WATERLOO METRO QUARTER OVER STATION DEVELOPMENT

Environmental Impact Statement
Appendix P – Structural Design Report

SSD-10438 Basement Car Park

Detailed State Significant Development
Development Application

Prepared for **Waterloo Developer Pty Ltd**

30 September 2020

Reference	Description
Applicable SSD Applications	SSD-10438 Basement Carpark
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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
ETABS	Structural Engineering Software
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

Reference	Description
VIA	Visual Impact Assessment
WMQ	Waterloo Metro Quarter
WMP	Waste Management Plan
WSUD	water sensitive urban design

2. Executive summary

This planning report has been prepared by Robert Bird Group to accompany a detailed State significant development (SSD) development application (DA) for the Basement Car Park 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 10438.

This report concludes that the proposed Basement OSD is suitable and warrants approval.

3. Introduction

This report has been prepared to accompany a detailed State significant development (SSD) development application (DA) for the Basement Car Park 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:

- 2-storey shared basement car park and associated excavation
- Ground level structure
- carparking for the commercial Building 1, residential Building 2, social housing Building 4, Waterloo Congregational Church and Sydney Metro
- service vehicle spaces
- commercial end-of-trip and bicycle storage facilities
- retail end-of-trip and bicycle storage facilities
- residential storage facilities
- shared plant and services.

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 Basement Car Park of the Waterloo Metro Quarter site. The site has an area of approximately 5,700sqm. The subject site comprises the following allotments and legal description at the date of this report.

- 1368 Raglan Street (Lot 4 DP 215751) (Part)
- 59 Botany Road (Lot 5 DP 215751) (Part)
- 65 Botany Road (Lot 1 DP 814205) (Part)
- 67 Botany Road (Lot 1 DP 228641) (Part)
- 124–128 Cope Street (Lot 2 DP 228641) (Part)
- 69–83 Botany Road (Lot 1, DP 1084919)
- 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).

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).

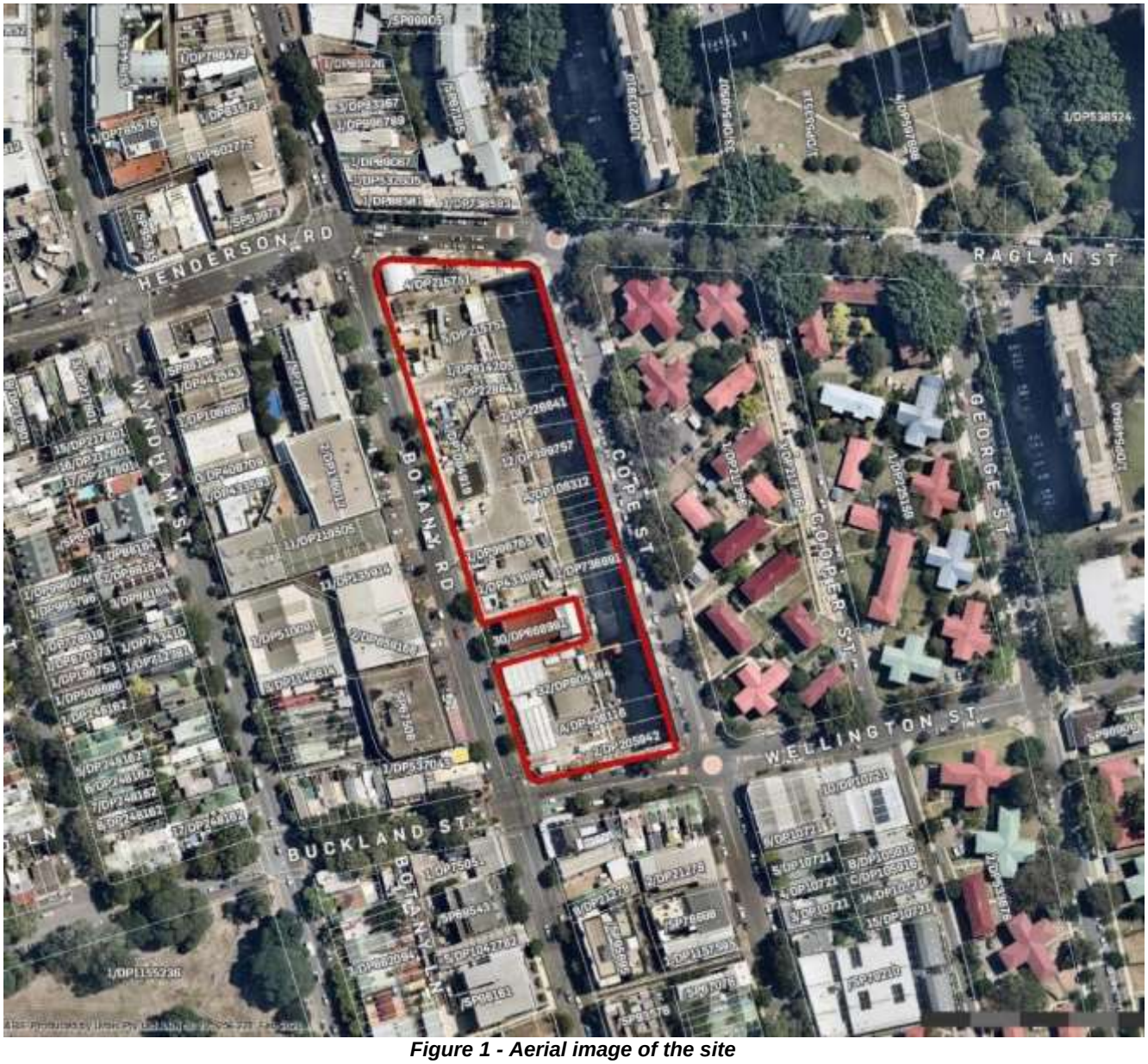

Figure 1 - Aerial image of the site
Source: Urbis

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.

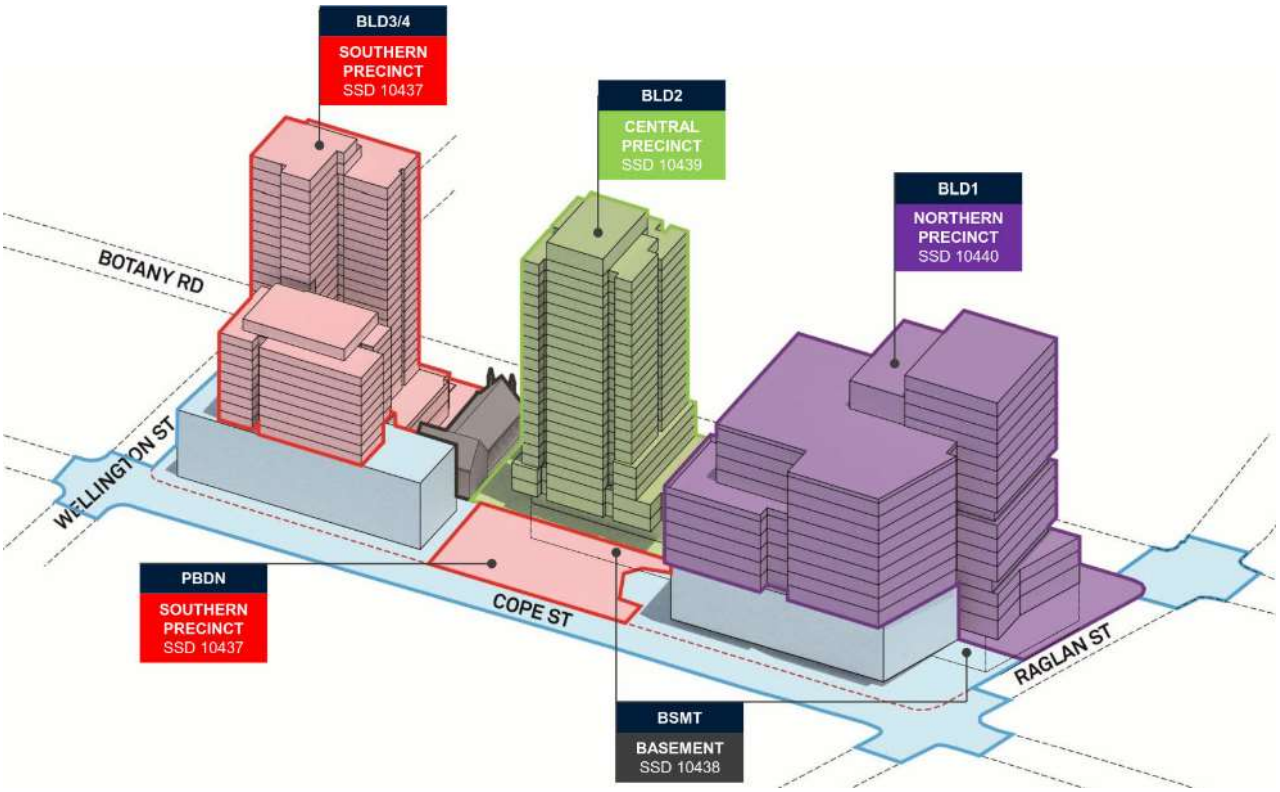

Figure 2 - Waterloo Metro Quarter site, with sub-precincts identified
Source: HASSELL

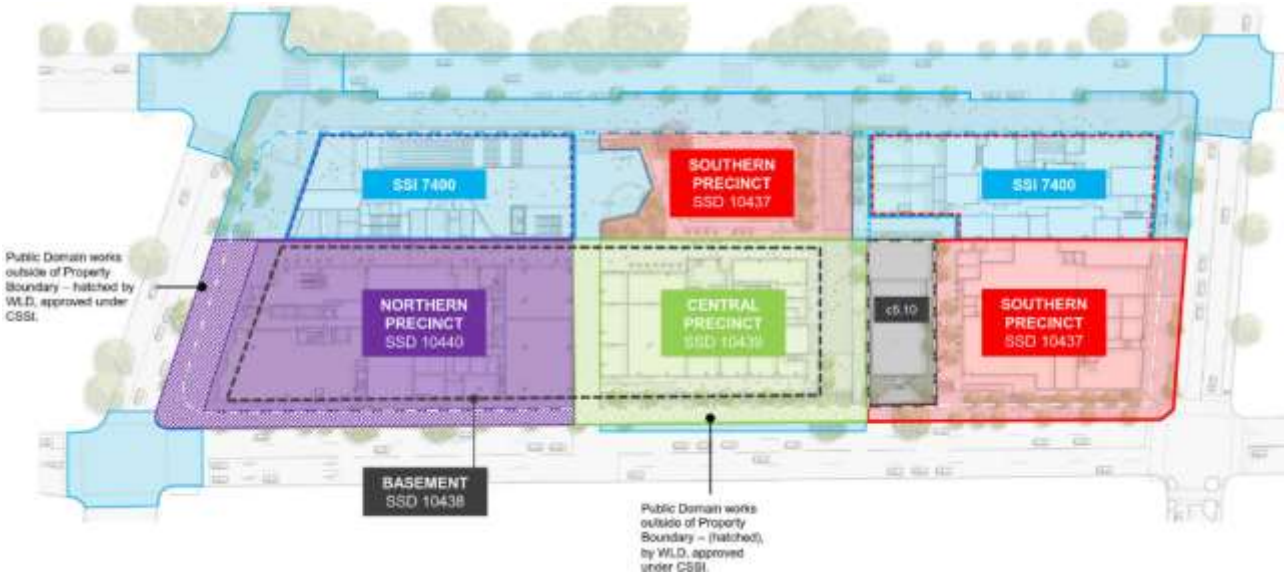

Figure 3 - Waterloo Metro Quarter site, with sub-precincts identified
Source: Waterloo Developer Pty Ltd

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.

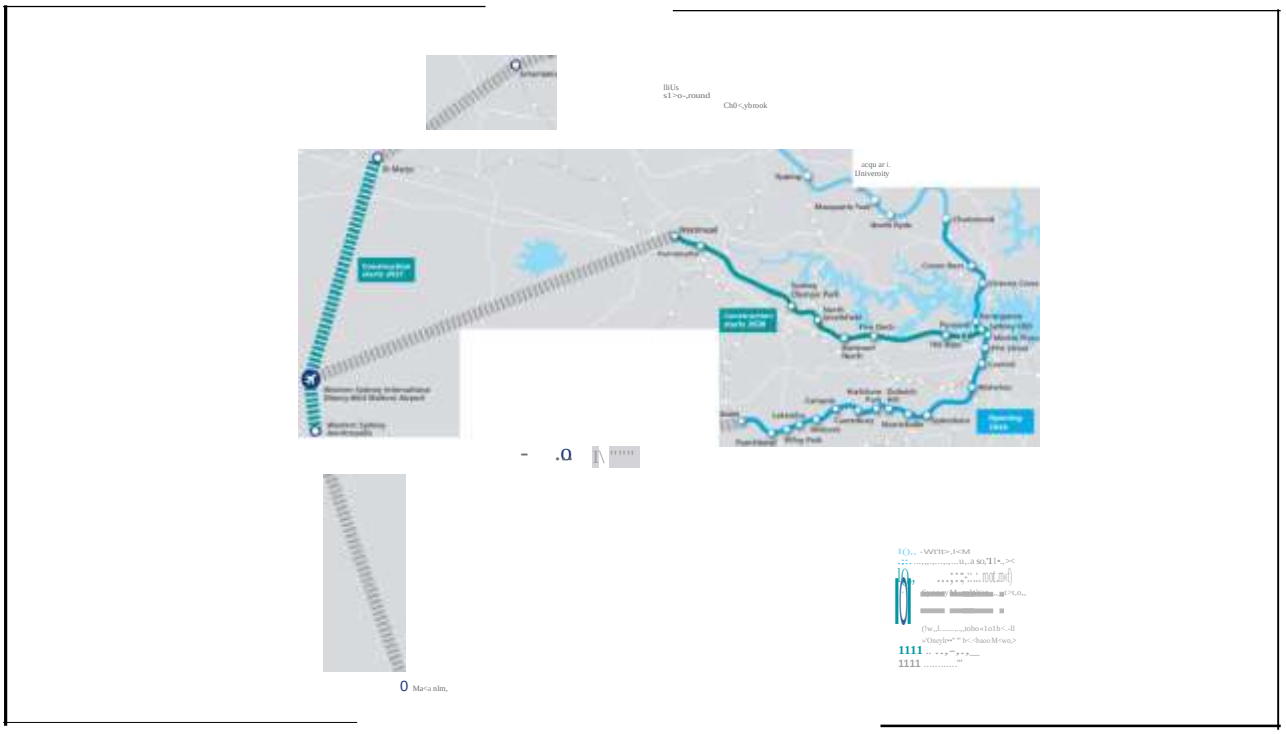

Figure 4** - **Sydney Metro alignment map
Source: Sydney Metro

5.2 Sydney Metro CSSI Approval (551 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.

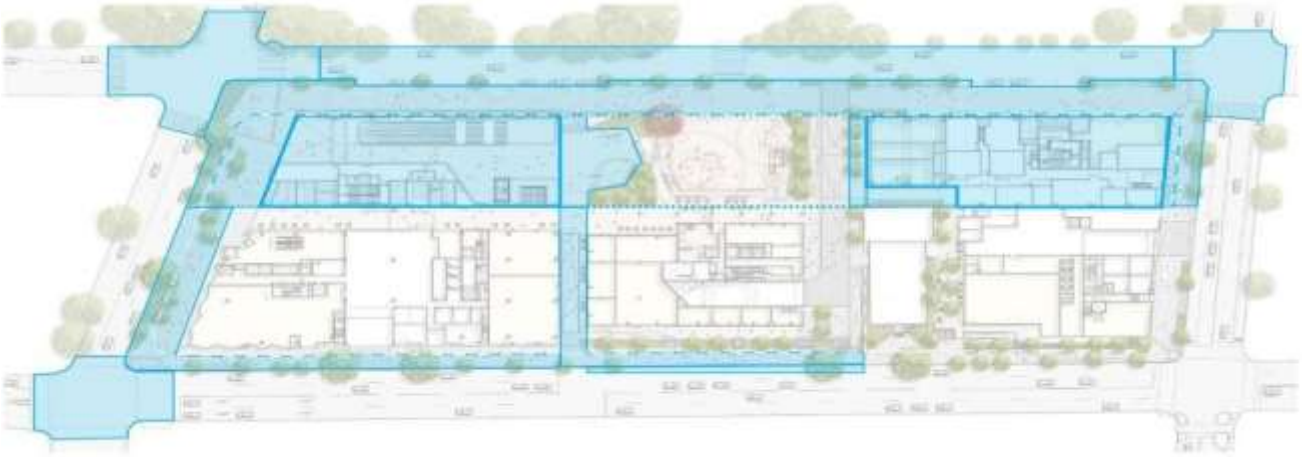

Figure 5 - CSSI Approval scope of works
Source: WL Developer Pty Ltd

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

6.1.1 Southern Precinct

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 - Subject DA

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. Structural Design Standards

The structural design for the proposed development shall be in accordance with the current revision of all relevant Australian Standards. These standards will include, but are not limited to:

Standard	Title	Edition
AS 1170.0	Structural Design Actions Part 0: General Principles	2002
AS 1170.1	Structural Design Actions Part 1: Permanent, Imposed and other	2002
AS1170.2	Structural Design Actions Part 2: Wind Actions	2009
AS1170.4	Structural Design Actions Part 4: Earthquake Loads	2007
AS 3600	Concrete Structures	2018
AS 3700	Masonry Structures	2001
AS 4100	Steel Structures	1998

7.1 Design Life and Importance Level

The design life and importance level of the structure is given by the NCC requirements for the following building classifications:

Usage	Classification
Parking	Class 7a

Design Life	Importance Level
50 years - Basement structure	3
100 Years – Buttress Walls and their supporting footings, connected slabs	4

8. Design Loads

All loadings and load combinations shall be in accordance with Australian standards AS1170 Parts 0 to 4. The relevant design loads are defined in Section 9.1.1 to 9.1.4 of this report.

8.1.1 Permanent Actions – Dead Loads

Dead loads shall be the self-weight of the structure plus an allowance for toppings, partitions, ceilings and services. The additional dead loads are outlined below:

Usage	Uniform distributed load (kPa)
Parking	0.5
Ground floor	2.5
Loading dock	2.0
Garbage Area	1.5
Substation	5.0
Plantroom	2.5

8.1.2 Imposed Loads – Live Loads

The design floor loadings are to be in accordance with the minimum provisions of AS1170.1 and are outlined below:

Usage	Uniform distributed load (kPa)
Parking	2.5
Ground Floor	5.0
Loading dock	15
Garbage Area	5
Substation	15
Plantroom	7.5
Maximum Hydrostatic Uplift Pressure	80

8.1.3 Wind Loads

Wind pressures are in accordance with AS1170.2 using the following parameters:

Criteria	Value
Location	Sydney NSW
Region	A2
Importance level	3
Design event for strength	1:1000
Design event for serviceability	1:25
V_{1000}	46m/s
V_{20}	37m/s
M_s	1.0
M_t	1.0
Terrain Category	3
Design Wind Speed	Varies 38m/s to 53m/s

8.1.4 Earthquake Loads

Earthquake loadings are in accordance with AS1170.4 using the following parameters

Criteria	Value
Location	Sydney NSW
Importance level	3
Design event for strength	1:1000
Probability Factor K_p	1.3
Hazard Factor Z	0.09
Subsoil Class	C_e
Earthquake Design Category	EDCIII
Performance Factor S_p	0.77
Ductility Factor μ	2

8.2 Deflection Criteria

The deflection structural elements under service loads shall be controlled in accordance with the following criteria unless noted otherwise on Robert Bird Groups structural drawings:

Structural Element	Deflection Type	Limit
Overall Building Structure	Lateral sway from service wind load	Height/500
Overall Building Structure	Inter-storey drift from lateral sway due to ultimate earthquake load Inter-storey drift from lateral sway due to serviceability wind loading	Height/150 Height /500
Floor Slabs: No Sensitive Partitions	Long term total deflection	Lesser of Span/250 or 25mm
Floor Slabs: Sensitive Partitions	Long term incremental deflection	Lesser of Span/500 or 25mm

8.3 Fire Resistance

Structural elements are to be designed in accordance with the Building Code of Australia and the relevant Australian Standards to satisfy the required FRL levels for fire.

8.4 Durability

Structural elements will have a structural design life as nominated by their relevant Australian Standards. Concrete works will be designed for the relevant exposure classifications.

9. Structural Design

9.1 Basement Overview

The basement is a concrete structure consisting of reinforced concrete walls and columns and post-tensioned slabs. The basement is undrained, and the structure has been designed to resist hydrostatic pressures. Building 1 (SDD10440) is positioned over the Northern extent of the basement and Building 2 (SSD10439) over the Southern portion.

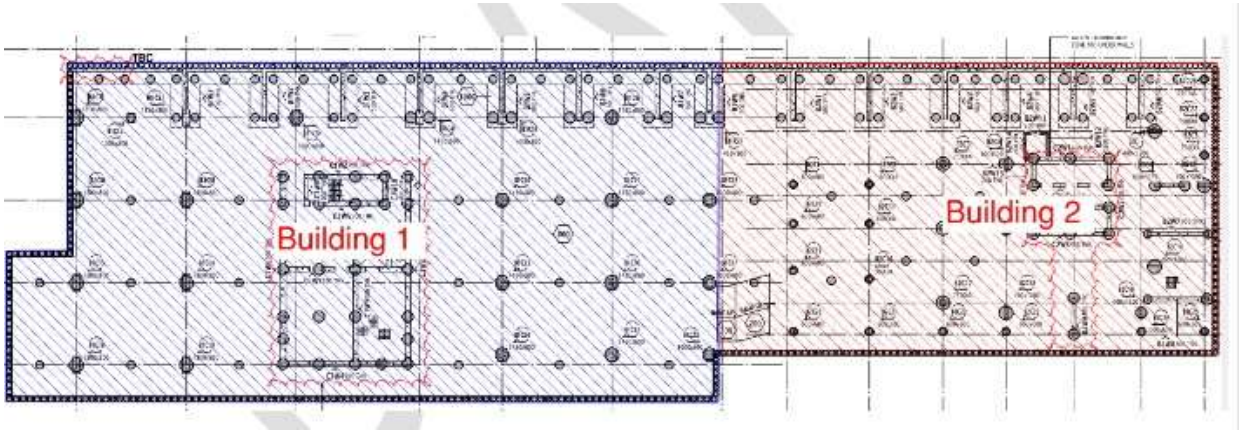

Figure 6 – Basement outline

9.2 Lateral Stability

Lateral stability for the building from earthquake and wind loads is provided by a stair / lift core to each of buildings 1 and 2. These cores support the vertical and lateral loads from the buildings above. Building 1 will experience additional loads from the station structure from an earthquake event. These loads will be transferred to the building 1 core through a diaphragm slab at level 4. To model these actions a combined ETABS model was established to assess the lateral performance of the building and the station structure. The loads provided by the stations team account for the higher importance level (level 4) of the station structure.

Both the station design team and Building 1 teams have carry out this overall assessment to ensure each of the respective structures meets the earthquake requirements outlined in section 8.1.4.

It is also understood that the station design team will be required to ensure that the station meets lateral stability requirements should Building 1 not be constructed.

9.3 Retaining Walls

A secant pile wall has been adopted as the earth retaining structure to the northern, southern and western walls to the basement. The secant pile walls provide a temporary support of the excavation during construction and are designed to form the permanent retaining wall. During construction temporary ground anchors will be required to support the piles. These will be destressed once the basement and ground floor slabs have been completed.

Along the east boundary with the station box, a temporary pile wall exists constructed as part of the station excavation. A permanent insitu concrete wall will be constructed in front of this temporary wall. This wall will span between floor levels and between the buttress walls provided to support the out of balance earth pressure loads (refer section 9.6).

9.4 Adjoining Waterloo Congregational Church

The heritage listed Waterloo Congregation Church is located to the south of basement to Building 1 and 2. Due to the age of the building the church is likely founded on high level pad footings. Construction for the basement will require excavation to approximately 8m below the existing ground level. The basement is positioned approximately 10m from the church building. Shoring of the excavation will be required to ensure the foundations to the church are not disturbed. The shoring will consist of a secant pile wall with temporary ground anchors. The ground anchors will be destressed following construction of the basement and ground floor slabs. The wall will be designed for all surcharge loads from Church lane and the Church building. The wall will be modelled and designed for all stages of construction with deflection limits set to limit movement of the church to acceptable limits. Rock excavation will not be required for basement however a vibration monitoring plan should be developed by the projects geotechnical engineer prior to any piling or excavations are undertaken.
A detailed dilapidation report of the church and surrounds should be prepared prior to works commencing on site. The report would provide a record of existing conditions prior to commencement of works.

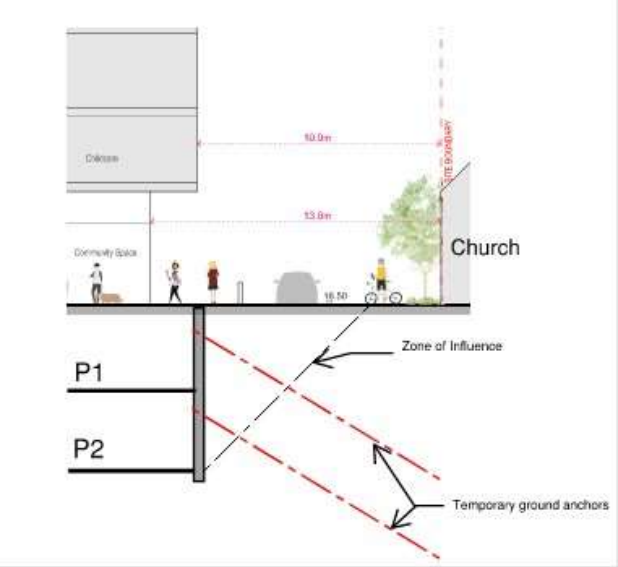

Figure 7 – Basement Section

9.5 Floor Plates

Basement level P2 slab is a reinforced concrete slab 800mm thick designed to resist hydrostatic surcharge. The slab is supported by primary piles positioned under columns and secondary piles positioned mid columns. A waterproof membrane (by others) is to be provided to the underside of the slab and serves as the primary waterproofing layer. The slab relies on the waterproof membrane and is not designed in accordance with the liquid retaining structures code. The P2 hydrostatic slab steps down at each core to provide the clearance required for the lift pits and plantrooms.

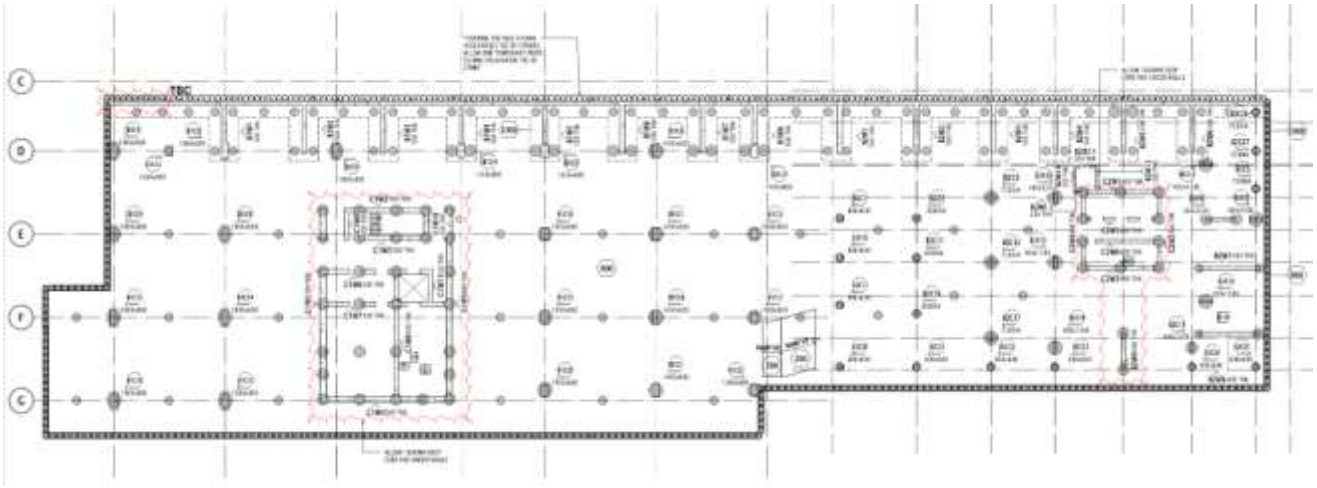

Figure 8 – Basement Slab

The basement P1 slab is a suspended post tension slab supported on columns and walls. Due to the uniform column grid under building 1 a banded slab system has been adopted. The band beams are generally 450D x 1800W supporting a 200mm deep slab. Towards the southern end under building 2 a 200mm flat plate solution has been adopted due to the irregular arrangement of column.

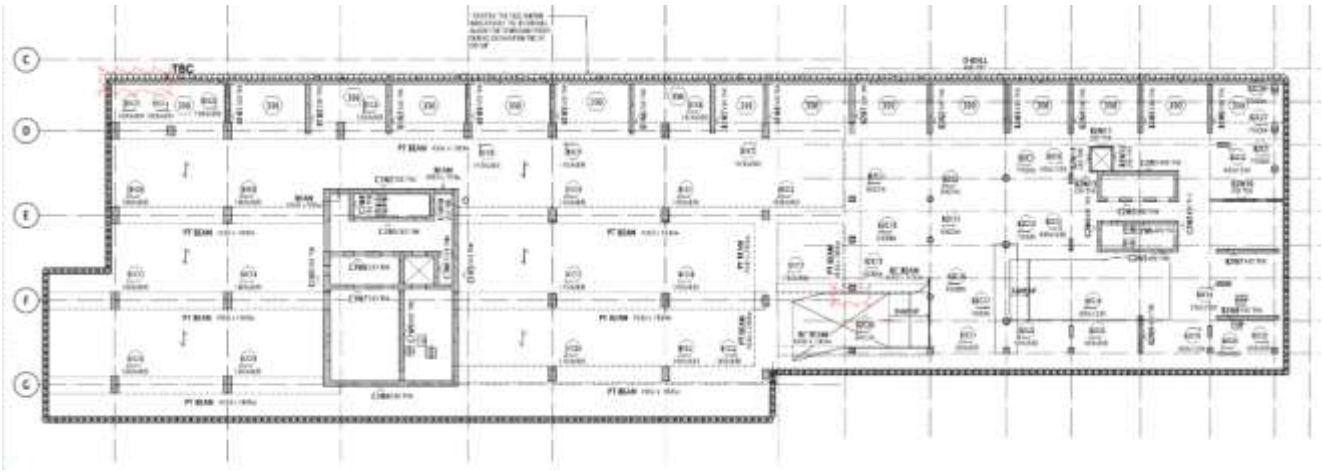

Figure 9 – Basement slab

The ground floor is a suspended post tension slab supported on columns and walls. The slab consists of 700D x 2400W band beams supporting a one-way slab of differing thicknesses. The slab has been designed to support the dead and live loads noted in section 9.1.1 and 9.1.2 as well as a temporary construction live load of 20kPa.

9.6 Footings

The building is supported by reinforced concrete bored piers socketed into class I or II sandstone in accordance with the geotechnical engineers' requirements. Further geotechnical analysis is required to assure surcharge loadings onto the station structure from the piles are within acceptable limits.

9.7 Buttress Walls

Buttress walls have been provided along the eastern boundary with the station box. These buttresses are designed to resist the out of balance loads on the station box in the event the basement is demolished at some time in the future. The buttresses are to be designed for a design life equivalent to the station structure (100 years) and are noted on the structural drawings as not to be demolished. The floor slabs between the buttress walls (P1, P2, and ground) form part of this system and likewise must remain if the structure is to be demolished.

The structural scheme consists of; an 500mm thick buttress wall, supported on 1000mm thick pile cap in turn supported on piles and is completely separate from the station structure and station waterproofing. The basement wall will cast hard against the TSE existing pile to transfer any out of balance load from station to the buttress. During the design life of the basement the P1, P2 and ground floor slabs will act as diaphragms and distribute loading uniformly across the basement to be resisted by the basement wall on the western side. If at some time in the future the basement is demolished the buttress walls will remain and the out of balance earth loads from the station will be resisted by the buttresses wall system, P2 slab and the supporting piles. A finite element analysis of the buttress walls has been undertaken by WSP (ref PS1119449-GEO-LTR-001 Rev A MCK) for the various stages of construction and deconstruction. The report concluded the differential deflection allowance of 25mm between the B3 slab and ground floor slab of the station box was not exceeded.

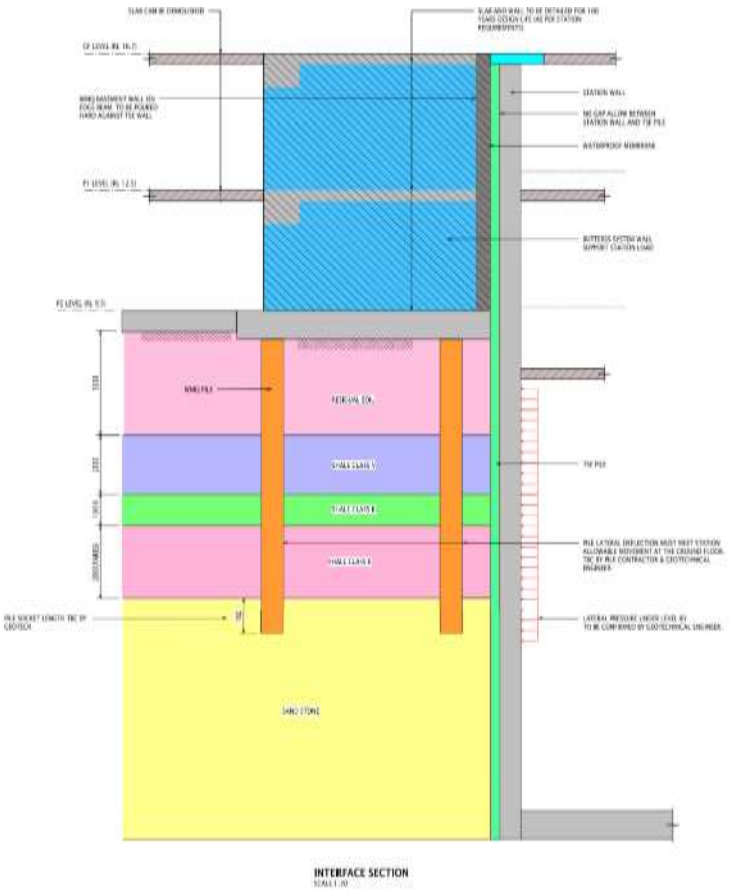

Figure 10 – Buttress walls

Figure 11 – Basement cross section

10. Conclusion

The structural design of the Basement is a coordinated design with the Waterloo Metro Station. During the SSD design development, Robert Bird Group have provided advice and input into wider design team by producing a structural scheme design, development of finite element building model ETABs and preparation interface loading reports. Preliminary coordination with other engineering consultants has been undertaken and further design development will be required for Construction Certificate. Further geotechnical analysis and modelling will be required to inform the design team to ensure the pile foundations do not adversely impact on the station structure.

The structural design is compliant to the relevant design and planning criteria and industry standards and will not adversely impact on the Waterloo Metro station or adjoining structures.