS-UD-MDL-0005	DWG	12/06/2020
WMQ-BLD2-HAS-AR-DRG-DA001	DWG	29/07/2020
WMQ-BLD2-HAS-AR-DRG-DA002		
WMQ-BLD2-HAS-AR-DRG-DA010		
WMQ-BLD2-HAS-AR-DRG-DA011		
WMQ-BLD2-HAS-AR-DRG-DA012		
WMQ-BLD2-HAS-AR-DRG-DA013		
WMQ-BLD2-HAS-AR-DRG-DA014		
WMQ-BLD2-HAS-AR-DRG-DA015		
WMQ-BLD2-HAS-AR-DRG-DA016		
WMQ-BLD2-HAS-AR-DRG-DA017		
WMQ-BLD2-HAS-AR-DRG-DA018		
WMQ-BLD2-HAS-AR-DRG-DA019		
WMQ-BLD2-HAS-AR-DRG-DA020		
WMQ-BLD2-HAS-AR-DRG-DA021		
WMQ-BLD2-HAS-AR-DRG-DA022		
WMQ-BLD2-HAS-AR-DRG-DA023		
WMQ-BLD2-HAS-AR-DRG-DA024		
WMQ-BLD2-HAS-AR-DRG-DA025		
WMQ-BLD2-HAS-AR-DRG-DA026		
WMQ-BLD2-HAS-AR-DRG-DA027		

File Name	File Type	Date Received (dd/mm/yyyy)
WMQ-BLD2-HAS-AR-DRG-DA028		
WMQ-BLD2-HAS-AR-DRG-DA029		
WMQ-BLD2-HAS-AR-DRG-DA030		
WMQ-BLD2-HAS-AR-DRG-DA031		
WMQ-BLD2-HAS-AR-DRG-DA032		
WMQ-BLD2-HAS-AR-DRG-DA033		
WMQ-BLD2-HAS-AR-DRG-DA034		
WMQ-BLD2-HAS-AR-DRG-DA035		
WMQ-BLD2-HAS-AR-DRG-DA101		
WMQ-BLD2-HAS-AR-DRG-DA102		
WMQ-BLD2-HAS-AR-DRG-DA103		
WMQ-BLD2-HAS-AR-DRG-DA201		
WMQ-BLD2-HAS-AR-DRG-DA202		
WMQ-BLD2-HAS-AR-DRG-DA301		
WMQ-BLD2-HAS-AR-DRG-DA302		
WMQ-BLD2-HAS-AR-DRG-DA303		
WMQ-BLD2-HAS-AR-DRG-DA304		
WMQ-BLD2-HAS-AR-DRG-DA401		
WMQ-BLD2-HAS-AR-DRG-DA402		
WMQ-BLD2-HAS-AR-DRG-DA501		
WMQ-BLD2-HAS-AR-DRG-DA502		
WMQ-BLD2-HAS-AR-DRG-DA503		
WMQ-BLD2-HAS-AR-DRG-DA601		
WMQ-BLD2-HAS-AR-DRG-DA701		
WMQ-BLD2-HAS-AR-DRG-DA801		
WMQ-BLD2-HAS-AR-DRG-DA901		
WMQ-BLD2-HAS-AR-DRG-DA902		
Building 3 (Bates Smart)		
WMQ-SITE-HAS-UD-MDL-0005	DWG	12/06/2020
WMQ-BLD3-BSA-AR-DRG-DA100-dwg_G	DWG	28/07/2020
WMQ-BLD3-BSA-AR-DRG-DA100M-dwg_F		
WMQ-BLD3-BSA-AR-DRG-DA101-dwg_F		
WMQ-BLD3-BSA-AR-DRG-DA102-dwg_F		
WMQ-BLD3-BSA-AR-DRG-DA103-dwg_F		

File Name	File Type	Date Received (dd/mm/yyyy)
WMQ-BLD3-BSA-AR-DRG-DA106-dwg_F WMQ-BLD3-BSA-AR-DRG-DA116-dwg_D WMQ-BLD3-BSA-AR-DRG-DA123-dwg_F WMQ-BLD3-BSA-AR-DRG-DA124-dwg_F WMQ-BLD3-BSA-AR-DRG-DA125-dwg_F		
WMQ-BLD3-BSA-AR-DRG-DA140-dwg_C WMQ-BLD3-BSA-AR-DRG-DA141-dwg_C WMQ-BLD3-BSA-AR-DRG-DA142-dwg_C WMQ-BLD3-BSA-AR-DRG-DA143-dwg_C WMQ-BLD3-BSA-AR-DRG-DA150-dwg_E WMQ-BLD3-BSA-AR-DRG-DA151-dwg_F	DWG	29/07/2020
<b>Building 4 (Bates Smart)</b>		
WMQ-SITE-HAS-UD-MDL-0005	DWG	12/06/2020
WMQ-BLD4-BSA-AR-DRG-DA101-dwg_I WMQ-BLD4-BSA-AR-DRG-DA102-dwg_D WMQ-BLD4-BSA-AR-DRG-DA103-dwg_I WMQ-BLD4-BSA-AR-DRG-DA108-dwg_H WMQ-BLD4-BSA-AR-DRG-DA109-dwg_H WMQ-BLD4-BSA-AR-DRG-DA110-dwg_G	DWG	28/07/2020
WMQ-BLD4-BSA-AR-DRG-DA140-dwg_D WMQ-BLD4-BSA-AR-DRG-DA141-dwg_D WMQ-BLD4-BSA-AR-DRG-DA142-dwg_D WMQ-BLD4-BSA-AR-DRG-DA143-dwg_D WMQ-BLD4-BSA-AR-DRG-DA150-dwg_H WMQ-BLD4-BSA-AR-DRG-DA151-dwg_B WMQ-BLD4-BSA-AR-DRG-DA160-dwg_E WMQ-BLD4-BSA-AR-DRG-DA161-dwg_E WMQ-BLD4-BSA-AR-DRG-DA162-dwg_E WMQ-BLD4-BSA-AR-DRG-DA163-dwg_E	DWG	29/07/2020