



# WATERLOO METRO QUARTER OVER STATION DEVELOPMENT

Environmental Impact Statement Appendix LL - Overshadowing Analysis

SSD-10437 Southern Precinct SSD-10439 Central Precinct and SSD-10440 Northern 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 SSD-10439 Central Precinct
	SSD-10440 Northern Precinct
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# **Table of Contents**

1.	Glossa	ary and abbreviations	5
2.	Execut	tive summary	8
3.	Introdu	uction	9
4.	The sit	te1	1
5.	Backq	round1	5
	5.1	About Sydney Metro1	
		5.1.1 Sydney Metro North West	15
		5.1.2 Sydney Metro City & Southwest	
		5.1.3 Sydney Metro West	
		5.1.4 Sydney Metro Greater West	
	5.2	Sydney Metro CSSI Approval (SSI 7400)	
	5.3	Concept Approval (SSD 9393)1	
6.		sed development1	
	6.1	Waterloo Metro Quarter Development1	
		6.1.1 Southern Precinct [Subject DA]	
		6.1.2 Basement Car Park	
		6.1.3 Central Precinct [Subject DA]	
_		6.1.4 Northern Precinct [Subject DA]	
7.		dology	
	7.1	Assumptions and Limitations	
	7.2	Overshadowing Objectives & Criteria	
8.		sment and findings2	
	8.1	Approved DA Envelope Design and Proposed Scheme	
	8.2	Cumulative impacts	
		8.2.1 Alexandria Park	
		8.2.2 Cope Street Plaza	
		<ul><li>8.2.3 Building 4 Rooftop Communal Area.</li><li>8.2.4 Neighbouring Developments and Waterloo Heritage Precinct.</li></ul>	
•	Conclu		
9.		1sion	
10.	Applic	ability of Results	5
11.	Appen	dices3	
	11.1	Appendix 1 – Alexandria Park Survey	
	11.2	Appendix 2 - Point-in-time shadow diagrams - Alexandria Park - 21 Jun4	
	11.3	Appendix 3 – Point-in-time shadow diagrams – Cope Street Plaza – 21 Jun4	11
	11.4	Appendix 4 - Point-in-time shadow diagrams - Full domain - 21 Jun4	
	11.5	Appendix 5 - Point-in-time shadow diagrams - Full Domain - 21 Mar4	13
	11.6	Appendix 6 - Point-in-time shadow diagrams - Full Domain - 21 Dec4	14
	11.7	Appendix 7 – Sun View Diagrams – 21 Jun	15





## List of Figures

Figure 1 - Aerial image of the site
Figure 2 - Waterloo Metro Quarter site, with sub-precincts identified14
Figure 3 - Waterloo Metro Quarter site, with sub-precincts identified14
Figure 4 - Sydney Metro alignment map16
Figure 5 - CSSI Approval scope of works17
Figure 6 - 3D Computer Model of the Proposed Building (purple), Key Park Surfaces (green), Waterloo
Heritage Precinct (orange), and Surrounding Urban Context (grey)20
Figure 7 Close-up View of a Park Surface, Showing Surface Subdivisions21
Figure 8 Close-up View of the Proposed Development
Figure 9 – Approved DA Envelope Design Scheme – View from North-East (Left) and South-West (right) Error!
Bookmark not defined.
Figure 10 - Comparison of 21 June 9:00 AM Overshadowing on Alexandria Park Between Approved DA Model
(top) and the Proposed Scheme (bottom)26
Figure 11 - Area in Cope Street Plaza where Direct Solar Access is Available Above 2 Hours (red)
Figure 12 - Area in Cope Street Plaza where Direct Solar Access is Available (red)
Figure 13 - Grade Level Areas Where Direct Solar Access is Reduced from At or Above 2 Hours to Less Than
2 Hours on 21 June Due to the Approved DA Envelope Design Scheme (top) and the Proposed Scheme
(bottom)
Figure 14 - Annual Increase in Potential Sunlight Hours on Ground Due to Proposed Scheme Compared to
Approved DA Envelope Design Scheme

## List of Tables

Table 1 -	SEARs requirements	0
Table 2 -	Conditions of Concept Approval	0
Table 3 -	Shadowed Percentage of Alexandria Park (excluding the oval)	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	

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Page 5 of 45





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	

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





## 2. Executive summary

This planning report has been prepared by RWDI Anemos Ltd. (RWDI) to accompany a detailed State significant development (SSD) development application (DA) for the following Precincts: Southern Precinct Central Precinct and Northern 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 SSD 10439 and SSD 10440).

This report has been prepared in respect of precinct-wide overshadowing impcats for the three SSD DA's referenced above, and concludes that the proposed Southern Precinct, Central Precinct, and Northern Precinct of the OSD are suitable and warrants approval.

This report concludes that overshadowing caused by the proposed development was found to comply with the Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020). The conclusions in respect of the individual areas assessed are summarised below.

#### Alexandria Park

- The Proposed Development will not create new shadowing on Alexandria Park between 10:00 am and 3:00 pm on 21 June.
- Very slight new shadowing is predicted on Alexandria Park before 10:00 am. This shadowing is expected to be at a maximum at 9:00 am, amounting to 29.94% of the Park area and reducing rapidly. This indicates that both criteria are met for the Proposed Development impact on Alexandria Park.
- The Proposed Scheme results in less overshadowing of Alexandria Park compared to the Approved DA Envelope Design Scheme.

#### Cope Street Plaza

• The simulations predict that 57.3% of Cope Street Plaza can receive at least 2 hours of direct sunlight between 9:00 am and 3:00 pm on June 21, thereby complying with the requirement in the Waterloo Metro Quarter Design and Amenity Guidelines.

#### **Neighbouring Developments and Waterloo Heritage Precinct**

• The Amended Envelope would have less of an impact on neighbouring buildings that of the DA Concept SSD 9393 Approved Design, and a minimal impact on solar access to the residences in the Heritage Precinct. The study notes that there are no areas within the Heritage Precinct that currently receive 2 hours of direct sunlight which will experience a reduction to below 2 hours.

Page 8 of 45





# 3. Introduction

This report has been prepared to accompany a detailed State significant development (SSD) development application (DA) for the following precincts: Southern Precinct Central Precinct and Northern 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).

**Central Precinct** 

- 24-storey residential building (Building 2) comprising approximately 126 market residential and 24 affordable housing apartments, to be delivered as a mixture of one-bedroom, two-bedroom and three-bedroom apartments
- ground level retail tenancies, community hub, precinct retail amenities and basement carpark 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 car park 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).

Page 9 of 45





Northern Precinct

- 17-storey commercial building (Building 1) comprising Commercial floor space, with an approximate capacity of 4000 workers
- ground level retail tenancies, loading 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).

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 8 April 2020, 9 April 2020 and 9 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)
6 Visual and Amenity Impacts	provide a solar access and overshadowing analysis, comparing the overshadowing impacts of the proposal to the existing situation and the approved envelopes having regard to the impact of the proposal on solar access to Alexandria Park and Alexandria Heritage Conservation Area. This shall include a statement on the benefits and issues of any alternative design options that was considered with respect to shadow impacts to Alexandria Park.	7, 8, 9, 11

#### 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.

ltem	Description of requirement	Section reference (this report)
Part 3 Section K Built Form above the Podium	Identify opportunities to improve solar access to Alexandria Park through redistribution of floorspace and building bulk and scale between the hours of 9am and 10am in midwinter (21 June) when compared to the shadow cast by the indicative scheme lodged with the RtS.	8.1, 8.2.1

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 Central Precinct Northern Precinct (the site) of the Waterloo Metro Quarter site. The site has an area of approximately 4830sqm 2,460sqm 5,120sqm. 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)

Page 11 of 45





- 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).

**Central Precinct DA** 

- 130–134 Cope Street (Lot 12 DP 399757) (Part)
- 136–144 Cope Street (Lots A-E DP 108312) (Part)
- 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) (Part).

#### Northern Precinct DA

- 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).

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).

Page 12 of 45







Figure 1 - Aerial image of the site Source: Urbis

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





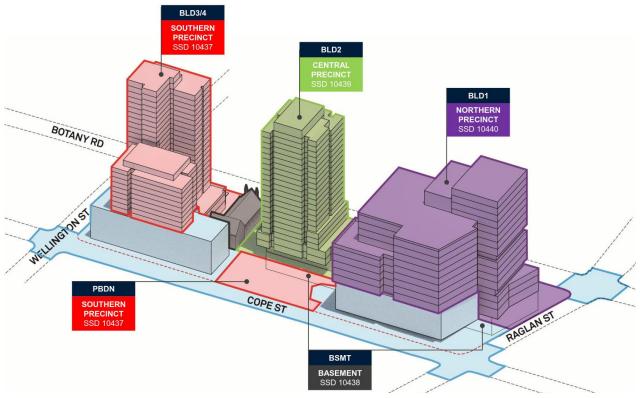


Figure 2 - Waterloo Metro Quarter site, with sub-precincts identified Source: HASSELL

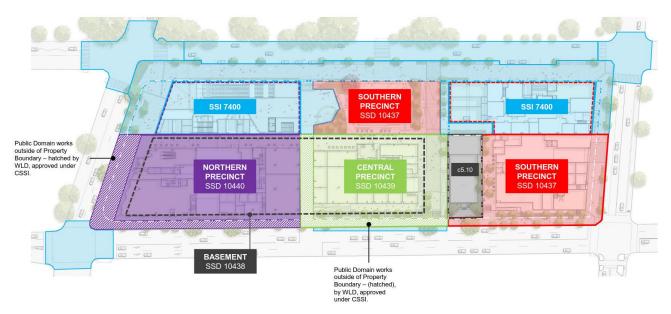


Figure 3 - Waterloo Metro Quarter site, with sub-precincts identified Source: Waterloo Developer Pty Ltd

Page 14 of 45





## 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.

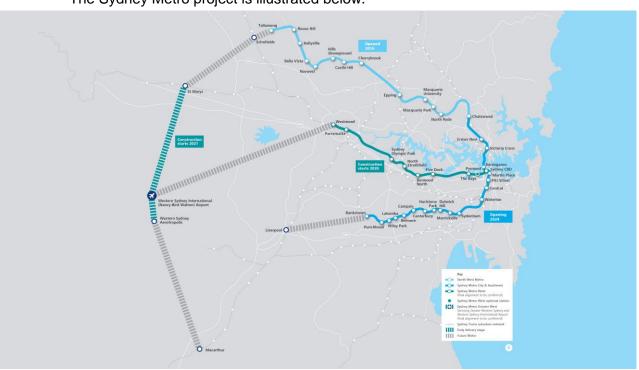
The Australian and NSW governments are equal partners in the delivery of this new railway.

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Page 15 of 45







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.

Page 16 of 45





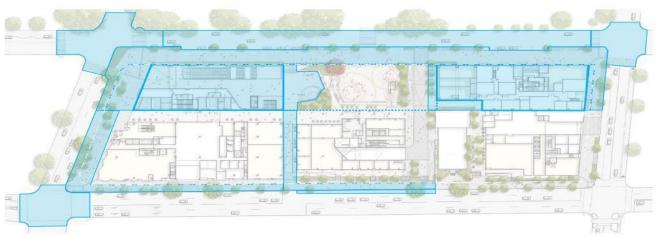


Figure 5 - CSSI Approval scope of works Source: WL Developer Pty Ltd

### 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 Central Precinct Northern Precinct of the site, consistent with the parameters of this concept approval. Separate SSD DAs have been prepared and will be submitted for the 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.

Page 17 of 45





## 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, Central Precinct, and Northern 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

Page 18 of 45





- 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 [Subject DA]

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 [Subject DA]

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).

Page 19 of 45





# 7. Methodology

An assessment has been undertaken to determine the effect of the proposed development on the contribution of additional shadowing to the nearby parks, specifically Alexandria Park, as well as neighbours including the Waterloo Heritage Precinct, and a proposed public pedestrian plaza fronting Cope Street. The analysis was based on computational 3D modelling of the proposed development and its surrounding context combined with climate data for Sydney.

The analysis was conducted using RWDI's in-house proprietary Eclipse software, as per the steps outlined below:

- The assessment began with the development of a 3D model of the area of interest (as shown in Figure 6). This includes LIDAR data for the area to account for topographic changes, with calibration to survey plans for the area. The park spaces and the ground were then subdivided into many triangular patches approximately 0.125 m<sup>2</sup> in area (see Figure 7).
- At 15-minute increments from 9:00am to 3:00pm on June 21, the expected solar position was determined, and "virtual rays" were drawn from the sun to each triangular patch of the park surfaces. Any rays which were not obstructed by a building are considered exposed to direct sunlight.
- This analysis is conducted with and without the proposed building and the results subtracted to compute the total minutes of net-new shadowing caused by the proposed development (i.e. not including existing shadows) on the park during this period.
- Point-in-time shadow diagrams at the 15-minute increments for the 21st of December (Summer Solstice), March (Autumn Equinox), and June (Winter Solstice) were also generated for a large area around the site.



Figure 6 - 3D Computer Model of the Proposed Building (purple), Key Park Surfaces (green), Waterloo Heritage Precinct (orange), and Surrounding Urban Context (grey)

Page 20 of 45



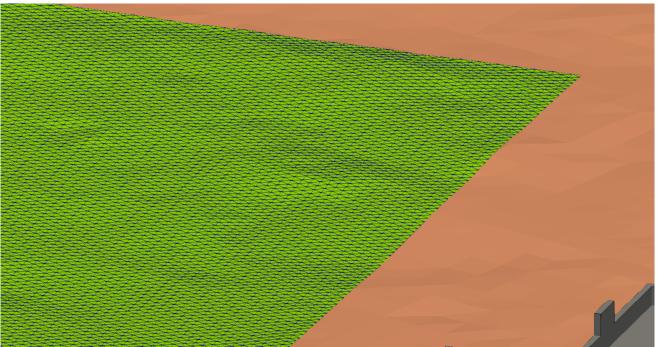


Figure 7 Close-up View of a Park Surface, Showing Surface Subdivisions

## 7.1 Assumptions and Limitations

#### **Meteorological Data**

This model has been geolocated to a reference latitude and longitude of (-33.89778, 151.2000).

#### **Study Building and Surrounds Models**

The analysis was conducted based on information provided by Bates Smart, Hassell, and Woods Bagot and the WL Developer to RWDI up to 27 June 2020. The surrounds and local topography were developed using a combination of survey and other data provided to RWDI by the design team and confirmed with LIDAR data. The spatial relationship between the development site and Alexandria Park and elevations of the park were confirmed based on the survey provided by Veris, dated 20 April 2020, included as Appendix 1. All data which was provided in MGA coordinates have been corrected to true north for the purposes of this study.

All elements of the proposed buildings have been treated as fully opaque to light and any shading provided by vegetation (i.e. trees) was neglected. Figure 8 illustrates the 3D model used in this study and Figure 9 presents approximate spot heights of the buildings investigated.

#### Applicability of Results

The results presented in this report are highly dependent on the form of the proposed development. Should there be any changes to the design of the building, it is recommended that RWDI be contacted and requested to review their potential effects on the findings of this report.





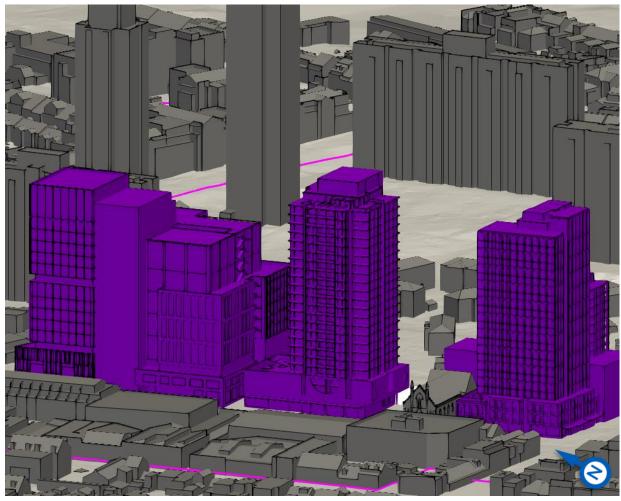


Figure 8 Close-up View of the Proposed Development

### 7.2 Overshadowing Objectives & Criteria

The Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020) provide guidance on the acceptable level of shadow impact by the development. The following Objectives and Criteria are stipulated:

#### Section 3M Solar access and amenity

- Objectives
  - **Objective 1** Ensure solar access to the public domain on the site including Cope St Plaza and Raglan St Plaza
  - **Objective 2** Minimise overshadowing on Alexandria Park and the wider public domain
- Design Criteria
  - **Design Criteria 1** The development does not result in any additional overshadowing of Alexandria Park after 10am on 21 June
  - **Design Criteria 2** No more than 30% of Alexandria Park excluding the oval is overshadowed by the development as measured at any time after 9am on 21 June.
  - **Design Criteria 3** Proposed apartments in a development and neighbouring developments including the Waterloo Heritage Precinct must achieve a minimum of





2 hours direct sunlight between 9am and 3pm on 21 June onto at least 1m<sup>2</sup> of living room windows and a minimum 50% of the required minimum area of private open space area. Note: This applies to at least 70% of the apartments in a development in accordance with the NSW Apartment Design Guide.

• **Design Criteria 4** - The new development does not create any additional overshadowing onto a neighbouring dwelling where that dwelling currently receives less than 2 hours direct sunlight to habitable rooms and 50% of the private open space between 9am and 3pm on 21 June.

Design criteria for Cope Street Plaza states:

- Section 3C Public Domain
  - **Design Criteria** 4 At least 50 percent of the area of the Cope Street plaza receives at least two hours sunlight between 9am and 3pm on 21 June.

The results of the analysis regarding these requirements is presented for each space (Alexandria Park, Cope Street Plaza, Waterloo Heritage Precinct and other neighbouring buildings) in the following sections.





## 8. Assessment and findings

#### 8.1 Approved DA Envelope Design and Proposed Scheme

Comparison is made between the Approved DA Envelope Design Scheme and the Amended Envelope in Figure 9 below. The Proposed Design Scheme has responded to the Objectives and Criteria of the Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020) in order to improve overshadowing to the neighbours.

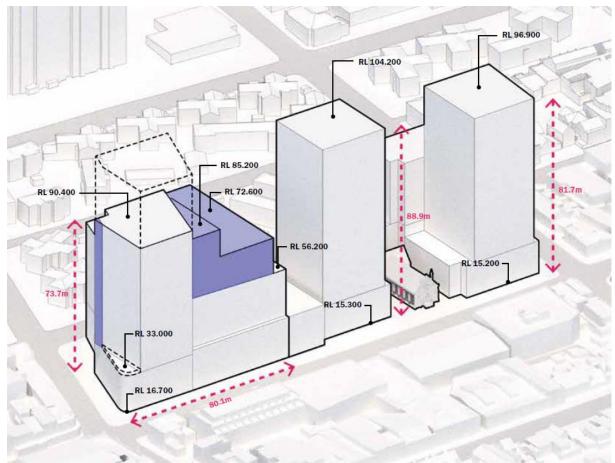


Figure 9 – Comparison of Approved DA Envelope and Amended Envelope (Amendments Highlighted)

**Objective 2** of Section 3M (Solar access and amenity) of the Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020) requires minimising the overshadowing on Alexandria Park and the wider public domain. The detailed design of the development incorporates initiatives to minimise overshadowing on Alexandria Park and nearby developments including:

- A reduction in the height of Building 2 as compared to the approved envelope by approximately 6 m on east side and approximately 12 m on the west and south; and,
- A reduction in the height of Building 3 as compared to the approved envelope by approximately 3.5 m on the east side and approximately 10 m on west and south.





**Objective 1** of Section 3M (Solar access and amenity) of the Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020) seeks to ensure solar access to the public domain on the site including Cope Street Plaza and Raglan Street Plaza. The detailed design of the development incorporates initiatives to achieve these objectives:

- Cope Street plaza sits on the eastern side of the site with the stepped form of the northern station box and Building 1 to the north and Building 2 to the west, as such is exposed primarily to morning sunlight.
- Raglan Street Plaza sits along the north side of Building 1 and the northern station box, as such is minimally impacted by the proposed development in terms of solar access.

Results of the technical assessments to demonstrate the performance of the spaces with respect to the objectives and criteria are discussed in the following sections. Reference is made to the improvement in performance compared to the Approved DA Envelope Design Scheme as applicable.

#### 8.2 Cumulative impacts

Overshadowing impacts have been considered cumulatively for the entire development, as summarised in the following sections.

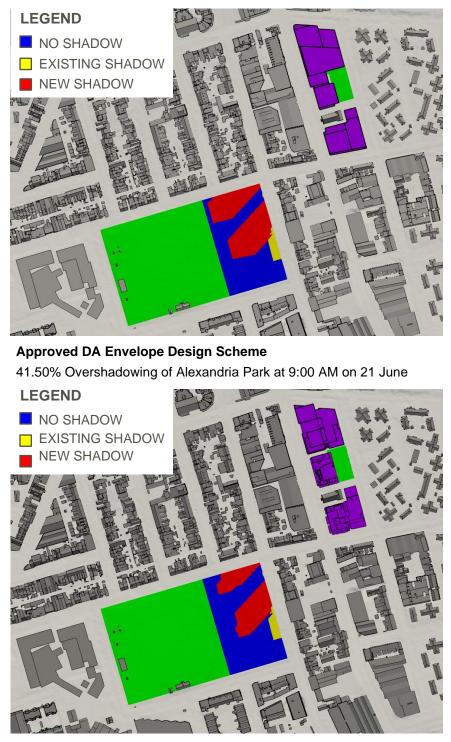
#### 8.2.1 Alexandria Park

The criteria that needs to be met for Alexandria Park are:

- **Design Criteria 1** The development does not result in any additional overshadowing of Alexandria Park after 10am on 21 June
- **Design Criteria 2** No more than 30% of Alexandria Park excluding the oval is overshadowed by the development as measured at any time after 9am on 21 June

Table 3 summarizes the results of the point-in-time shadow analysis (plots of which can be found in Appendix 2). The table presents the percentage of new shadow resulting from the proposed development landing on Alexandria Park (excluding the oval), and makes comparison to the overshadowing caused by the Approved Envelope. A comparison of the overshadowing onto Alexandria Park at 9:00 AM on 21 June is shown in Figure 10. These figures do not include the impact of any existing overshadowing.





Proposed Scheme 29.94% Overshadowing of Alexandria Park at 9:00 AM on 21 June

Figure 10 - Comparison of 21 June 9:00 AM Overshadowing on Alexandria Park Between Approved DA Model (top) and the Proposed Scheme (bottom).

The simulations indicate that no additional overshadowing of Alexandria Park after 10 am on 21 June, and that no more than 30% of Alexandria Park (excluding the oval) is





overshadowed by the development after 9:00 am. Furthermore, the overshadowing caused by the proposed scheme is significantly less than that caused by the Approved Envelope.

Therefore, the proposed development is predicted to be compliant with the criteria stipulated for Alexandria Park.

Time (AEST)	Approved Envelope 21 June	Proposed Scheme 21 June
9:00	41.50%	29.94%
9:15	27.41%	18.39%
9:30	14.86%	7.67%
9:45	4.99%	0.62%
10:00 - 15:00	0.00%	0.00%

 Table 3 - Shadowed Percentage of Alexandria Park (excluding the oval)

#### 8.2.2 Cope Street Plaza

The criterion that needs to be met for Cope Street Plaza is:

• **Design Criteria 4** - At least 50 percent of the area of the Cope Street plaza receives at least two hours sunlight between 9am and 3pm on 21 June.

As was undertaken for Alexandria Park, solar simulations at 1-minute increments were conducted for 21 June to understand the total potential minutes of direct solar exposure in the plaza.

The simulations confirm that the criterion is met for Cope Street Plaza. Figure 11 shows the area in Cope Street Plaza which was predicted to receive at least two hours of sunlight between 9:00 am and 3:00 pm. This amounts to 57.3% of the total area. Figure 12 shows point-in-time shadow plots with the percentage of area receiving sunlight at 15-minute increments to demonstrate the overall availability of sunlight at the winter solstice. These images show that sunlight is generally available in the morning hours between 9:15 and 11:15 AM when the 50% criterion is achieved, with afternoon hours mostly in shadow.

Point-in-time shadow plots were also generated for the winter solstice and can be found in Appendix 3.





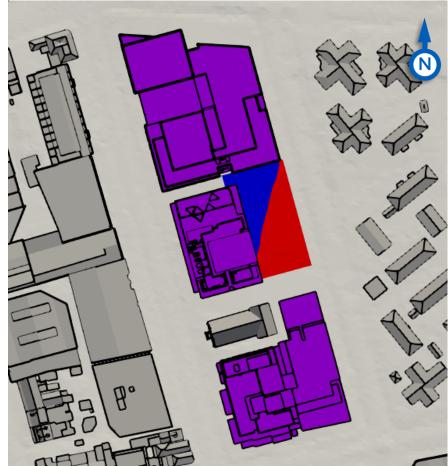
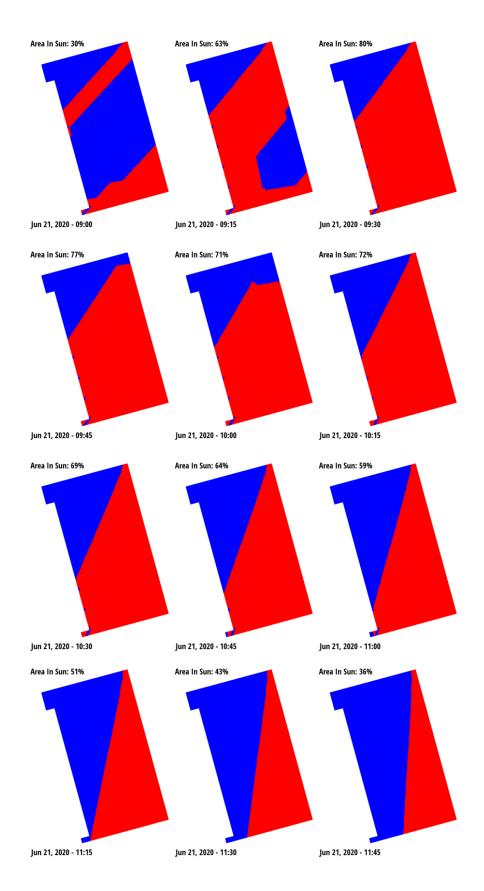


Figure 11 - Area in Cope Street Plaza where Direct Solar Access is Available Above 2 Hours (red).

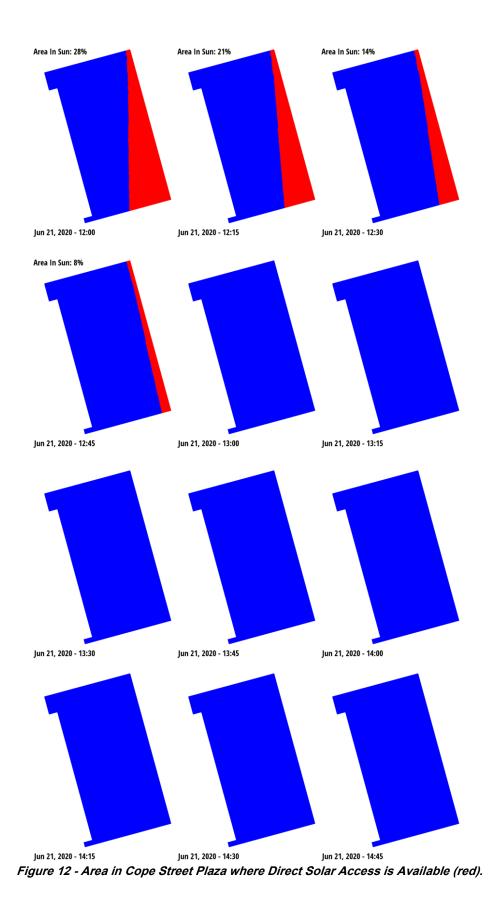












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#### 8.2.3 Building 4 Rooftop Communal Area

A communal open space is located on the eastern aspect of Level 9 of Building 4. As noted in Section 11.7 (Appendix 7 – Sun View Diagrams) this area will receive access to direct sunlight from 9:00 am until 1:45 pm before overshadowing from Building 2 will occur.

This area will therefore meet the requirement for at least 50% of the area receive at least two hours sunlight between 9:00 am and 3:00 pm on 21 June.

#### 8.2.4 Neighbouring Developments and Waterloo Heritage Precinct

The criteria that needs to be met for neighbouring developments and the Waterloo Heritage Precinct are:

- Design Criteria 3 Proposed apartments in a development and neighbouring developments including the Waterloo Heritage Precinct must achieve a minimum of 2 hours direct sunlight between 9:00 am and 3:00 pm on 21 June onto at least 1 m<sup>2</sup> of living room windows and a minimum 50% of the required minimum area of private open space area. Note: This applies to at least 70% of the apartments in a development in accordance with the NSW Apartment Design Guide.
- **Design Criteria 4** The new development does not create any additional overshadowing onto a neighbouring dwelling where that dwelling currently receives less than 2 hours direct sunlight to habitable rooms and 50% of the private open space between 9:00 am and 3:00 pm on 21 June.

Solar simulations at 1-minute increments were conducted for 21 June to understand the total potential minutes of direct solar exposure at grade with and without the proposed development in place. Figure 13 illustrates (in red) areas at grade which received 2 hours of sun under the existing condition, which do not under the proposed condition. This analysis was conducted for both the Proposed Scheme and the Approved DA Envelope Design Scheme.

The simulations indicate that under the Proposed Scheme it is primarily the areas immediately south of the proposed development where the impact can occur, and that no areas within the Heritage Precinct which currently receive 2 hours of direct sunlight experience a reduction to below 2 hours. Conversely, the Approved DA Envelope Design Scheme was predicted to create areas within the Heritage Precinct that see reductions below 2 hours.

The size of the grade level areas impacted by the Approved DA Envelope Design Scheme along Wellington St. and Botany Rd. in particular are also larger compared to the current design. The Proposed Scheme reduced the total impacted area compared to the Approved DA Envelope Design Scheme by approximately 1,330 m<sup>2</sup>, or approximately 12%.

Page 31 of 45





#### Approved DA Envelope Design Scheme





Proposed Scheme



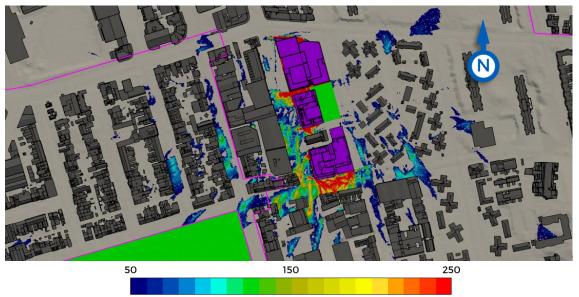
Figure 13 - Grade Level Areas Where Direct Solar Access is Reduced from At or Above 2 Hours to Less Than 2 Hours on 21 June Due to the Approved DA Envelope Design Scheme (top) and the Proposed Scheme (bottom)

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An annual assessment of potential sunlight hours on the ground was also conducted to provide an understanding of sunlight impacts during other times of year. Figure 14 illustrates the total hours of potential sunlight gained under the Proposed Scheme compared to the Approved DA Envelope Design Scheme. Note that areas with gains below 50 hours per year equate to approximately 1% of daytime hours or less, and are not shown in the interest of clarity.



Annual Increase in Potential Sunlight Hours on Ground [hours]

Figure 14 - Annual Increase in Potential Sunlight Hours on Ground Due to Proposed Scheme Compared to Approved DA Envelope Design Scheme

This diagram better illustrates the benefits of the Proposed Scheme by including a wider range of possible solar positions compared to the uniformly low elevation sun angles found in the 21 June analysis. Improvements in solar access were predicted up to 450 m away, though the majority of the improvement is confined to a radius of approximately 250 m.

Along Botany Rd. the Proposed Scheme increases potential solar access at grade by between 50 and 200 hours per year. Along Wellington St. increases up to 300 hours per year were predicted.

Overall, RWDI would expect the proposed development to have a minimal impact on solar access to the residences in the Heritage Precinct and an impact on other neighbouring buildings that is lower than that of the Approved DA Envelope Design Scheme.

Appendix 4 contains point-in-time shadow diagrams for 21 June over a wide area surrounding the project to clarify when and where shadows can fall in the surrounding vicinity. Sun view diagrams are shown in Appendix 7.

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Page 33 of 45





## 9. Conclusion

The overshadowing caused by the proposed development was found to comply with the Waterloo Metro Quarter Design and Amenity Guidelines FINAL (March 2020). The conclusions in respect of the individual areas assessed are summarised below.

#### Alexandria Park

- The simulations predict that the Proposed Development will not create new shadowing on Alexandria Park between 10:00 am and 3:00 pm on 21 June.
- Very slight new shadowing is predicted on Alexandria Park before 10:00 am. This shadowing is expected to be at a maximum at 9:00 am, amounting to 29.94% of the Park area and reducing rapidly. This indicates that both criteria are met for the Proposed Development impact on Alexandria Park.
- The Proposed Scheme results in less overshadowing of Alexandria Park compared to the Approved DA Envelope Design Scheme.

#### **Cope Street Plaza**

• The simulations predict that 57.3% of Cope Street Plaza can receive at least 2 hours of direct sunlight between 9:00 am and 3:00 pm on June 21, thereby complying with the requirement in the Waterloo Metro Quarter Design and Amenity Guidelines.

#### **Neighbouring Developments and Waterloo Heritage Precinct**

• An assessment of the grade level conditions in the surrounding neighbourhood and Waterloo Heritage Precinct indicated that the proposed development would have a minimal impact on solar access to the residences in the Heritage Precinct and an impact on other neighbouring buildings that is lower than that of the DA Approved Design.

Point-in-time shadow diagrams for the autumn equinox (21 March) and the summer solstice (21 December) have been included in Appendices 4 and 5 for further reference.





# **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] WMQ-BLD1-WBG-AR-DRG-DA002-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-DA100-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA100-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA102-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA102-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA103-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA103-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA105-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA105-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA108-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-DA110-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA113-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA113-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA115-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA115-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA117-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA117-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA112-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA121-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA122-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA122-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA122-dwg[B]	DWG	12/06/2020
WMQ-BLD1-WBG-AR-DRG-DA131-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA132-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA133-dwg[B]		

Page 35 of 45





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-DA149-dwg[B] WMQ-BLD1-WBG-AR-DRG-DA190-dwg[B]		
Building 2 (Hassell)		
WMQ-SITE-HAS-UD-MDL-0005	DWG	12/06/2020
WMQ-BLD2-HAS-AR-DRG-DA001 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-DA022 WMQ-BLD2-HAS-AR-DRG-DA023 WMQ-BLD2-HAS-AR-DRG-DA023 WMQ-BLD2-HAS-AR-DRG-DA025 WMQ-BLD2-HAS-AR-DRG-DA026 WMQ-BLD2-HAS-AR-DRG-DA026 WMQ-BLD2-HAS-AR-DRG-DA027	DWG	29/07/2020





File Name	File Type	Date Received (dd/mm/yyyy)
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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 WMQ-BLD3-BSA-AR-DRG-DA100M-dwg_F	DWG	28/07/2020
WMQ-BLD3-BSA-AR-DRG-DA101-dwg_F		
WMQ-BLD3-BSA-AR-DRG-DA102-dwg_F		
WMQ-BLD3-BSA-AR-DRG-DA102-dwg_F WMQ-BLD3-BSA-AR-DRG-DA103-dwg_F		
www-DED3-D0A-AILDING-DA103-dwg_F		

Page 37 of 45





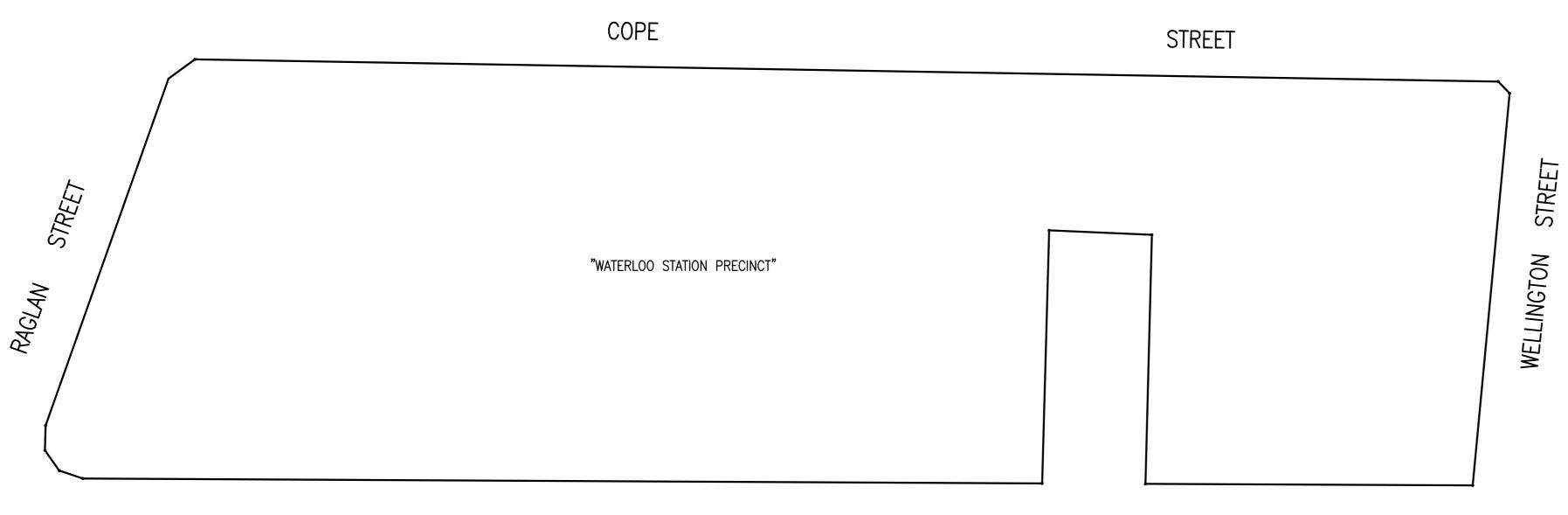
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WMQ-BLD3-BSA-AR-DRG-DA140-dwg_C WMQ-BLD3-BSA-AR-DRG-DA141-dwg_C WMQ-BLD3-BSA-AR-DRG-DA142-dwg_C WMQ-BLD3-BSA-AR-DRG-DA143-dwg_C WMQ-BLD3-BSA-AR-DRG-DA150-dwg_E WMQ-BLD3-BSA-AR-DRG-DA151-dwg_F	DWG	29/07/2020
Building 4 (Bates Smart)		
WMQ-SITE-HAS-UD-MDL-0005	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	DWG	29/07/2020





### 11. Appendices

11.1 Appendix 1 – Alexandria Park Survey



BOTANY

# <u>LOCALITY</u> <u>SEE SHEET 2 FOR PARK DETAIL</u>

ROAD

BUCKLAND

STF REET

## WYNDHAM

### "ALEXANDRIA PARK"

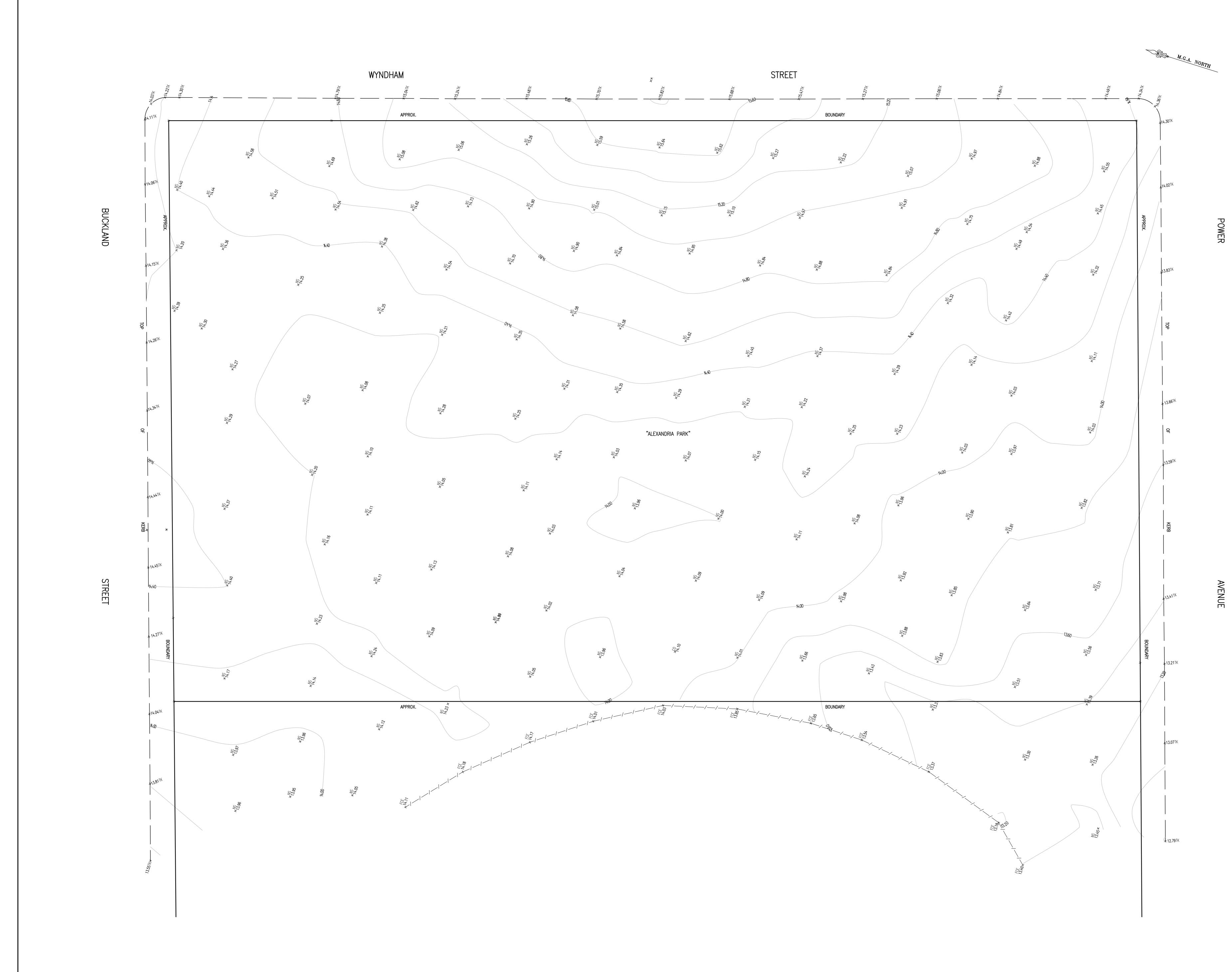
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FCE – FL – FFL –	FENCE FLOOR LEVEL FINISHED FLC	TS - TOP OF STEPS TW - TOP OF WALL NOR LEVEL TWIN - TOP OF WINDOW	
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M.G.A. NORTH





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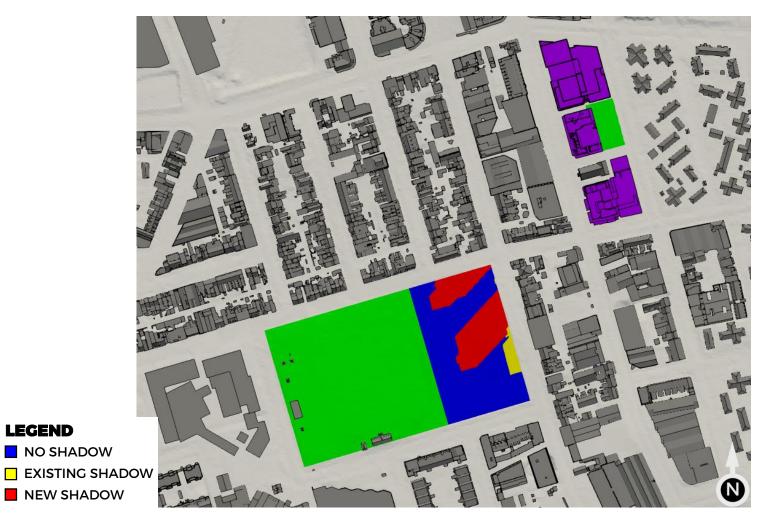




#### 11.2 Appendix 2 – Point-in-time shadow diagrams – Alexandria Park – 21 Jun



#### 21 June - 9:00 AEST





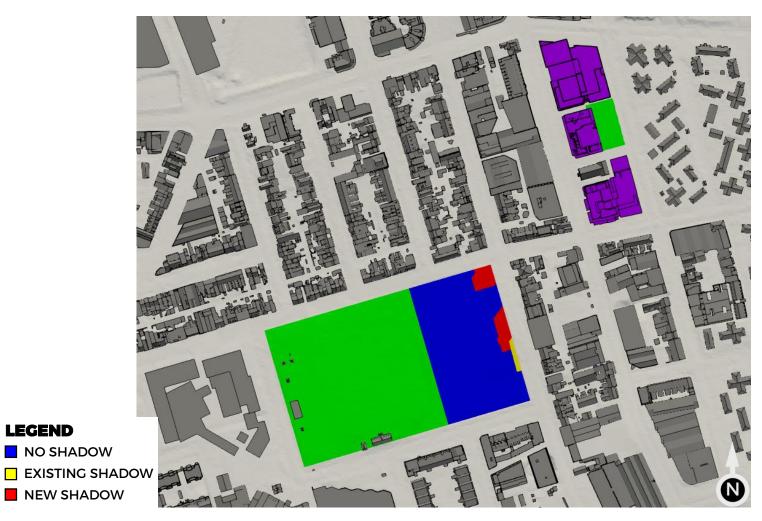
#### 21 June - 9:15 AEST



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#### 21 June - 9:30 AEST



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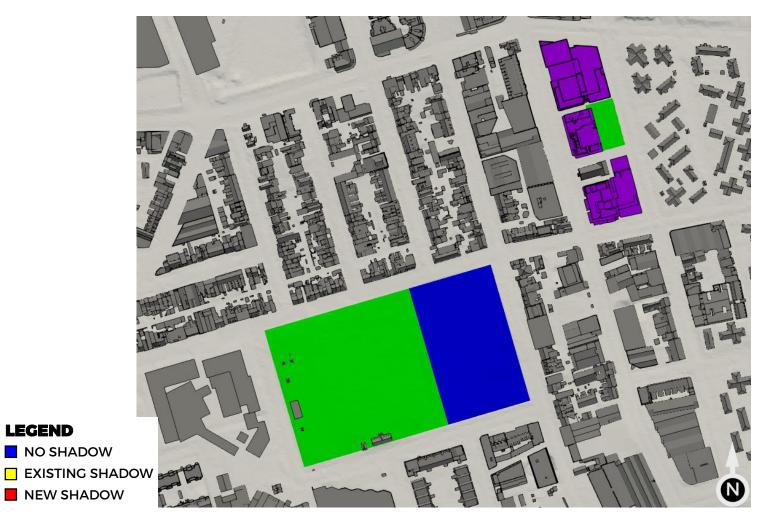
#### 21 June - 9:45 AEST



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#### 21 June - 10:00 AEST



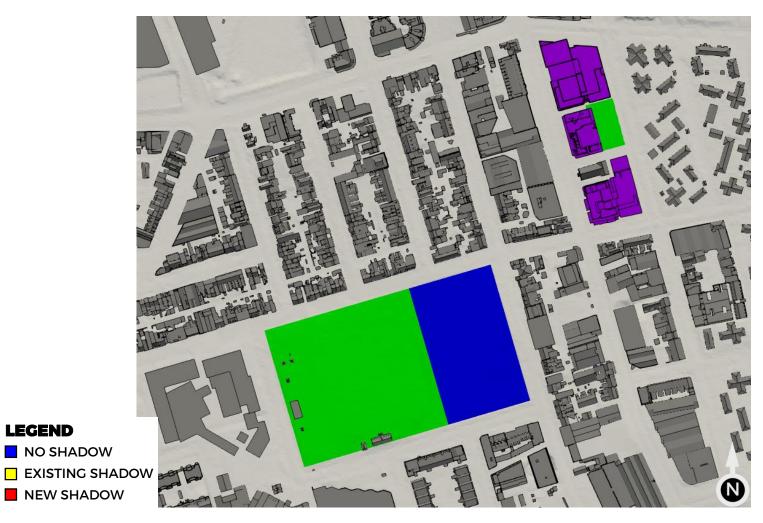


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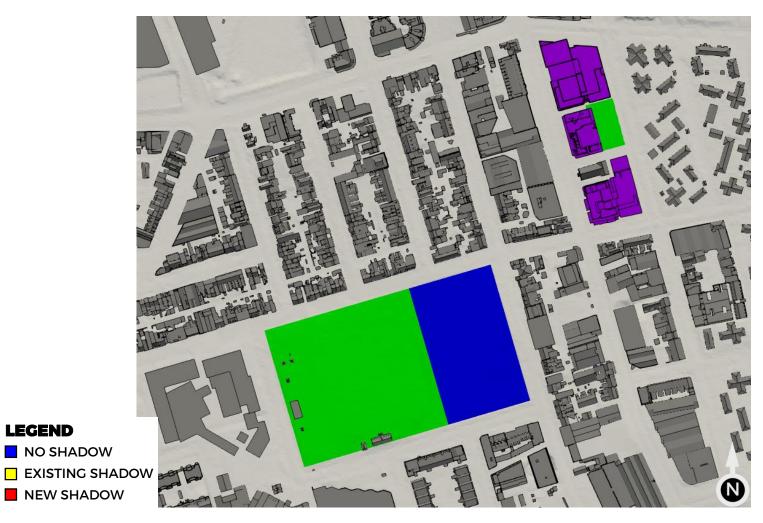


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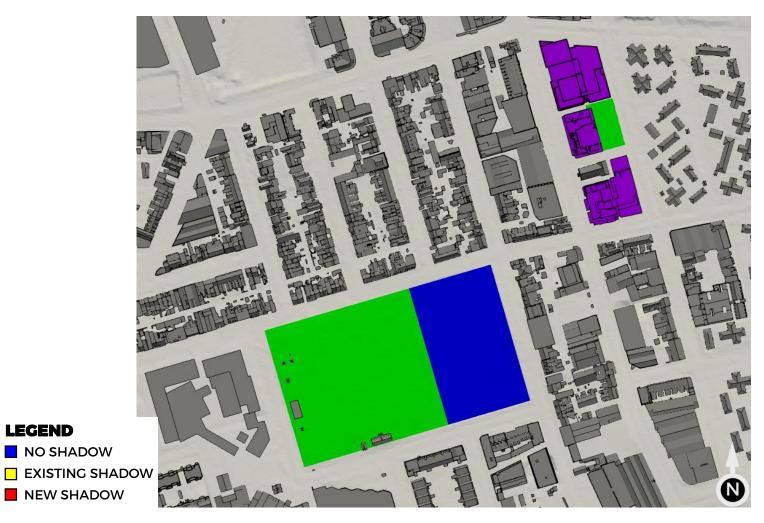


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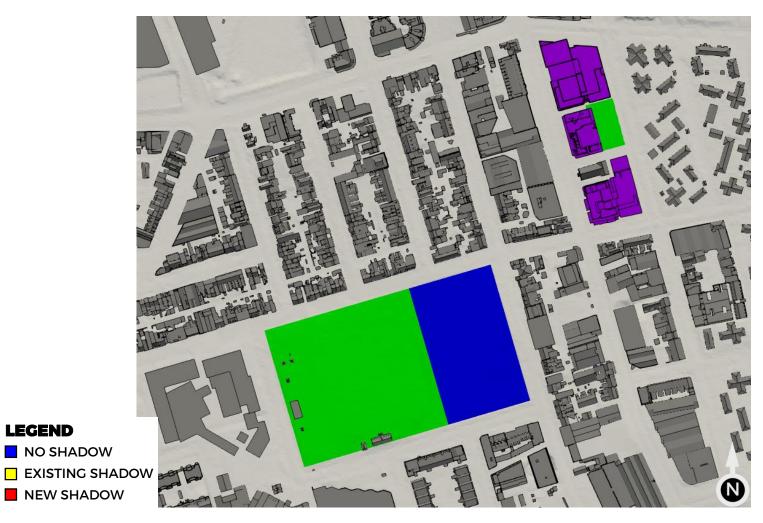


#### 21 June - 11:00 AEST



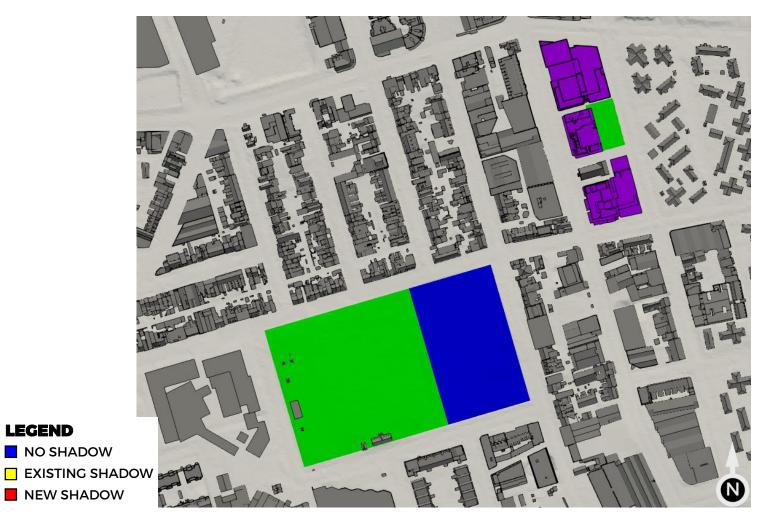


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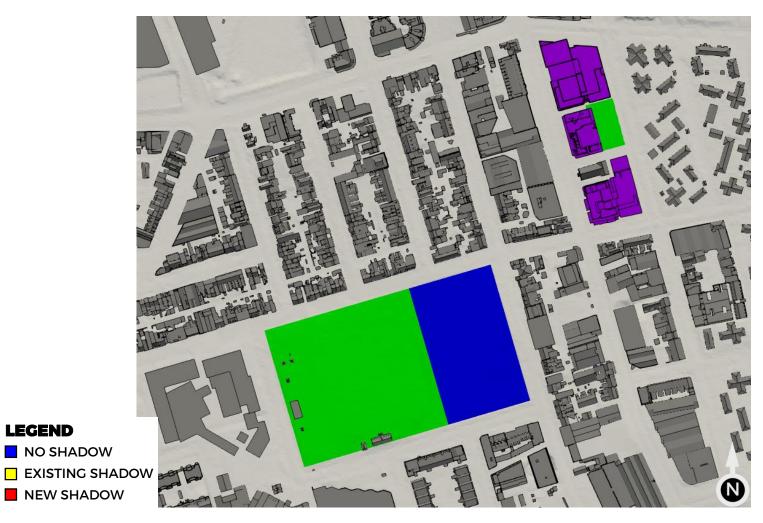


#### 21 June - 11:30 AEST





#### 21 June - 11:45 AEST





#### 21 June - 12:00 AEST



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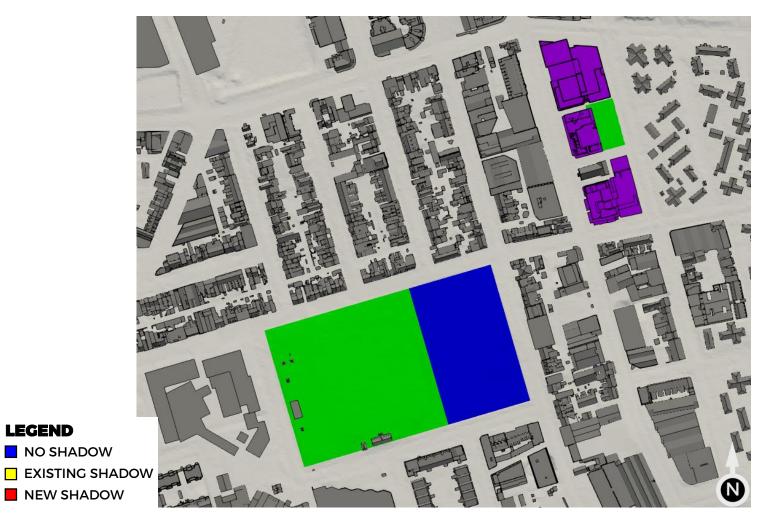


#### 21 June - 12:15 AEST





#### 21 June - 12:30 AEST



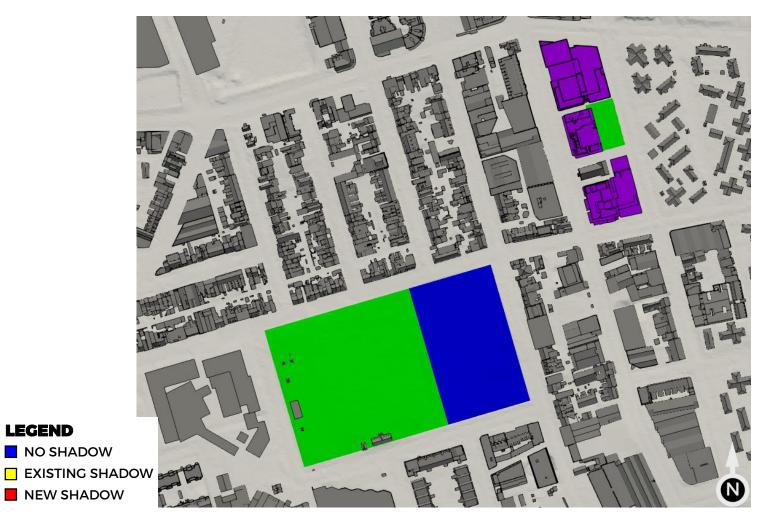


#### 21 June - 12:45 AEST



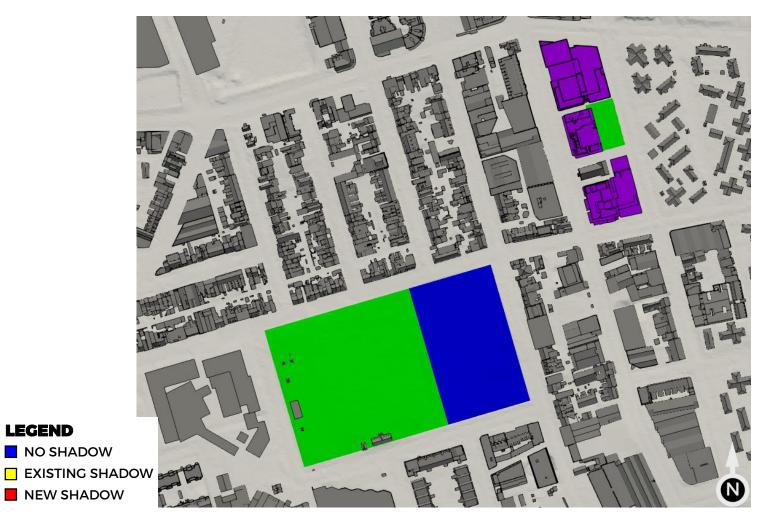


#### 21 June - 13:00 AEST



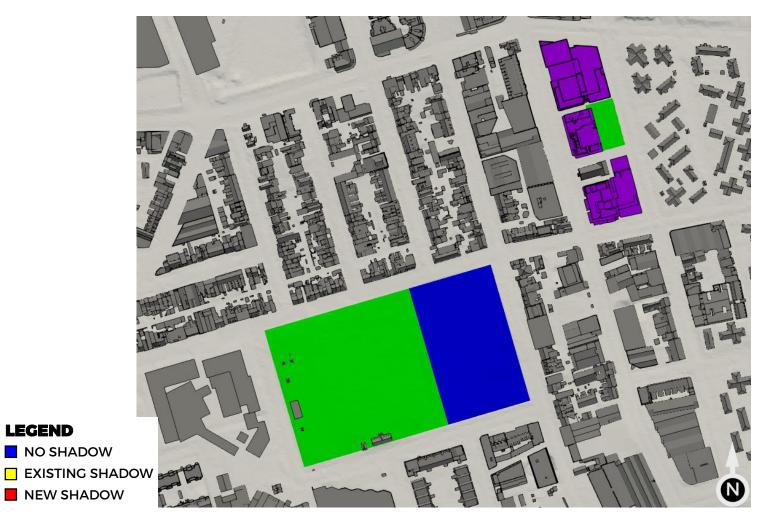


#### 21 June - 13:15 AEST



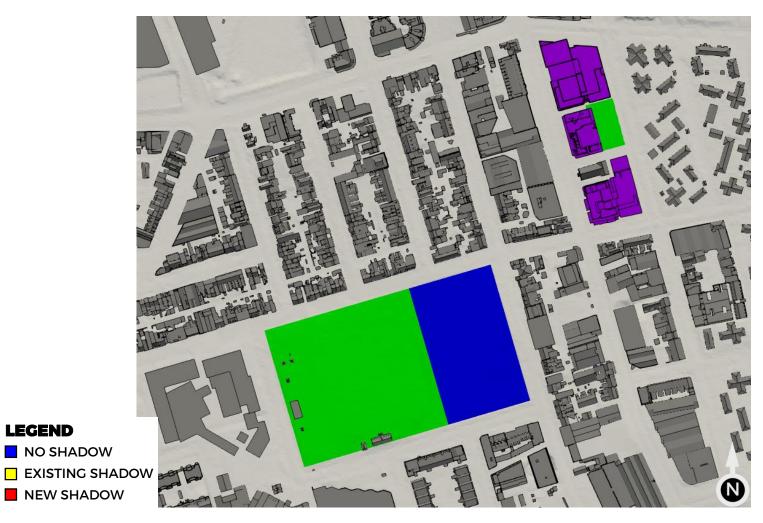


#### 21 June - 13:30 AEST





#### 21 June - 13:45 AEST



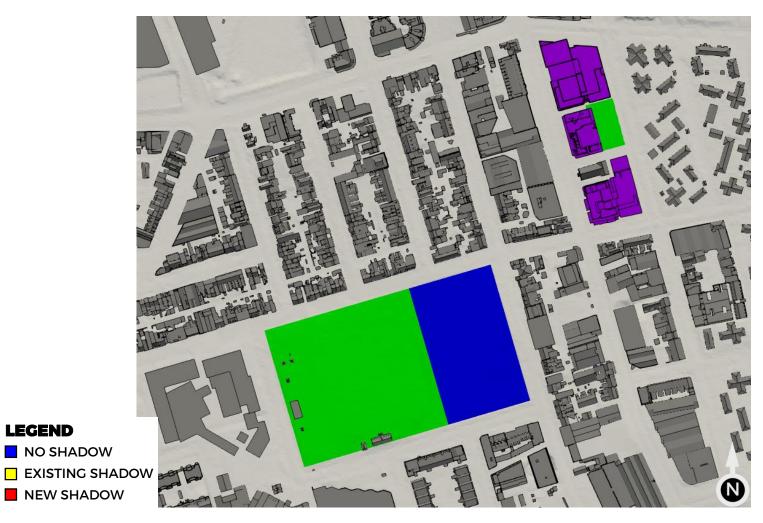


#### 21 June - 14:00 AEST



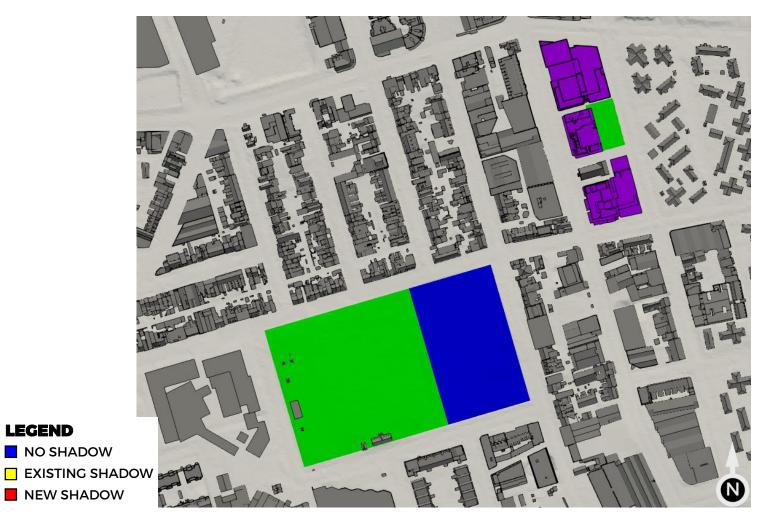


#### 21 June - 14:15 AEST





#### 21 June - 14:30 AEST



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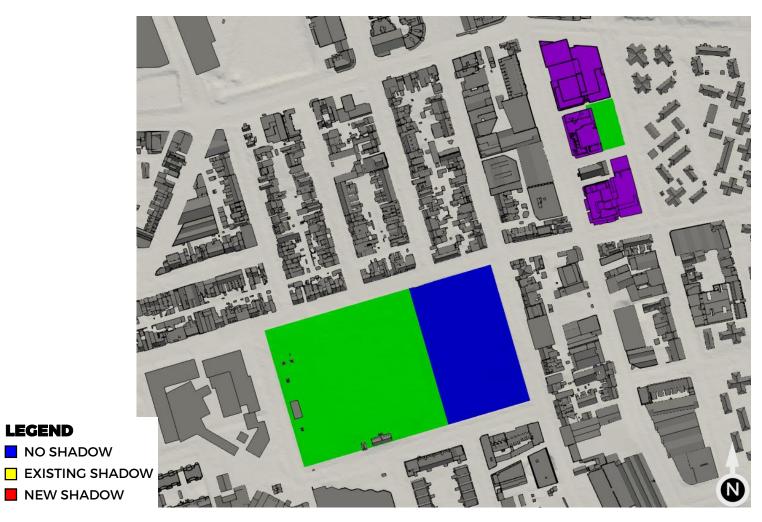


#### 21 June - 14:45 AEST





#### 21 June - 15:00 AEST





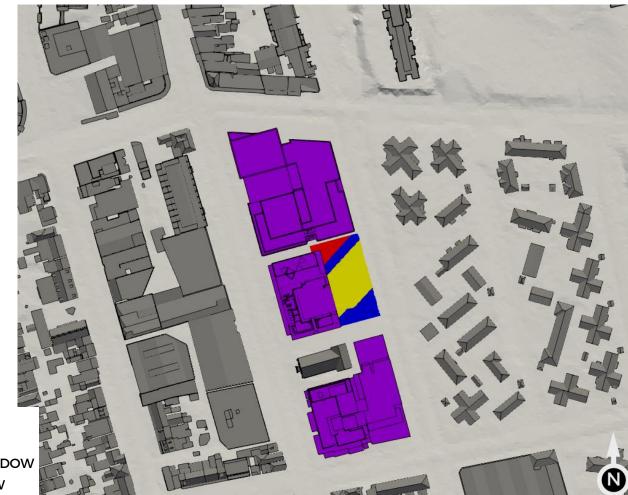


#### 11.3 Appendix 3 – Point-in-time shadow diagrams – Cope Street Plaza – 21 Jun

Page 41 of 45



#### 21 June - 9:00 AEST

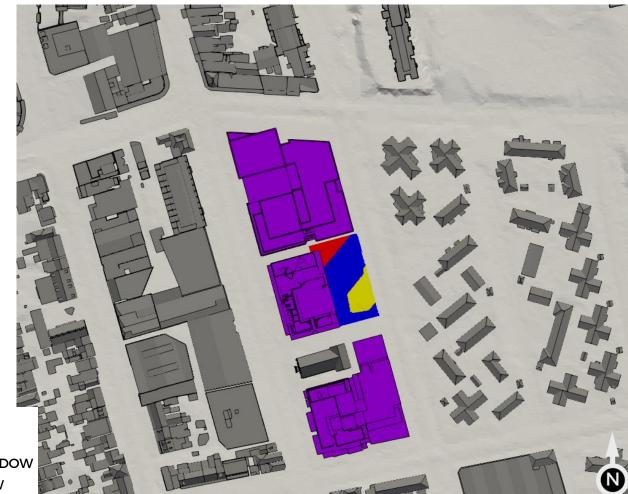


LEGEND NO SHADOW

EXISTING SHADOWNEW SHADOW



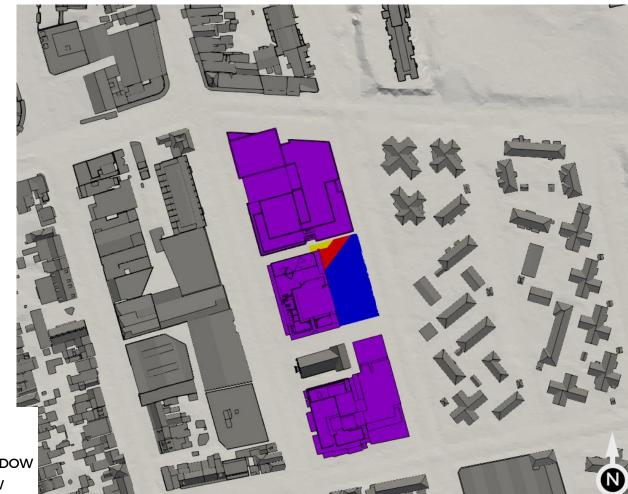
#### 21 June - 9:15 AEST



NO SHADOW
 EXISTING SHADOW
 NEW SHADOW



#### 21 June - 9:30 AEST



NO SHADOW
 EXISTING SHADOW
 NEW SHADOW



#### 21 June - 9:45 AEST



EXISTING SHADOW
NEW SHADOW

NO SHADOW



#### 21 June - 10:00 AEST



LEGEND NO SHADOW



#### 21 June - 10:15 AEST



LEGEND NO SHADOW



#### 21 June - 10:30 AEST



LEGEND NO SHADOW



#### 21 June - 10:45 AEST



LEGEND NO SHADOW



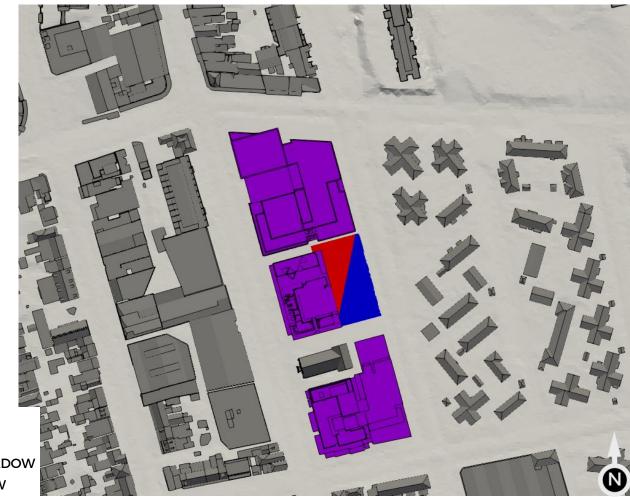
#### 21 June - 11:00 AEST



LEGEND NO SHADOW



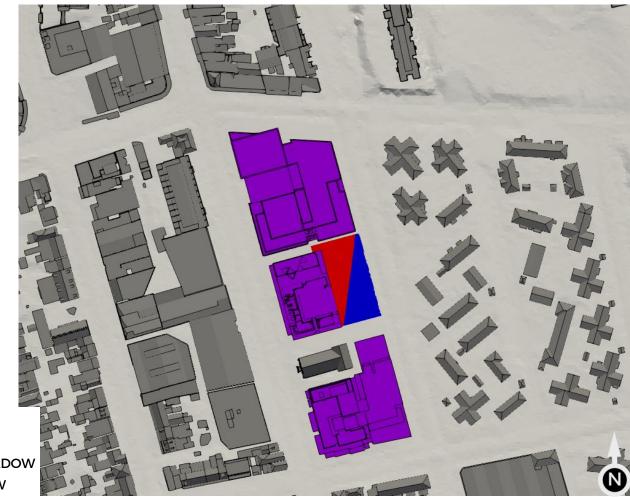
#### 21 June – 11:15 AEST



LEGEND NO SHADOW



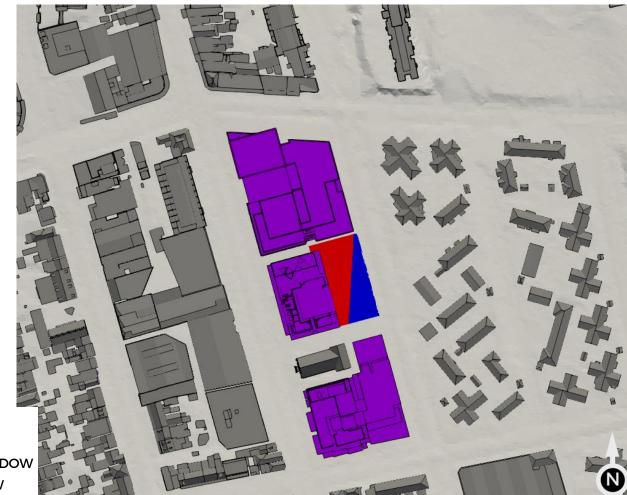
#### 21 June – 11:30 AEST



LEGEND NO SHADOW



#### 21 June - 11:45 AEST



LEGEND NO SHADOW



#### 21 June – 12:00 AEST

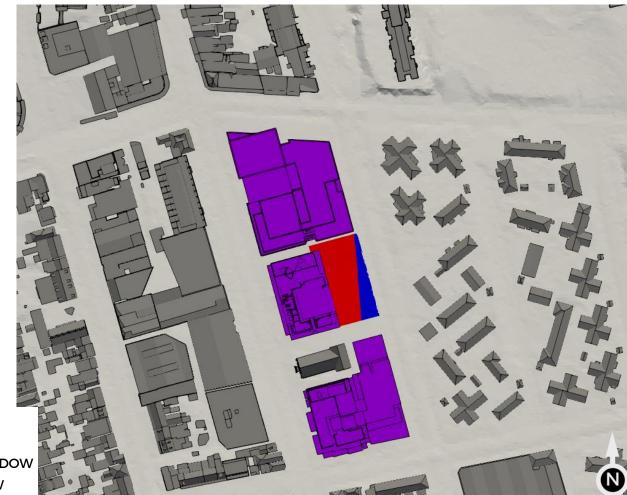


© Waterloo Developer Pty Ltd 2020

LEGEND



#### 21 June - 12:15 AEST



LEGEND NO SHADOW



#### 21 June – 12:30 AEST

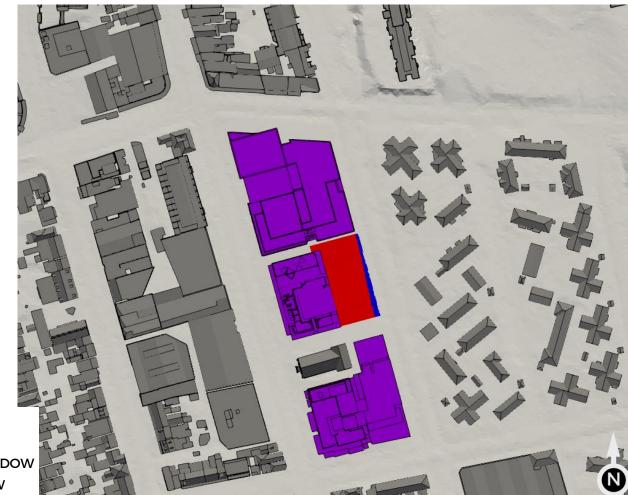


© Waterloo Developer Pty Ltd 2020

LEGEND



#### 21 June - 12:45 AEST



LEGEND NO SHADOW



#### 21 June – 13:00 AEST

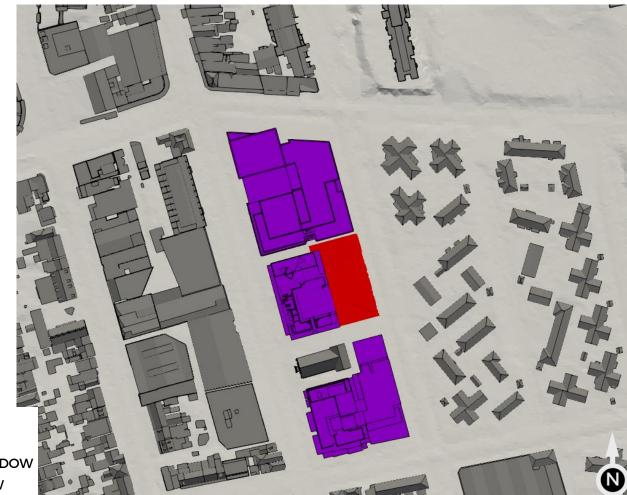


© Waterloo Developer Pty Ltd 2020

LEGEND



#### 21 June - 13:15 AEST



LEGEND NO SHADOW



#### 21 June – 13:30 AEST

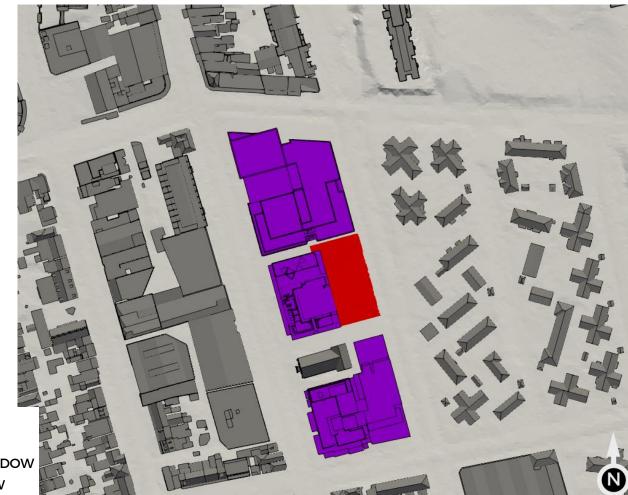


© Waterloo Developer Pty Ltd 2020

LEGEND



#### 21 June - 13:45 AEST



LEGEND NO SHADOW



#### 21 June – 14:00 AEST



LEGEND NO SHADOW

NEW SHADOW



#### 21 June – 14:15 AEST



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LEGEND



#### 21 June – 14:30 AEST

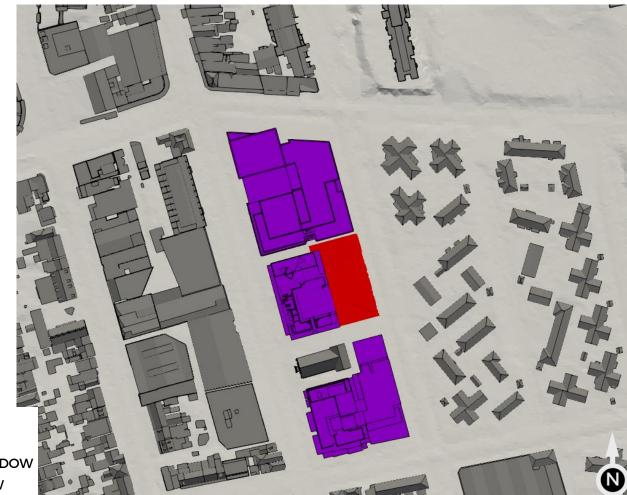


© Waterloo Developer Pty Ltd 2020

LEGEND



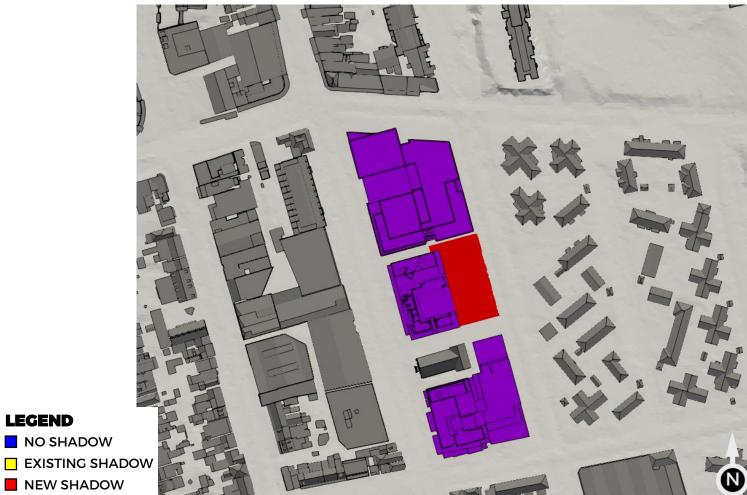
#### 21 June - 14:45 AEST



LEGEND NO SHADOW



#### 21 June - 15:00 AEST



LEGEND NO SHADOW

NEW SHADOW

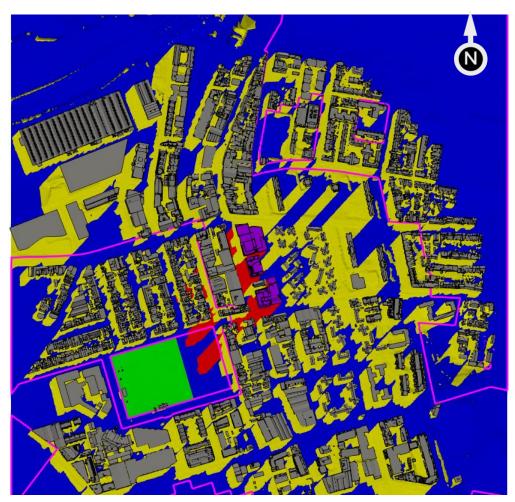




#### 11.4 Appendix 4 – Point-in-time shadow diagrams – Full domain – 21 Jun



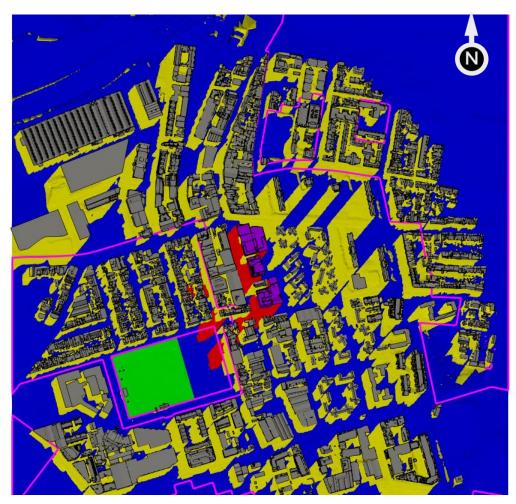
21 June – 9:00 AEST



LEGEND



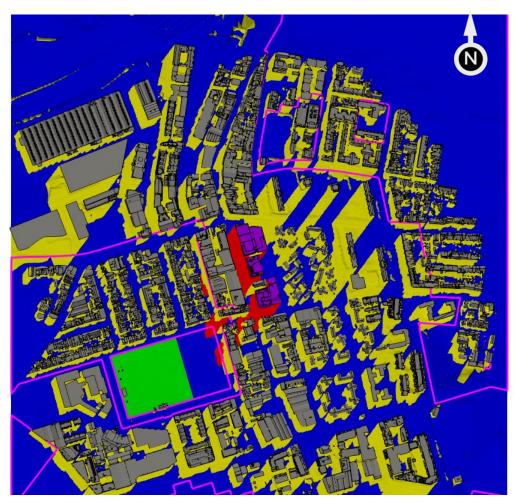
21 June – 9:15 AEST



LEGEND



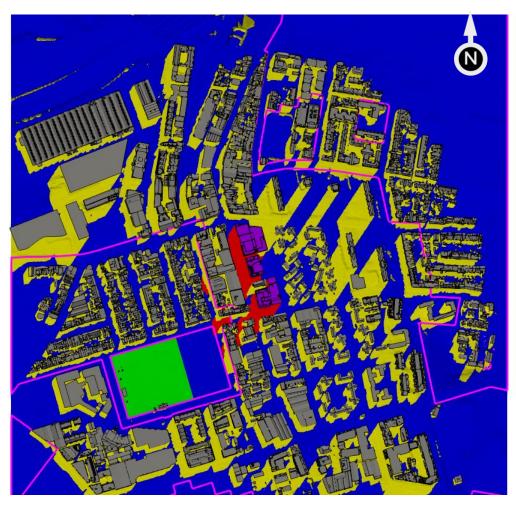
21 June – 9:30 AEST



LEGEND



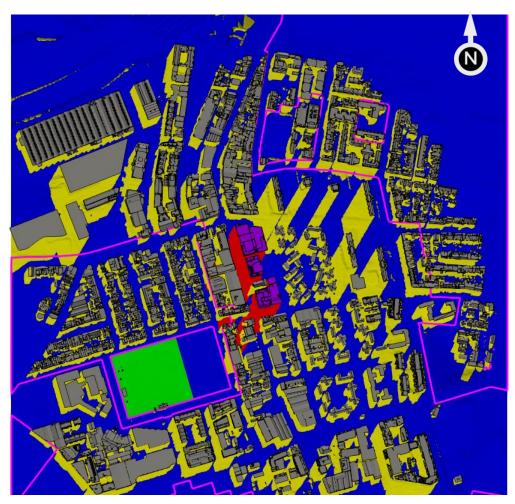
21 June – 9:45 AEST



LEGEND



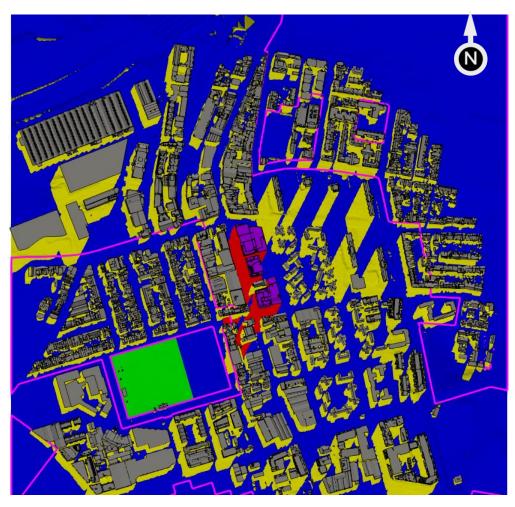
#### 21 June – 10:00 AEST



LEGEND



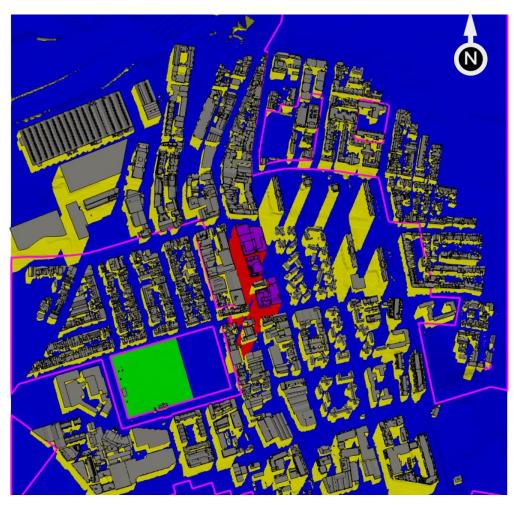
#### 21 June – 10:15 AEST



#### LEGEND



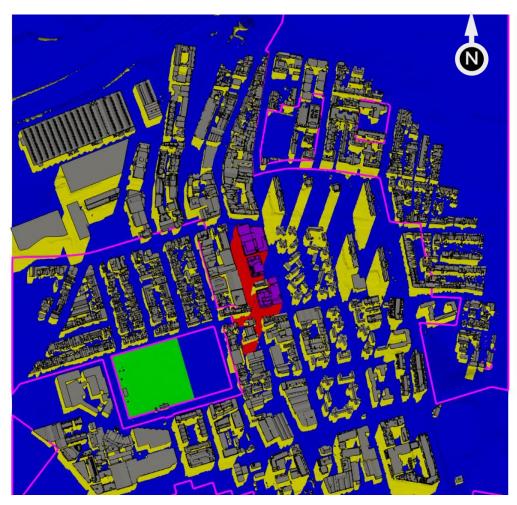
#### 21 June – 10:30 AEST







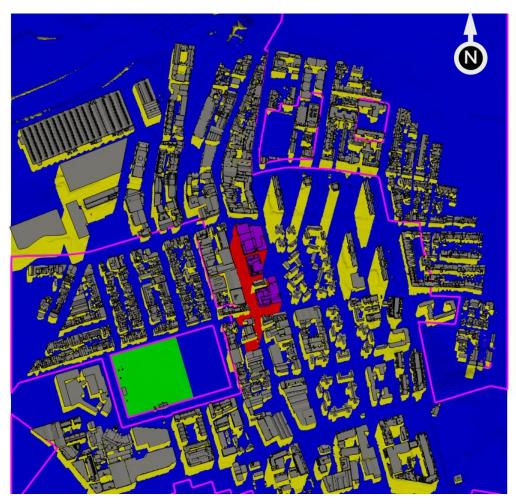
21 June – 10:45 AEST



LEGEND



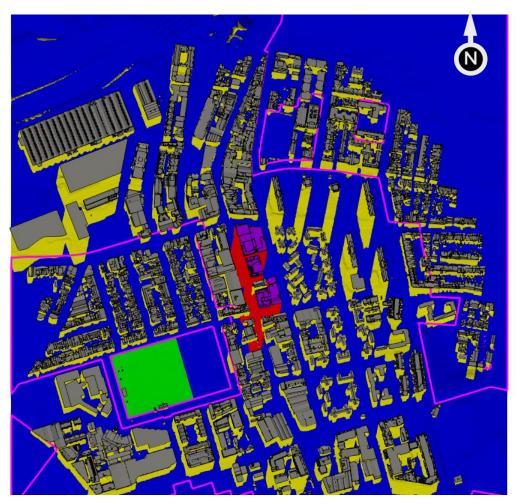
21 June – 11:00 AEST



LEGEND



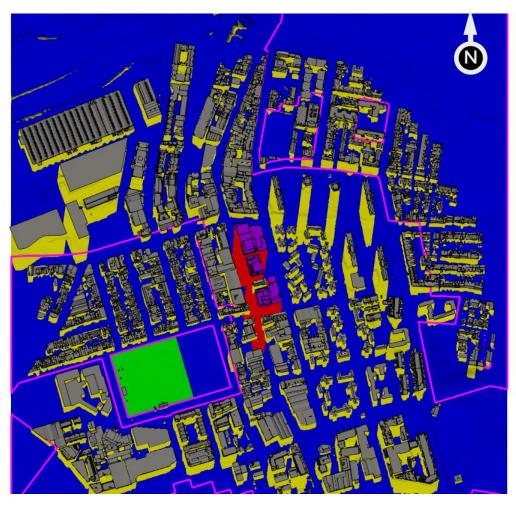
21 June – 11:15 AEST



LEGEND



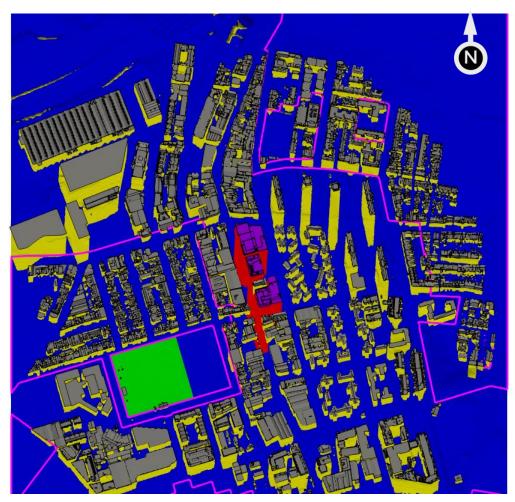
21 June – 11:30 AEST



LEGEND



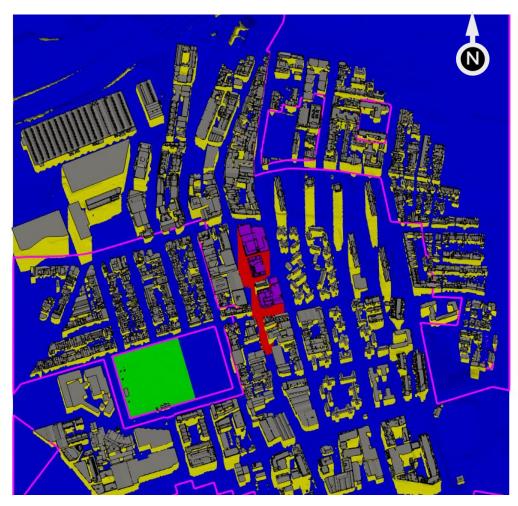
21 June – 11:45 AEST



LEGEND



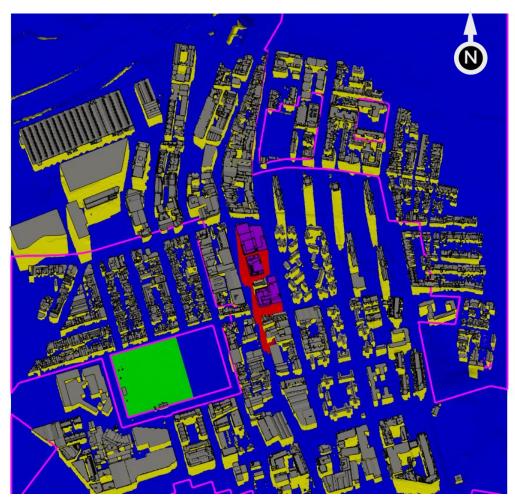
#### 21 June – 12:00 AEST



LEGEND



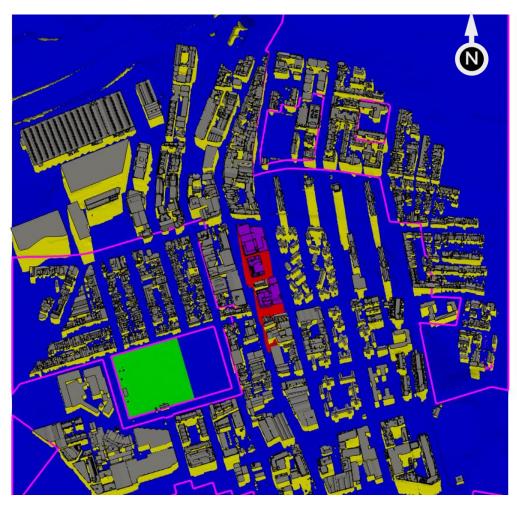
21 June – 12:15 AEST



LEGEND



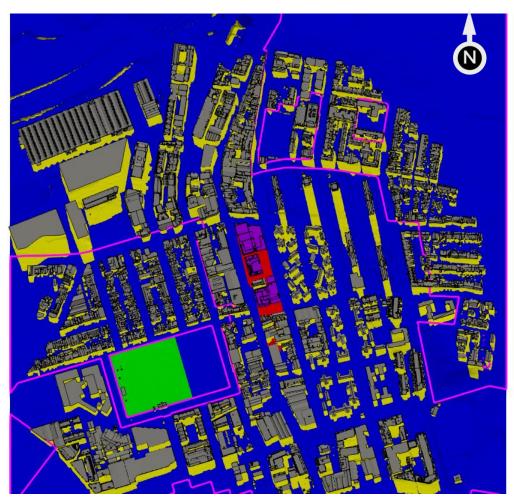
### 21 June – 12:30 AEST



LEGEND



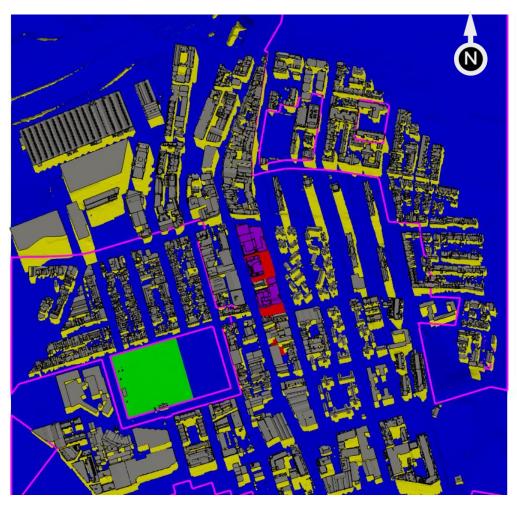
21 June – 12:45 AEST



LEGEND



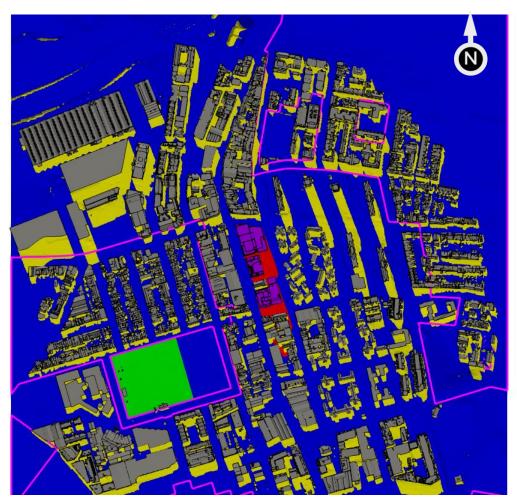
21 June – 1:00 AEST



LEGEND



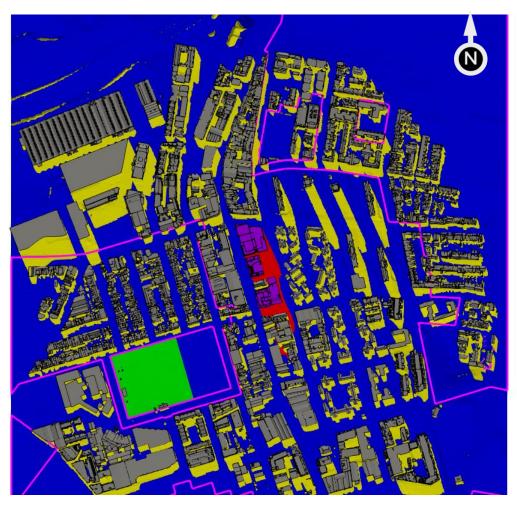
21 June – 1:15 AEST



LEGEND



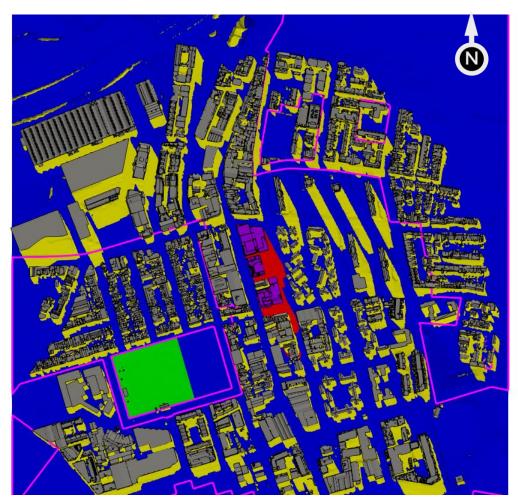
21 June – 1:30 AEST



LEGEND



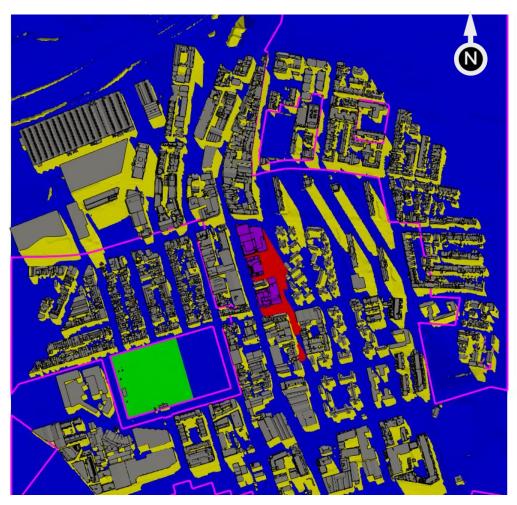
21 June – 1:45 AEST



LEGEND



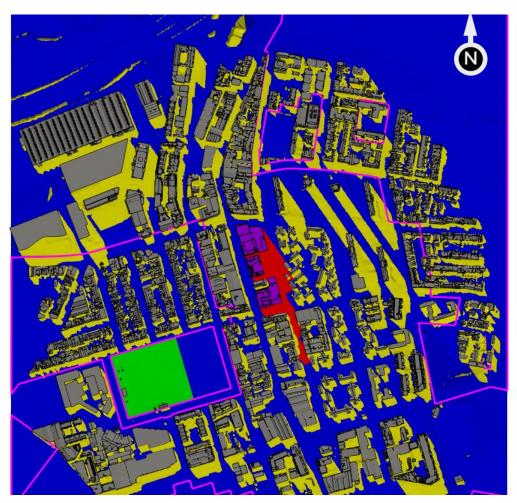
21 June – 2:00 AEST



LEGEND



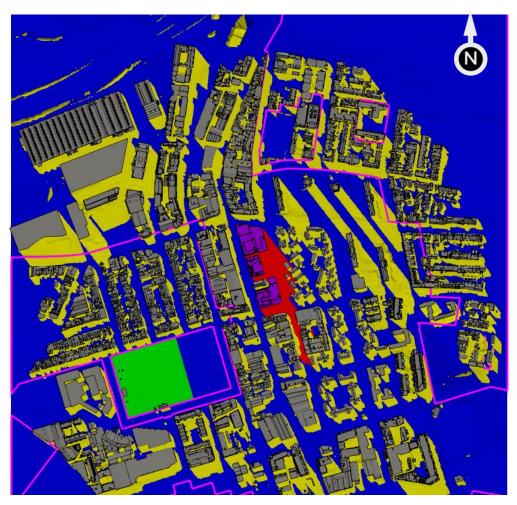
21 June – 2:15 AEST



LEGEND



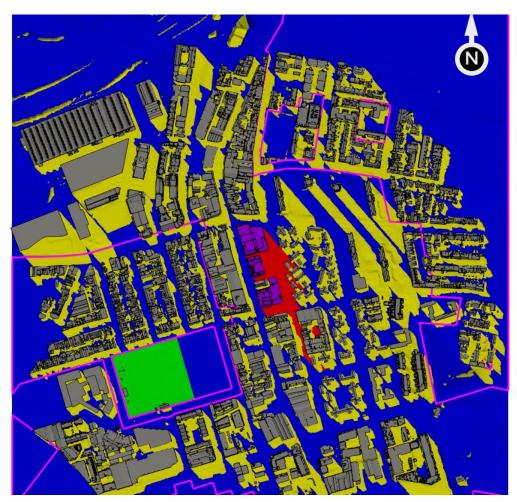
21 June – 2:30 AEST



LEGEND



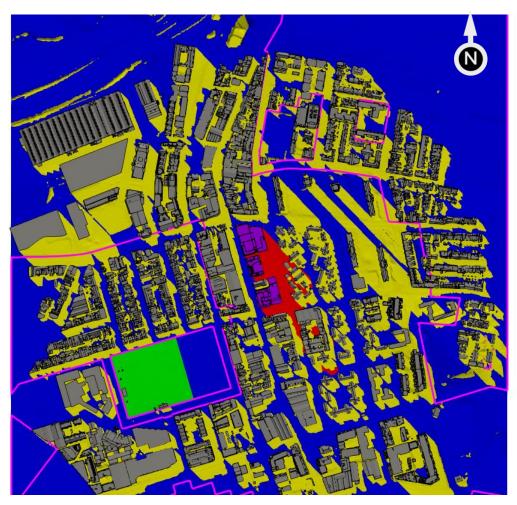
21 June – 2:45 AEST



LEGEND



21 June – 3:00 AEST



LEGEND

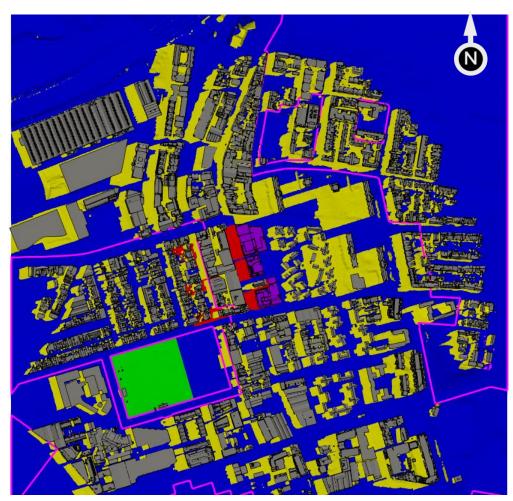




### 11.5 Appendix 5 – Point-in-time shadow diagrams – Full Domain – 21 Mar



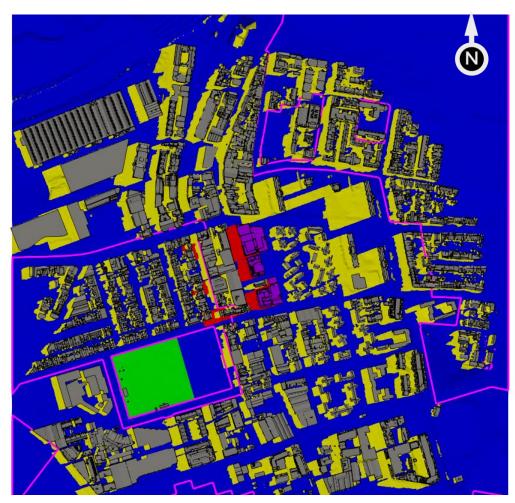
### 21 March - 9:00 AEDT



#### LEGEND



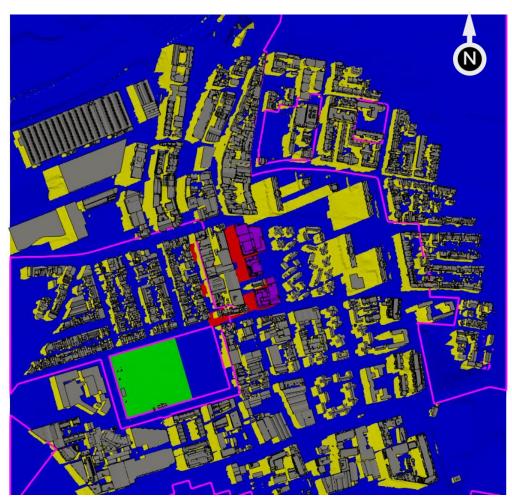
### 21 March - 9:15 AEDT



LEGEND



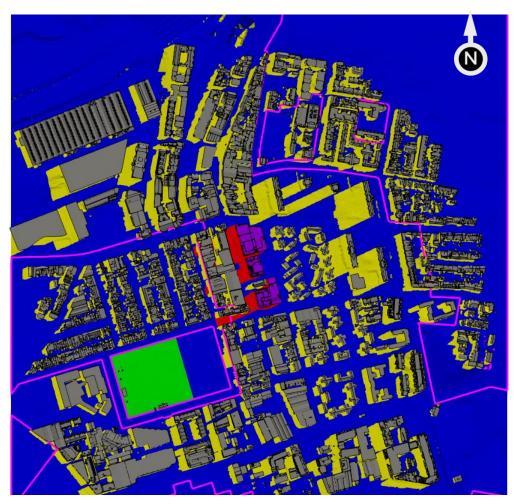
### 21 March - 9:30 AEDT







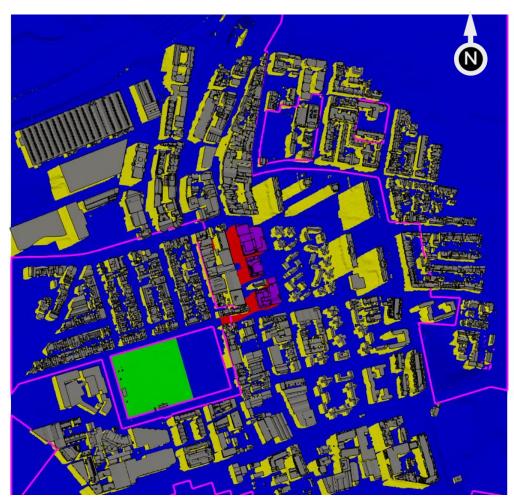
### 21 March - 9:45 AEDT



#### LEGEND



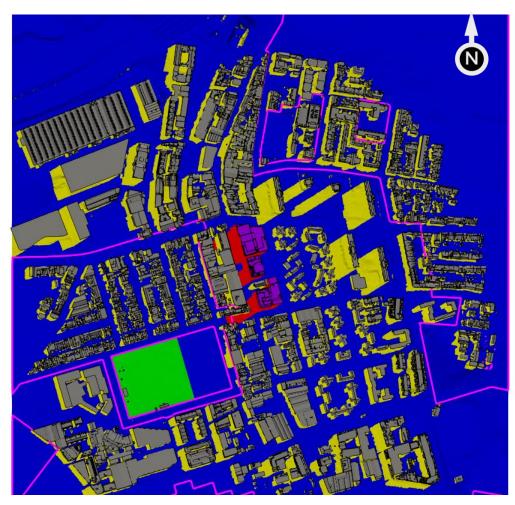
### 21 March - 10:00 AEDT



LEGEND



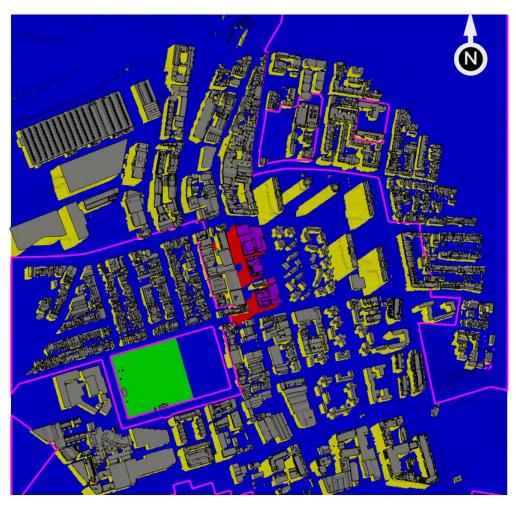
### 21 March - 10:15 AEDT







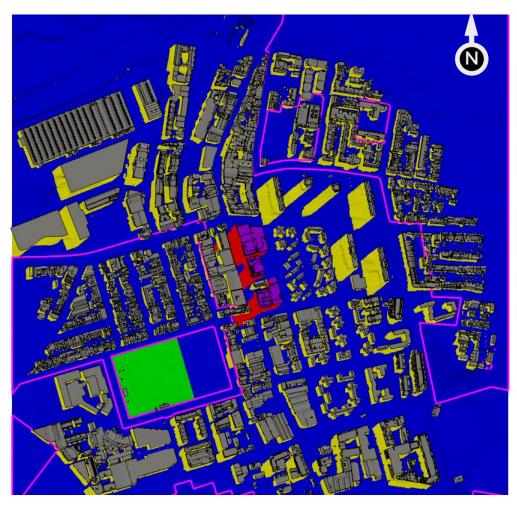
### 21 March - 10:30 AEDT



LEGEND



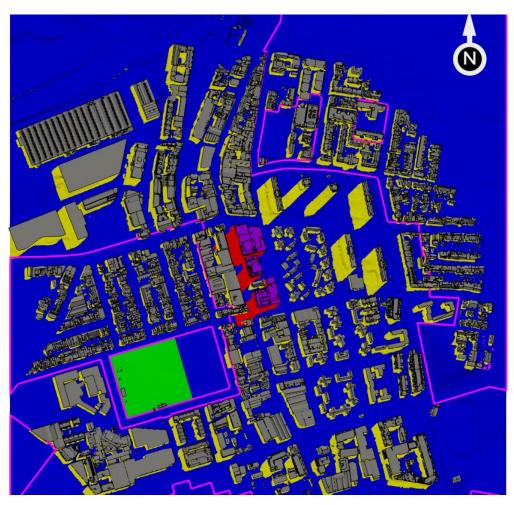
### 21 March - 10:45 AEDT







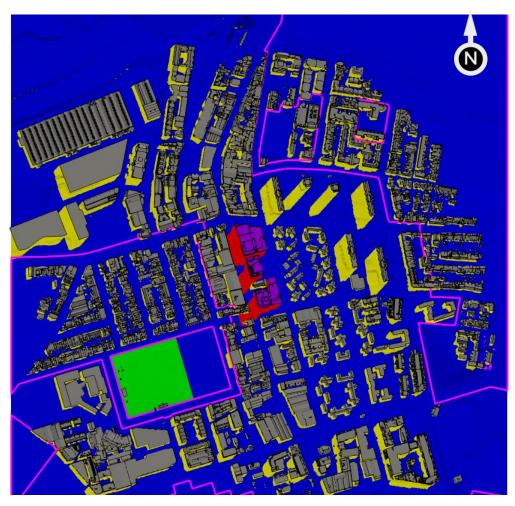
### 21 March – 11:00 AEDT



LEGEND



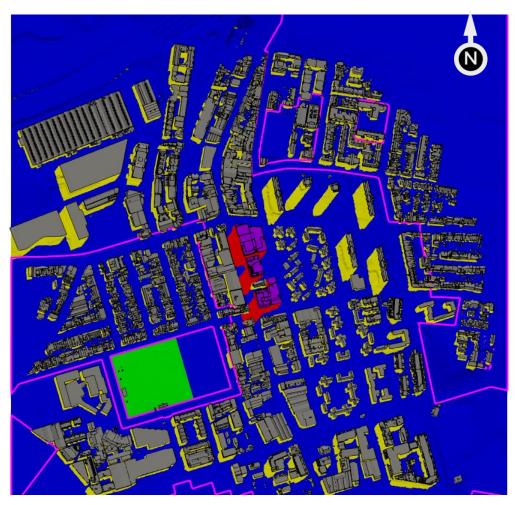
### 21 March – 11:15 AEDT



LEGEND



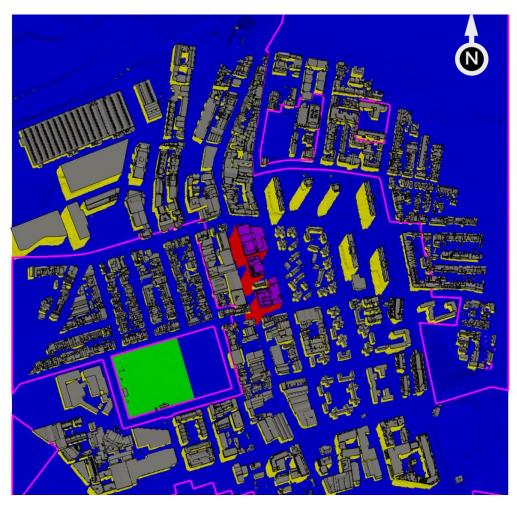
### 21 March – 11:30 AEDT



LEGEND



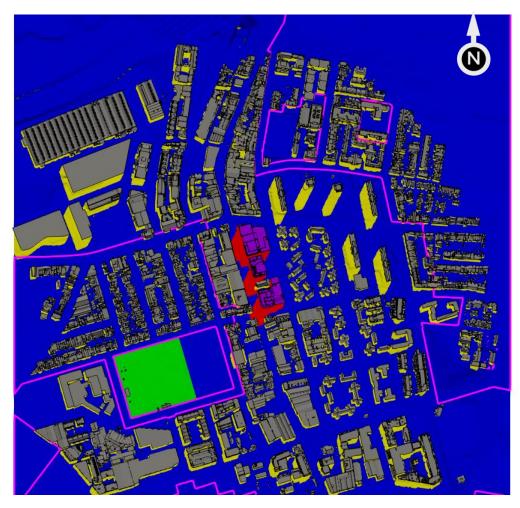
#### 21 March – 11:45 AEDT







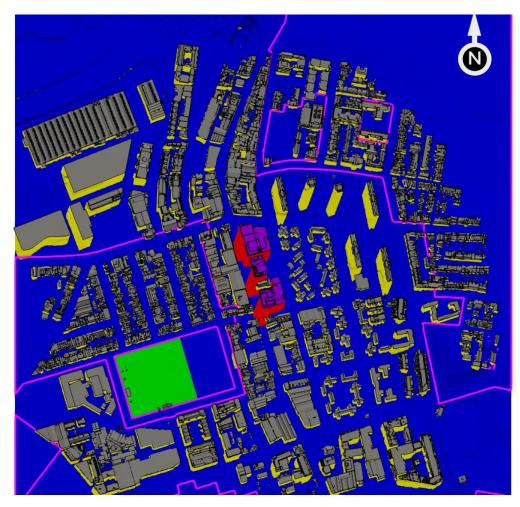
### 21 March – 12:00 AEDT



LEGEND



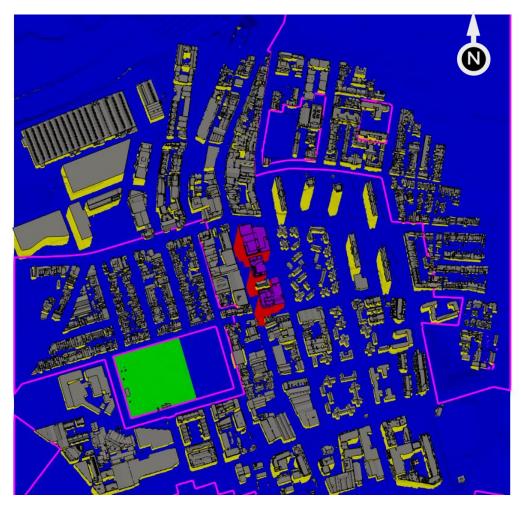
### 21 March – 12:15 AEDT







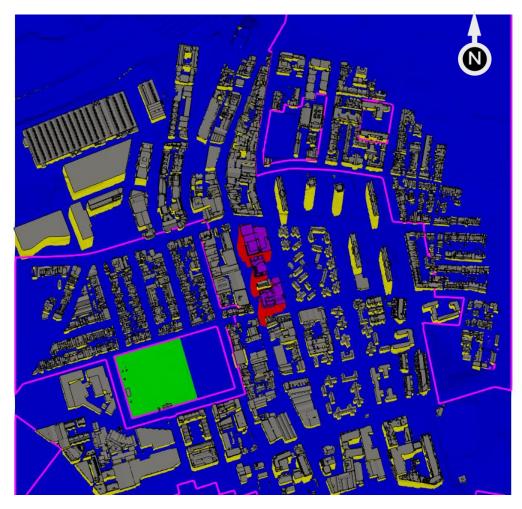
### 21 March – 12:30 AEDT



LEGEND



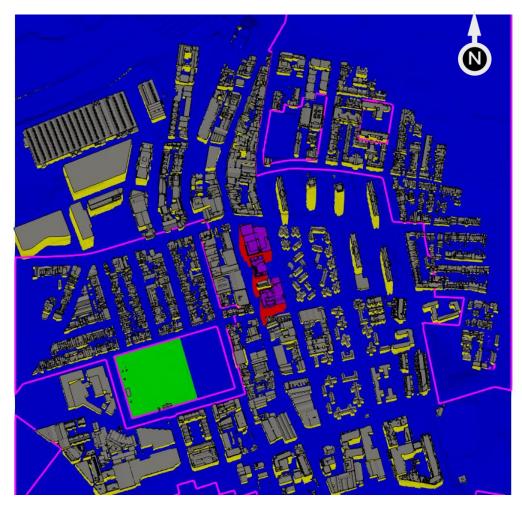
### 21 March – 12:45 AEDT



LEGEND



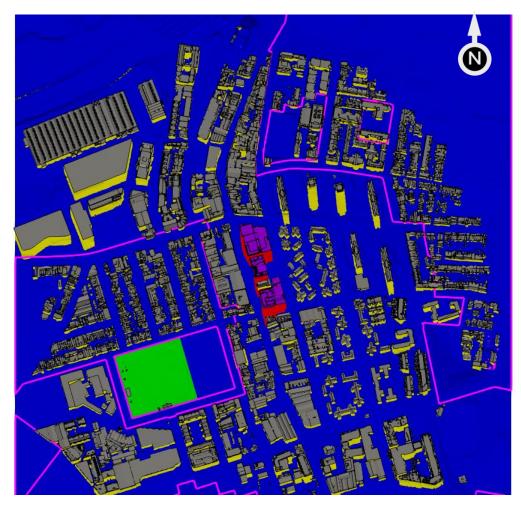
### 21 March – 1:00 AEDT



#### LEGEND



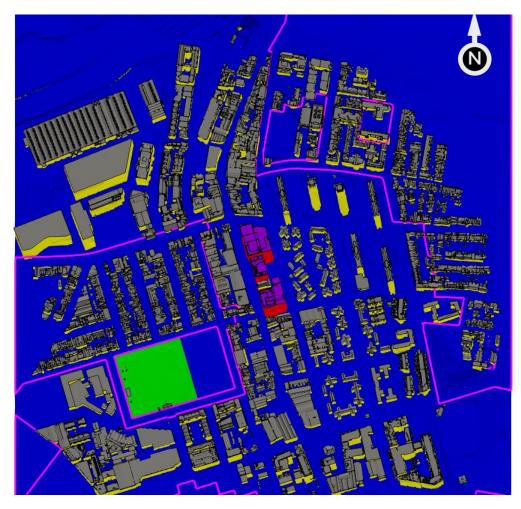
### 21 March – 1:15 AEDT



#### LEGEND



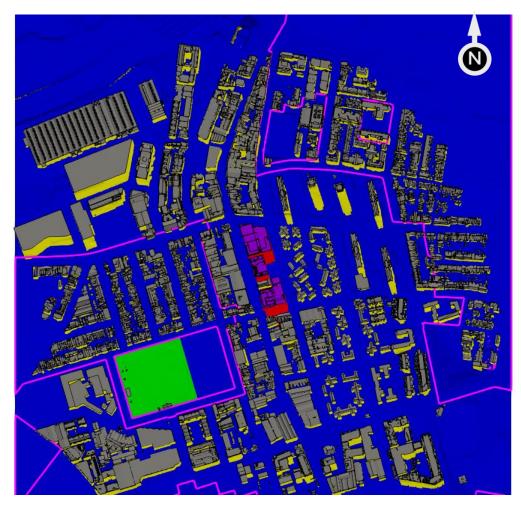
### 21 March – 1:30 AEDT



LEGEND



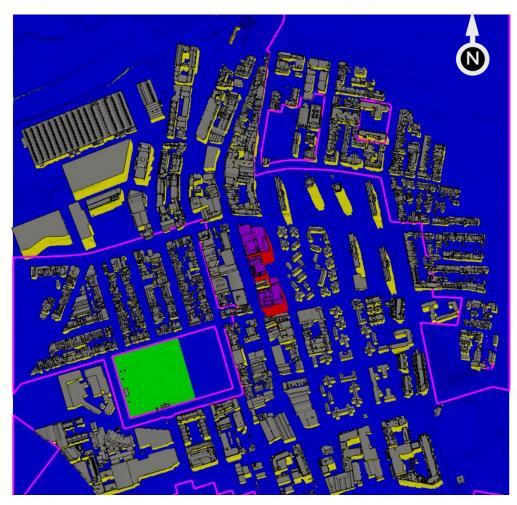
### 21 March – 1:45 AEDT



LEGEND



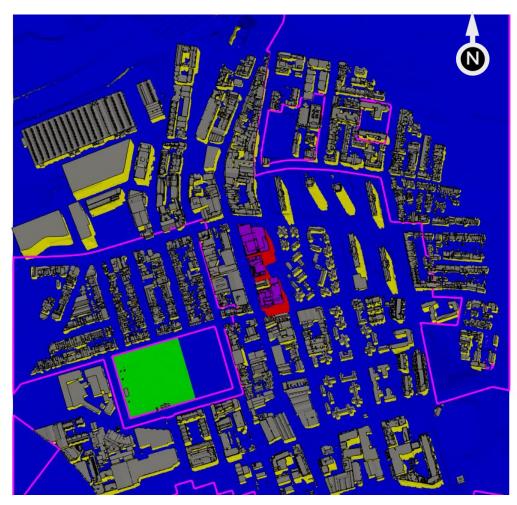
### 21 March – 2:00 AEDT



#### LEGEND



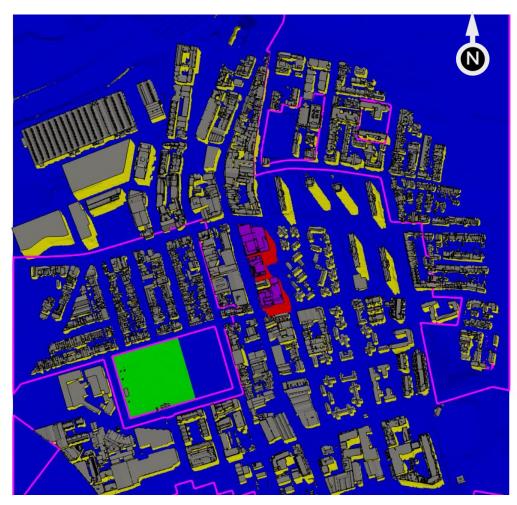
### 21 March – 2:15 AEDT







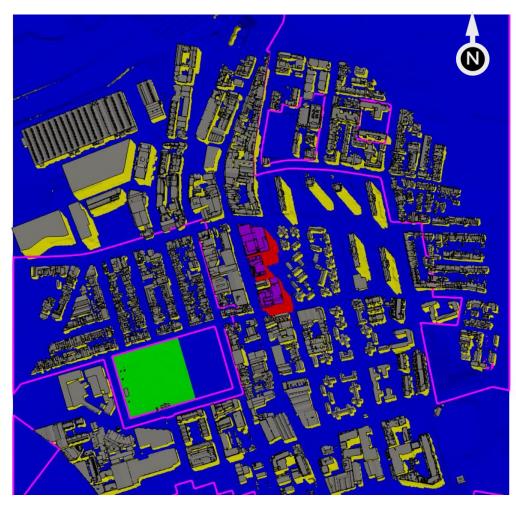
### 21 March – 2:30 AEDT







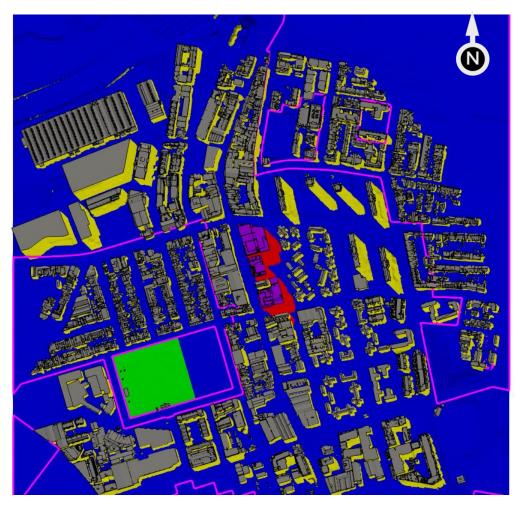
### 21 March – 2:45 AEDT



#### LEGEND



### 21 March – 3:00 AEDT



LEGEND

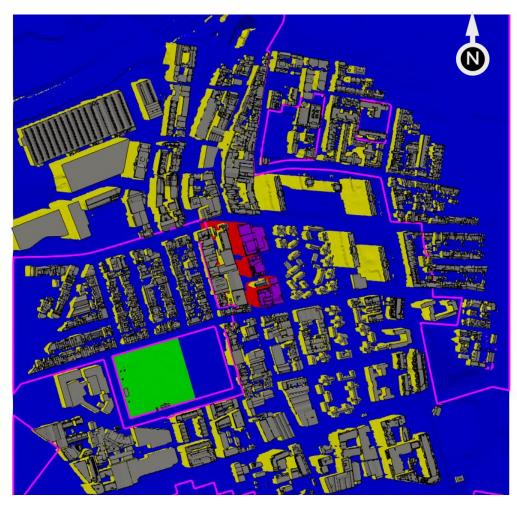




### 11.6 Appendix 6 – Point-in-time shadow diagrams – Full Domain – 21 Dec



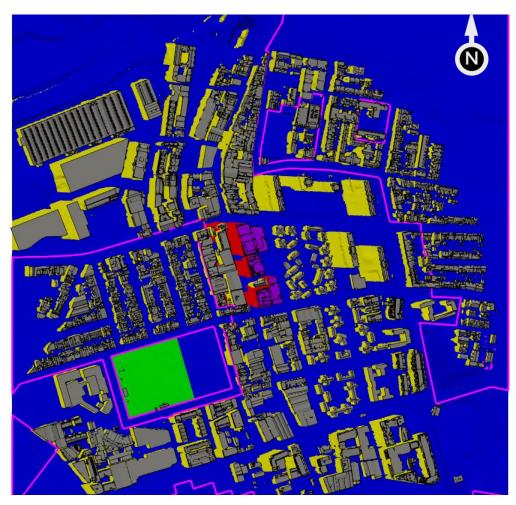
#### 21 December – 9:00 AEDT







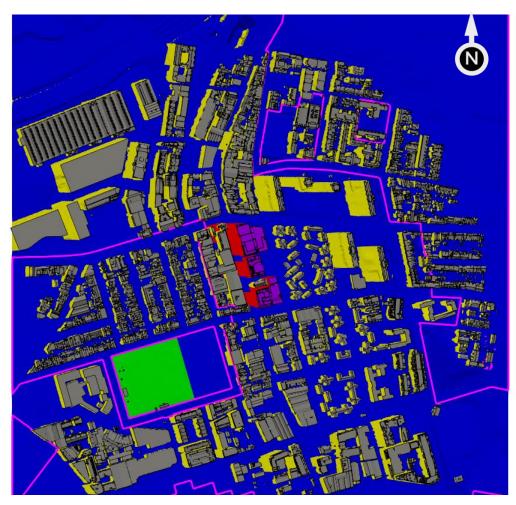
#### 21 December – 9:15 AEDT



LEGEND



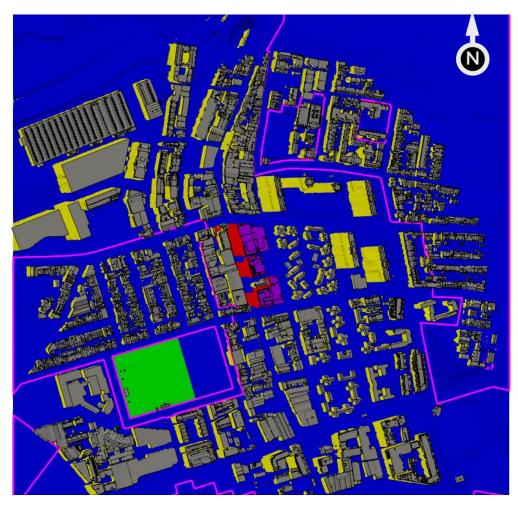
#### 21 December – 9:30 AEDT







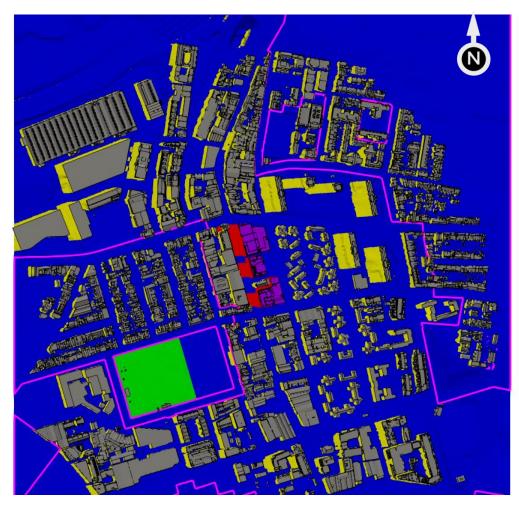
#### 21 December – 9:45 AEDT







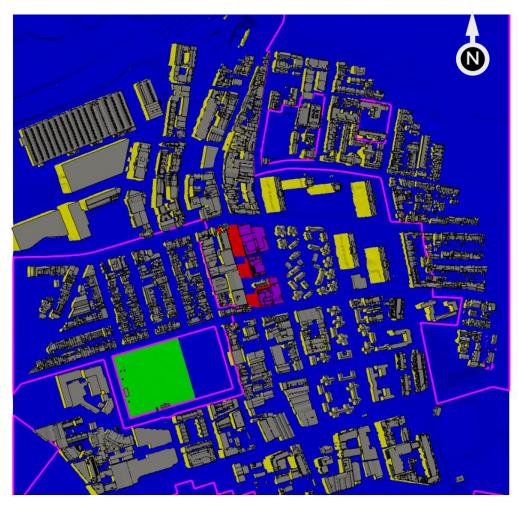
#### 21 December – 10:00 AEDT



#### LEGEND



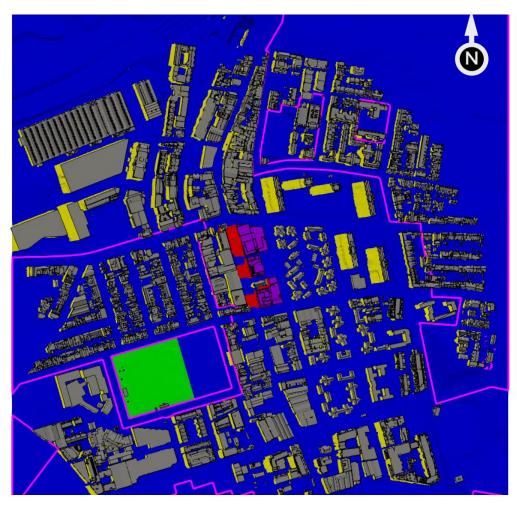
#### 21 December – 10:15 AEDT



LEGEND



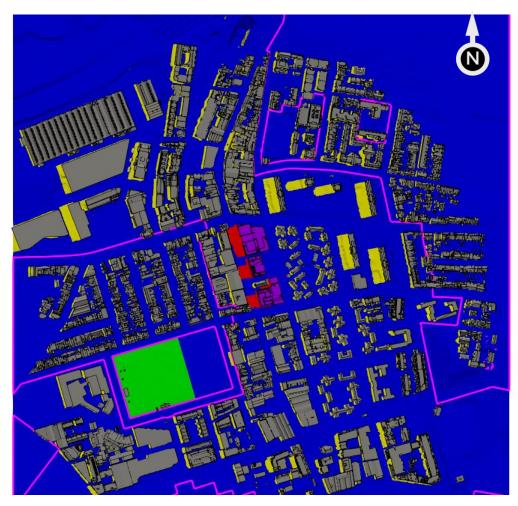
#### 21 December – 10:30 AEDT



LEGEND



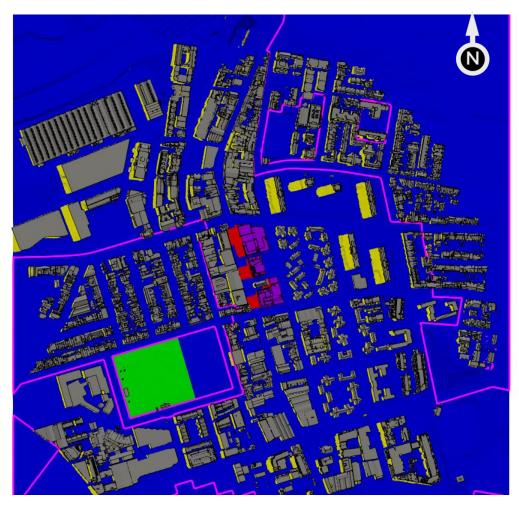
#### 21 December – 10:45 AEDT







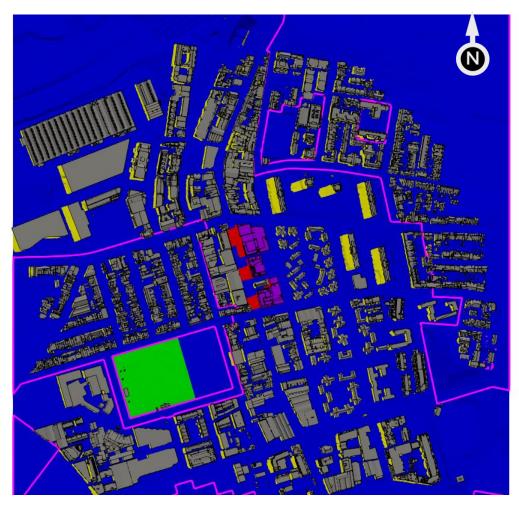
#### 21 December – 11:00 AEDT







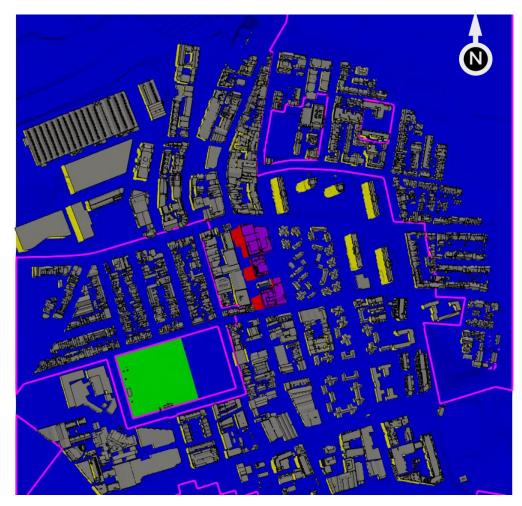
#### 21 December – 11:15 AEDT



#### LEGEND



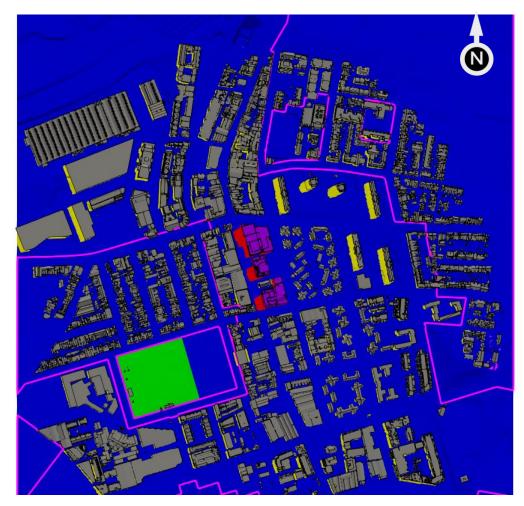
#### 21 December – 11:30 AEDT



#### LEGEND



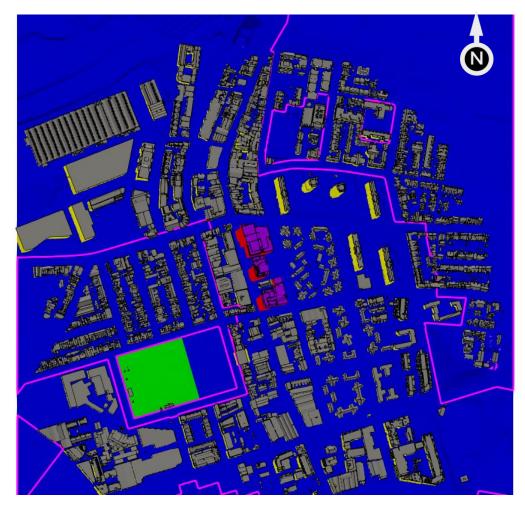
#### 21 December – 11:45 AEDT



#### LEGEND



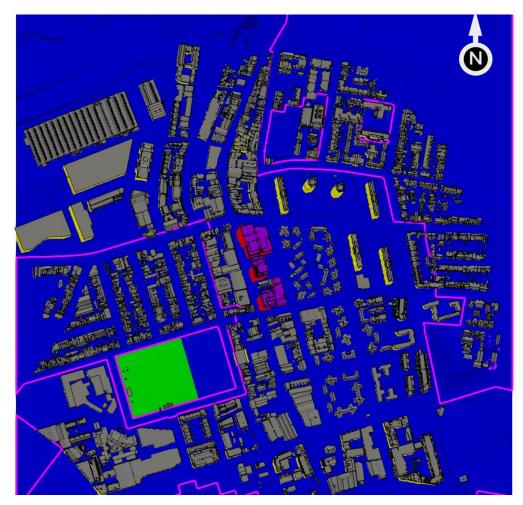
#### 21 December – 12:00 AEDT







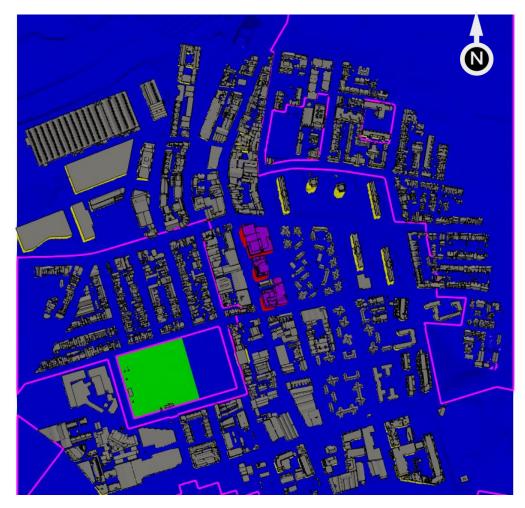
#### 21 December – 12:15 AEDT



LEGEND



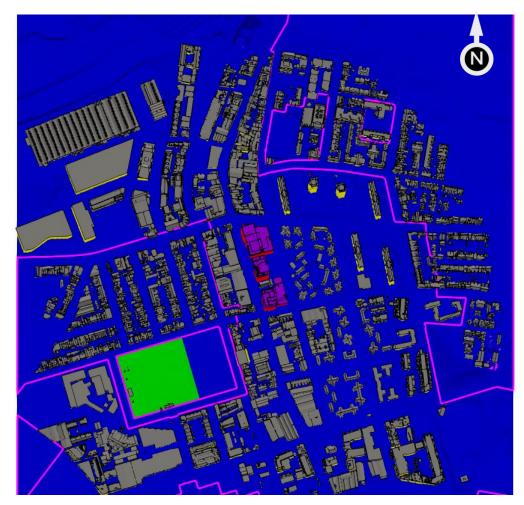
#### 21 December – 12:30 AEDT







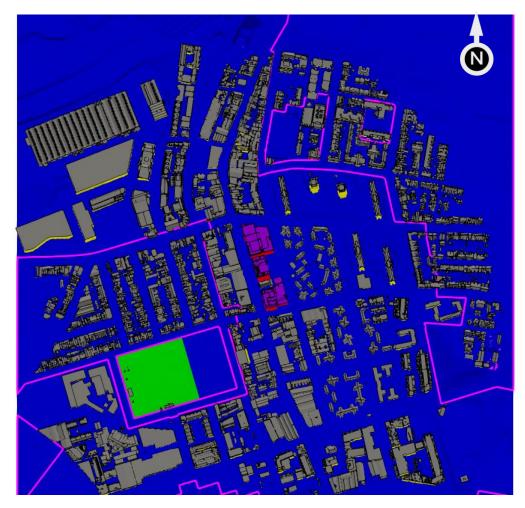
#### 21 December – 12:45 AEDT



LEGEND



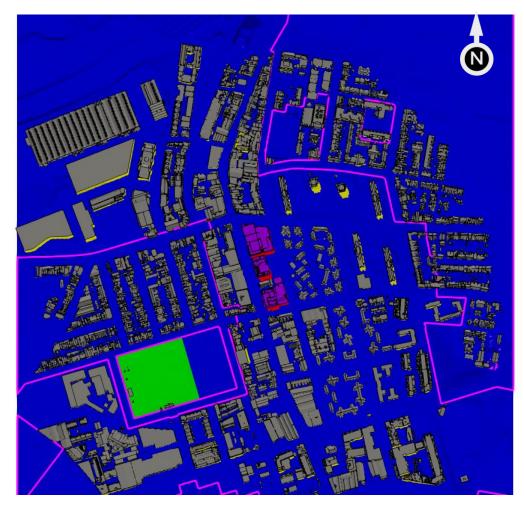
#### 21 December – 1:00 AEDT



LEGEND



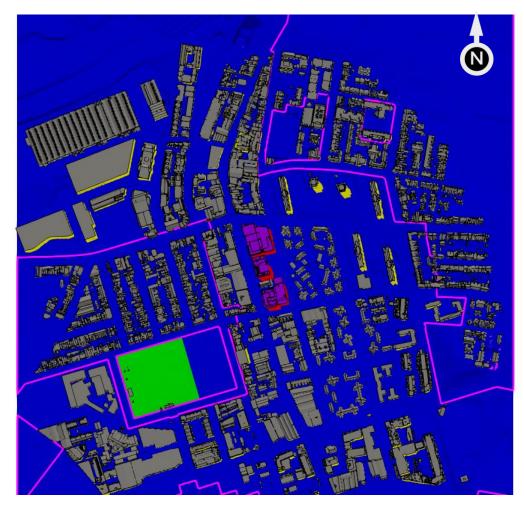
### 21 December – 1:15 AEDT



#### LEGEND



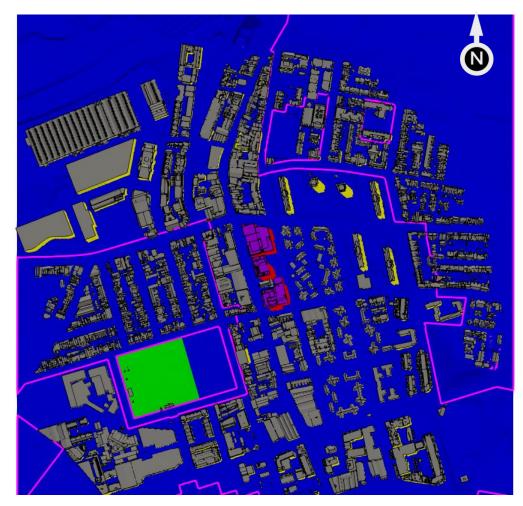
#### 21 December – 1:30 AEDT



#### LEGEND



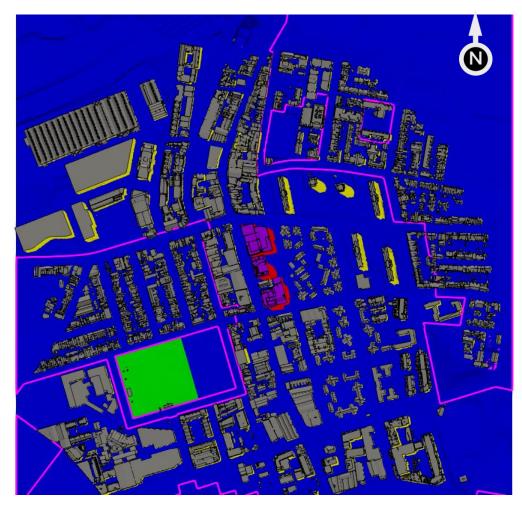
#### 21 December – 1:45 AEDT



#### LEGEND



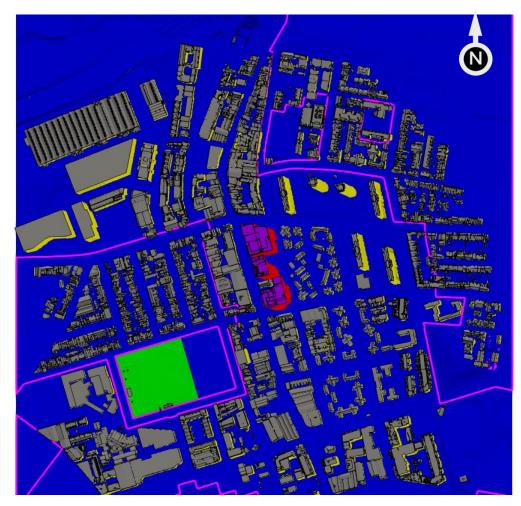
#### 21 December – 2:00 AEDT







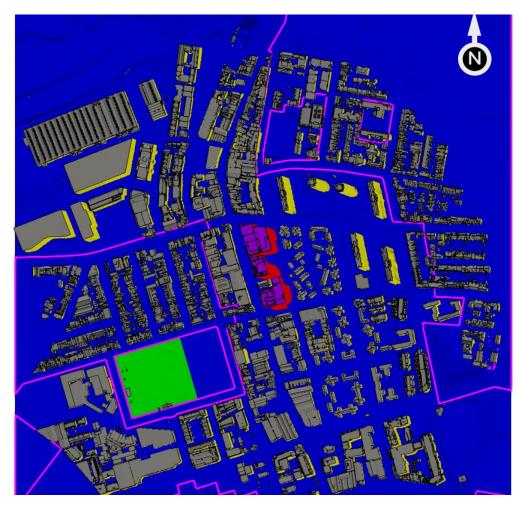
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LEGEND



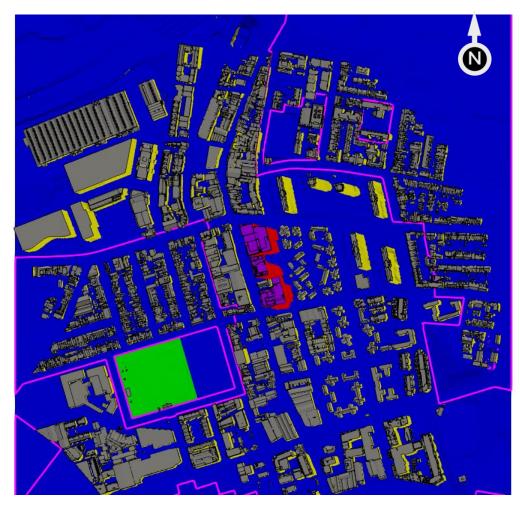
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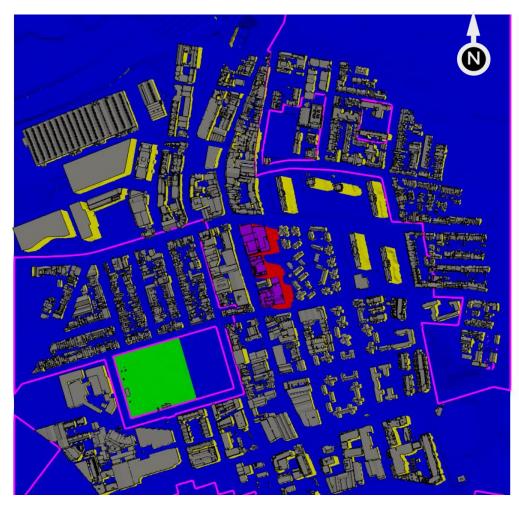
#### 21 December – 2:45 AEDT



LEGEND



#### 21 December – 3:00 AEDT



LEGEND

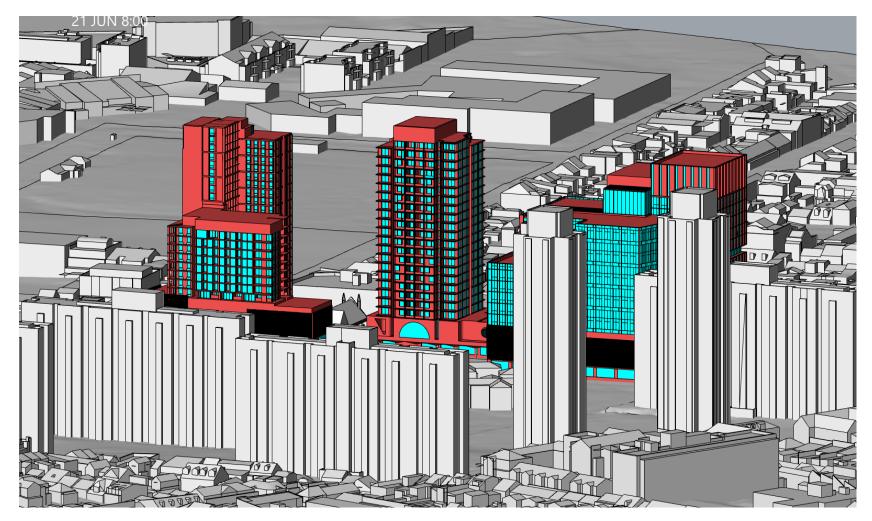




### 11.7 Appendix 7 – Sun View Diagrams – 21 Jun

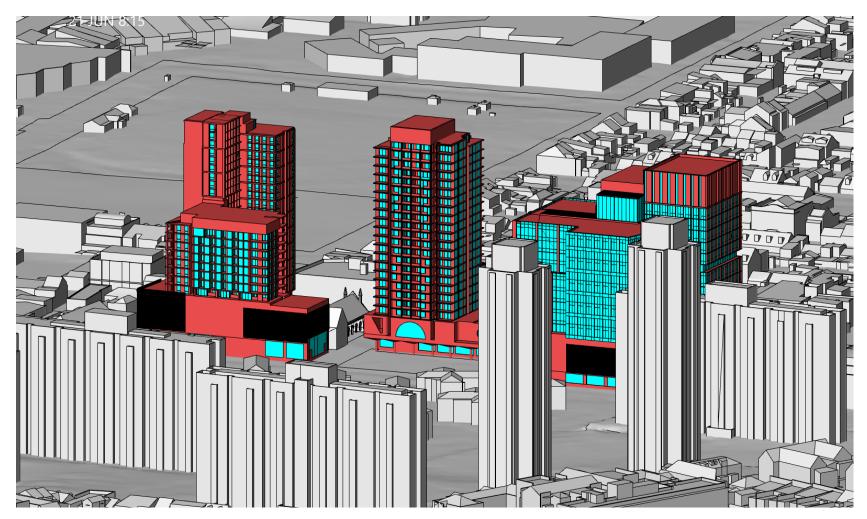


### Jun 21 - 08:00 AEST





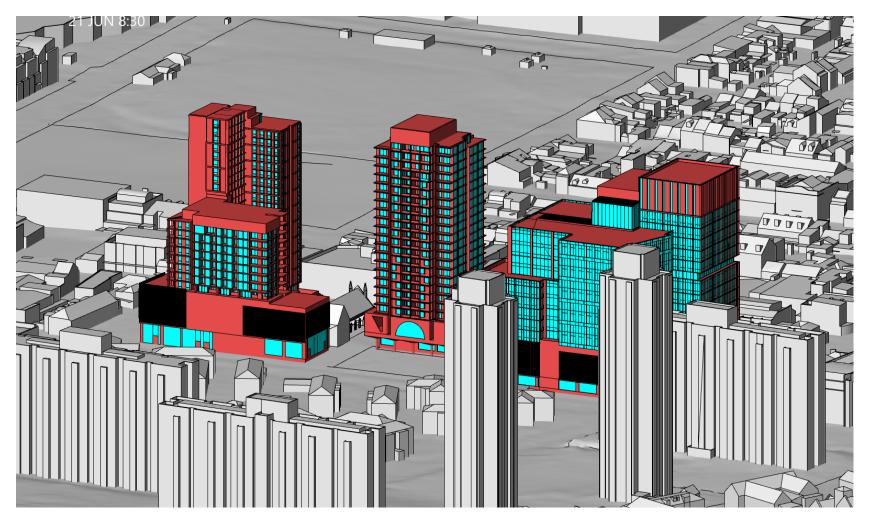
### Jun 21 - 08:15 AEST



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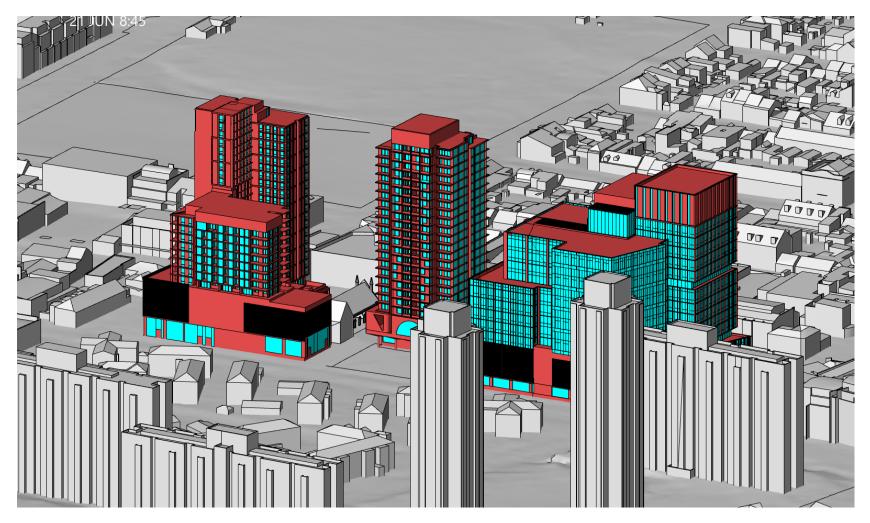


Jun 21 - 08:30 AEST



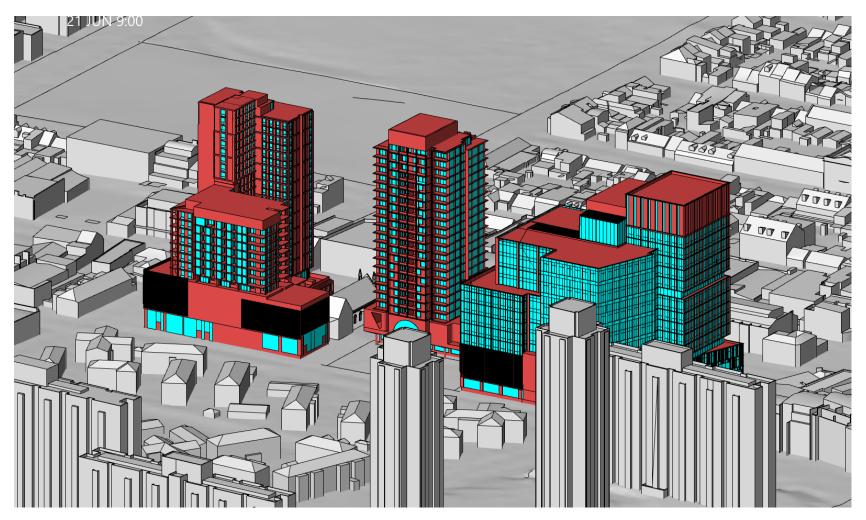


Jun 21 - 08:45 AEST





### Jun 21 - 09:00 AEST



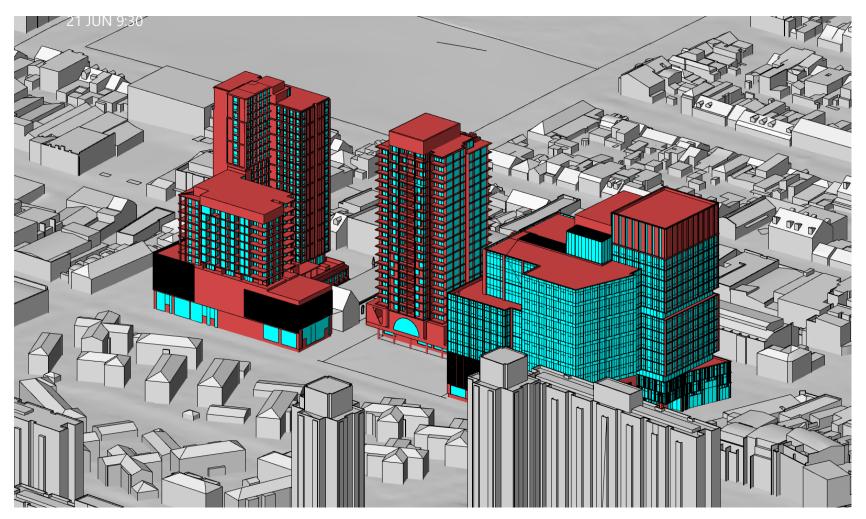


Jun 21 - 09:15 AEST



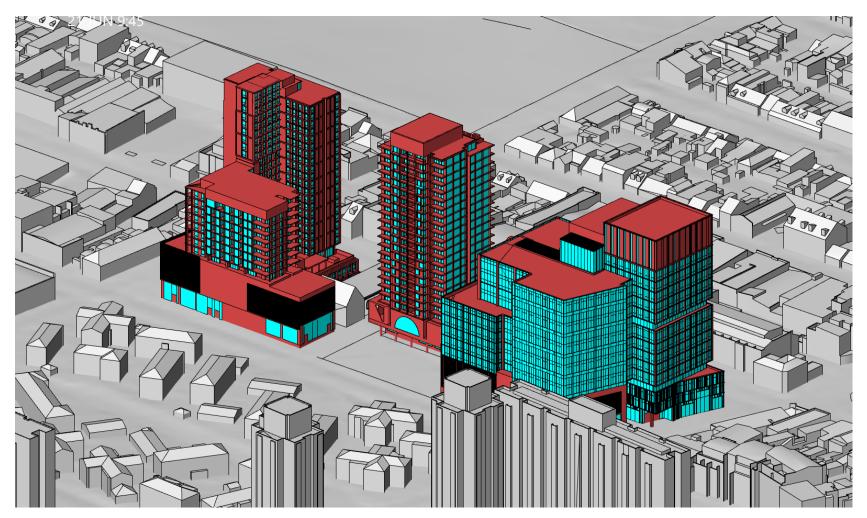


Jun 21 - 09:30 AEST



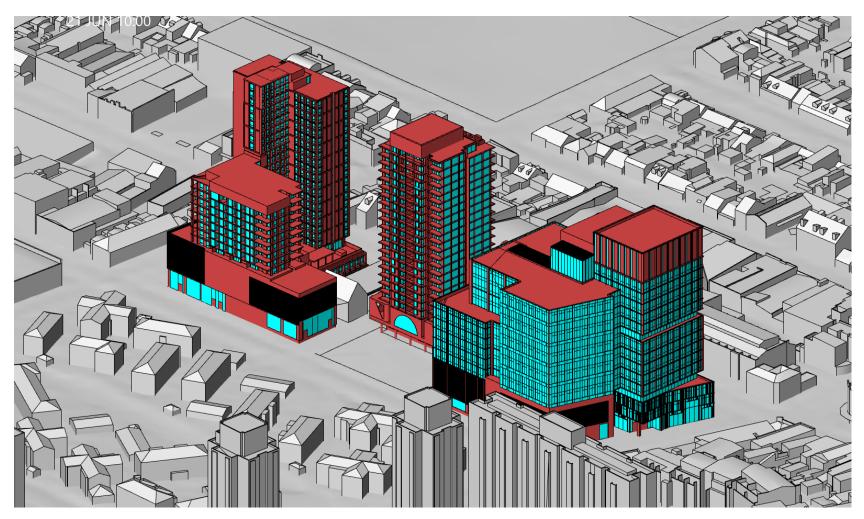


Jun 21 - 09:45 AEST



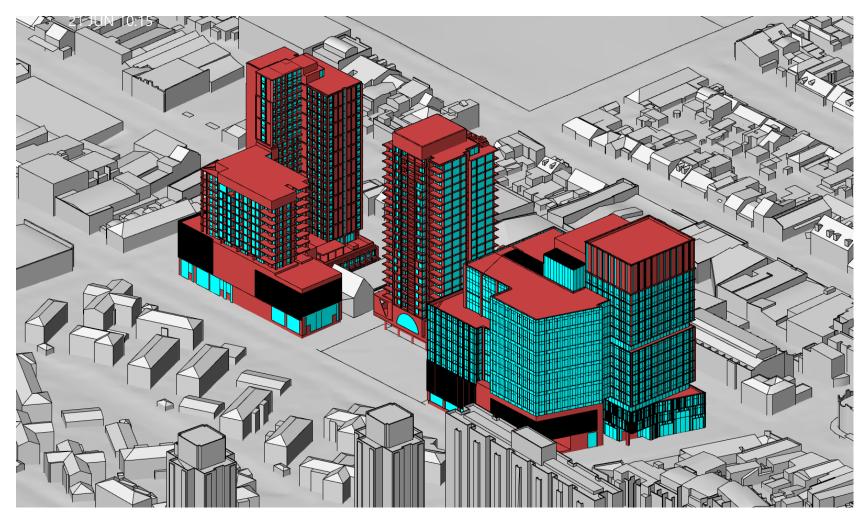


Jun 21 - 10:00 AEST





Jun 21 - 10:15 AEST



Waterloo Metro Quarter Over Station Development EIS Appendix LL – Overshadowing Analysis



Jun 21 - 10:30 AEST



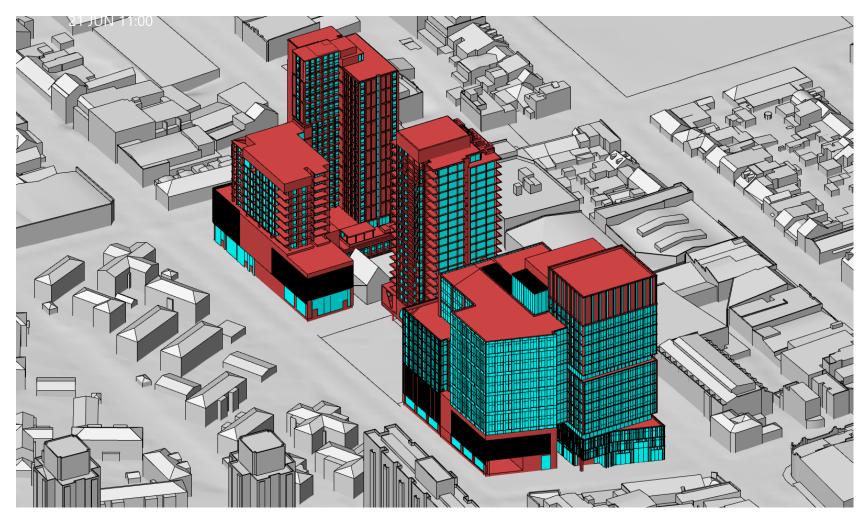


Jun 21 - 10:45 AEST



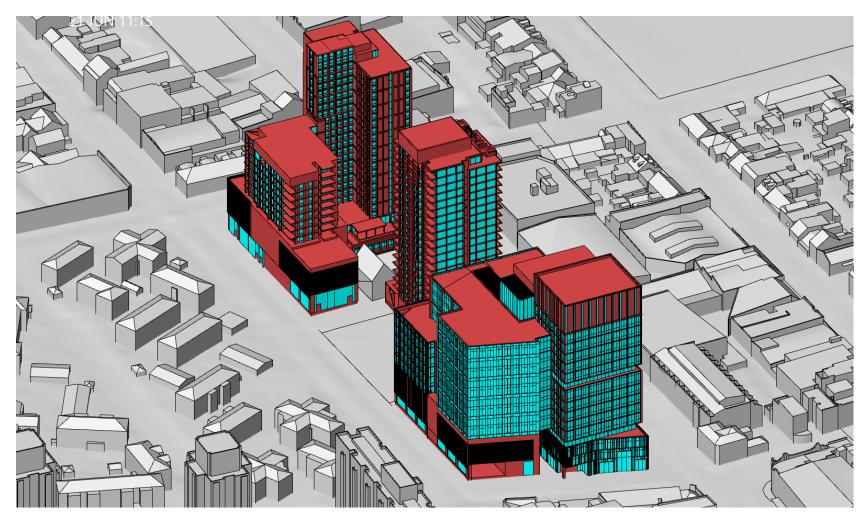


Jun 21 - 11:00 AEST



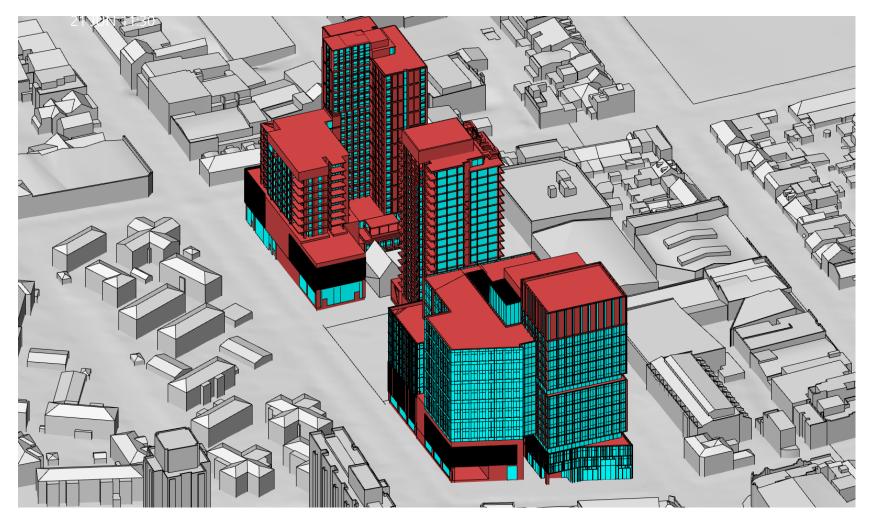


Jun 21 - 11:15 AEST





Jun 21 - 11:30 AEST



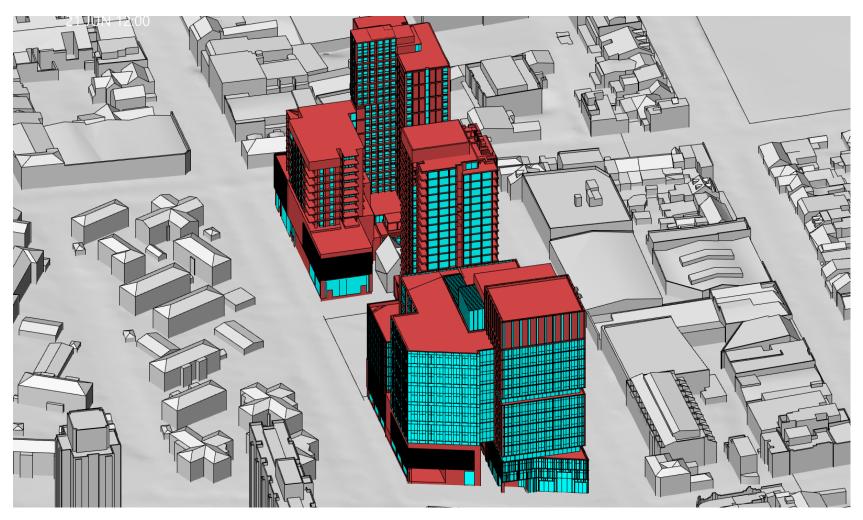


### Jun 21 - 11:45 AEST



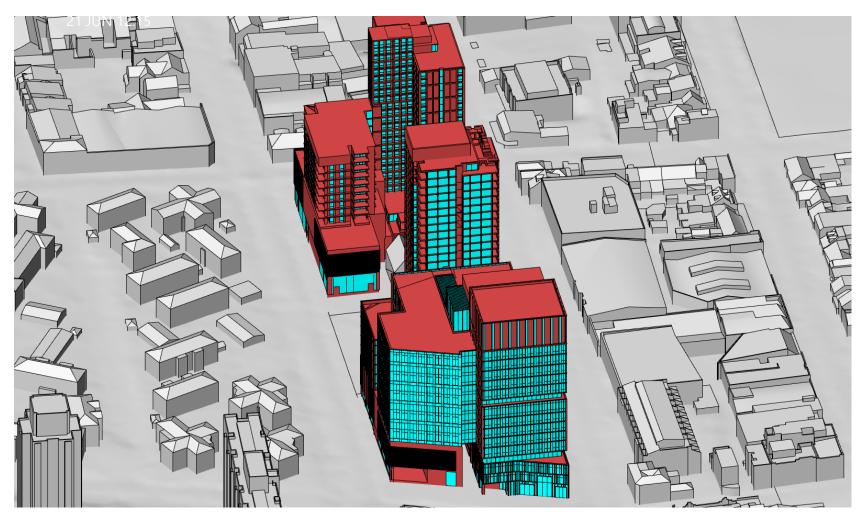


### Jun 21 - 12:00 AEST



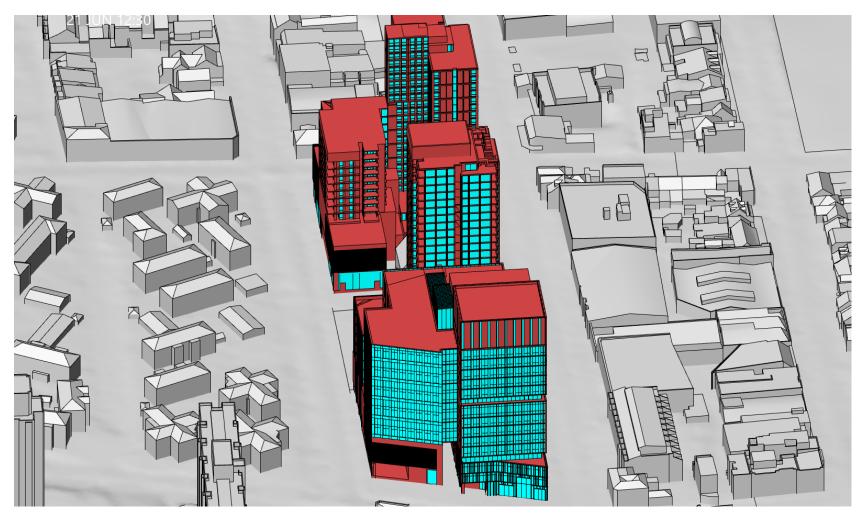


### Jun 21 - 12:15 AEST



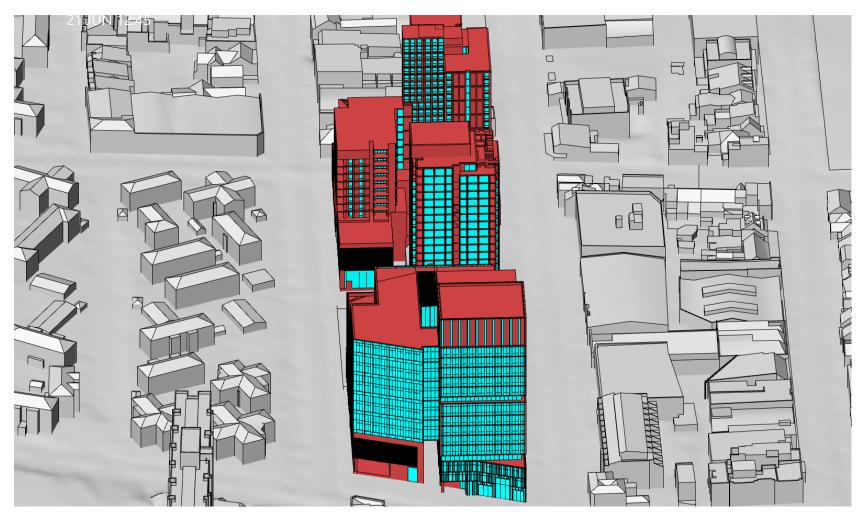


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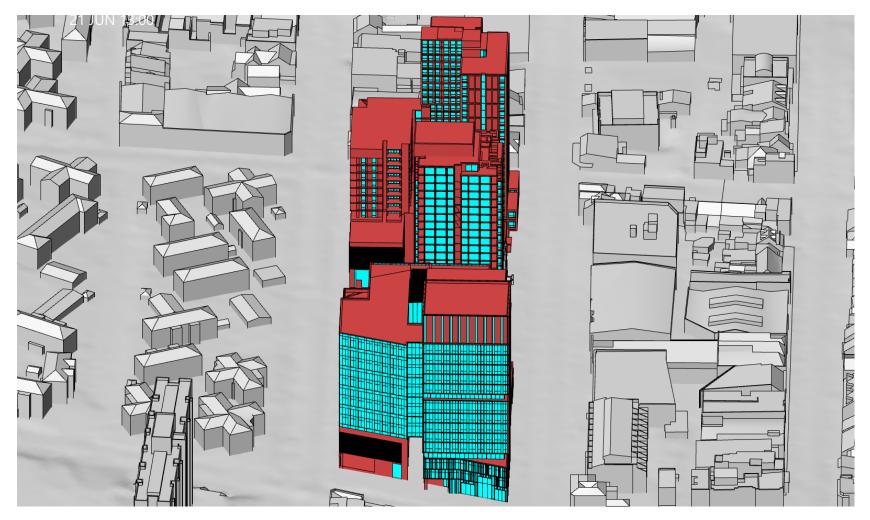


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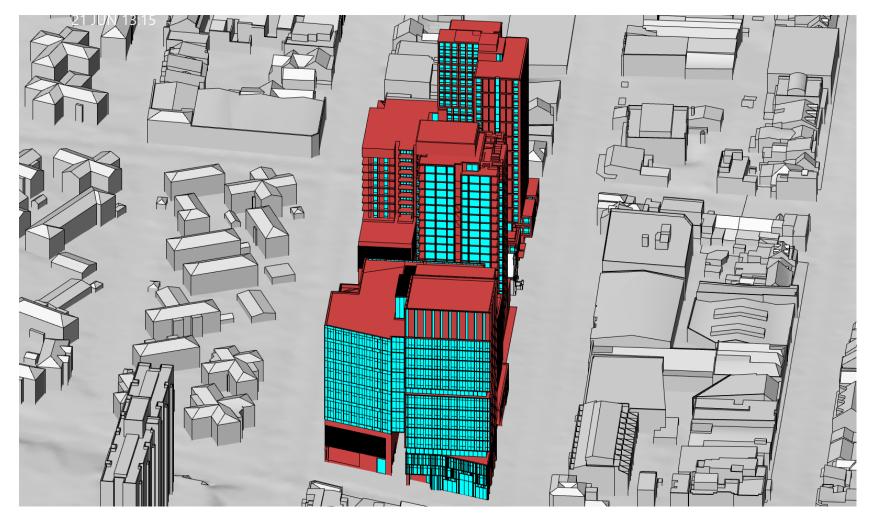


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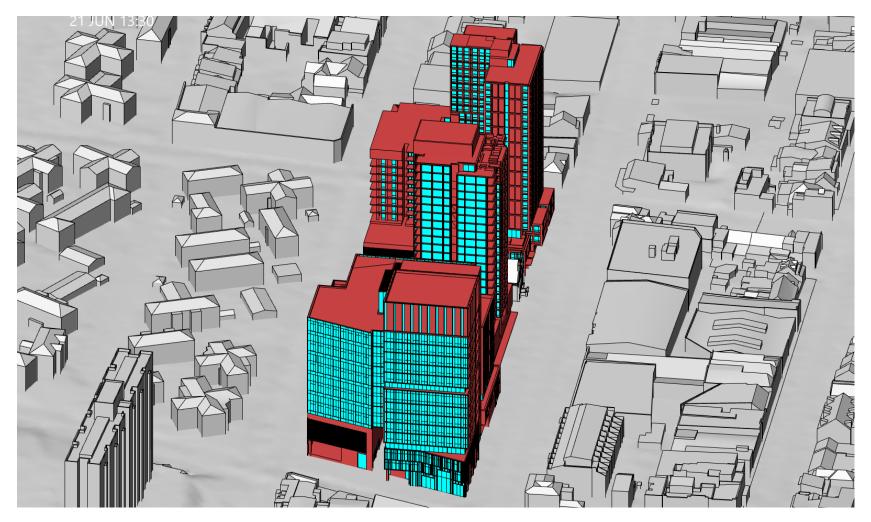


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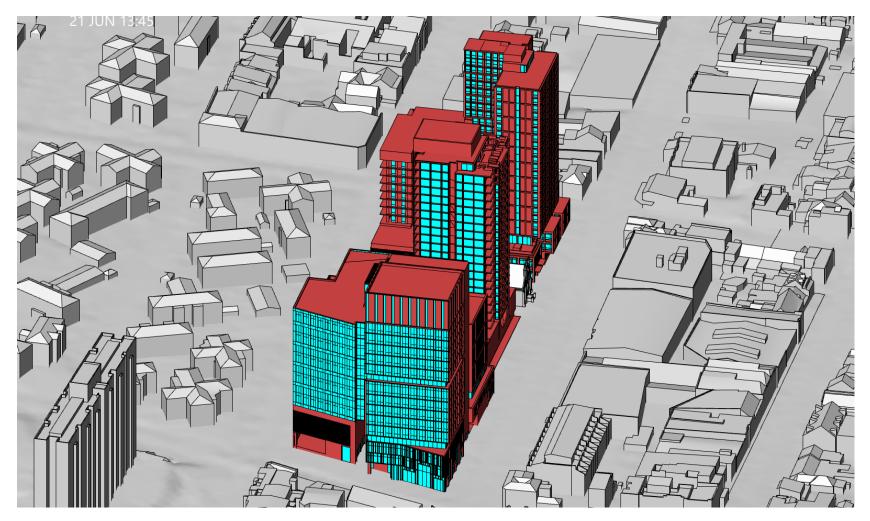


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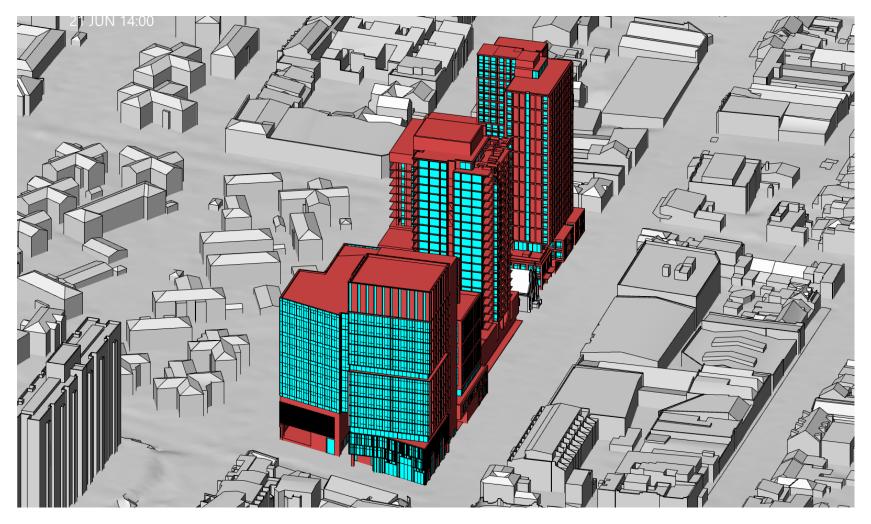


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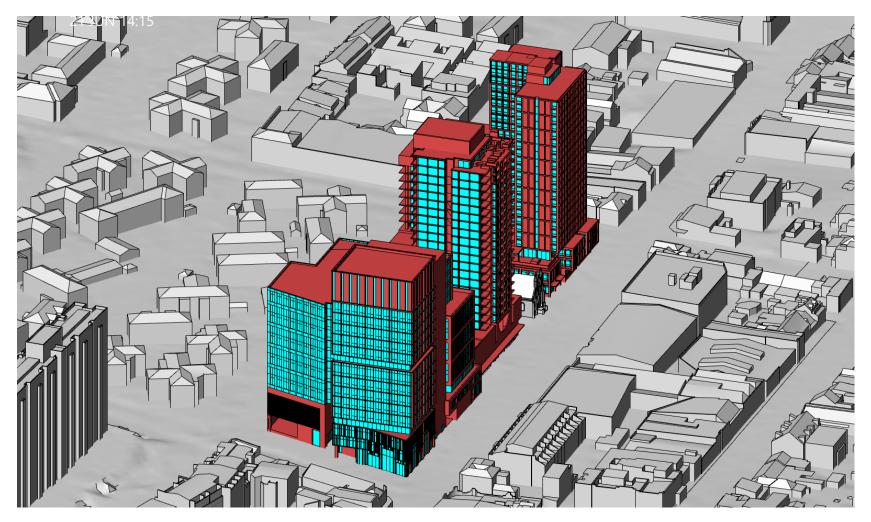


### Jun 21 - 14:00 AEST





### Jun 21 - 14:15 AEST



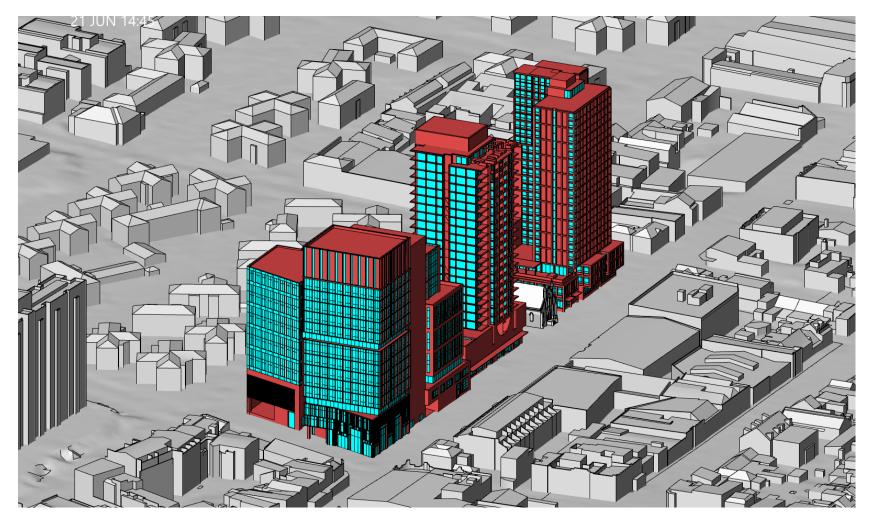


Jun 21 - 14:30 AEST



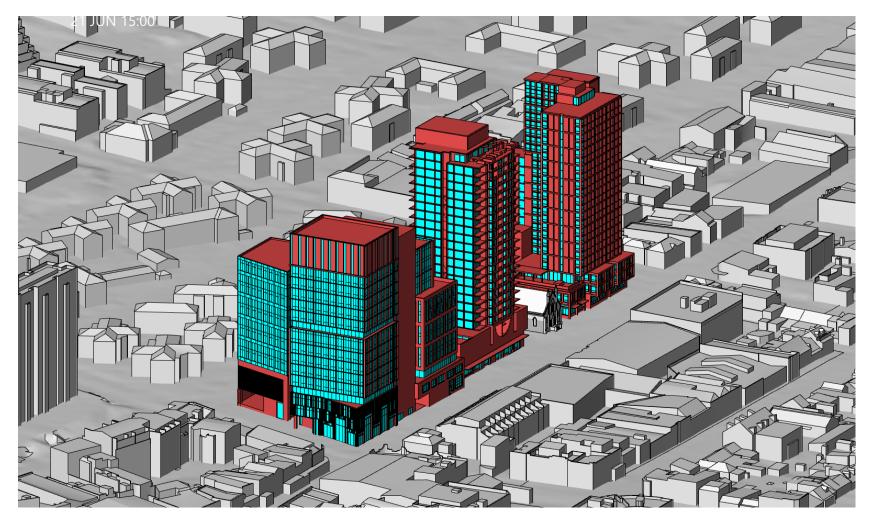


Jun 21 - 14:45 AEST





Jun 21 - 15:00 AEST





Jun 21 - 15:15 AEST





Jun 21 - 15:30 AEST





#### Jun 21 - 15:45 AEST



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### Jun 21 - 16:00 AEST

