TTW Structural Civil Traffic Façade

Structural SSDA Report

Lang Walker AO Medical Research Building - Macarthur

Prepared for BVN / 14/10/2021

201940

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Your Partner in Engineering

Contents

1.0 Executive Summary

This structural report has been prepared by TTW (NSW) Pty Ltd to describe the structural works associated with the State Significant Development Application (SSDA) for the new five storey building with two partial basement levels located at 100 Parkside Crescent, Campbelltown, NSW. The Centre designed by BVN Architects will include research facilities, amenities, and plant rooms.

The proposed site is currently occupied by a helipad which services two relatively new medical facilities to the east and west. The site slopes downwards from east to west, and a 4m high (approx.) gabion retaining wall lies adjacent to Parkside Crescent which allows for a level helipad surface. The new research facility contains two basement levels built into the existing site topography, ground level and three levels of structure over.

This new multi-storey structure is to consist of a concrete frame with steelwork features. The column grid for the new structure varies due to the asymmetrical layout but is generally no more than 8.0 metres in each direction, which accommodates efficient PT flat plate usage. In order to minimise differential settlement, all columns will be supported on piles socketed into siltstone. Lower ground two slab will consist of slab on grade construction, while upper ground bearing slabs will be suspended on intermediate piles to rock as per geotechnical recommendations. Due to the topography, the eastern portion of lower ground floors must retain backfilled soil/gravel.

The suspended slabs are proposed to be post-tensioned flat plate slabs with bands required to accommodate larger spans, transfer columns and architectural features. A specific vibration performance level has been specified for one area of the structure, while the rest will achieve typical office requirements, figures of performance can be found within this report. No vertical expansion has been allowed for in the design, however, link bridges to adjacent structures have been allowed for.

Lateral loads are to be resisted by 250mm thick in-situ concrete core walls which house lifts, stair cores and mechanical risers. The structure is Importance Level 3 for the determination of design return periods, this figure is in line with the neighbouring MCS building and agreed upon during design team meetings.

2.0 Introduction

2.1 Project Description

The project vision is to develop a facility that is combining people-centred health research with public engagement spaces, the MMRC will create a unique and exciting opportunity for community interaction and ownership. Located on the Campbelltown Hospital Campus, the research centre will be shared facility bringing together the following partner organisations:

- Western Sydney University (WSU);
- South Western Sydney Local Health District (SWSLHD);
- Ingham Institute for Applied Medical Research (IIAMR);
- University of New South Wales (UNSW); and
- Health Infrastructure (HI).

This development will consist of the following:

- Demolition of existing at-grade helicopter pad;
- Site preparation civil works;
- Construction of a five-storey medical research facility named Macarthur Medical Research Centre (MMRC);
- Link bridges connecting MMRC to 'Building D' and Macarthur Clinical School (MCS);
- Associated site and landscaping works; and
- Signage.

Embedding the MMRC within the existing hospital campus will enable opportunities for translational research outcomes directly improving the health outcomes for the local population to be realised.

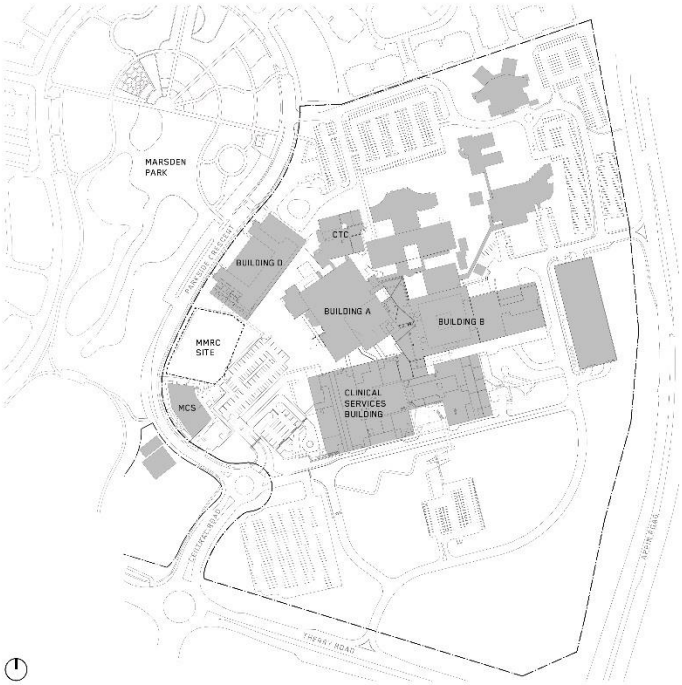


Figure 1 - Precinct Plan

3.0 Existing Conditions

3.1 Site Description

The site is an approximately rectangular shaped parcel of land of some 3,384 m^2, located at 100 Parkside Crescent, Campbelltown (Part Lot 6 DP 1058047). The site has a frontage of approximately 65 m to Parkside Crescent and is bound by the Western Sydney University Clinical School Building to the south, Building D of the Campbelltown Hospital Complex to the north and the main hospital carpark to the east.

The site is currently occupied by the hospital helipad which comprises an on-grade concrete slab at RL83 m AHD. The helipad has been constructed on a fill platform which is approximately level with the carpark to the east. Surface levels fall away from the helipad to the north, with battered slopes are then supported by gabion walls up to 4 m in height along Parkside Crescent and the access driveways for the adjacent buildings.

Figure 2 - Aerial view of the proposed site

3.2 Geotechnical Information

A geotechnical investigation for the site has been undertaken by Douglas Partners with the findings presented in the Geotechnical report dated July 2021 (Report No and Project 34275.31.R.001.Rev0). A Site Contamination Report was also prepared in June 2021(Report No. 34275.27.R.001.Rev0). Refer Appendix C.

The results of the investigation indicate that the site is underlain by fill to depths of 4.8 – 7.3 m (deepening to the west under the helipad). The fill was variably compacted. The fill is underlain by a natural residual clay profile, typically stiff to very stiff consistency to depths of 5.5 – 8.9 m (deepening to the west). The increasing depths of fill and clay to the west is consistent with historic aerial imagery which indicates that the original site graded to the west prior to the placement of fill.

Underlying the fill and residual clays is shale (Ashfield Shale) that is slightly weathered to fresh, initially very low strength but increases to medium strength within the upper 1 – 2 m, and then high strength generally from about 2 – 3 m below the rock surface.

3.2.1 Groundwater

Groundwater was measured at RL 75.1 – 76.6 (Bores 203, 204 and 208 as measured 11 June 2021) which appears to along the interface of the fill and natural clay.

3.2.2 Site Contamination

Based on the results of the soil contamination assessment (Refer Appendix C), no soil contamination such as Lead or Asbestos were identified and therefore no remedial works are likely to be required.

However, the soil will be classified as general waste for uncontrolled fill used to construct the helipad, which will come at a premium to dispose of. We recommend ensuring this existing uncontrolled fill be used as fill on site where possible, and exporting as much of the VNM as possible at a cheaper rate. These items require further investigations from Douglas Partners to establish exact quantities of VNM and General waste we can expect to find on site.

4.0 Proposed Development

4.1 General Description

The proposed development comprises the construction of a new multi-storey research facility on a site that is currently occupied by a helipad, servicing adjacent hospitals. The structure will comprise of five storeys in total, with two partial basement levels, providing 5,745m^2 gross floor area. Each floor can be split into three different sections, Block A, B and C, as shown in the below plan view. In order to provide a link to the adjacent MCS building and Building D, we will be providing link bridges constructed using reinforced concrete and lightweight framing. We will also be providing a multilevel atrium space, which will house a feature stair and an amphitheatre.

The current scheme comprises of reinforced core walls providing vertical and lateral support, reinforced column providing vertical support, and suspended post tensioned floor plates to upper levels, which is the best suited solution for the current architectural gridlines and vibration requirements for such research facilities.

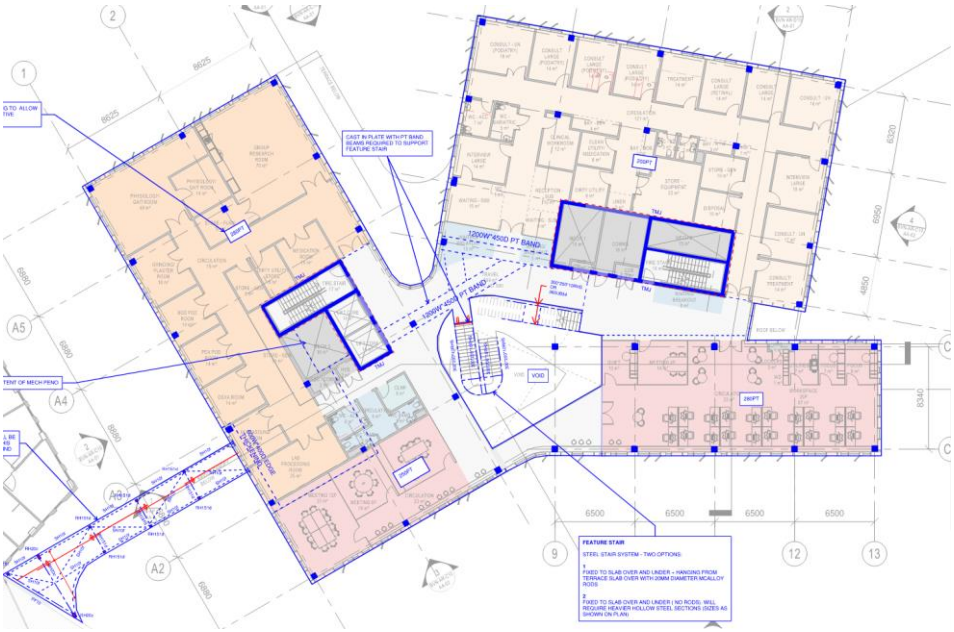


Figure 3 - General Structural Markup Level 1

Figure 4 - Architectural Section

4.2 Structural Works

4.2.1 Foundations

Based on the advice provided within the Geotechnical report dated July 2021 (Report No and Project 34275.31.R.001.Rev0), the building foundation system is recommended to comprise piers extended into the underlying bedrock. Based on the results of the field investigation and laboratory testing, building footings and retaining wall footings could be proportioned using the maximum design parameters presented in Table 7 below.

Table 7: Estimated Design Parameters

Material	Ultimate Base Bearing Pressures (kPa) (1)	Ultimate Shaft Adhesion Pressures (kPa) (2)	Allowable Base Bearing Pressures (kPa) (3)	Allowable Shaft Adhesion Pressures (kPa)	Allowable Lateral Resistance (kPa)
Class IV Shale	6,000	150	1,000	100	300
Class III Shale	20,000	750	3,500	350	1,000
Class II Shale	70,000(4)	1,000(4)	6,000(4)	600(4)	1,500(4)

Notes (1) The values are in accordance with Pells et al- 1998 (Ref 3);
(2) Ultimate values occur at large settlements (generally >5% of the minimum footing width);
(3) Assumes adequately cleaned and roughened pile sockets;
(4) Values for Class II Shale only to be adopted after additional investigation (coring footings or spoon testing).

Figure 5 - Estimated design parameters by Douglas Partners

A typical highly loaded column will be in the region of 2000KN, which will require a 600mm diameter pile socketed minimum 1000mm into class III shale. Note, coring into class III rock will require a specialist machine that can achieve high torque, if this machine is not desired from a cost perspective, we could use double piles where the loads are high and found these piles in class IV shale This decision would ultimately lie with the cost consultant to establish which is more economical. Intermediate piles not supporting loads from suspended slab on ground only can be 450mm diameter piles, unless the contractor wishes to keep diameters consistent across the site.

Piles supporting core walls must be 750mm diameter to allow for tensions/compressions and shears generated from earthquake analysis. Following analysis it was found that some piles (4) experience up to 2,500kN uplift, which will require approximately 4 m socket into class III shale.

As the site is temporarily battered from lower ground two to ground floor, any retaining walls required must be propped temporarily until the slab over is installed and provides support. It must also be noted that backfilling of retaining walls must occur in stages following erection of walls, meaning a stockpile of fill material will be required on site during construction.

4.2.2 Lower Ground Floor slabs

The lower ground 2 slab will be 150mm slab on grade (SOG) as outlined in section 7.6 of the geotechnical report, as it is expected to be variably founded on natural clay and shale and could be designed to a CBR of 3%. Further advice from the geotechnical engineer is required to confirm site preparation methods to accommodate this SOG. If fill is encountered below grade, over excavate to natural ground, and backfill with inert material excavated from other areas on site if possible.

Lower ground 1 and ground floor will be a 180mm thick RC slab supported on piles to rock, as the fill is uncontrolled and not considered suitable for ground bearing slabs. A 40mm void former layer will be required to accommodate any possible shrink swell within the clay, as recommended by geotechnical engineers.

4.2.3 Retaining structures

As the development requires two levels of partial basements, and the natural topography is falling to the north, retaining walls are required at various zones from Lower ground 2 to ground floor. Refer to drawings in appendix A for reference. These retaining walls will be supported on piles to rock. Where columns exist adjacent to walls, a 20mm layer of flexible material will be provided between the wall and column, to prevent horizontal load transferring to the column. Retaining walls will be propped by the slab over, meaning they must be temporarily propped during construction until the slab above has been cast.

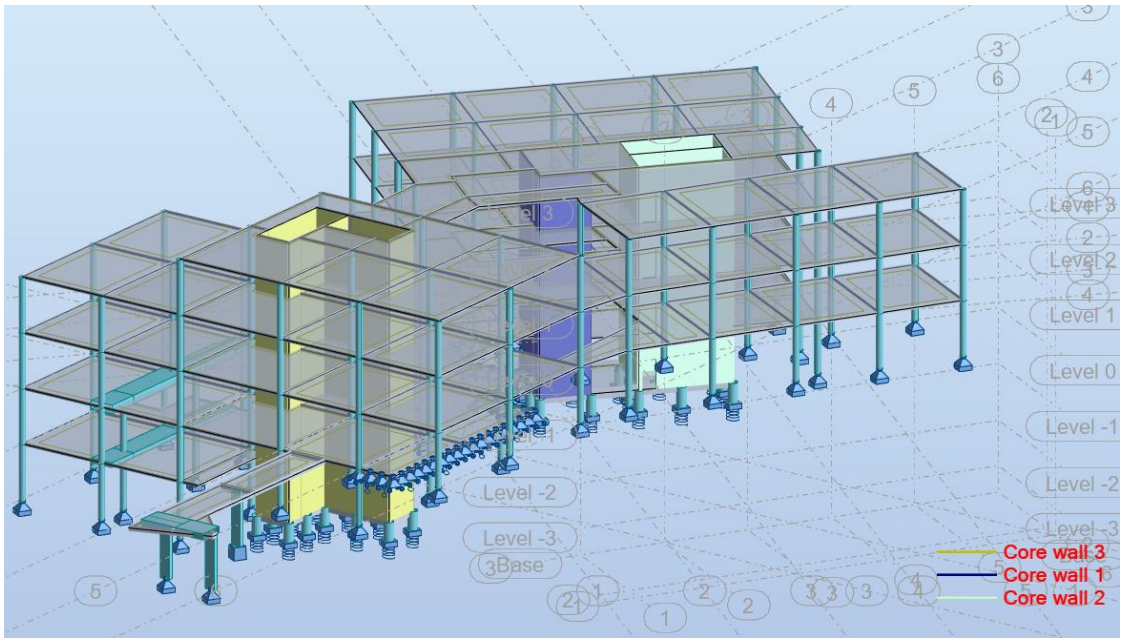
All walls must provide adequate drainage to prevent build-up of water at the wall or below the slab on grade. This can be achieved by backfilling the wall with a layer of granular material, providing strip drains and placing an ag drainpipe towards at the bottom of the wall, this must be captured in hydraulic/civil documentation

As mentioned in section 4.2.1, stockpiling of materials must be allowed for onsite to accommodate backfilling of temporary batters. For example, temporary batters must be provided behind retaining walls, once the slab over has been cast to support the top of walls and adequate drainage provided, batters can be backfilled with excess cut from site. Following this, back propping to retaining walls can be removed. This backfilling must allow for a layer of granular material directly behind the wall, but any other fill material could be reclaimed General Waste, rather than ENM to reduce costs of exporting from site.

There is an existing gravity gabion wall running parallel to Parkside crescent, and adjacent to existing building D. It is proposed to partially retain this wall alongside building D (as seen in appendix A). The remainder of the wall is proposed for demolition to allow for landscaping and OSD tank. External levels along gridline B1 will determine the depth of retaining walls required.

4.2.4 Superstructure

The current superstructure scheme is to be a braced frame with columns placed at approx. 7m centres as per the current architectural layout. Lateral resistance is to be provided by 250mm thick in-situ reinforced core walls, to an 850mm deep footing supported by piles to rock. Generally, column sizes are 500x500 (520mm diameter if preferred). Refer to the below image from Robot Structural Analysis model indicating the typical superstructure elements.



4.2.5 Floor Systems

We developed post tensioned flat plate, composite steel and mass timber options during the schematic phase to assist with preliminary costing. While each option had its relative benefits and weaknesses, the flat plate option is preferred given its suitability to the current grid layout, inherent vibration performance, slim profile for ease of services reticulation and formwork simplicity.

Post Tensioned Flat plate

This is the most widely used structural system due to the availability of skilled labour, slim structural depth, ease of formwork, ability to achieve long spans and its inherent vibration performance. Typical spans in Block A are 6.9 m by 8.7m, leading to a 250mm thick flat plate required as seen in appendix A. This option would allow for a flat soffit throughout and could accommodate ease of reticulation of services, and wet area set downs of up to 50mm without the need for soffit folds (depending on location). Only one transfer member is required under the current architectural layout, which will consist of deep beam relative to load and span.

Given the intended use as a research facility, Level 01 “research assessment zone” must achieve a Response Factor RF = 1 to allow for installation of certain vibration sensitive equipment, as stated by “White Noise Acoustics” consultant. The flat plate in this zone jumps from 250mm thick to 280mm thick to accommodate this requirement. All other floors will achieve an RF value of < 4, which is suitable for a typical office building. It must be noted that if the acoustic consultant states that we will require and RF < 1, we will likely have to install secondary slabs on isolated springs to accommodate this.

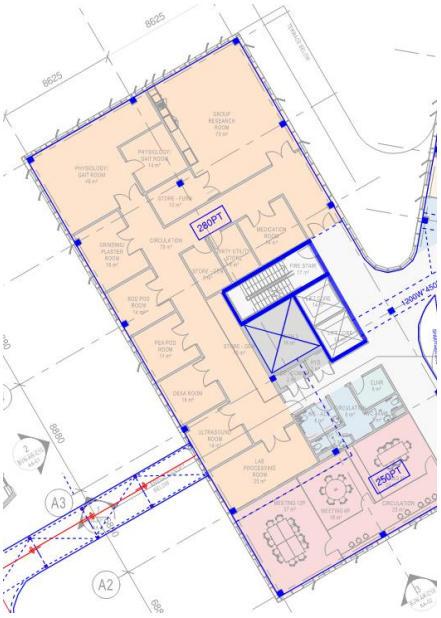


Figure 7 - Typical Flat Plate Option

Figure 6 - Typical PT Slab under construction

The superstructure will be braced by 250 mm thick core walls. These walls will require additional ‘boundary element’ reinforcement to deal with localised tensile and compressive stresses.

4.2.6 Architectural Features

Several architectural features are proposed for the project that require structural input, as described below.

Atrium zone

This area must accommodate a tiered seating amphitheatre running from Lower Ground 1 to Ground Floor slab, this will simply consist of a suspended RC stair system spanning from the two levels, supported at midspan by an RC retaining wall wall.

Suspended above this amphitheatre will be a switch back stair system, with the aim of having this stair as a double cantilever with no support at the landing. Such stair systems are inheritably vibration sensitive (bouncy) and require larger than regular members to increase stiffness. This stair system would require 300*200*10RHS stringers, with steel plate treads, supported by PT bands at the upper and lower landing for support, as shown in Appendix A. Stair treads and finishes are TBC.

Alternatively, the landing can be suspended from the terrace slab over using McAlloy bars, allowing for smaller steel sections and less critical connections at landings.

Link bridges

Two link bridges are proposed to connect Ground floor to the MCS Building to the west and Building D of the Campbelltown Hospital Complex to the east. The eastern bridge to Building D will consist of an extension of the suspended slab on ground, as the natural ground in this zone is almost level with the bridge. Further information of the existing Building D existing structure is required to establish if it can support the new bridge vertically. The bridge is expected to be partially enclosed with louvers allowing airflow, the roof and walls will consist of steelwork braced back to the level 1 structural slab.

The eastern link bridge will be suspended approximately 4m above ground and will aim to mimic the existing bridge servicing the MCS building, which is a 650mm deep beam tapering to 300mm deep at edges. The structure will be stabilised in the east-west direction by a portalised concrete frame to ground, a cantilever RC column in the middle, and fixed to the main structure to the east. A steel portalised frame will provide an enclosure for the walkway, which will be braced back to the main structure with steel roads. No load will be applied to the existing structure, at which point a flexible movement joint with adequate drainage must be provided.

Terrace garden

The terrace zone is elevated above the main entrance and will consist of a continuation of the internal PT slab, allowing it to support the elevated planter beds proposed in the area. Preliminary sizes can be seen in Appendix A. Loading from planters, and details of planter beds in this zone must be confirmed.

Planters

Planters are proposed throughout the building and will be designed for as per TURF landscaping package.

Set-downs

To date it has been indicated that 150mm setdowns will be required for external areas, and 50mm for wet areas. To avoid excessive soffit fold formwork costing, we recommend set-downs be kept to a minimum where possible.

4.2.7 Provisions for Future Expansion

No areas have been identified for future expansion at the time of writing this report.

5.0 Design Criteria

5.1 BCA Classification

A BCA report has been submitted by Group DLA, dated 23/07/2021. Refer to the following relevant extracts:

3.3 BCA Description / Details

Characteristic	Description
Type of Construction:	Type A
Classification	Class 5 *
Floor Area of Building:	Approximately 6,500m²
Max Fire Compartment Size:	Approximately 6,500m²
Rise in Storeys:	5 (five)
Levels Contained:	5 (five)
Effective Height ***	Approx. 17 m
Fire Compartments:	1 (one)
Climate Zone:	Zone 6
Importance Level (BCA B1.2) **	Importance Level 2 (Structural Engineer to confirm)
Earthquake Design Category (AS 1170.4)	II (Structural Engineer to confirm)

Table 5 – Building Characteristic

Figure 8 - BCA Extract

We can confirm the earthquake design category and importance levels listed above are suitable for the structural design. However, following discussions with the client and architect, it has been agreed to design this structure to Importance level 3, which increases the design to Earthquake Design Category 3.

It must be noted the BCA report has classified the building as 5, assuming no laboratories existing in the building then this is satisfactory.

5.2 Design Codes

The structural design of the project will be carried out in accordance with the following Australian Standard Codes of Practice.

- Building Code of Australia
- AS1170: 2002 Part 0 — General Principles
- AS1170: 2002 Part 1 — Permanent imposed and other actions
- AS1170: 2021 Part 2 — Wind actions
- AS1170: 2007 Part 4 — Earthquake Actions in Australia
- AS3600: 2018 — Concrete Structures
- AS3700: 2018 — Masonry Structures
- AS4100: 2020 — Steel Structures Code
- AS4600: 2018 — Cold-formed Steel Structures

5.3 Design Loads

Loads and their appropriate load combinations will be in accordance with the above listed codes. The applied loading is summarised in this section.

Self-Weight loads shall be calculated as provided for in the current version of AS1170. Part 1: Permanent, Imposed and Other Actions.

Material densities are taken from AS1170.1 and manufacturer guidelines (where appropriate).

Live loads are taken from AS1170. Part 1: Permanent, Imposed and Other Actions. The following table describes the more significant loading on the project, and further clarification of floor loads can be obtained by referring to the loading diagrams in the structural set of drawings. Pattern Live loads shall be considered if applicable in accordance with Clause 2.4.4 of AS3600. Live load reduction shall be applied to AS1170.1 if appropriate for vertical elements.

Table 1 - Floor Loads

Floor Type	Uniform Imposed Load (kPa)	Super Imposed Dead Load (kPa)
Stairs, ramps	4.0	0.75
Corridors, circulation areas and foyer spaces	5.0	1.5
Office Spaces	3.0	1.5
Labs	3.0	1.5
Plant rooms	5.0	0.75
Construction Loading	T.B.C	-
Library	5.0	1.5
Compactus	10.0	1.5
Truck Dock	10.0	0.25
Carpark	2.5	0.25
Store Rooms	5	0.25
Staff Areas, design studio	4.0	1.5
Steel Roofs	0.25	0.5

1KPa has been allowed for to accommodate façade loads.

5.3.1 Wind Loads

Wind Load will be assessed in accordance with AS1170. 2, using following parameters.

Table 2 - Wind Loads

Item	Value
Location	Region A2
Importance Level	2
Vu	46m/s
Vs	37m/s
Ms	1.0
Mt	1.0
Md	1.0
Terrain Category	3.0

5.3.2 Earthquake Loads

Earthquake loads will be assessed in accordance with AS1170.4-2007, and the design parameters are as follow:

Table 3 - Earthquake Loads

Item	Value
Importance Level	2
Probability Factor, Kp	1.0
Hazard Factor, Z	0.08
Sub-Soil Class	Ce
Earthquake Design Category	ii
Structural Ductility Factor, μ	2
Structural Performance Factor, Sp	0.77

5.3.3 Robustness

In accordance with the requirements of AS1170.0/2002 Amendment 3 the robustness load is taken as 1.5% of the gravity load (G + ψcQ).

5.3.4 Blast and Impact Loading

It is noted that the design of the building and structure and boundary walls if any, has not been designed for any vehicle impact loads (other than car-park barriers loads taken from AS1170.1), nor has the building or its structure been designed for any blast/explosion loadings.

5.3.5 Balustrade Loading

According to AS1170.1 Table 3.3, horizontal balustrade loading for 1.5kN/m for C1/C2 Occupancy, and 0.75kN/m for C3 occupancy.

5.4 Limit State Design Criteria for structural elements

5.4.1 General Design Approach

The limit state design for strength, serviceability and stability of the relevant structural elements within the building will generally follow the established criteria in the relevant material design codes AS4100 and AS3600 unless noted otherwise below.

5.4.2 Structural Movements

Building Sways (Deflection) subject to service wind loads and earthquake shall satisfy.

- Total lateral deflection to not exceed height/500
- Inter-storey deflection to not exceed 1.5% storey height

Floor Deflections to AS3600: 2018 and AS4100: 2020,

- Incremental slab deflection less than span/500 for flexible partitions, span/1000 for rigid partition walls without regularly spaced movement joints
- Total long-term deflection less than span/250 or 25mm or span/500 for rigid partition walls without regularly spaced movement joints
- Cantilever slab – Total long-term deflection - span/150
- Transfer Structures – Span/1000 or 10 mm
- limited to span/250 total and span/500 incremental for flexible partitions

5.4.3 Fire Resistance

The BCA report states the structure must be designed to achieve FRL's suitable for a Type A, class 5 structure. Depending on the structural system in question, elements will be designed to FRL's as outlined by the NCC, and to relevant design codes. The following FRL's must be achieved as per the NCC:

Columns: 120/-/- (internal load bearing)

Columns: 120/-/- (external load bearing)

Floors: 120/120/120

Core walls: 120/120/120

Roof: 120/60/30

** Refer to table 3 in NCC Vol 1 2019

5.4.4 Crack Control

Generally, all internal suspended slabs will be designed for a moderate degree of crack control, except for external roof slabs over living areas where a strong degree of crack control will be adopted. For Post tension slabs, this will result in a minimum post tension stress of 1.4MPa and 2.0MPa for moderate and strong degree of crack control, respectively. Refer to Section 4.8 for further minimum requirement to external slabs over living areas.

Pour strips or Temporary Movement Joints (TMJs) will be introduced where appropriate to minimise the long-term creep and shrinkage effect of the concrete and these will be coordinated with the builder construction program.

5.4.5 Minimum Connection Requirements and Ties

All connections, including but not limited to beam/slabs to columns/wall, precast, etc, shall be designed to clause 6.2.3 AS1170.1 for the transfer of the lateral loads and robustness.

5.4.6 Durability

Durability to be to AS3600/AS4100/AS2311 / 2312. Maintenance levels and design life are to be nominated by the client regarding surface coatings.

5.4.7 Footfall induced vibrations

All laboratory spaces which house sensitive equipment will be designed for a minimum response factor (R) of 1. This is based on preliminary advice from Pulse White Noise Acoustic. All other areas will be deemed office space and designed to an RF of (4). The exact locations where RF =< 1 are yet to be confirmed. Refer to the below extract from "A design Guide for footfall induced vibrations" to put "RF" values into context. It must be noted that if an RF < 1 is required, this should take place on ground bearing slabs, which will likely require secondary slabs on isolated springs.

Table 3.2
Generic vibration criteria for sensitive equipment.

Criterion curve	Max. velocity level* µm/sec (RMS)	Detail size** microns	Description of use
Workshop (ISO2631 and BS6472) *R* = 8, ASHRAE J	800	N/A	Distinctly perciptible vibration. Appropriate to workshops and non-sensitive areas.
Office (ISO2631 and BS6472) *R* = 4, ASHRAE I	400	N/A	Perceptible vibration. Appropriate to offices and non-sensitive areas.
Residential day (ISO2631 and BS6472) *R* = 2, ASHRAE H	200	75	Barely perceptible vibration. Appropriate to sleep areas in most instances. Probably adequate for computer equipment, probe test equipment and low-power (to 20X) microscopes.
Operating theatre (ISO2631 and BS6472) *R* = 1, ASHRAE F	100	25	Threshold of perception. Suitable for sensitive sleep areas. Suitable in most instances for microscopes to 100X and for other equipment of low sensitivity.
VC-A (BBN-A or ASHRAE E) *R* = 0.5	50	8	Adequate in most instances for optical microscopes to 100X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B (BBN-B or ASHRAE D) *R* = 0.25	25	3	An appropriate standard for optical microscopes to 1000X, inspection and lithography equipment (including steppers) to 3 micron line widths.
VC-C (BBN-C or ASHRAE C) *R* = 0.125	12.5	1	A good standard for most lithography and inspection equipment to 1-micron detail size.
VC-D (BBN-D or ASHRAE B) *R* = 0.0625	6	0.3	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems, operating to the limits of their capability.
VC-E (BBN-E or ASHRAE A) *R* = 0.03125	3	0.1	A difficult criterion to achieve in most instances. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems and other systems requiring extraordinary dynamic stability.

Notes
* As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz.
** The detail size refers to the line widths for microelectronics fabrication, the particle(cell) size for medical and pharmaceutical research, etc. the values given take into account the observation that the vibration requirements of many items depend upon the detail size of the process.

Figure 9 - Extract from " A design guide of footfall induced vibrations (2006)"

BVN have identified the areas where sensitive equipment may be required, which will be limited to the zones hatched in orange on level 1, Block A. In order to achieve an RF=1 in this zone, slabs must increase from 250 to 280mm thick.

The analysis of the slab has been carried out using Robot Structural Analysis, with excitation forces calculated using “Concrete Centre (2006) Slabs” within the program. The following values have been considered in the analysis:

Footfall frequency range: 1.0Hz – 2.0Hz

Walkers Mass: 70Kg

Level of damping: 5%

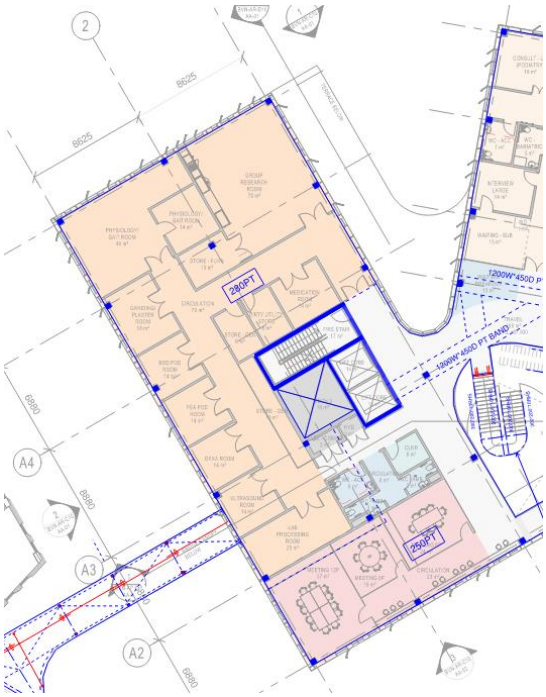


Figure 11 - Vibration sensitive zone Level 1

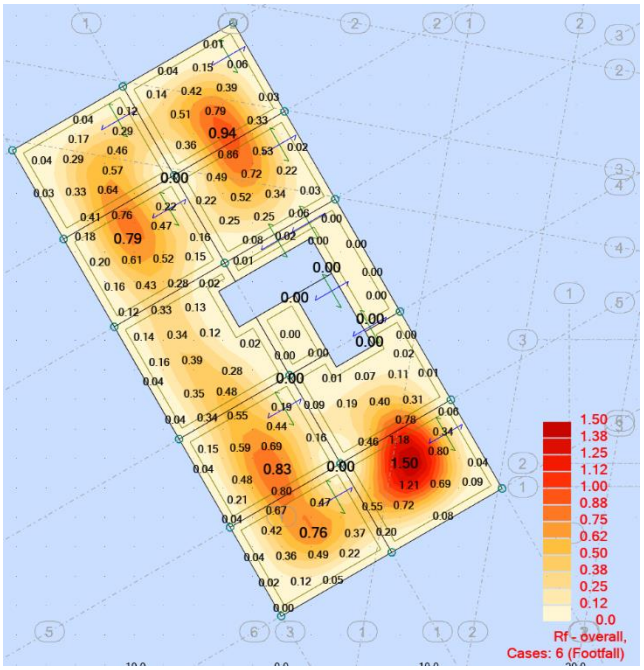


Figure 10 - Robot output (RF Values)

6.0 Conclusion

After reviewing the architectural layout and geotechnical conditions, we have provided the required structural scheme for the development. The preferred system from an economical, constructability and architectural suitability point of view is the flat plate scheme.

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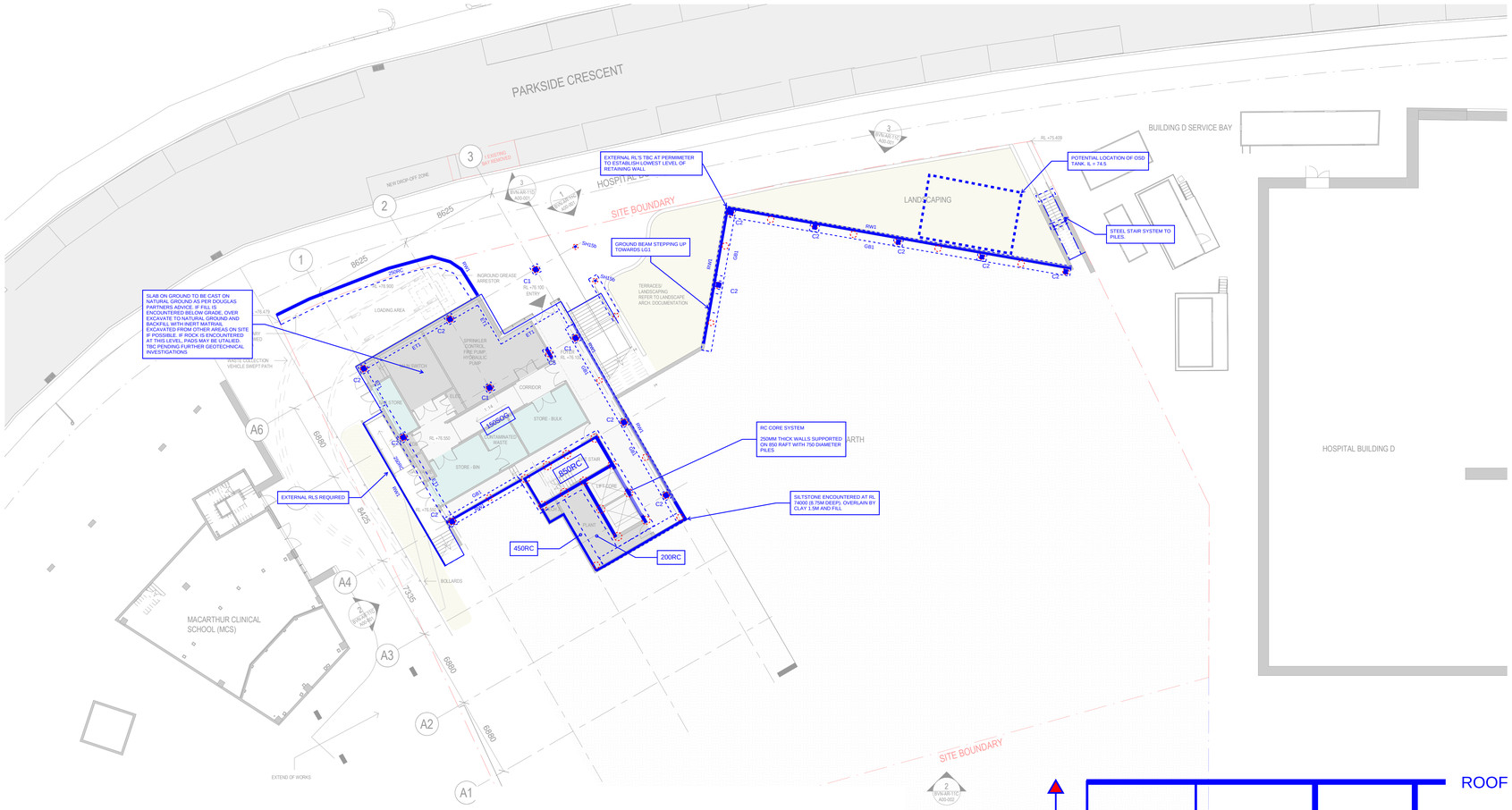
Appendix A

Structural Sketches for 100% SD

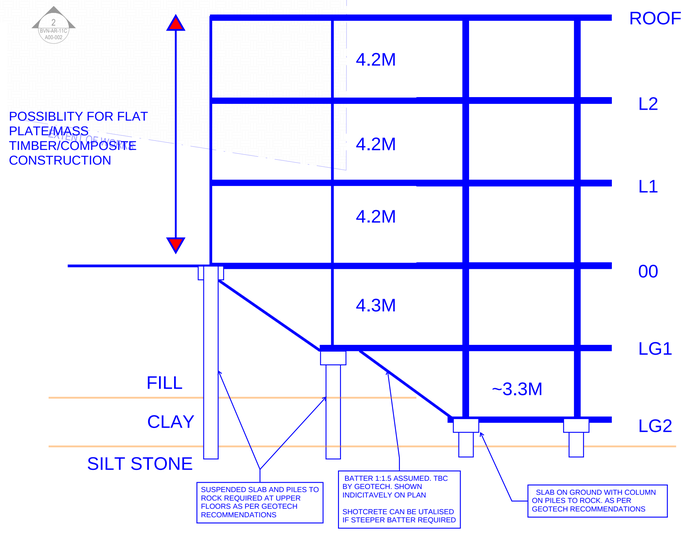
NOTE

ITEMS TO BE CONFIRMED:
- LANDSCAPE LOADING/PLANTER SECTIONS
- EXTERNAL RL'S AT BUILDING PERIMETER
- EXISTING STRUCTURAL DRAWINGS BUILDING D



LEGEND

	WALL OVER/UNDER
	WALL UNDER
	COLUMN OVER AND UNDER
	COLUMN OVER
	COLUMN UNDER
	FLOOR PLATE OUTLINE
GB1	450D 700W RC GROUND BEAM
EB1	400D 600W RC EDGE BEAM
ET1	300D 400 WIDE EDGE THICKENEING
RW1	200MM THICK INSITU RC RETAINING WALL
C1 500*500	P1 750 DIAMETER PILE (SUPPORTING CORE WALLS)
C2 450*450	P2 600 DIAMETER PILE (SUPPORTING COLUMNS)
	P3 450 DIAMETER PILE (ALL OTHER PILES)
C4 1000*300	CORE WALLS 250THICK INSITU RC WALLS
C5 800*200	PC1 600D 800W 800 L PILE CAP (SUPPORTING COLUMNS)
	PC2 300D 600 W 600L PILE CAP (SUPPORTING SSOG)
	PC3 800D 1000W 3400MML PILE CAP (AT BRIDGE)



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Macarthur - SSDA 100% STRUCTURAL

TTW
Job 201940
By BN
Date 7-10-2021

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10726 CATHERINE SKINNER
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CLIENT
WESTERN SYDNEY UNIVERSITY

PROJECT
MACARTHUR MEDICAL RESEARCH CENTRE (MMRC), CAMPBELLTOWN

BVN PROJECT NUMBER
201100a

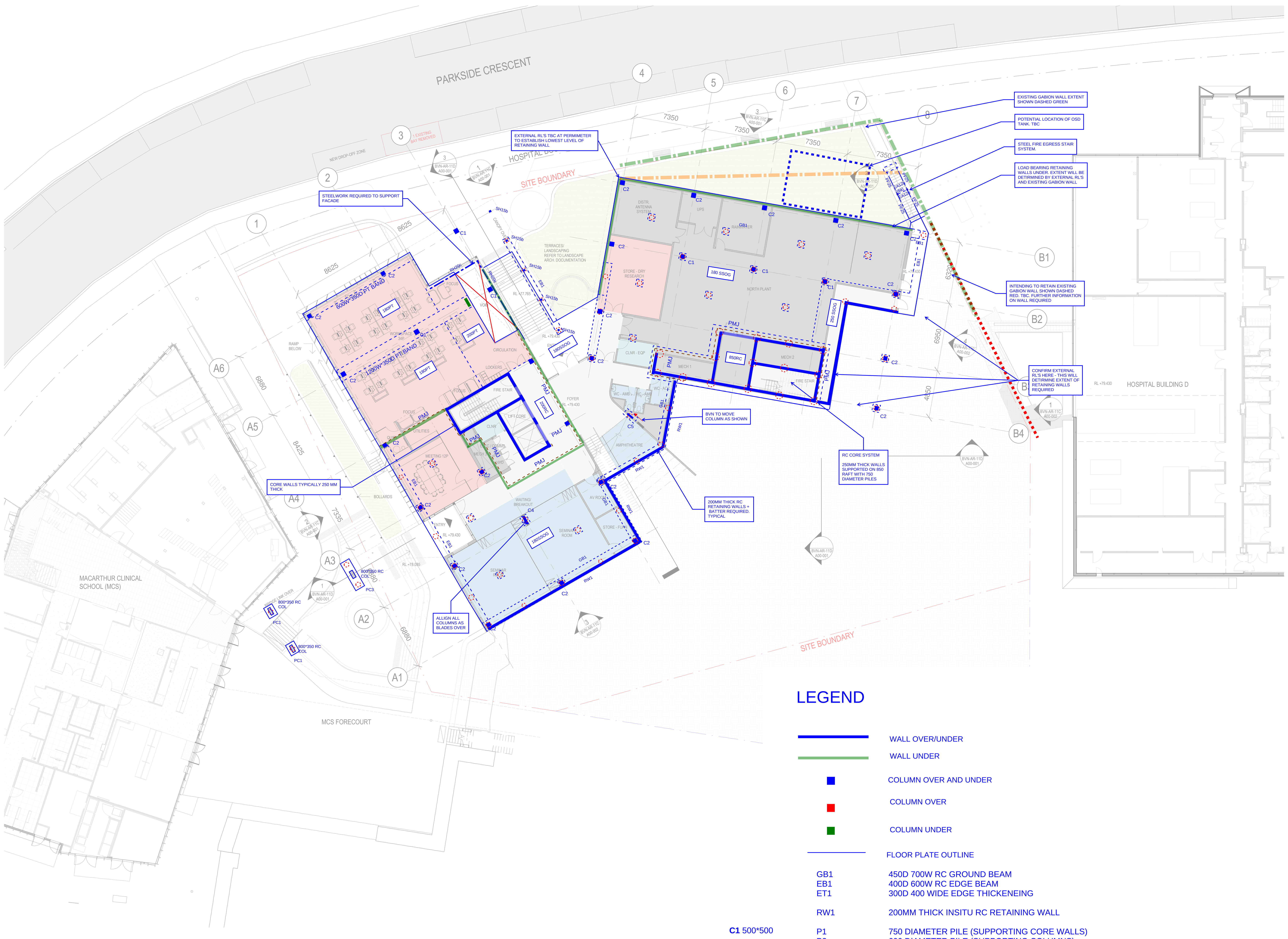
DRAWING KEY

Shared Public
Dry Research
Clinical Research
Research Assessment Zone
Logistics and Support
Travel
Plant

TRUE NORTH
PROJECT NORTH
GRAPHIC SCALE
0 4000 10000
SCALE
200@B1
STATUS
FOR INFORMATION
DRAWING
GENERAL ARRANGEMENT PLAN - LEVEL LOWER GROUND 02
AR-BVN-AR-11B B01-000
ISSUE
02

NOTE

ITEMS TO BE CONFIRMED:
- LANDSCAPE LOADING/PLANTER SECTIONS
- EXTERNAL RL'S AT BUILDING PERIMETER
- EXISTING STRUCTURAL DRAWINGS BUILDING D



LEGEND

WALL OVER/UNDER
WALL UNDER
COLUMN OVER AND UNDER
COLUMN OVER
COLUMN UNDER
FLOOR PLATE OUTLINE

	GB1	450D 700W RC GROUND BEAM
	EB1	400D 600W RC EDGE BEAM
	ET1	300D 400 WIDE EDGE THICKENEING
	RW1	200MM THICK INSITU RC RETAINING WALL
C1 500*500	P1	750 DIAMETER PILE (SUPPORTING CORE WALLS)
	P2	600 DIAMETER PILE (SUPPORTING COLUMNS)
C2 450*450	P3	450 DIAMETER PILE (ALL OTHER PILES)
C4 1000*300	CORE WALLS	250THICK INSITU RC WALLS
C5 800*200	PC1	600D 800W 800 L PILE CAP (SUPPORTING COLUMNS)
	PC2	300D 600 W 600L PILE CAP (SUPPORTING SSOG)
	PC3	800D 1000W 3400MML PILE CAP (AT BRIDGE)

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Dry Research
Clinical Research
Research Assessment Zone
Logistics and Support
Travel
Plant

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PROJECT
MACARTHUR MEDICAL RESEARCH CENTRE (MMRC), CAMPBELLTOWN
BVN PROJECT NUMBER
2011004
DRAWING KEY

TRUE NORTH
PROJECT NORTH
GRAPHIC SCALE
0 4000 10000
SCALE
1 : 200@B1
STATUS
FOR INFORMATION
DRAWING
GENERAL ARRANGEMENT PLAN - LEVEL LOWER GROUND 01
AR-BVN-AR-11B
B02-000
ISSUE
02

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By BN
Date 7-10-2021

NOTE

ITEMS TO BE CONFIRMED:
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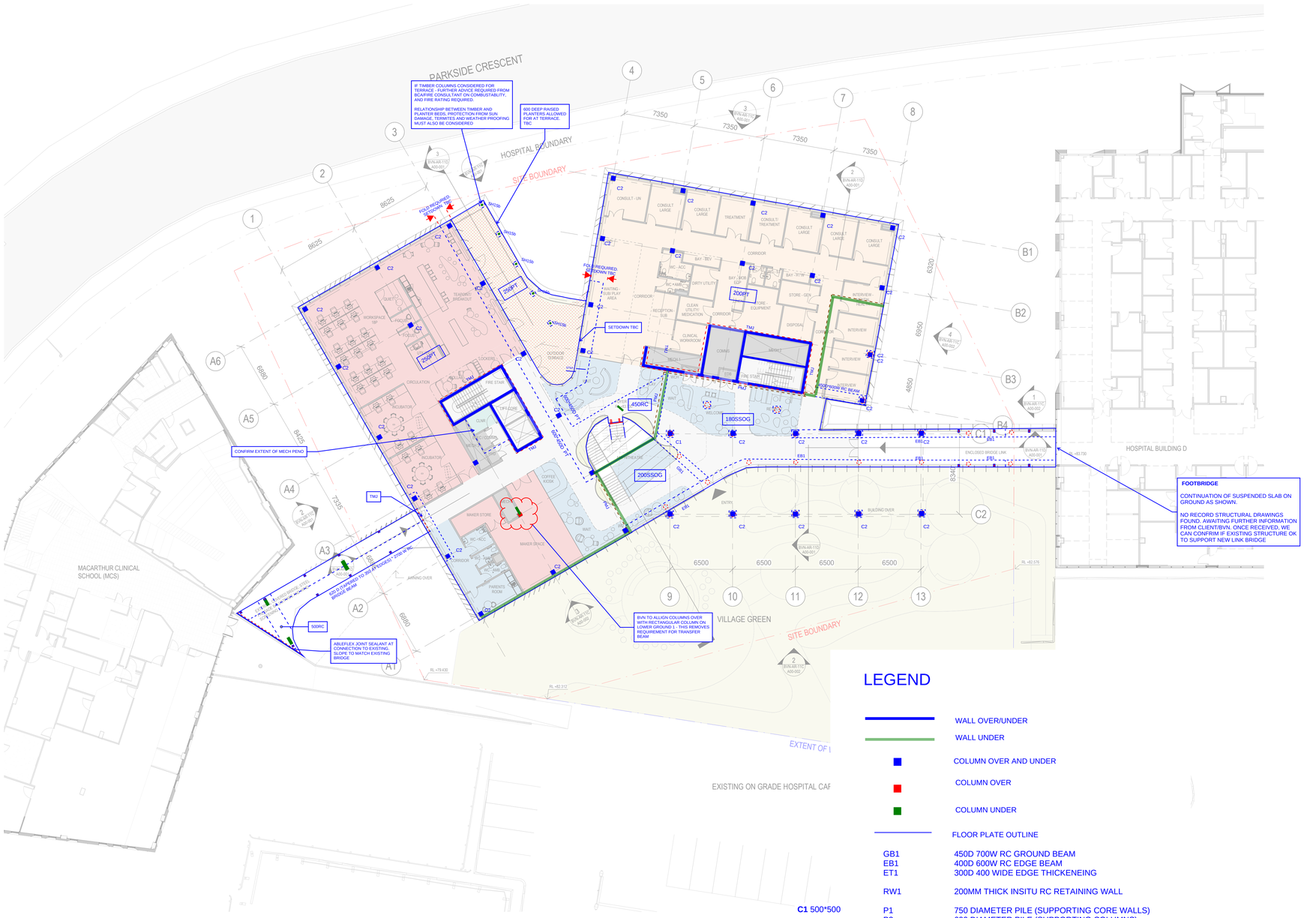

LEGEND

- WALL OVER/UNDER
- WALL UNDER
- COLUMN OVER AND UNDER
- COLUMN OVER
- COLUMN UNDER
- FLOOR PLATE OUTLINE

	GB1	450D 700W RC GROUND BEAM
	EB1	400D 600W RC EDGE BEAM
	ET1	300D 400 WIDE EDGE THICKENEING
	RW1	200MM THICK INSITU RC RETAINING WALL
C1 500*500	P1	750 DIAMETER PILE (SUPPORTING CORE WALLS)
C2 450*450	P2	600 DIAMETER PILE (SUPPORTING COLUMNS)
	P3	450 DIAMETER PILE (ALL OTHER PILES)
C4 1000*300	CORE WALLS	250THICK INSITU RC WALLS
C5 800*200	PC1	600D 800W 800 L PILE CAP (SUPPORTING COLUMNS)
	PC2	300D 600 W 600L PILE CAP (SUPPORTING SSOG)
	PC3	800D 1000W 3400MML PILE CAP (AT BRIDGE)

- Shared Public
- Dry Research
- Clinical Research
- Research Assessment Zone
- Logistics and Support
- Travel
- Plant

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MACARTHUR MEDICAL RESEARCH CENTRE (MMRC), CAMPBELLTOWN

BVN PROJECT NUMBER
201100

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 4000 10000

SCALE
1:200@B1

STATUS
FOR INFORMATION

DRAWING
GENERAL ARRANGEMENT PLAN - LEVEL 00

AR-BVN-AR-11B L00-000

ISSUE
02

NOTE

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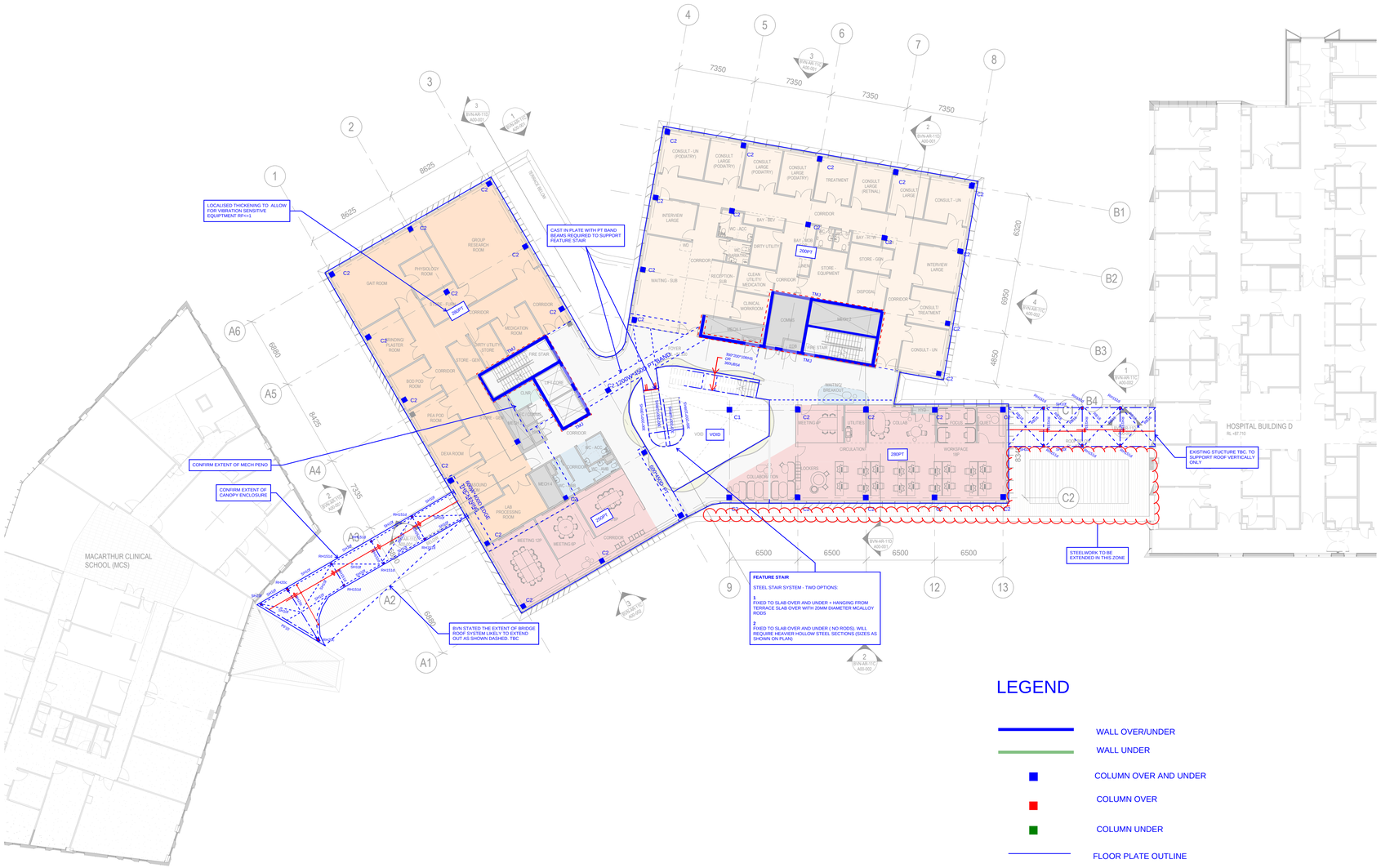

LEGEND

		WALL OVER/UNDER
		WALL UNDER
		COLUMN OVER AND UNDER
		COLUMN OVER
		COLUMN UNDER
		FLOOR PLATE OUTLINE
	GB1	450D 700W RC GROUND BEAM
	EB1	400D 600W RC EDGE BEAM
	ET1	300D 400 WIDE EDGE THICKENEING
	RW1	200MM THICK INSITU RC RETAINING WALL
C1 500*500	P1	750 DIAMETER PILE (SUPPORTING CORE WALLS)
C2 450*450	P2	600 DIAMETER PILE (SUPPORTING COLUMNS)
	P3	450 DIAMETER PILE (ALL OTHER PILES)
C4 1000*300	CORE WALLS	250THICK INSITU RC WALLS
C5 800*200	PC1	600D 800W 800 L PILE CAP (SUPPORTING COLUMNS)
	PC2	300D 600 W 600L PILE CAP (SUPPORTING SSOG)
	PC3	800D 1000W 3400MML PILE CAP (AT BRIDGE)

- Shared Public
- Dry Research
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- Research Assessment Zone
- Logistics and Support
- Travel
- Plant

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By BN
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BVN PROJECT NUMBER
201100a

DRAWING KEY

TRUE NORTH | PROJECT NORTH

GRAPHIC SCALE
0 4000 10000

SCALE
200@B1

STATUS
FOR INFORMATION

DRAWING
GENERAL ARRANGEMENT PLAN - LEVEL 01

AR-BVN-AR-11B L01-000

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02

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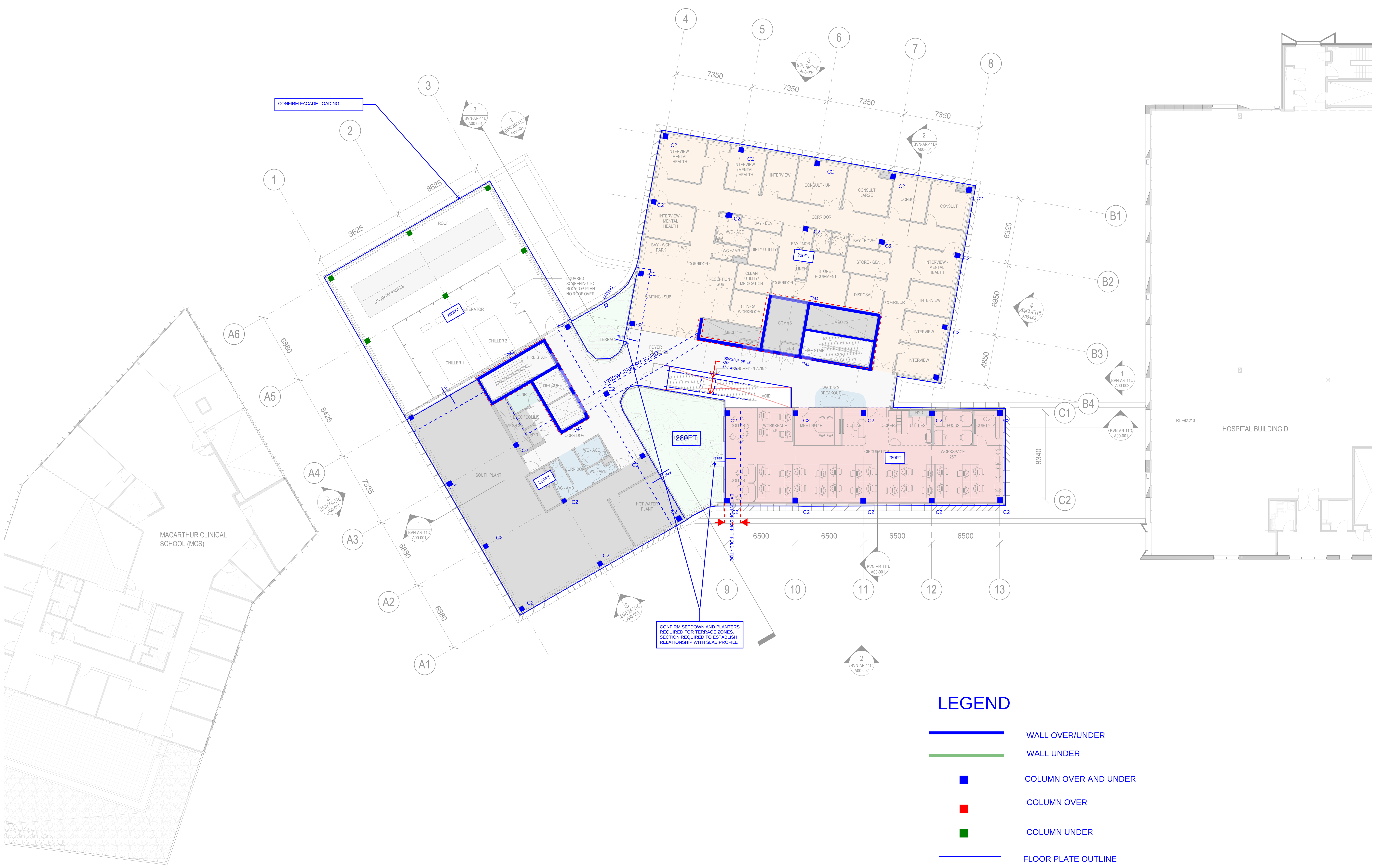

LEGEND

	WALL OVER/UNDER
	WALL UNDER
	COLUMN OVER AND UNDER
	COLUMN OVER
	COLUMN UNDER
	FLOOR PLATE OUTLINE
GB1	450D 700W RC GROUND BEAM
EB1	400D 600W RC EDGE BEAM
ET1	300D 400 WIDE EDGE THICKENEING
RW1	200MM THICK INSITU RC RETAINING WALL
P1	750 DIAMETER PILE (SUPPORTING CORE WALLS)
P2	600 DIAMETER PILE (SUPPORTING COLUMNS)
P3	450 DIAMETER PILE (ALL OTHER PILES)
CORE WALLS	250THICK INSITU RC WALLS
PC1	600D 800W 800 L PILE CAP (SUPPORTING COLUMNS)
PC2	300D 600 W 600L PILE CAP (SUPPORTING SSOG)
PC3	800D 1000W 3400MML PILE CAP (AT BRIDGE)

C1 500*500
C2 450*450
C4 1000*300
C5 800*200

Shared Public
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Logistics and Support
Travel
Plant

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BVN PROJECT NUMBER
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DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
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SCALE
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STATUS
FOR INFORMATION

DRAWING
GENERAL ARRANGEMENT PLAN - LEVEL 02

AR-BVN-AR-11B L02-000

ISSUE 02

NOTE

ITEMS TO BE CONFIRMED:
- LANDSCAPE LOADING/PLANTER SECTIONS
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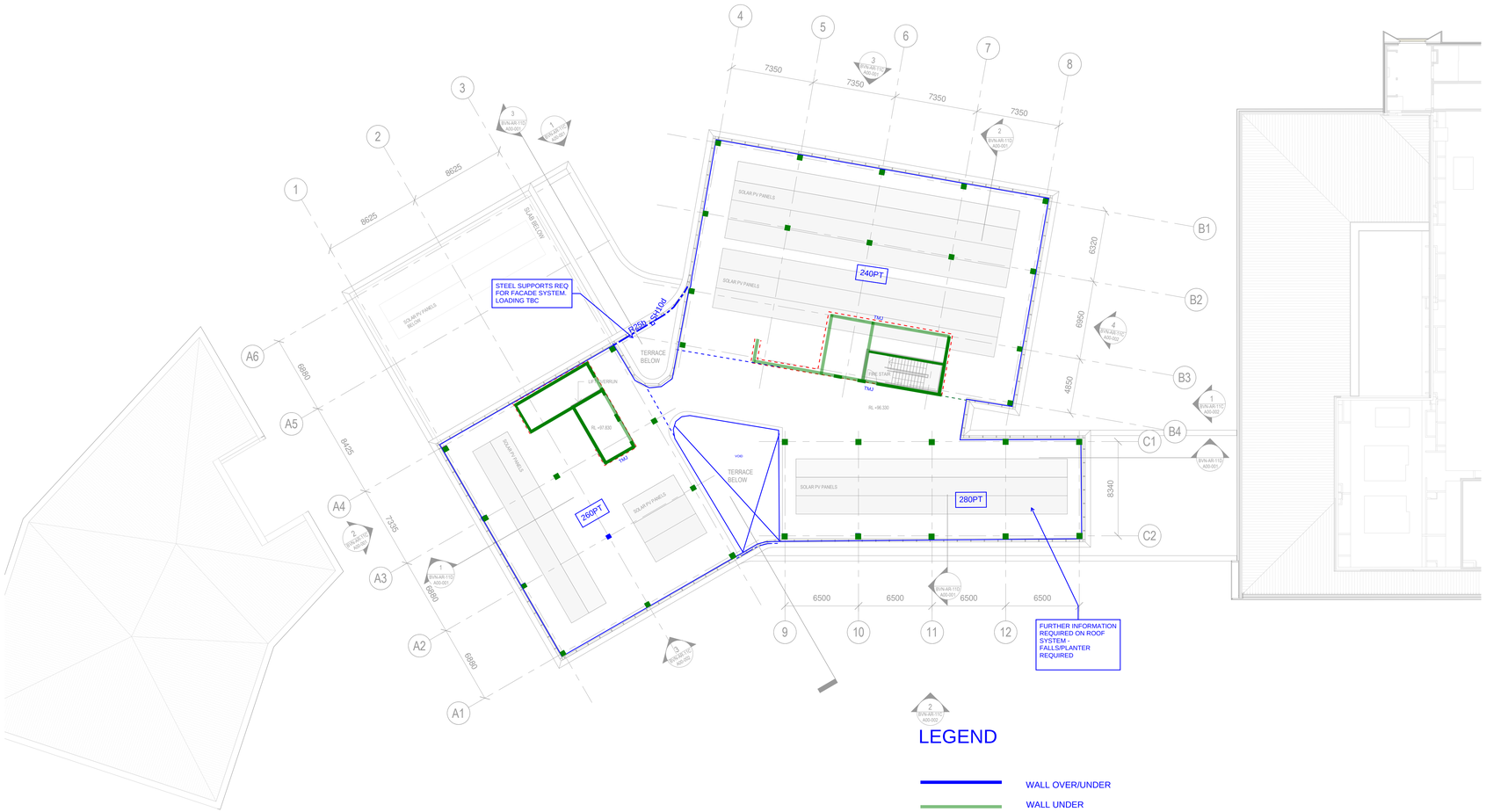

LEGEND

	WALL OVER/UNDER
	WALL UNDER
■	COLUMN OVER AND UNDER
■	COLUMN OVER
■	COLUMN UNDER
	FLOOR PLATE OUTLINE
GB1	450D 700W RC GROUND BEAM
EB1	400D 600W RC EDGE BEAM
ET1	300D 400 WIDE EDGE THICKENEING
RW1	200MM THICK INSITU RC RETAINING WALL
P1	750 DIAMETER PILE (SUPPORTING CORE WALLS)
P2	600 DIAMETER PILE (SUPPORTING COLUMNS)
P3	450 DIAMETER PILE (ALL OTHER PILES)
COLUMNS	TYPICALLY 450 SQUARE COLUMNS
CORE WALLS	250THICK INSITU RC WALLS
PC1	700D 800W 800 L PILE CAP (SUPPORTING COLUMNS)
PC2	300D 600 W 600L PILE CAP (SUPPORTING SSOG + ETAINING WALLS)
PC3	800D 800W 3400MML PILE CAP (AT BRIDGE)

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Job 201940
By BN
Date 7-10-2021

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BVN PROJECT NUMBER
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DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 4000 10000

SCALE
@ 200@B1

STATUS
FOR INFORMATION

DRAWING
GENERAL ARRANGEMENT PLAN - LEVEL ROOF

AR-BVN-AR-11B
L03-000

ISSUE
02