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Our Ref: PSM5710-010L FINAL

1 December 2025

Landcom
Level 14
60 Station Street
Parramatta NSW 2150

RE: BTR TOWER AT 607 PACIFIC HIGHWAY, CHATSWOOD, NSW - GEOTECHNICAL COMMENTS ON SEARS - GROUND AND WATER CONDITIONS

1. Executive Summary

This report has been prepared by PSM to accompany a State Significant Development Application (SSDA) for the proposed Built to Rent (BTR) Tower at 607 Pacific Highway, Chatswood, NSW ('**the Site**') in the Willoughby Local Government Area (LGA).

This report has been prepared to address the site-specific Secretary's Environmental Assessment Requirements (SEARs) (application number: SSD-100006957).

2. Introduction

The proposed development will comprise the following:

- The Site was previously used to be a part of the Sydney Metro construction site and is currently an empty lot, Inset 1.
- The proposed development would consist of one high-rise "Build to Rent" apartment tower with an approximate height of 79.250 m. The BTR tower will include twenty-three (23) levels including a ground floor level, a roof level, and no proposed basements.

PSM has previously issued a Geotechnical Due Diligence report for the entire 607 Pacific Highway, Chatswood site, refer to PSM5710-002R dated 6 March 2025 [**PSM Due Diligence Report**]. PSM Geotechnical Due Diligence Report provides the expected geotechnical conditions at the Site and geotechnical risk presents at the Site. This report is attached as Appendix A.

Specifically, this letter has been prepared to respond to the SEARs requirement listed below in Table 1 (list numbering added for clarity).

Table 1 – SEARs Requirements

Item	Description of Requirement
12. Ground and Water Conditions	1. Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site and including the soil erosion. 2. Where required provide a Groundwater Impact Assessment in accordance with relevant Groundwater Guidelines. 3. If the proposed development is on land identified as having high salinity or acid sulfate soil potential in an EPI provide a Salinity Management Plan or Acid Sulfate Soil Management Plan that includes appropriate management measures and strategies.

Inset 1: Locality plan showing the approximate extent of the Site.

3. Assessment of SEARs – Geotechnical Items

This section presents our response to Item 12 of the SEARs as listed in Table 1.

3.1 Item 1 – Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site and including the soil erosion.

PSM Response:

Details of the earthworks to be undertaken at the Site (e.g. civil cut-fill plans) are not known to PSM however the provided architectural plans by FK Australia dated 3 December 2025 indicate that the proposed development may include some excavation of soil and rock to accommodate a ground floor. We note there are no proposed basement levels. We assess that from a geotechnical point of view, the proposed development will likely have close to no impact on the soil resource at the Site.

With regard to the impact on existing related infrastructure, the existing structures / buildings on the Site include Mowbray House and Sydney Metro Chatswood Dive infrastructures. The proposed development is expected to be supported on piles. The design of the piles will be designed to avoid impacts on neighbouring structures.

Further, appropriate erosion control will be implemented during construction and the civil designer will design the stormwater system, surface gradients and landscaping to control surface water flows and minimize soil erosion and the effects of soil erosion. We note that the majority of the Site will be sealed by the proposed development, and appropriate surface runoff collection and disposal systems will be included in the design. We understand riparian lands / areas are not present. The impacts of the proposed development on riparians lands on and near the Site will be minimal given appropriate erosion and surface water flows controls as mentioned above are implemented.

This section will be revised at due diligence stage following the provision of the proposed earthworks plan (eg. Cut and fill plan). An impact assessment for the Sydney Metro Chatswood Dive structure will be undertaken separately once the actual structural details of the development are known (e.g. building loads and arrangements).

3.2 ITEM 2 – Where required provide a Groundwater Impact Assessment in accordance with relevant Groundwater Guidelines.

The proposed development does not involve significant excavation or basements. On this basis, the proposed development will have a negligible impact on groundwater resources at the Site, thus a groundwater impact assessment will not be required.

This section will be revised at due diligence stage following the provision of the proposed earthworks plan (eg. Cut and fill plan).

3.3 ITEM 3 - If the proposed development is on land identified as having high salinity or acid sulfate soil potential in an EPI provide a Salinity Management Plan or Acid Sulfate Soil Management Plan that includes appropriate management measures and strategies.

According to SEED[1] (Sharing and Enabling Environmental Data in NSW), the Site is classified as Class 5 based on the likelihood of the acid sulphate soils being present. Acid Sulfate soils are not typically found in Class 5 areas, however areas classified as Class 5 are located within 500 metres on adjacent class 1,2,3 or 4 land. It should be noted that Section 2.9 of the Site Audit Report from Geosyntec Consultants (ref. GSY0119_SAR dated 3 May 2021) indicates that potential of encountering acid sulfate soils is low as reported by other consultants.

If further investigation indicates otherwise, we recommend a suitably qualified Environmental Consultant to address the acid sulfate soil potential and to prepare an Acid Sulphate Soil Management Plan. This plan should be submitted as a condition of consent prior to the start of construction works.

High salinity is unlikely to be present, therefore salinity related impacts and management plan are not expected. However, if further geotechnical investigation indicates otherwise, a Salinity Management Plan (SMP) should be prepared as a condition of consent prior to the commencement of construction. The SMP would effectively

[1] https://datasets.seed.nsw.gov.au/dataset/

manage site salinity, minimise the effect of the proposed development on salinity processes and to protect the proposed development from salinity damage.

Further comments / inputs from other disciplines (e.g. civil designer, ecologist, etc.) should be requested if required.

4. Conclusion

This letter concludes that the proposed development (as designed) is suitable from a groundwater and geotechnical perspective and warrants approval.

Yours Sincerely

HENRY ZHANG
GEOTECHNICAL ENGINEER

STEPHANIE SALIM
ASSOCIATE GEOTECHNICAL ENGINEER

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PRINCIPAL

Encl.

Appendix A PSM Geotechnical Due Diligence Report (PSM5710-002R)

Appendix A
PSM Geotechnical Due Diligence Report (PSM5710-002R)

Sydney Metro Chatswood Dive Site at 607 Pacific Highway, Chatswood NSW

Geotechnical Due Diligence Study

PSM5710-002R 6 March 2025

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1. Introduction

This Geotechnical Due Diligence Report presents the results of a study undertaken at the Sydney Metro Chatswood Dive Site at 607 Pacific Highway (the Site). The work was undertaken following PSM's proposal email dated 27/02/2025 (PSM5710-001E).

The report provides geotechnical advice as follows to inform the Due Diligence stage assessments for the Site:

1. Collates in a single report the available information regarding the geotechnical conditions at the Site.
2. Summarises the activities that have occurred on site through historical and recent maps of the area.
3. Provides advice regarding the inferred subsurface conditions across the Site based on available information on site investigation and observations available on the Site.
4. Identifies the geotechnical risks associated with the Site and the proposed development, including discussion of:
    a. Expected founding conditions i.e. deep residual profile.
    b. Presence of buried historical foundation i.e. shallow and deep foundations.
    c. Likely groundwater and disposal conditions.
    d. Interaction of proposed high-rise basement and excavation retention with the brownfield site.
    e. Expected interface requirements for excavation and construction works, including effects on neighbouring Sydney Metro dive structure, heritage building, pacific highway, structures and services.

2. Reference Documents

Table 1 presents a list of reference documents which we have considered was part of this study. Some relevant elements of these documents have been reproduced and included in the Appendix A of this report.

Table 1 – List of Reference Documents

ID	Category	Title	Author	Date	Extract/reference
1	PSM Job Proposal	PSM5710-001E	PSM	27/02/2025	Appendix A
2	Proposed Development	Chatswood Dive Site – Urban Design options	Landcom/Urbis	27/02/2025	Appendix A
3	Proposed Development	Chatswood Dive Site – Property Snapshot	NSW Government	27/02/2025	Appendix A
4	Sydney Metro Report	TSE Geotechnical Interpretive Report (GIR)	PSM	23/03/2018	SMCSWTSE-JPS-TPW-GE-RPT-100001-00
5	Sydney Metro Report	TSE Geotechnical Factual Report (GFR)	Golder Associates	31/01/2018	1784301-041-R-Rev0
6	Sydney Metro Report	TSE Geotechnical Data Report (GDR)	Douglas Partners and Golder Associates	21/03/2017	1650773-041-R-Rev3
7	Online Sydney Metro Guidelines	Sydney Metro Underground Corridor Protection Technical Guidelines	Sydney Metro	April 2021	Appendix A; https://www.sydneymetro.info/sites/default/files/2021-09/ SM-Underground-Corridor-Protection-Technical-Guidelines.pdf

3. The Site

3.1 Proposed Development

'Chatswood Dive Site – Urban Design options' document indicates Urbis has been commissioned by Landcom to conduct high-level urban design studies to potentially acquire the Site to develop residential and commercial high rise. The document discussed 2 development options for the Site:

- Option 1: A fully compliant scheme, yielding between 594 to 622 dwellings. The building ranged from 14 to 16 floors with 1 to 3 basement floors.
- Option 2: A non-compliant scheme, seeking to vary maximum building height, FSR, quantum of non-residential floorspace and floorplate sizes. It would yield between 871 to 934 dwellings and would require a Planning Proposal. The building ranged from 25 to 27 floors with 1 to 3 basement floors.

The Floor Space Ratio (FSR) is 4:2:1 and the Height of Building (HOB) is 53 m.

3.2 Site Layout

The Site is located at 607 Pacific Highway adjacent to the Sydney Metro Chatswood Dive site. This is situated within the Willoughby City Council LGA. It is noted that currently the site is zoned as MU1 – Mixed Use, SP2 Infrastructure and RE1 Recreation.

The total site area is approximately 22,748 m^2, and approximately 14,641 m^2 of developable area outside of the dive structure and Mowbray House, which is a local heritage item. The current developable area were previously used to support the construction of the Sydney Metro project.

We have not been provided with the exact extents of the Sydney Metro Chatswood Dive site **(Sydney Metro Site)**. We have adopted the boundaries for the Sydney Metro Site as shown in Figure 1 below based on the information in the *Chatswood Dive Site – Urban Design options'*. We note that this is an important detail as for metro dive structures and tunnels the extent of the First Reserve and Second Reserve (that will be discussed in Section 5.5.1 of this report) is contingent on the extent of the Sydney Metro Site boundaries for the dive and the *'substratum'* for the tunnels.

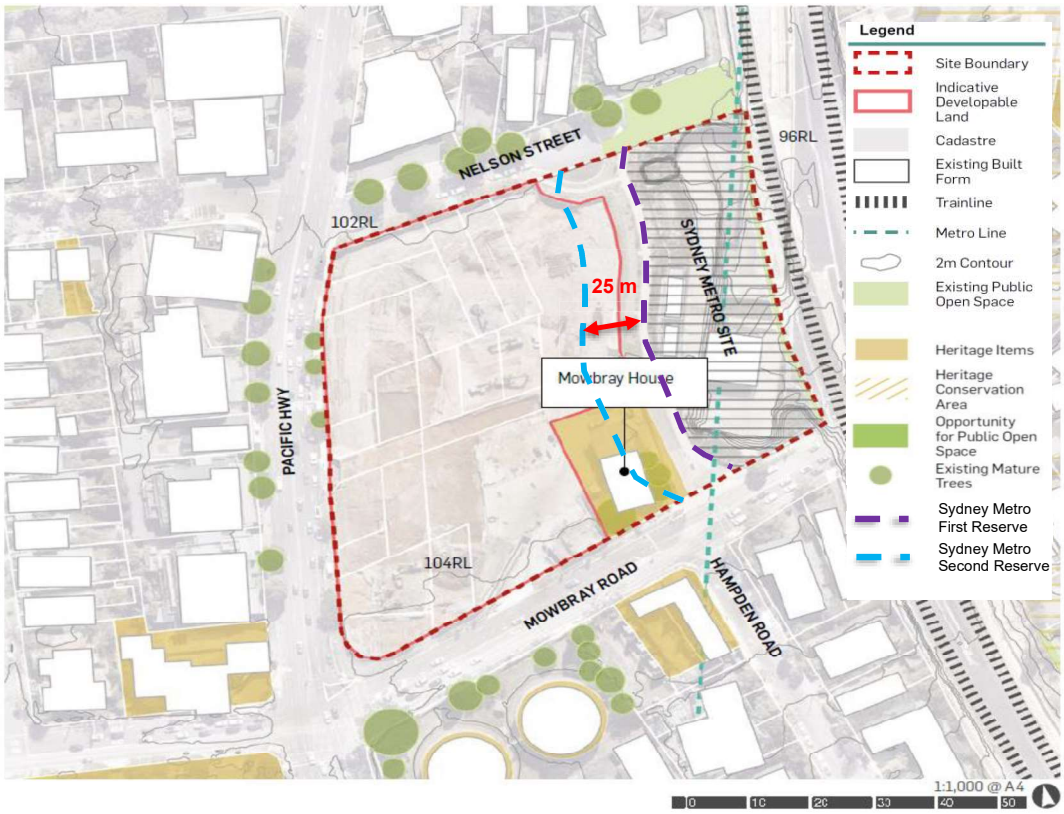


Figure 1: Site location plan with Sydney Metro Site extent, first and second reserve boundaries.

3.3 Site History

We have reviewed historical aerial photographs from Six Maps and recent georeferenced maps from Nearmap, which are included in Appendix B in the following order:

1. **Pre-1960:** Based on historical aerial photographs from Six Maps, the Site was occupied by residential housing, while the location of the dive structure was previously a recreational field.
2. **1965 to 2005:** In 1965, the field was replaced by a commercial property, which appears to have been either a large office or retail building. The residential properties in the southern half of the Site were demolished and replaced with commercial properties before 1965. The Site remained mostly unchanged until 1986, when the northwestern properties were converted into larger commercial properties.
3. **2014 to 2017:** The northwestern properties were converted into a parking lot. High-rises were constructed across the Pacific Highway to the west.
4. **2017 to 2023/24:** This period marks the construction of the Sydney Metro dive structure. Most commercial properties on the Site were demolished by April 2018, except for a building at the southwestern corner. Site establishment had commenced, and piles were drilled for the dive structure. By 2021, the acoustic shed for the dive structure had been constructed, and what appears to be a spoil shed was built at the northwestern corner.
5. **2024 to Present:** After the completion of the dive structure, the last remaining building at the southwestern corner was demolished. All temporary site structures were also removed. The basements of previous structures were demolished at this time, and earthworks had commenced. The only building remaining on the Site is Mowbray House, a heritage-listed building. The latest Nearmap imagery shows two ponds collecting rainfall in the western and northern areas of the Site.

4. Ground Condition

4.1 Geological Setting

The 1:100,000 Sydney geological map (1983) in Figure 2 indicates that the site is underlain by Ashfield Shale (Rwa) as part of the Wianamatta Group – Black to dark grey Shale and Laminite, however this is not indicative of results from site investigations undertaken.

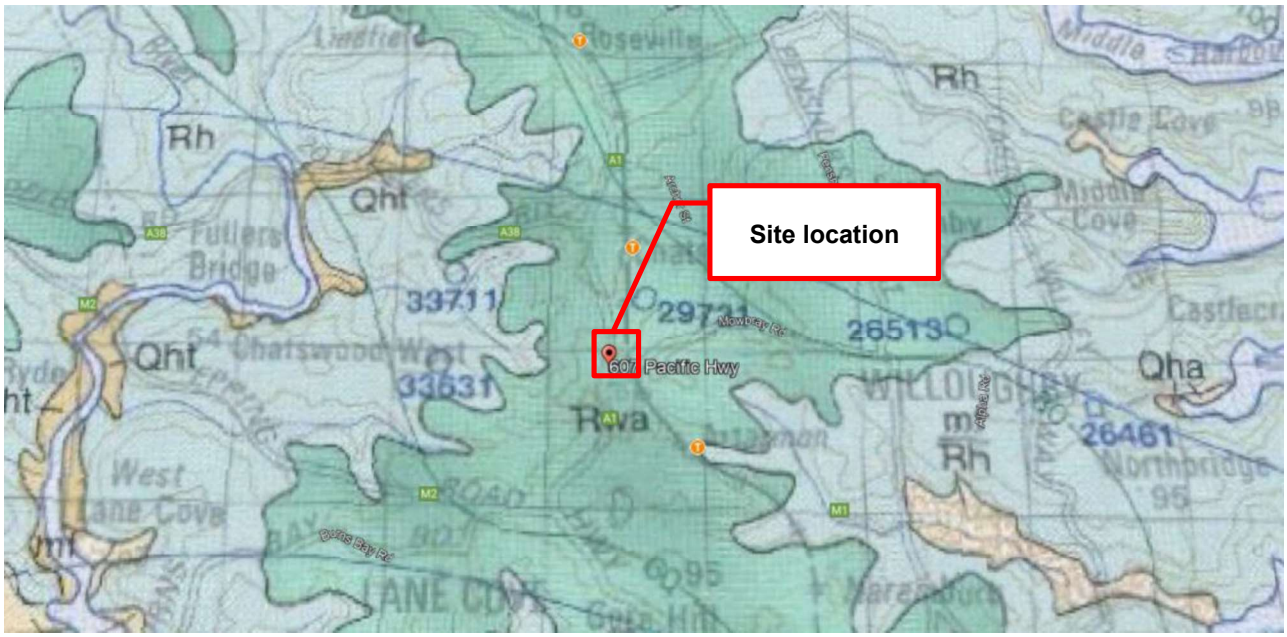


Figure 2: Location of Site on the 1:100,000 Sydney Geological Map (1983).

4.2 Factual Ground Condition

The Sydney Metro - City & Southwest tracks and Sydney Metro Chatswood Dive Structure are located approximately 20 m east of the Site. Multiple investigations have been undertaken on the site associated with the dive structure

works for both geotechnical and environmental purposes. This includes borehole (BH) drilling, large diameter auger drilling (LD), and Cone Penetrometer Tests (CPT), as well as face mapping of the dive structure.

4.2.1 Geotechnical Data Report (GDR)

The GDR contained 4 BH and 2 LD investigations at the Site prior to the dive structure works being completed. Figure 3 presents core photographs of different rock class extracted from the Borehole 26 (SRT_BH026) that is closest to the developable site.

Figure 4 shows the locations of all the site investigation relative to the Site. The collation of the site investigation logs is attached in Appendix C.

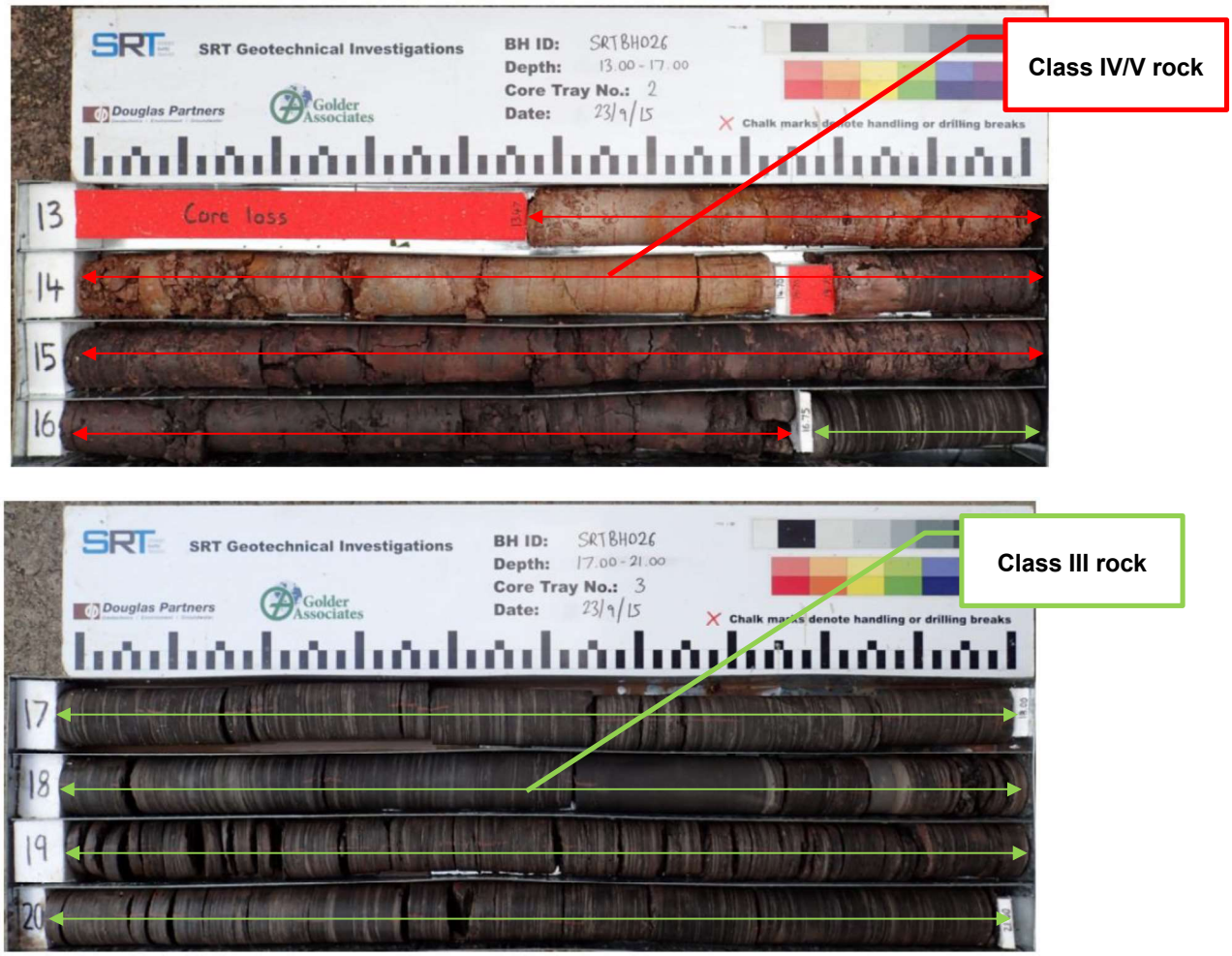


Figure 3: Core photographs from SRT_BH026 showing different rock class.

Figure 4: Site location plan and site investigation locations.

The general ground profile can be summarised as follows:

- Flexible Asphalt pavement up to 0.1 m thick or topsoil, overlying
- 0.1 m to 0.5 m thick gravel to silty clay Fill, overlying
- 3 m to 11 m of Residual Soil to very low strength Shale, overlying
- Low strength Shale.

4.2.2 Geotechnical Factual Report (GFR)

The GFR contained 3 CPTs investigations at the Site prior to the dive structure works being completed. The general ground profile can be summarised as follows:

- 2 to 3 m Residual Soil, overlying
- 3 m to 6 m of Residual Soil to very low strength Shale, overlying
- Low strength Shale.

4.2.3 Face Mapping

PSM have undertaken face mapping for the dive structure including the walls facing north i.e. Wall C and wall D.

The top of Class V Shale dips from approximately 95 m AHD from the south parts of the dive structure (wall C) to approximately 92 m AHD at the north parts of the dive structure (Wall D). This corresponds to a depth to Low strength shale of between 9 m and 10 m. Generally, the Shale is characterised by extremely weathered, very low strength pale grey, red and orange Siltstone.

4.3 Inferred Ground Condition

4.3.1 Geotechnical Interpretive (GIR)

The inferred conditions are then presented as a geological cross section through the dive structure and construction area adjacent to it. Figure 5 presents the location of the cross sections at the Site. The C-C and D-D cross sections are presented in Figure 6 and Figure 7, and the Section A-A in Appendix D.

The ground conditions as presented in the GIR comprised:

Table 2 - Summary of expected sub-surface conditions - Chatswood Dive

Unit	Reduced Level of Top of Unit (m AHD)	Thickness (m)	Description
FILL	96.0 to 104.5	0 to 1	Variable – gravel to Silty Clay
RESIDUAL SOIL	95.0 to 104.0	5 to 15	Silty Clay – very stiff to hard
ASHFIELD SHALE CLASS IV/V	84.5 to 96.0	14.5 to 24.5	Extremely weathered to highly weathered shale, typically Class IV/V
ASHFIELD SHALE CLASS III	88.0 to 80.0	10.0 to 17.0	Moderately weathered to fresh shale

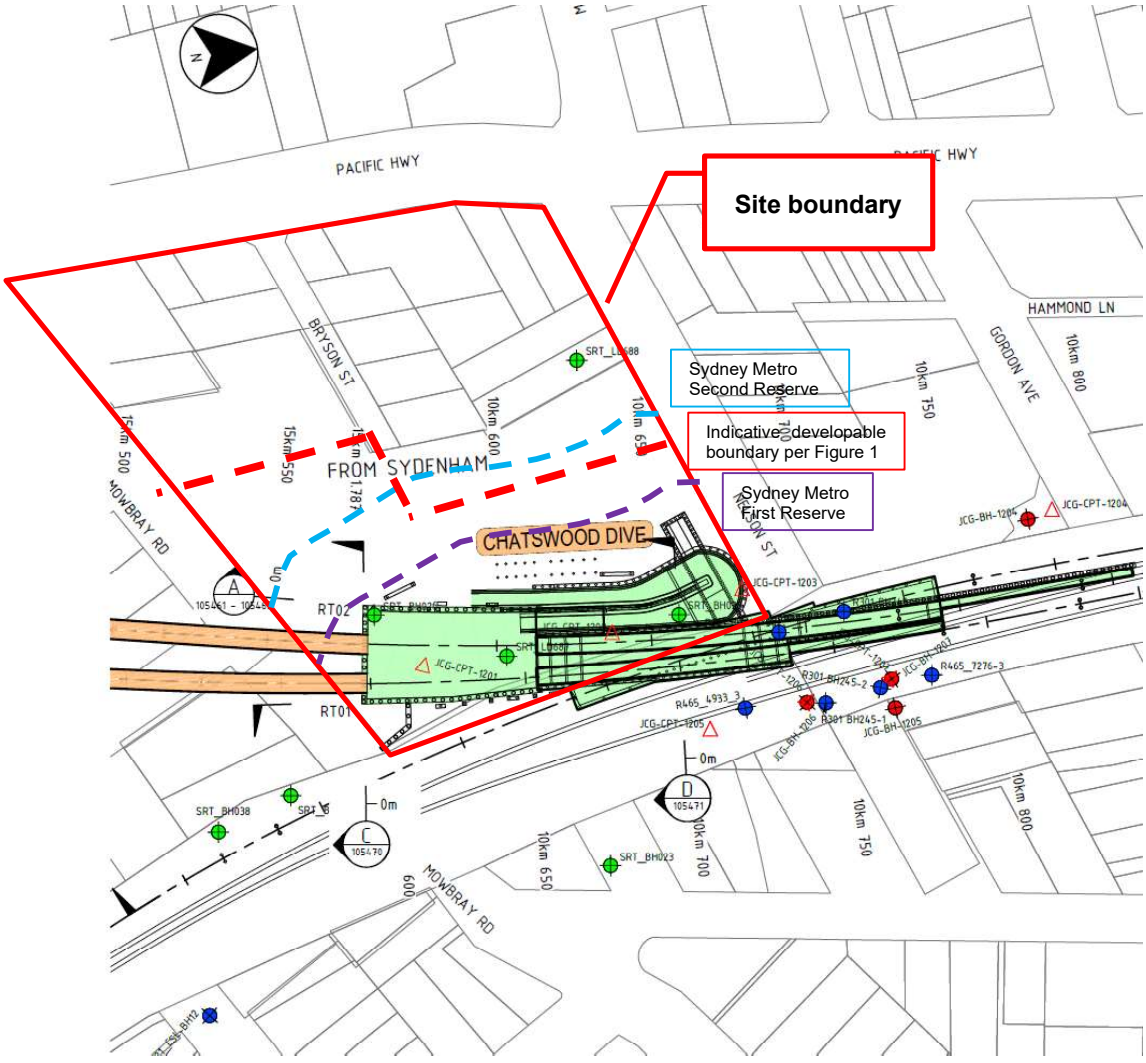


Figure 5: Site locality plan showing geological cross sections (A-A, C-C and D-D) of the Site.

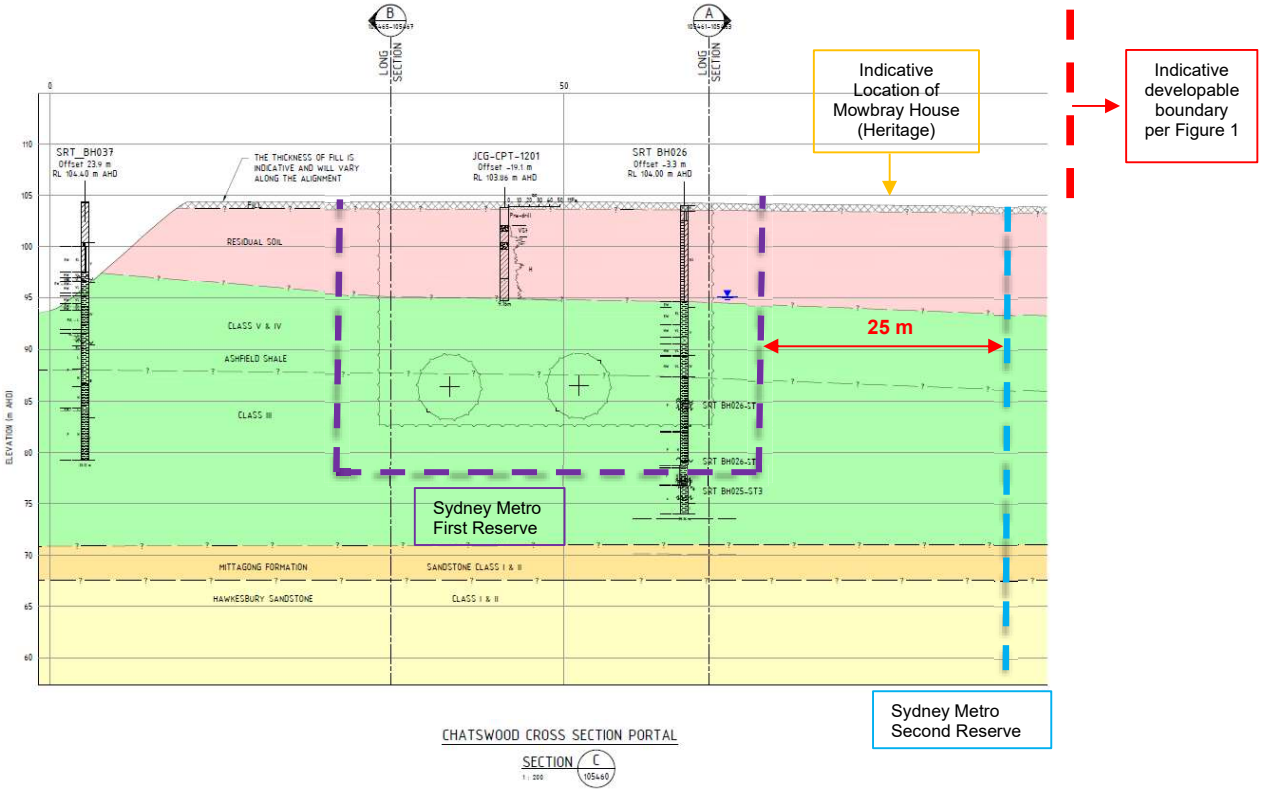


Figure 6: Cross Section C-C of Chatswood Dive with indicative Sydney Metro Reserves.

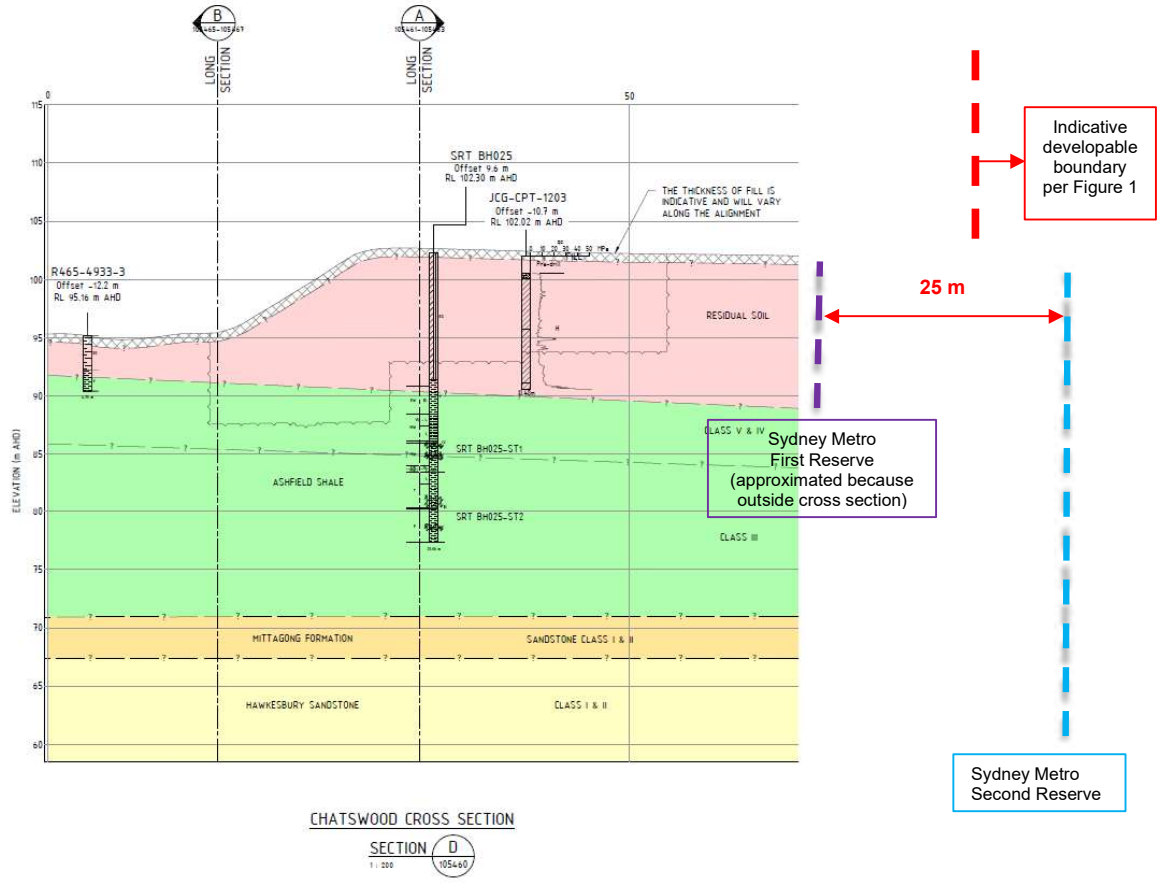


Figure 7: Cross Section D-D of Chatswood Dive with indicative Sydney Metro Reserves.

5. Geotechnical Risk

The design advice provided in the following sections have been prepared for due diligence purposes based on the inferred subsurface conditions presented in Section 4 of this report.

Prior to the next stages of design, confirmation of this advice and its applicability to the proposed development should be sought.

5.1 Deep Residual Profile

5.1.1 General – A Typical Condition

The ground conditions are characterised by a very deep weathering profile which has resulted in a deep layer of RESIDUAL SOIL and extremely weathered, low strength shale. This is somewhat atypical for weathering profile in Ashfield Shale unit.

We recommend that as part of the next stages of design development detailed site investigations across the Site itself be undertaken to confirm the profile.

5.1.2 Effect on Excavatability

We understand that excavation of up to three (3) basement levels is proposed. Whilst details of the excavation footprint and depth are not provided, we anticipate the maximum excavation depth for the proposed basement levels to be approximately 3 to 10 m below the existing ground surface. i.e. lowest to be approximately RL 93 m AHD.

It is thus anticipated that excavation will include excavation of FILL, RESIDUAL SOIL, and potentially ASHFIELD SHALE CLASS IV/V.

This should be achievable using conventional earth moving equipment (e.g., excavators and dozers). As the ASHFILED SHALE unit increases with strength with depth ripping with dozers or use of rock breaking equipment such as rock impact hammers may be necessary. Prospective contractors should make their own assessment of excavatability based on the information in this report including review of available logs and their experience. It is our experience that excavatability is heavily dependent on both the operator and the plant used. Heavy rock breaking equipment will generate vibrations that may impact on neighbouring structures. Where controls on vibrations are required, the contractor should consider the use of smaller hammers, rock saws and grinders to undertake the excavation. The contractor should recognise that there is a potential for damage to adjacent buildings or infrastructure (if any) and consider this in its planning.

5.1.3 Effects on Excavation Retention

The presence of the deep residual profile will result in the requirement for a more robust retention structure for the excavation of the basement.

This would typically comprise a combination of:

- Cantilevered soldier or contiguous pile walls where one basement level is proposed, and
- Anchored or propped soldier or contiguous pile walls were more than one basement level is proposed. This is what was adopted to support the Chatswood dive structure.

Such systems are routinely constructed for basement excavations in Ashfield Shale in Sydney. However, the presence of the deeper residual profile at this location could be expected to result in the need for larger diameter piles, more closely spaced and longer ground anchors.

Between the piles, the ground would need to be supported by reinforced shotcrete panels installed progressively as excavation progressed.

5.1.4 Effects on Foundations

It is anticipated that the multi-storey buildings will need to be supported on either:

- Larger shallow pad footings founded on ASHFIELD SHALE Class IV or better where more than 3 basement levels are adopted and the base of the excavation is within this unit, or

- Deep pile foundations within the stronger ASHFIELD SHALE unit at depth. For Option 2 development where the column loads are significant this may require the use of large diameter piles or pile groups with pile caps.

Such systems are routinely constructed for foundations for multi storey buildings in Ashfield Shale in Sydney. However, the presence of the deeper residual profile at this location could be expected to result in the need for larger diameter, deeper piles and potentially pile groups for the more heavily loaded columns. These are feasible but can result in additional costs.

Lightweight, ancillary structures could be supported by pad footings founded on or within the RESIDUAL SOIL unit below the FILL units.

5.2 Groundwater Conditions

5.2.1 Observations

Ashfield Shale is the dominant lithology present beneath the Site. Ashfield Shale is described as a fine-grained mudstone, which displays bedding and secondary structural features such as joints, fractures, and faults.

Groundwater was observed to be present below the residual soil and near the top of the weathered shale based on the standpipe piezometer in BH026 approximately 10 m below surface level. It is likely that perched water tables within Residual Soil is present at some locations.

The Sydney Metro dive structure is a drained structure and as such could be locally drawing down the water table at the site.

We recommend that as part of the next stages of design development detailed site investigations across the Site include installation of piezometers at various depth to identify the presence of perched and deeper water tables.

5.2.2 Dewatering During Basement Excavations

Single basement levels are likely to be above the ground water table. Three levels of basements may result in excavation below the deeper groundwater level as well as intersecting perched groundwater levels at the contact between the residual soil and the less weathered shale.

During excavation, seepage is likely to occur through the overlying soil units (fill and residual clay) and at the contact of the more permeable surface layers with the less permeable massive shale unit. Based on our experience with projects in a similar geological environment, such seepage should be able to be controllable during construction by conventional sump and pump systems. Drainage can be undertaken concurrently with basement excavation.

Should higher localised inflows be encountered, localised grouting can be undertaken to reduce the inflows.

5.2.3 In Perpetuity

In the permanent condition, typically basements such as this one can be designed as a drained structure. This is subject to approval by the relevant authorities.

Given the depth to the groundwater table and the site conditions we consider that a drained basement would result in at most minimal impact on groundwater resource, neighbouring groundwater users, groundwater dependant ecosystems, and neighbouring structures. On this basis, it is our opinion, at this stage, that a drained basement would be suitable for this Site.

Notwithstanding our opinion, it will ultimately be up to be the regulatory authorities (e.g. Department of Planning, local council, Water NSW) to make a determination on whether a drained basement is permitted at the site.

Should a drained basement be adopted, provision will need to be made for permanent and effective drainage. Such permanent drainage systems will need to be able to be maintained throughout the life of the structures and thus allow for access to flushing to remove chemical deposits that may build up over time or include redundancy in the system to allow for possible reduction in capacity in the future.

Details of the drainage system are a matter of design but would typically include a sub-floor drainage blanket with slotted drainage pipes within drainage aggregate, plus strip drains behind the shotcreted / concreted walls (or a plenum space between the rock face and an internal dry-wall where shotcrete is not required), and sump and pump system with the ability to effectively back flush the system for long-term maintenance.

The bedrock units present at the site may degrade with time if left exposed with ongoing groundwater seepage. It is recommended that shotcrete facing be provided to protect against degradation.

Disposal of water from the sumps, during construction and particularly in the permanent condition, into the stormwater or sewer system may be possible but will also be subject to regulatory approvals and sediment controls. These should be negotiated with the relevant authorities (e.g., council, Sydney Water, WaterNSW).

Alternatively, a tanked basement can be adopted. We note that this could also be mandated by the regulatory authority. Where a tanked basement is adopted the basement structure will need to be designed to resist hydrostatic forces. This is unlikely to be require at this site unless mandated by the relevant regulatory authority.

5.3 Disposal of Spoil

The presence of fill and historical structures on this site will need to be considered when arranging disposal of the excavated spoil from the Site. Fill units will need to be excavate separately from the underlying natural materials and classified and disposed of correctly.

This risk is typical of developments on brownfield sites across Sydney.

5.4 Buried Structure Associated with Brownfield Site

The presence of historical buried structures shall be considered when developing excavation plans and methodologies. For example, based on historical photographs, the site previously housed a fuel station with an underground fuel tank.

The types of buried structures may include slabs, footings, services, tanks, retaining structure etc. The risk can be mitigated as part of basement excavation.

This risk is typical of developments on brownfield sites across Sydney.

5.5 Interface Risks

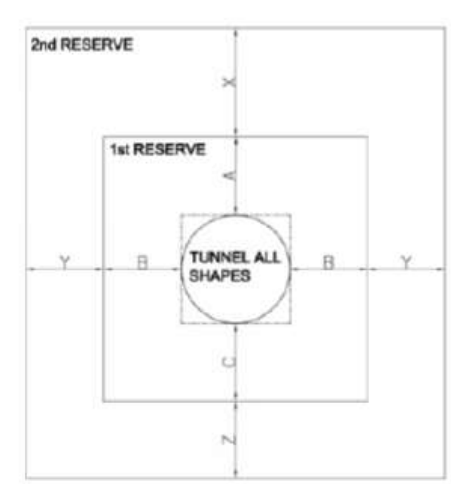
5.5.1 Interaction with Sydney Metro Assets

The proposed new development is near the existing Sydney Metro Chatwood dive structure and has thus the potential to impact on the structural stability and operations of this infrastructure.

The Sydney Metro Underground Corridor Protection Technical Guidelines is the relevant standard that addresses developments and excavation adjacent to metro assets.

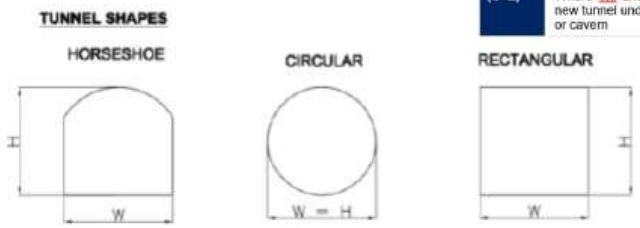
It defines the extent of '*protection reserves'* zones that have been established to protect existing metro infrastructure and protect the feasibility of planned metro infrastructure from adjacent proposed development.

Figure 8 shows protection reserves extents and are categorised as either the 'first reserve' or 'second reserve'.



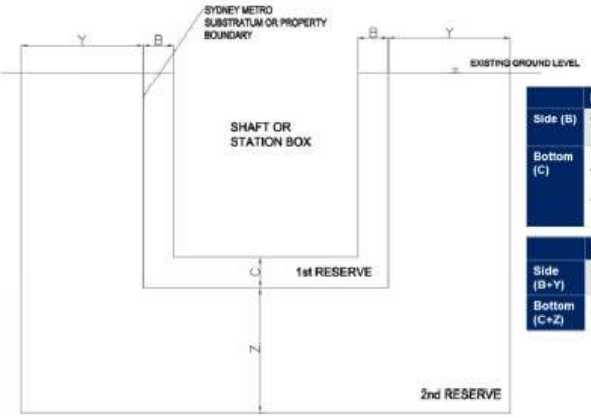
	First reserve dimensions (m)
Top (A)	The greater of the following: • 5 m from the crown of tunnel or cavern or • Support zone based on 1/3* tunnel width plus 1 metre (1/3*W+1) or • Extent of Sydney Metro substratum above crown
Side (B)	The greater of the following: • 5 m from side wall of tunnel or cavern or • Lateral extent of Sydney Metro substratum
Bottom (C)	The greater of the following: • 5 m below the invert of the tunnel or cavern or • Extent of Sydney Metro substratum below invert

	Second reserve dimensions (m)
Top (A+X)	The greater of the following: • 1.5 x (W+H) or • A + 25 or • Where 'W' and 'H' are width and height of the existing rail tunnel
Side (B+Y)	The greater of the following: • W or • B + 25
Bottom (C+Z)	C + 1.5 x (W_n + H_n) Where 'W_n' and 'H_n' are width and height of new tunnel under the existing metro tunnel or cavern



Note: all dimensions are taken from the excavated profile of tunnels and caverns

Figure 4.1 Protection reserves for metro tunnels and caverns



	First reserve dimensions (m)
Side (B)	• Lateral extent of Sydney Metro substratum or property boundary
Bottom (C)	The greater of the following: • 5 m below the invert of the shafts or boxes or • Extent of Sydney Metro substratum below invert

	Second reserve dimensions (m)
Side (B+Y)	• B + 25
Bottom (C+Z)	• C + 25

Figure 4.2 Protection reserves for shafts and station boxes

Figure 8: Snippet from Sydney Metro Guidelines on protection reserves extent and definition.

'First reserves' represents the area that must not be encroached upon by any proposed development and its construction. No construction activity is allowed within the First Reserve with the exception of investigation holes and installation of instrumentation (which are subject to assessment).

In addition, Section 9.2 of the Sydney Metro Guideline reiterates that ground anchors are not allowed within the First Reserve, and this includes temporary and permanent anchors.

'Second reserve' refers to areas that require an engineering assessment of the works to demonstrate that induced effects on the underground rail infrastructure are acceptable to Sydney Metro, in accordance with the performance requirements outlined in Section 9 of the guideline.

Figure 1 presents the Sydney Metro Site extent and approximate first and second reserve boundaries, assuming the site extent is the first reserve. The proposed development falls outside the First Reserve, with a small portion being in the Second Reserve. The indicative first and second reserve are also presented in Figure 5, Figure 6, and Figure 7.

Based on current information, no geometrical restrictions apply to these for the proposed development. When assessing the shoring options, the restriction on ground anchors entering the First Reserve will need to be considered. It is possible that on the Eastern side of the excavation a combination of propping and bracing may be required in place of anchoring. Nevertheless, the permission for excavation and loading in the Second Reserve will be required and will thus require an impact assessment completed in accordance with the requirements in the Sydney Metro Guideline.

We consider that further work will need to be undertaken at future stages to confirm that the impacts on the dive structure in accordance with the Sydney Metro Guidelines.

At minimum this will need to include:

- Detailed survey plan showing the boundaries of proposed development, rail corridor and Sydney Metro easements or substratum extent.
- Details of development (e.g. excavation extent, support system and building loads).
- Site investigation to confirm subsurface conditions. Two boreholes are recommended to be drilled on the western side of the Site and extend to reach competent bedrock. Boreholes should be cored in the shale or sandstone.
- Detailed numerical analysis to confirm predicted deformations at the Chatswood Dive Structure due to the proposed development.
- Preparation of a risk assessment.
- Assessment of the noise and vibration impacts on the dive structure.
- Preparation of an instrumentation and monitoring plan.

Sydney Metro may also require:

- Dilapidation surveys of the tunnels to be completed.
- Structural assessment of the effect of the deformations on the structural lining to be completed. This may not be required should the initial assessment indicate that the deformations are significantly lower than typical limits.

5.5.2 Interaction with Heritage Asset

The heritage-listed Mowbray House is located at the southeastern corner of the developable site. The approximate setback, or horizontal distance between the heritage building and the developable site boundary, ranges from 8 m to 20 m according to Nearmap. This needs to be confirmed with an onsite survey.

The designer and contractor shall consider the effects of excavation, including horizontal and vertical deflections, on the heritage structures. Ground movements will occur as a result of basement excavations; therefore, instrumentation and monitoring with appropriate trigger levels shall be implemented during construction.

The effects of vibrations will also need to be considered.

5.5.3 Interaction with Adjacent Infrastructure

The buildings surrounding the site and across the roads include mid-rise commercial and residential properties to the north along Nelson Street, a petrol station and several mid- to high-rise residential and commercial properties across the Pacific Highway to the west, the Sydney Water Chatswood Reservoir to the south, and the Sydney Metro Chatswood Dive Site to the east. Sydney Water should be notified and consulted before any works adjacent to the reservoir on the other side of Mowbray Road.

The Site is between the Sydney Metro Chatswood Dive site and the intersection between the Pacific Highway and Mowbray Road. According to Before You Dig Australia (BYDA), the buried services and utilities include Ausgrid, NBN, Sydney Water, Telstra, TPG Telecom, Primus Telecom and Willoughby City Council Stormwater assets.

The proposed development works, particularly the basement excavation, may impact existing neighbouring infrastructure located adjacent to the development footprint, including RMS roads, council roads, and buildings. The presence of the Sydney Water assets in vicinity of the site may require an Specialist Engineering Assessment.

It is likely that impact assessment of potential ground movements due to excavation and vibrations from construction activities will need to be undertaken for at least the Sydney Water Assets and the RMS roads.

We consider that these will indicate that provided appropriate design and construction measures are adopted I combination with an appropriately detailed instrumentation and monitoring plan (IMP) during construction activities the impacts will be acceptable. It is likely that dilapidation surveys of some of these structures will be required.

The requirement for these impacts assessments may result in impacts to scheduling of the works as these will need to be undertaken early in the design stage and approval from the authorities will be required. The timing of this is often outside the developer's control. The risk can be mitigated with good planning.

Additional costs to the development for instrumentation, dilapidation surveys, impact assessments and correspondence with the asset owners should be allowed for.

6. Closure

The advice in this report is suitable for due diligence considerations. Once details of the proposed development are advance prior to the next stages of design, these details shall be provided, and confirmation of the advice be sought from PSM or another suitably qualified and experienced geotechnical engineering firm.

Additional ground breaking geotechnical investigations at the site are recommended for the subsequent stages of designed development and should include installation of piezometers with data loggers to confirm groundwater conditions.

Please do not hesitate to contact us should you have further queries.

Yours Sincerely

DANIEL TAN
SENIOR GEOTECHNICAL ENGINEER

DAVID PICCOLO
PRINCIPAL

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Appendix A
Reference Documentation

Daniel (Jia Yao) Tan

From: David Piccolo
Sent: Thursday, February 27, 2025 2:31 PM
To: Daniel (Jia Yao) Tan
Subject: FW: Urgent - Landcom Chatswood metro dive site DD opportunity

David Piccolo
Principal | BE Civil (Hons), MEngSc, NER
Direct: **02 9812 5025** | Mobile: **0418 245 159** | **David.Piccolo@psm.com.au**

From: Sean Fu <sfu@landcom.nsw.gov.au>
Sent: Thursday, 27 February 2025 1:55 PM
To: Joanne Rosner <JRosner@jbsg.com.au>; David Piccolo <David.Piccolo@psm.com.au>; Michelle Delandro <MDelandro@jbsg.com.au>; Amy Cao <acao@landcom.nsw.gov.au>
Subject: RE: Urgent - Landcom Chatswood metro dive site DD opportunity

Thank you, David & Joanne, for accommodating us,

@David Piccolo – As discussed on the phone, we would proceed on the basis of the simple Due Diligence level Geotechnical Report for the fee of $12k (excl GST).

We would like to add to the scope that it is all to be related back to the 2x Proof of Concept Schemes curated from Urbis (622 dwelling & 5 Superlots, 902 dwellings & 3 Superlots).

The concept schemes will be shared with you and JBS&G in due course.

In the meantime, please send me a list of documents that you need to reference so that we may raise a formal request for information with Metro.

Thanks,
Sean

Sean Fu
Senior Manager, Acquisitions (Level 2)
T: (02) 9841 8600 **M:** 0439962450
Level 14, 60 Station Street Parramatta NSW 2150

LANDCOM

Electronic Data Transmission Disclaimer and Fraud Warning

From: Joanne Rosner <JRosner@jbsg.com.au>
Sent: Thursday, 27 February 2025 11:28 AM
To: David Piccolo <David.Piccolo@psm.com.au>; Michelle Delandro <MDelandro@jbsg.com.au>; Amy Cao <acao@landcom.nsw.gov.au>
Cc: Sean Fu <sfu@landcom.nsw.gov.au>
Subject: RE: Urgent - Landcom Chatswood metro dive site DD opportunity

CAUTION: This email originated from outside of the Landcom network. Do not click links or open attachments unless you recognise the sender and are expecting the content or attachment from the sender.

Thanks so much for the rapid response David,
Just to keep it all straight forward with regard to existing allowances, etc JBS&G will subcontract PSM as consistent with the initial DD phases for Camperdown and St Leonards, under our existing agreed terms, rather than Landcom having to raise a new Purchase Order for this work.

We will wait on Landcom confirmation of scope and then provide formal direction.

Best regards

Joanne Rosner | Senior Principal – Contaminated Land | JBS&G
Gadigal Country | Level 8, 179 Elizabeth Street, Sydney, NSW
T: 02 8245 0300 | M: 0448 185 588 | E: jrosner@jbsg.com.au | W: jbsg.com.au | L: Conditions and Limitations

Exceptional Outcomes

From: David Piccolo <David.Piccolo@psm.com.au>
Sent: Thursday, 27 February 2025 10:16 AM
To: Joanne Rosner <JRosner@jbsg.com.au>; Michelle Delandro <MDelandro@jbsg.com.au>; Amy Cao <acao@landcom.nsw.gov.au>
Cc: Sean Fu <sfu@landcom.nsw.gov.au>
Subject: RE: Urgent - Landcom Chatswood metro dive site DD opportunity

[EXTERNAL EMAIL]** Stop and think before opening attachments, clicking or responding.

Amy,

We can help with a due diligence letter by 7/3/25. We are familiar with the site and its conditions as we were part of the metro team working on the decline in some form.

We can prepare a simple Due Diligence level Geotechnical Report which would present:

1. Brief site history.
2. Inferred geotechnical conditions across the site based on geological maps and other available Geotech info at the site and surrounds. We are unlikely to be able to reference specific information as we would need clearance from Metro to reference the documents. We can send you report titles that you may seek to request from Metro.

3. Discussions of geotechnical risks associated with the site and in particular:
    a. Expected foundation conditions
    b. Excavation retention
    c. Interaction of proposed basement and excavation retention with:
        i. The metro decline
        ii. The pacific Hwy (TfNSW/RMS road)
        iii. Water reservoirs to the south
    d. Discussion of likely groundwater conditions and drained/versus tanked basement considerations.

Our lump sum fees to complete a geotechnical desktop due diligence assessment is $12,000 (excl. GST). We assume we can use the contract that is currently being agreed with landcom for the Camperdown site. If we need to negotiate a new set of conditions this would be on a time and expense basis.

We are happy to start working on this immediately if we need to meet the timeframes proposed and are happy to do this in good faith.

If you don't need a letter we can prepare a presentation and present to you by 5/3 for $9,000 (excl. GST). We would provide a powerpoint prior to the presentation.

Please advise if you would like us to proceed.

David Piccolo
Principal | BE Civil (Hons), MEngSc, NER
Direct: **02 9812 5025** | Mobile: **0418 245 159** | **David.Piccolo@psm.com.au**

From: Joanne Rosner <JRosner@jbsg.com.au>
Sent: Thursday, 27 February 2025 10:30 AM
To: David Piccolo <David.Piccolo@psm.com.au>; Michelle Delandro <MDelandro@jbsg.com.au>; Amy Cao <acao@landcom.nsw.gov.au>
Cc: Sean Fu <sfu@landcom.nsw.gov.au>
Subject: Urgent - Landcom Chatswood metro dive site DD opportunity

Hi David,
As per my text message last night, Landcom has in its final phase of DD for this Metro site and the project team has been asked to complete DD on in ground assumptions and as such has requested urgent assistance to quantify some of the potential risks, with intent that we can provide advice by next Friday 7th March (I have not committed anything for this date at this point, noting its next Friday).

Apparently, Sydney Metro indicated that they don't have any simple geotechnical report that can be provided, so effectively is not providing anything at all. We have been given an existing site audit statement and a remedial action plan, which we understand they have started work implementing, but validation works reports will not be available until June – July too late for Landcom. I can provide these if you are interested.

As such, I cannot provide any direct information, just pointing you to what is on the publicly available project websites for intrusive investigation. Not sure what you would be able to discuss based on work PSM has completed for others at this point?
I have attached urban design report including options Landcom is considering – note that the parking consideration in the back refers to two options – firstly a single level basement and second option – 3 level basement.

Given the time frames, I have copied in the Landcom project Team – Amy Cao and Sean Fu. Amy's contact details are provided below.

Amy Cao
Manager, Acquisitions
T: (02) 9841 8738 **M:** +61 472 838 893
Level 14, 60 Station Street Parramatta NSW 2150

David, please feel free to contact Amy if you have any direct queries so I don't hold things up!

Could you please provide a brief email proposal on scope of advice you would be able to provide Landcom within this timeframe and using the information available - whether this is a meeting to deliver a verbal advice and a short back up letter, or something more formal? If this is just not possible given time frames/capacity, please advise as soon as practicable (I have attached the Camperdown initial discussion on fees/scope for reference if this helps).

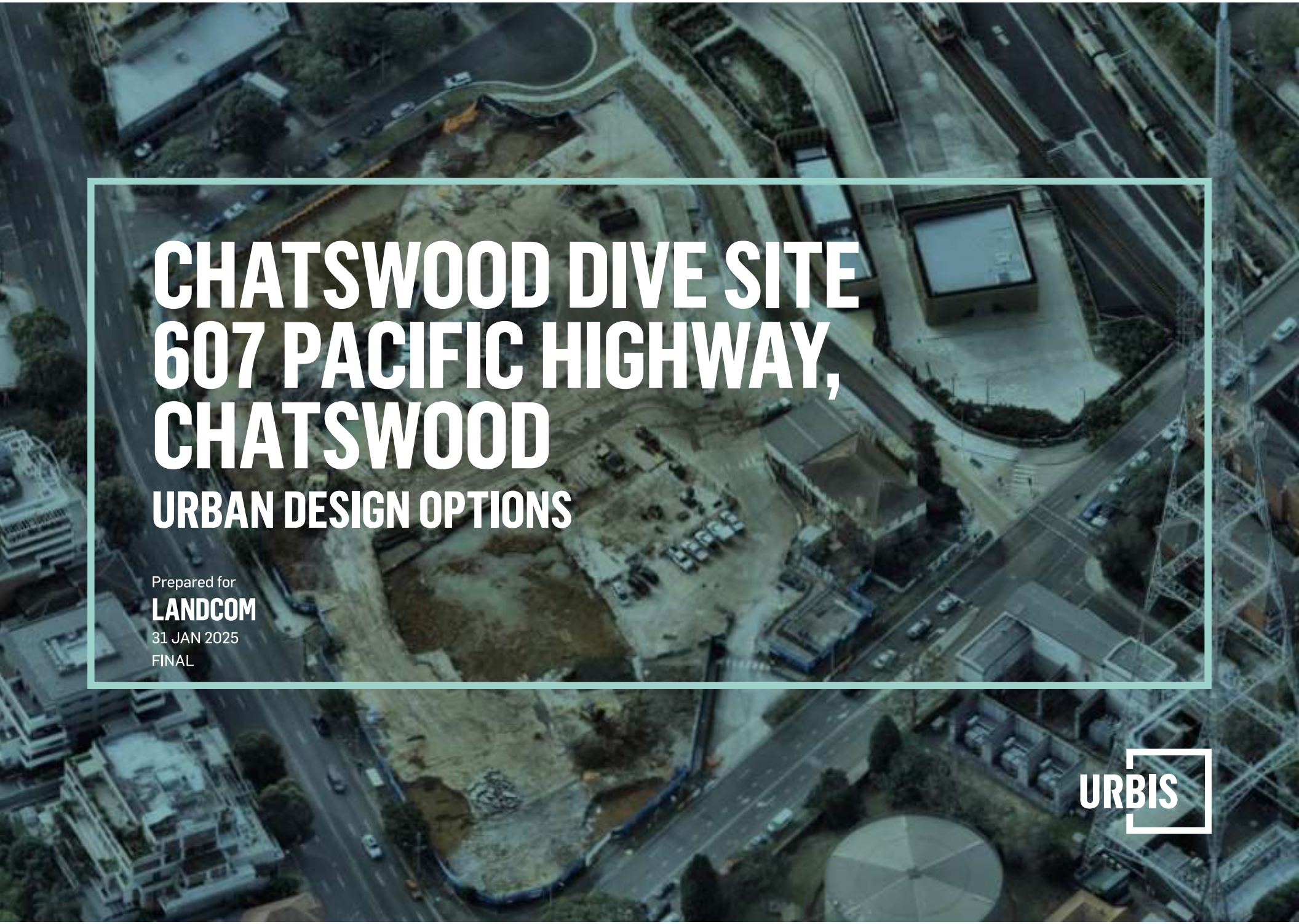
Landcom/PSM please note – under the existing contract arrangements, JBS&G pass through costs to Landcom with a minimum admin fee mark up, rather than a percentage mark up, we can confirm this in our updated cost summary which will come through once we confirm scope over the next couple of days.

Best regards

Jo

Joanne Rosner | Senior Principal – Contaminated Land | JBS&G
Gadigal Country | Level 8, 179 Elizabeth Street, Sydney, NSW
T: 02 8245 0300 | M: 0448 185 588 | E: jrosner@jbsg.com.au | W: jbsg.com.au | L: Conditions and Limitations

Exceptional Outcomes



CHATSWOOD DIVE SITE 607 PACIFIC HIGHWAY, CHATSWOOD

URBAN DESIGN OPTIONS

Prepared for

LANDCOM

31 JAN 2025

FINAL

URBIS

URBIS STAFF RESPONSIBLE FOR THIS REPORT:

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Project Team:	Urban Design: Sok Ng, Oscar James
	Planning: Christophe Charkos, Rob Battersby, Thomas Baird
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	Transport: Tim Sullivan, James Ramm
	Heritage: Kate Paterson
	Infrastructure Contributions: Suyash Pareek
Project Code:	P0056129
Reference:	RPT_P0056129_607 Pacific Hwy-241113
Version:	Rev C
Report Status:	FINAL
Date:	31 January 2025

We acknowledge Aboriginal and Torres Strait Islanders as the traditional custodians of all the lands throughout Australia. We recognise and respect the connection to their land, cultural heritage and community, and we pay respects to their Elders past, present and emerging.

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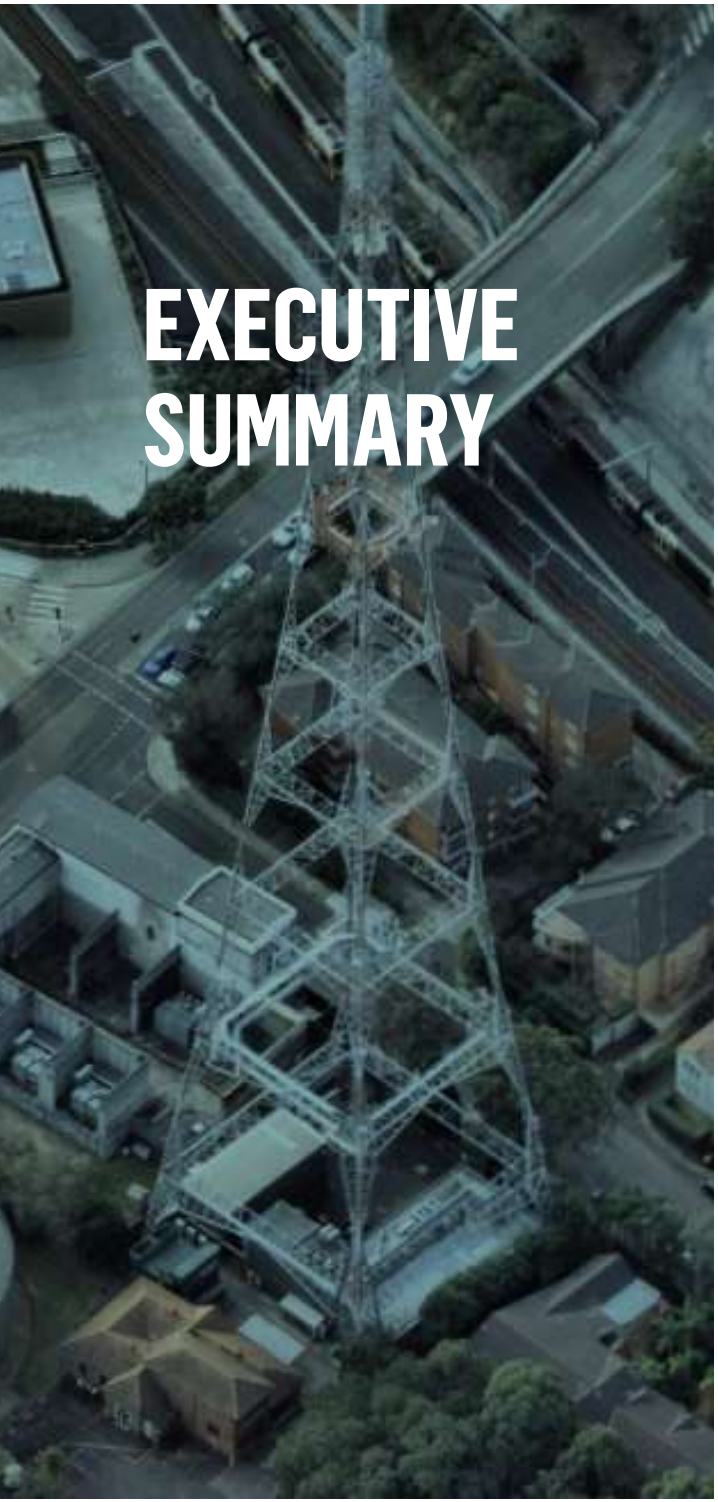


EXECUTIVE SUMMARY

Urbis has been commissioned by Landcom to conduct high-level urban design studies and provide comprehensive planning, market, transport, heritage, and infrastructure advice for the potential acquisition of the Chatswood Dive Site at 607 Pacific Highway, Chatswood.

The primary objectives are to identify the highest and best use of the site for residential development, provide high-level development options for feasibility testing, and deliver an integrated package of design, planning, and market assumptions to inform Landcom's feasibility testing.

Site Description and Current Uses

The site, owned by Sydney Metro, is located at the junction of Pacific Highway and Mowbray Road. It includes the Sydney Metro Dive Site, Frank Channon Walk, and Mowbray House, a locally listed heritage item. The remainder of the site is unoccupied and undergoing remediation.

Context & Site Analysis

The site is situated in between Chatswood CBD and Artarmon Village. It has minimal slope and is largely unencumbered, except for the heritage listed Mowbray House at the southeast corner. The site is flanked by major roads and the Metro Dive site, generators of noise. The northeast pocket park provides a desirable landscape interface.

Demographics and Market Analysis

The site is suitable for a mix of Build-to-Sell (BTS) and Build-to-Rent (BTR) apartments, with a preference for two-bedroom units targeting professional couples and downsizers. The required non-residential floorspace under current planning controls is high (in the order of 12,500sqm), but 4,300 – 6,300 sqm of non-residential space could be viable, subject to further market assessment.

Development Options

Option 1 – Base Case Scenario

This option explores a fully compliant scheme, yielding between 594 to 622 dwellings. It would follow a Regionally Significant Development Application approval pathway and poses the least planning risk given its level of compliance with local planning controls and ability to meet key amenity requirements under SEPP 65 Apartment Design Guide.

Option 2 – Planning Proposal

This option explores a non-compliant scheme, seeking to vary maximum building height, FSR, quantum of non-residential floorspace and floorplate sizes. It would yield between 871 to 934 dwellings and would require a Planning Proposal. This option poses a higher risk due to potential Council objections to varying recently adopted controls, however has the capability to meet key amenity requirements under SEPP 65 Apartment Design Guide.

Key planning issues that require further consideration and resolution relate to traffic, parking and site access; variation to floorplate sizes and quantum of non-residential floorspace.

In conclusion, the Chatswood Dive Site presents significant opportunities for residential development, with careful consideration needed regarding access constraints, planning controls, heritage conservation, and market demands. The proposed development options offer pathways to maximize the site's potential while addressing key planning and market challenges.

01. OVERVIEW

Project Scope

Urbis was engaged by Landcom to undertake high-level urban design studies and provide high-level planning, market, transport, heritage and infrastructure contributions advice to inform site investigations for the potential acquisition of the site at 607 Pacific Highway, Chatswood otherwise referred to as the Chatswood Dive Site.

Specifically, the scope objectives are:

- To identify the highest and best use of the site, with regards to its constraints and opportunities for residential development.
- To provide a high-level development options to inform feasibility testing and site valuation
- To provide an integrated package of design, planning and market assumptions (and a suite of complementary services) to inform Landcom's feasibility testing.

Site Description

Address: 607 Pacific Highway, Chatswood 2067, NSW

Legal Description: Lot 3//DP455907; Lot 4//DP455907; Lot 1//DP537580; Lot 2//DP537580; Lot 5//DP524631; Lot 6//DP66854; Lot 2//DP221896; Lot 4//DP 65670; Lot 5//DP 65670; Lot 6//DP65670; Lot 18//DP60346; Lot 1//DP243111; Lot 1//DP503447; Lot 2//DP1223080; Lot 3//DP961402; Lot 6//DP72759; Lot 1//DP216408; Lot 3//DP58646; Lot 1//DP508715; Lot 1//DP204133

Owner: Sydney Metro

Current Uses:

- Eastern sector (#ha) is occupied by the Sydney Metro Dive Site
- Frank Channon Walk shared path link adjacent to the Sydney Metro Dive Site
- Mowbray House, locally listed heritage item (Item I96), currently being used as site offices for the remediation works.
- The balance of the site is currently unoccupied and is undergoing site remediation following construction activities associated with the construction of the Sydney Metro.

Figure 1 View along cycle and pedestrian link

Figure 2 View along Pacific Hwy

Figure 3 Existing Site Plan

02. CONTEXT & ANALYSIS

The following has been informed by our review of the relevant planning documents by Willoughby Council, the Ethos Urban Preliminary Due Diligence report, design study undertaken by Bates Smart (2018), and desktop analysis of publicly available GIS data combined with ground truthing site visit.

Context

KEY INSIGHTS

- The site is situated at the junction of two key arterial roads:
  - Pacific Highway, a national highway connecting North Sydney to Chatswood and beyond to Central Coast, Newcastle and Brisbane.
  - Mowbray Road, a key east-west transportation corridor (Mowbray Rd) connecting the predominantly residential suburbs of Willoughby to the east to Lane Cove to the west.
- The site benefits from the newly completed Sydney Metro line that provides access to major employment precincts such as Macquarie Park, St Leonards, North Sydney, and Sydney CBD beyond.
- The site is located at the southern gateway of the Chatswood CBD Strategy 2036 study area and is approximately midway between Chatswood CBD and Artarmon local centre.

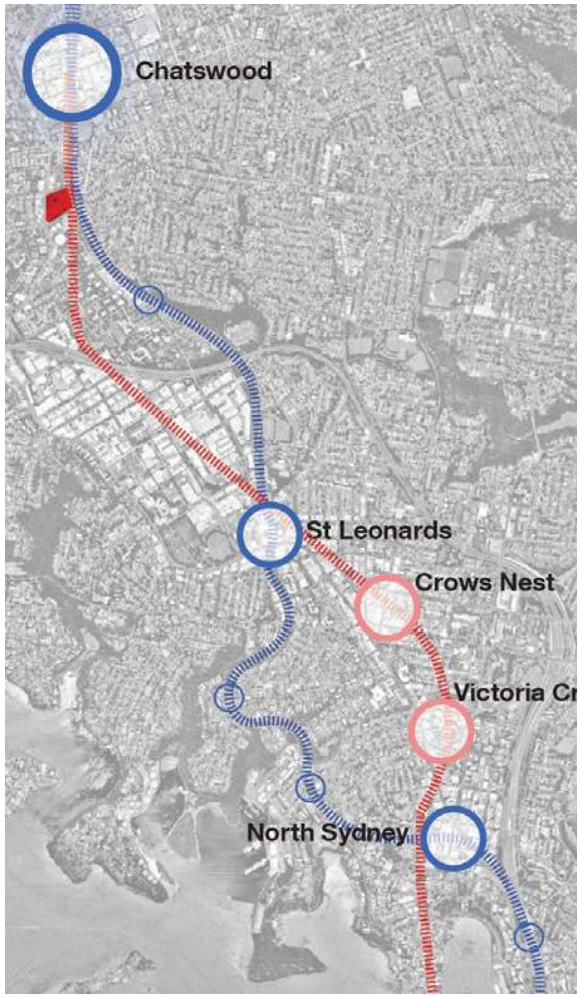


Figure 4 Context – Metro & Rail lines plan (Bates Smart 2018)

Legend

- Site Boundary
- Trainline
- Metro Line
- Existing Public Open Space
- 800 catchment

Roads

- Highway
- Main Road

Facilities

- Educational
- Pub
- Retail Shopping
- Food Shopping
- Hospital
- Medical

Figure 5 Context Plan

Walking Catchment

Legend

- Site Boundary
- Trainline
- Metro Line
- Existing Public Open Space

Walking Catchments (min)

- 5mins
- 10mins
- 15mins

KEY INSIGHTS

- The site benefits from being less than 15mins walk from both Chatswood Metro and Artarmon stations.
- However it is a busy and noisy pedestrian experience along Pacific Hwy & Mowbray roads.
- It is a gentle uphill experience to Chatswood.
- It is a steeper downhill experience to Artarmon.
- Pedestrians using the shared bikeway have to be aware of speeding bikes & trains.

Cycling Catchment

Legend

- Site Boundary
- Trainline
- Metro Line
- Existing Public Open Space

Walking Catchments (min)

- 5mins
- Existing Cycling Links

KEY INSIGHTS

- The site benefits from being about 5mins cycling from either Chatswood and Artarmon centres and stations.
- It is a generally pleasant experience using the bikeway parallel to the railway.
- Potential CPTED issue along bikeway.

Height of Buildings

Legend

- Site Boundary
- Trainline
- Metro Line
- Existing Public Open Space
- X — Zoned Height of Building (m)

KEY INSIGHTS

- While the site is zoned for 53m, the adjacent northern blocks are zoned for 90m; creating the potential for overshadowing of the site.
- Adjacent eastern and western blocks are zoned with lower heights; creating potential view premiums for upper storey dwellings.
- Adjacent southern blocks consists of low rise heritage items; creating potential view premiums.

Site Analysis

KEY INSIGHTS

- The site has minimal slope.
- The local heritage item (Mowbray House) is located at the peripheral southeast corner of the site.
- Therefore, the majority of the site is unencumbered.
- Yet, the site is flanked by Pacific Hwy, Mowbray Rd, and Metro Dive site and associated rail line; all generators of noise.
- The heritage items on adjacent southern block (Electrical Substation and Reservoirs) while contributing to a sense of place and historical connection, they are not a major encumbrance to the development potential of the site.
- The pocket open space park in the northeast provides desirable landscape interface with the residential blocks.

Legend

- Site Boundary
- Indicative Developable Land
- Cadastre
- Existing Built Form
- Trainline
- Metro Line
- 2m Contour
- Existing Public Open Space
- Heritage Items
- Heritage Conservation Area
- Opportunity for Public Open Space
- Existing Mature Trees

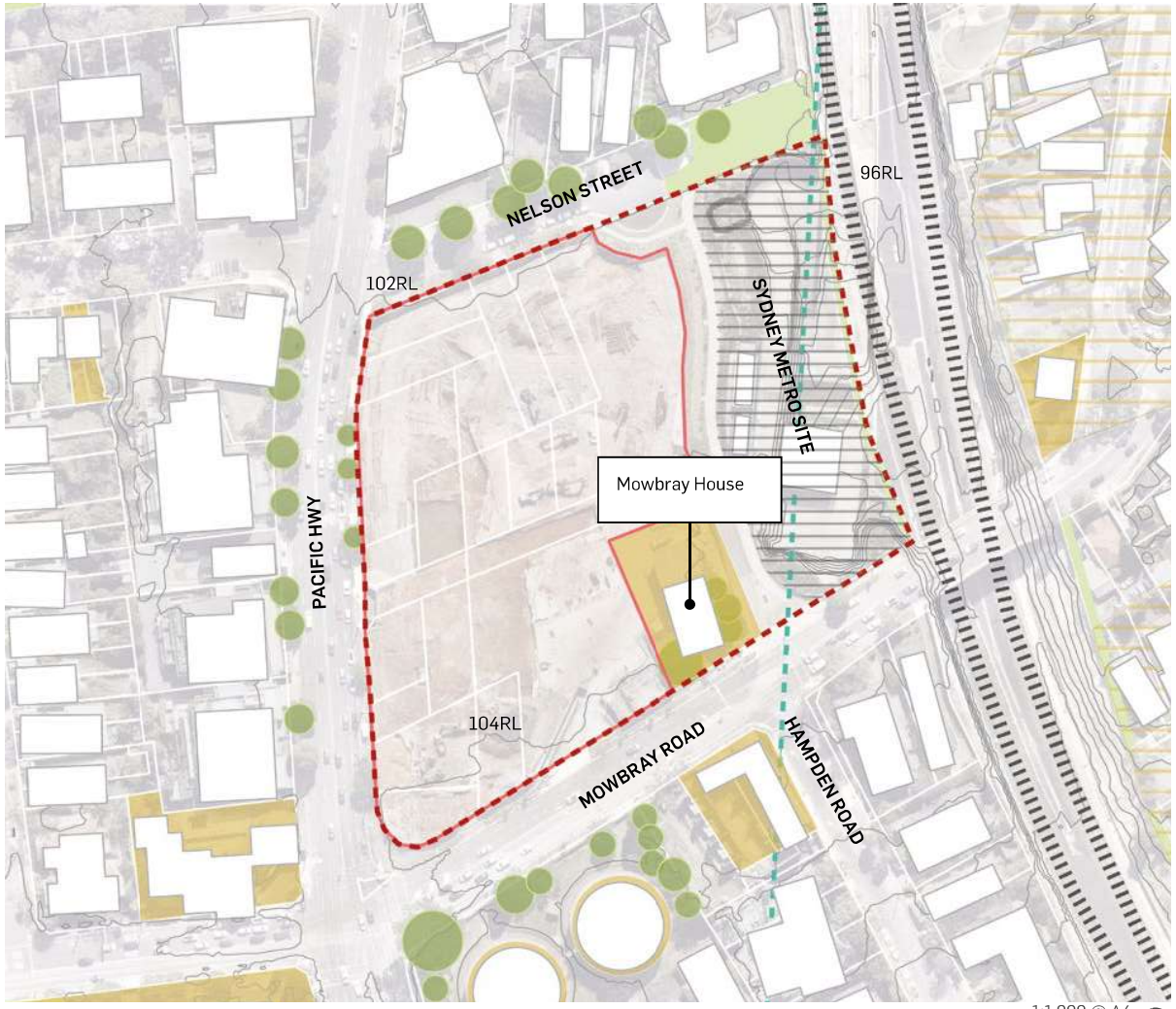


Figure 6 Site Analysis

Vehicular Site Access

KEY INSIGHTS

- Left in/Left out from Pacific Hwy into Nelson facilitates trips from Chatswood CBD.
- Northbound trips from the site is limited to exiting at Mowbray/Hampden intersection.
- Northbound trips to the site is limited to entry at Mowbray/Hampden intersection.
- The potential left in/left out closer to the Pacific/ Mowbray intersection is not expected to be a major site access.

Figure 7 Plan - Access Points

Views

KEY INSIGHTS

- From 10-15 storeys and above, undisrupted views east, west and south (views to CBD).
- Disrupted views to North due to existing and potential future developments zoned for 90m HOB.
- The transmission tower on adjacent southern block is a known landmark. Despite its height and presence, it is visually permeable, which offsets its significant presence.

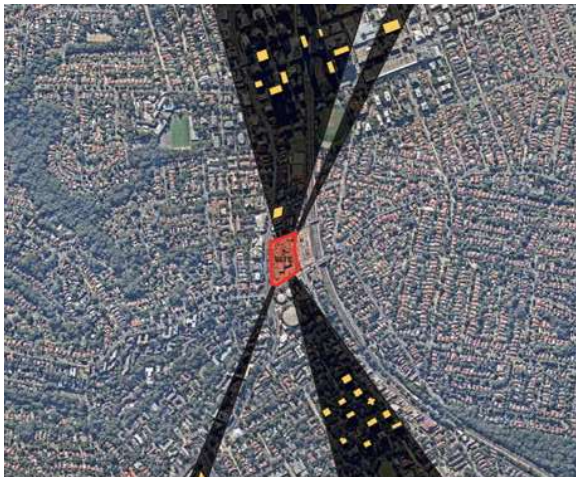


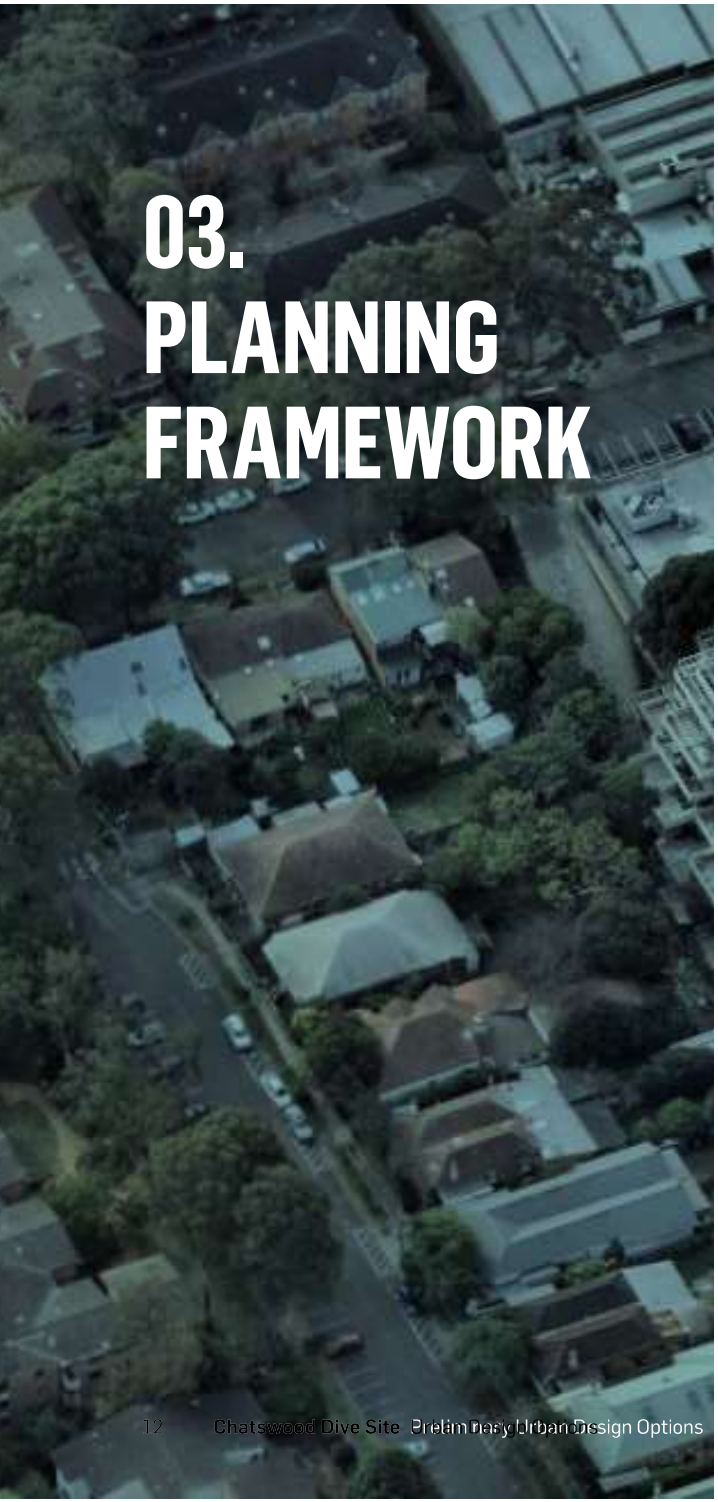
Figure 9 30m Low Rise Potential Views

Figure 10 60m High Rise Potential Views

Figure 8 Artarmon Communications Tower

Figure 11 30m Low Rise Potential Views

Figure 12 36m High Rise Potential Views



03. PLANNING FRAMEWORK

Planning Framework

The site is within Willoughby LGA and is subject to Willoughby LEP 2012 and Willoughby DCP 2023.

The key planning controls relevant to this study include:

Planning Controls	Permissible
LEP	
Land Use Zone	MU1 Mixed Use
FSR (n:1)	4.2
Maximum Height of Building (m) / storeys	53 (16)
Non-Residential GFA (sqm)	17% of Total GFA
DCP	
Minimum Floorplate	700m2
Setbacks	Various

In addition to the above, there is expectation from Council that the following will be delivered on the site:

- Public through-site link, open to the sky
- Public open space

The current planning framework is well documented in the Ethos Urban Preliminary Due Diligence Report.

The Urbis team has used this information as a basis for considering the development options for the site. The following summarises the key departures from the information set out by Ethos Urban.

Key Departures

Developable Area

Ethos Urban have adopted a Developable Area of approximately 14,119 sqm and that excludes Mowbray House and curtilage, the existing drainage swale along Frank Channon Walk and road access into the Metro Dive site. The permissible FSR has been calculated based on that boundary.

We note that the FSR control applies to the entirety of the DP lot area and therefore it would be possible to seek transfer of GFA applicable to land within the Site Area (Lot DP Plan) but which will not be developed. This approach is outlined in Section 6 Key Assumptions.

Residential Unit Size and Potential Yield

Ethos Urban has estimated dwelling yield of approximately 557 dwellings, based on an average unit size of 75sqm (NLA).

As part of this Study, we have obtained high-level market assessment information to better inform appropriate unit sizes and dwelling mix. This is outlined in the following section.

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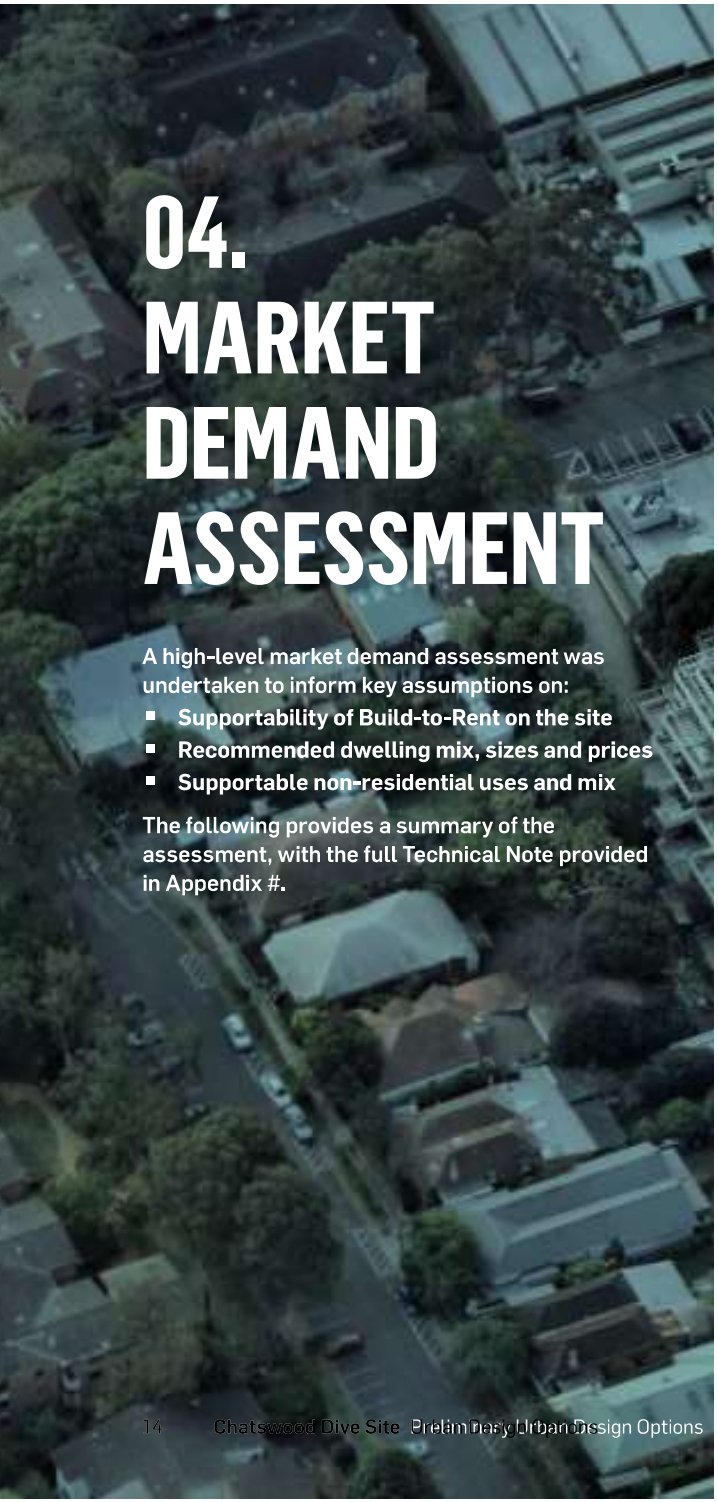


04. MARKET DEMAND ASSESSMENT

A high-level market demand assessment was undertaken to inform key assumptions on:

- **Supportability of Build-to-Rent on the site**
- **Recommended dwelling mix, sizes and prices**
- **Supportable non-residential uses and mix**

The following provides a summary of the assessment, with the full Technical Note provided in Appendix #.

Residential Market Analysis

Demographic Trends

- Based on ABS migration data, most new Chatswood residents come from Sydney's Lower North Shore and overseas. The defined Market Analysis Study Area includes Roseville, St Leonards, Artarmon, and Willoughby, aligning with the Willoughby LGA.
- NSW Department of Planning and Environment projects over 7,000 new residents in Willoughby LGA from 2026-2041, increasing housing demand. Retirees (65+) will grow significantly, driving demand for larger apartments.
- Younger professionals (25-39) will also increase, seeking smaller apartments due to Chatswood's amenities and transport links.
- In 2021, 50% of Chatswood households rented, higher than the Study Area (46.6%) and Greater Sydney (37.1%), which could justify Build to Rent development.
- The largest growth is projected for couple only households, which includes empty nesters and younger couples, highlighting the anticipated demand for 2 and 3 bedroom apartments to meet their needs.
- The number of lone person households is also projected to grow, which will drive demand for 1 bedroom units from first home buyers.

Competition

- An analysis of the apartment pipeline was undertaken looking at projects with 25 or more units across construction, presales, approved, DA and early planning development stages.
- Currently, only one project is under construction in Chatswood, reflecting limited market activity due to high construction costs and interest rates. Most supply is in early planning stages, creating uncertainty about progress.
- Several Build to Rent (BTR) projects are also in early planning in the Study Area, indicating interest in St Leonards and Chatswood. Competition for BTR should be monitored to assess its potential in future developments.
- Analysis of apartment mix in Chatswood and surrounding suburbs reveals an **average mix of 5% studios, 25% one bedroom, 51% two bedrooms and 19% 3 bedroom apartments.**

KEY INSIGHTS:

- A mix of BTS and/or BTR apartments could be provided, noting that for BTR, 150+ apartments would be optimal to achieve operational economies of scale.
- Professional couples and downsizers are the key buyer segments for the project, therefore majority of apartments should be two bedrooms.

Commercial Market Analysis

Benchmarking

- Commercial floorspace provision has been benchmarked against similar residential/ mixed-use developments in Sydney. Developments with significant floorspace are generally closer to train stations and have the scale to support a supermarket, which then acts as an anchor for additional retail/ service tenants.
- Five developments were benchmarked in terms of their quantum of non-residential GFA per unit, ranging from 0.6sqm per unit (Meriton Eastgardens) to 13.9sqm per unit (St Leonards Square). In comparison, the subject site would have in the order of 18.4sqm of non-residential GFA per unit (based on the current planning controls for 17% of total GFA to be non-residential and a site area of 17,500sqm), approximately 30% more than provided in St Leonards Square.

KEY INSIGHTS:

- The required quantum of non-residential floorspace required under the current planning controls is disproportionately high compared to similar mixed-use developments across Sydney.
- 4,300 – 6,300 sqm of non-residential floorspace in the form of child care, showroom, gym, and artisan food and drink industry could be supportable, subject to further market assessment.

Supportability

- A high-level view of supportable non-residential floorspace has been determined based on benchmarking, local competition and locational characteristics.

Non-Res Use	Supportability	Comment
Supermarket / Grocer	Low	A small supermarket is unviable due to low onsite residents and strong competition from nearby Chatswood, St Leonards, and Artarmon capturing local spending.
Convenience Retail	Low	Without an anchor supermarket, convenience retail will be limited to a few tenants like a café, hairdresser, or dentist.
Showroom Retail	Moderate	Potential interest from destination brands and furniture showrooms depends on Pacific Highway frontage and accessible parking, noting there is competition from Artarmon Homemaker precinct.
Gym	Moderate	Potential for smaller gyms like UFC, boxing or pilates. Larger tenants like Fitness First or Virgin prefer locations near major train stations.
Child Care	Moderate/ High	On-site residents are anticipated to be able to support a child care centre on the site.
Office	Low	Office space is not viable due to vacancies in better locations closer to Chatswood and St Leonards Stations. Private education (e.g. tutoring) is possible but faces nearby competition.
Micro Brewery	Moderate	Potential as there are not many micro-breweries in the area. Difficult to assess as success/ supportability of breweries are very operator dependant.

Recommendations

Dwelling Mix, Size and Price

Based on the demographics and market analysis, the following dwelling mix, size and prices assumptions are recommended.

Unit Type	Dwelling Mix	Average Internal Area (sqm)	Price Range ($2024)
Studio	~5%	43	$850,000 - $900,000
1 Bed	~25%	60	$1.1m - $1.5m
2 Bed	~60%	80	$1.6m - $2.4m
3 Bed	~10%	105	$2.4m - $3m*

Non-Residential Floorspace

Our high-level assessment indicates that the following quantum and mix of non-residential floorspace could be supportable though this would need to be assessed further by a comprehensive market assessment.

Commercial Use	GFA (sqm)
Convenience Retail	200 - 300
Showroom Retail	3,000 – 4,000
Gym	100 - 200
Child Care	500 - 800
Office	0 – 500
Micro Brewery	400 – 500
Total	**4,300 – 6,300**

05. CONSTRAINTS & OPPORTUNITIES

Determined by the team's analysis and discussion, the following are the key constraints and opportunities of the subject site. These findings are limited to the key design drivers that define the overarching development schemes.

Key Constraints

For the purposes of defining overarching design direction, the following are the site's key constraints:

- Ongoing access to Metro Dive Site from subject site.
- Access and nature of Mowbray Road / Hampden Road intersection.
- Retention of Mowbray House (+10m curtilage) local heritage item
- Preliminary traffic engineering indicates minor impacts to Mowbray House.

Figure 13 DP Plan

Figure 14 Truck and Dog Sweep Path

Figure 15 Mowbray House

Legend

- Site Boundary
- Indicative Developable Land
- Cadastre
- Existing Built Form
- Trainline
- Metro Line
- Existing Public Open Space
- 2m Contour

Constraints

- Heritage Items
- Residential Interface
- Commercial Interface
- Services Interface
- Access
- Existing Mature Trees
- Noise and Traffic Barrier
- 4m setback
- Road Widening (Earmarked)
- Current Metro truck entry and turning area
- Existing Water Main Easement

Figure 16 Plan - Constraints Mapping

Key Opportunities

For the purposes of defining overarching design direction, the following are the site's key opportunities:

- Chatswood-Artarmon nexus location ideal for additional housing (market, affordable, and BTR).
- Local and destination retail/F&B for on-site demand and communities along the east-west Mowbray Rd corridor.
- Retention of Mowbray House working with other heritage items within the intersection precinct to create a sense of place.
- Development has capacity to integrate with well-used existing bikeway.

Figure 17 Groundfloor retail activation

Figure 18 Childcare opportunities

Figure 19 Landmark corner development

Figure 20 Buildings in landscape setting

Figure 21 Plan - Opportunities Mapping

06. KEY ASSUMPTIONS

Determined in collaboration between Urbis and Landcom, the following are key assumptions that underpin the scope for development scheme options generation and testing.

These assumptions pertain to key design drivers only. Further detailed and technical assumptions for testing shall be undertaken to inform design development and validation.

Site & Developable Area

The Site Area for the purposes of calculating the permissible floorspace is 17,500sqm. This aligns with the DP and Easement Boundary. The intention is to transfer permissible GFA from these elements of the site to the Developable Area boundary.

The Developable Area defines the boundary for the built form massing and will be the land where the permissible GFA will be transferred.

This Excludes:

- Mowbray Road widening reserve,
- Mowbray House + 10m curtilage, and;
- Road reserve between the subject Site and Metro Site

Figure 22 DP Plan Boundary

Figure 23 Developable Site Area

Legend

Site Boundary

DP Plan Boundary

Built Form & Land Use Assumptions

Built Form Metrics

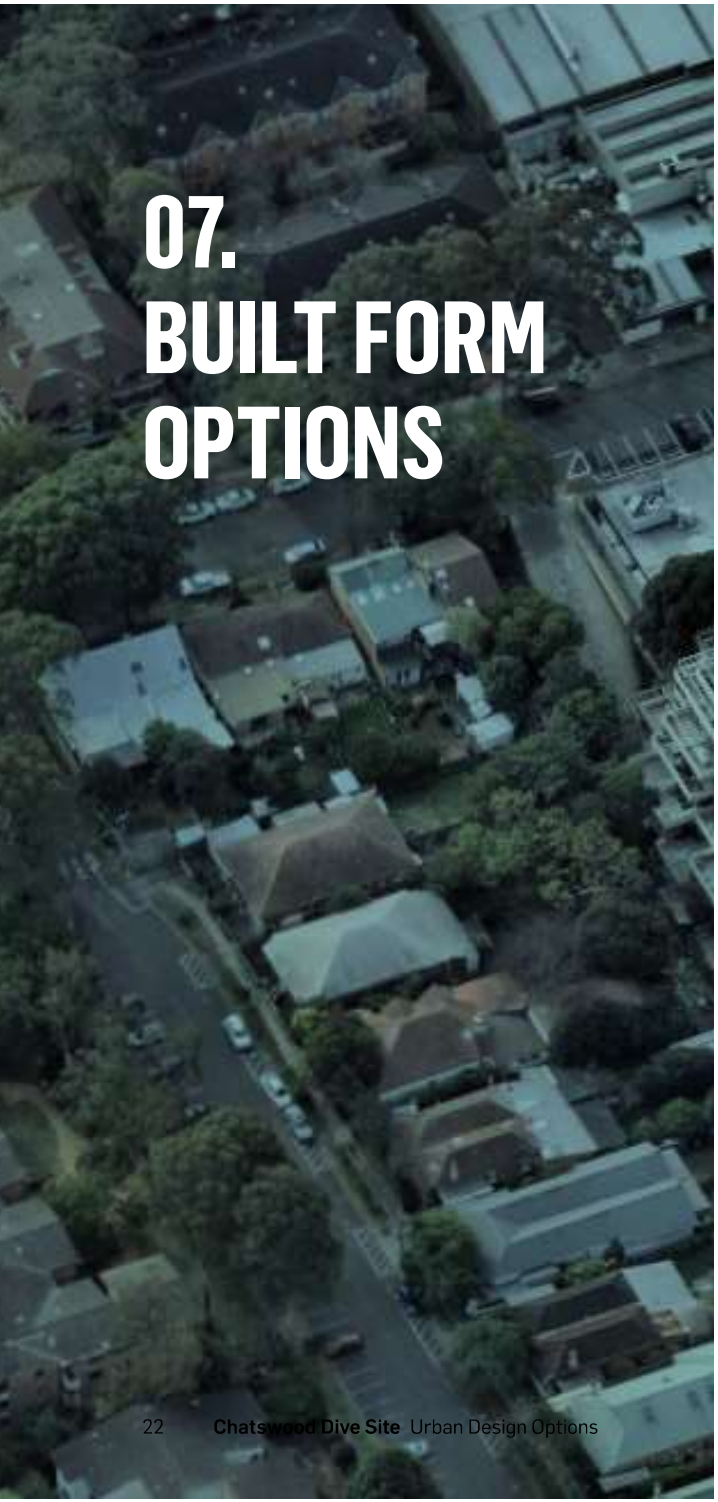
Metric		Willoughby DCP	Options Assumptions
Maximum floorplate (sqm GFA)	Residential	700	
	Non-Residential	2,000	
Floor to Floor Heights (m)	Residential		3.2
	Non-Residential Ground		4.0
	Non-Residential Podium		3.5
Unit Sizes (sqm GFA) & Mix	Studio (5%)	40	43
	One Bedroom (25%)	60	60
	Two Bedroom (60%)	80	80
	Three Bedroom (10%)	100	105

Table 1 Key Assumptions

Non-Residential Land Uses:

Supportable non-residential uses:

- Child care
- Convenience Retail / Service (e.g. hairdressers)
- Showrooms
- Small Office/Home Office (SOHO)



07. BUILT FORM OPTIONS

Option 1 – Base Case

Agreed Scope

The following outlines the base scope for Option 1:

- Assuming FSR of 4.2:1
- Retain Mowbray House
- Including 17% Total GFA as Non-Residential Uses as per LEP requirement
- Maintain Height Limit of 53m
- Comply with DCP restriction for maximum floorplate sizes to be no greater than 700sqm.
- Council DA to be assessed by Regional Planning Panel. If BTR component was to be provided, SSDA.

Design Response

- Maintain main access from existing internal access from Mowbray Road/Hampden Road intersection.
- Provide public open space amenity to the north of the site to maximise solar benefits and positioned away from Pacific Highway.
- Through-site link provided from Nelson Street to Mowbray Road, aligning with Chatswood Urban Design Strategy.
- North-south positioning of tower forms to maximise solar amenity.
- Developments on key corners for visual exposure

KEY INSIGHTS

- Retention of Mowbray House and DCP restrictions on floorplate size limits the ability to realise full GFA potential of the site.

Yield Summary

	Permissible	Achievable
FSR (n:1)	4.2	3.7
Maximum Height of Building (m) / storeys	53 (16)	53
Residential GFA (sqm)	61,005	53,467
Non-Residential GFA (sqm)	12,495	11,663
Total GFA (sqm)	73,500	65,130
Total No. Dwellings	**678***	**594 - 622**

* *Based on 90sqm GFA per unit*

** *Lower figure is based on 90sqm GFA per unit. Higher figure reflects achieved yield based on generated floorplates.*

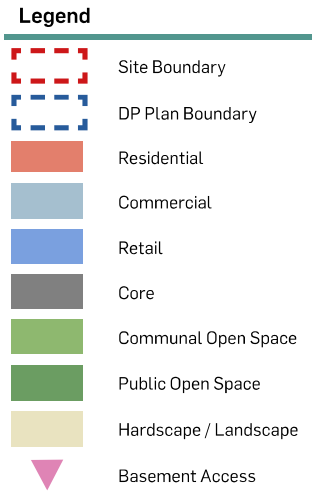


Figure 24 Indicative Site Plan - Option 1

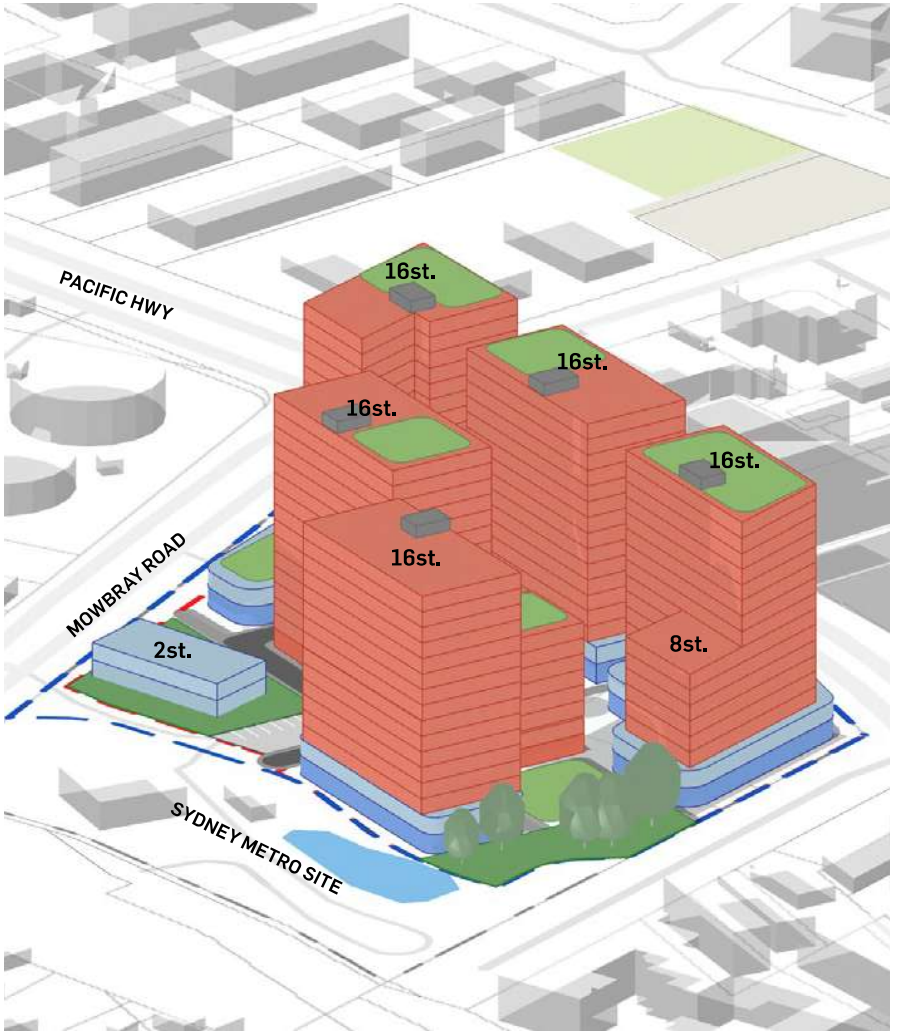


Figure 25 Indicative Massing - Option 1

Dwelling Mix

Apartment Type	No. of Units	Mix Percentage (%)
Studio	32	5
1 Bed	154	25
2 Bed	364	59
3 Bed	72	11
TOTAL	622	100

Table 2 Dwelling Yield

The typical floor plans have been generated using a parametric design tool (Giraffe) based on the dwelling mix and unit size assumptions. Further detailed Proof of Concept design work is required to validate dwelling yield.

Legend

- Site Boundary
- DP Plan Boundary
- Non-Residential
- Core
- Communal Open Space
- Public Open Space
- Hardscape
- Road

Figure 26 Indicative Apartment Layout - Option 1

ADG Open Space Compliance

The following diagram and below table summarise the solar access analysis to the active open spaces and communal open spaces to each of the residential lots.

Table 3 Deep Soil Zone Provision

LOT AREA (SQM)	DEEP SOIL ZONE		
	Deep Soil Zone - ADG Compliance (sqm)	Deep Soil Zone - ADG Compliance (%)	Total Deep Soil Zone (sqm)
16,110	**1,128**	**7%**	**1,892**

Table 4 Communal Open Space Solar Amenity Analysis

AREA (SQM)	COMMUNAL OPEN SPACE			
	PRINCIPAL USABLE	OTHER	TOTAL AREA (SQM)	% OF SITE
Lot Area	-	-	16,110	**100**
Ground	1,161	1,128	**2,289**	**14.2%**
Above Ground	2,674		**2,674**	**16.2%**
TOTAL	**3,835**	**1,128**	**4,963**	**30.8%**

Figure 27 Indicative ADG Compliance - Option 1

ADG Solar and Cross Ventilation Compliance

Preliminary testing indicates ADG solar amenity and cross ventialation can be achieved. Detailed design required for further analysis.

Legend

- Site Boundary
- DP Plan Boundary
- Preliminary 2hrs+ Solar Access achieved
- Preliminary Cross Ventilation achieved (first 9 storeys)

Figure 28 Indicative Solar Analysis - Option 1

Figure 29 Indicative ADG Compliance - Option 1

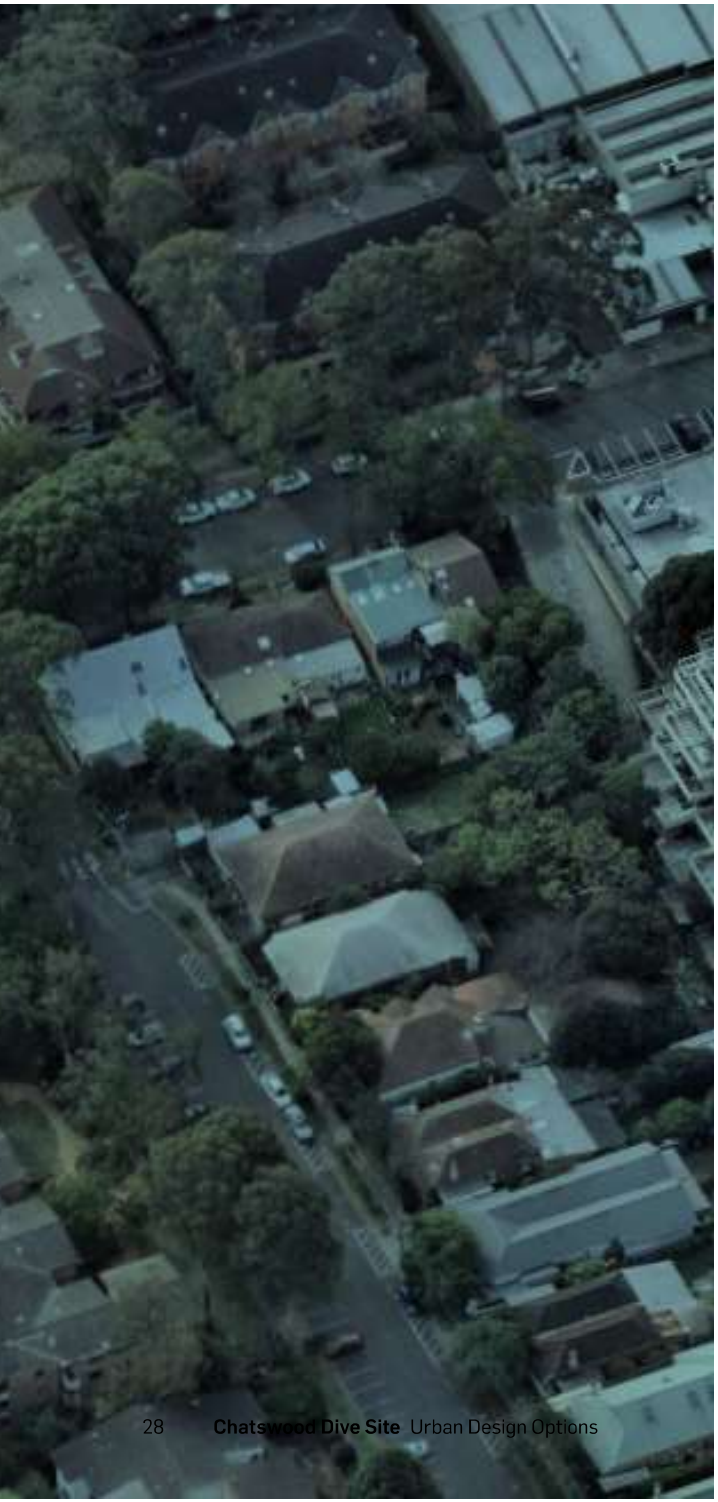
Indicative Development Staging

The development staging generally follows a north to south sequence. Specifically:

- Stage 1 – Upfront delivery of public open space
- Stage 2 and 3 – Establish presence to Pacific Highway
- Stage 4 and 5 – Manage close out of construction access. Potential intersection upgrade

It is assumed that construction access will be provided via existing access from Mowbray Road.

Figure 30 Indicative Staging Plan - Option 1



Option 2 – Maximum

Agreed Scope

The following outlines the scope for Option 2, which seeks to maximise development on the site, assuming that the current controls applicable to the site immediately north of Nelson Street could be applied to the subject site.

- Assume 90m maximum building height to the north of the site, stepping down to 53m to the south,
- Assume maximum FSR of 6:1
- Retain Mowbray House
- Reduce Non-Residential GFA to 50% of the required 17% Total GFA
- Planning Proposal Pathway
- Allow floorplate sizes to exceed DCP restriction of 700sqm GFA.

Design Response

- Access off Nelson Road and from internal road off Mowbray Road/Hampden Road intersection.
- Provide public open space amenity to the north of the site to maximise solar benefits and positioned away from Pacific Highway.
- Through-site link provided from Nelson Street to Mowbray Road, aligning with Chatswood Urban Design Strategy.
- North-south positioning of tower forms to maximise solar amenity.
- Developments on key corners for visual exposure.
- Cascading tower height from north to south.

KEY INSIGHTS

- Retention of Mowbray House and height limits make it difficult to realise full GFA potential of the site.

Metrics/Yield Summary

	Adjacent Controls	Achieved
FSR (n:1)	6	4.8
Maximum Height of Building (m) / storeys	90	53m to 90m
Residential GFA (sqm)	87,850	78,422
Non-Residential GFA (sqm)	17,850	5,574
Total GFA (sqm)	105,000	83,996
Total No. Dwellings	978*	871-902**

* *Based on 90sqm GFA per unit*

** *Lower figure is based on 90sqm GFA per unit. Higher figure reflects achieved yield based on generated floorplates.*

Legend

- Site Boundary
- DP Plan Boundary
- Residential
- Commercial
- Retail
- Core
- Communal Open Space
- Public Open Space
- Hardscape/ Landscape
- Basement Access

Figure 31 Indicative Site Plan - Option 2

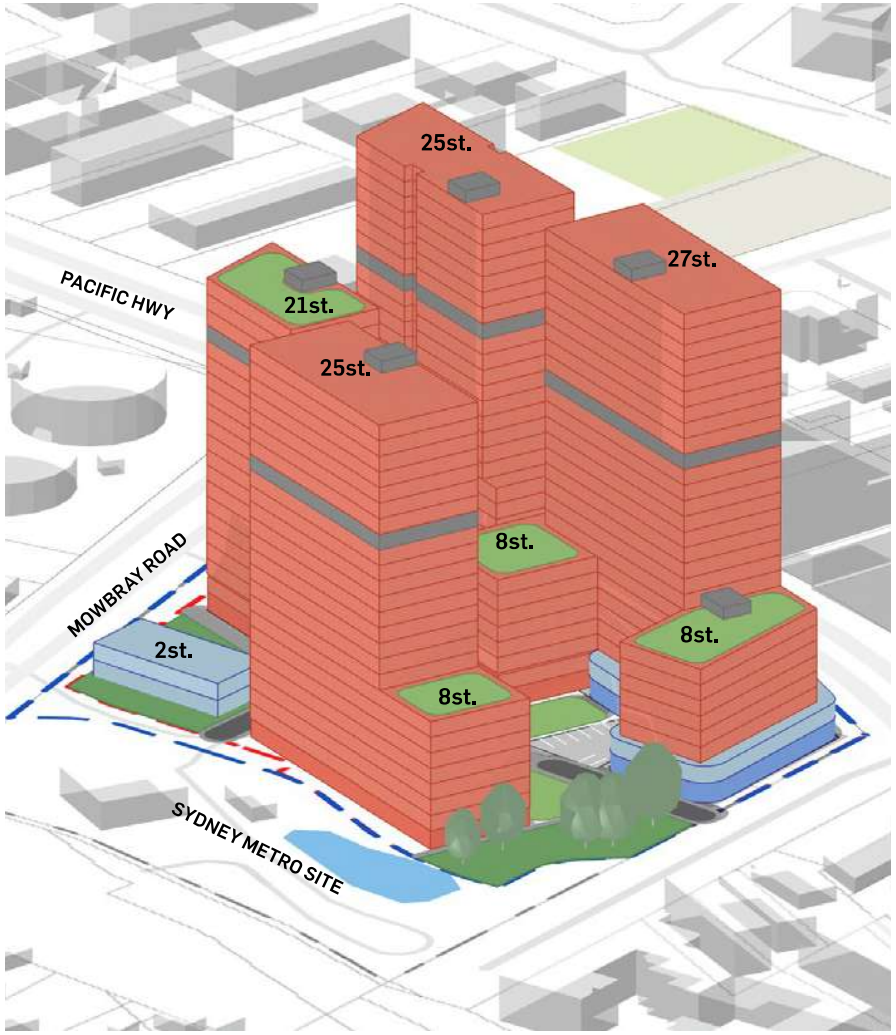


Figure 32 Indicative Massing - Option 2

Dwelling Mix

The typical floor plans have been generated using a parametric design tool (Giraffe) based on the dwelling mix and unit size assumptions. Further detailed Proof of Concept design work is required to validate dwelling yield.

Apartment Type	No. of Units	Mix Percentage (%)
Studio	50	5.5
1 Bed	206	23
2 Bed	542	60
3 Bed	104	11.5
TOTAL	902	100

Table 5 Dwelling Yield

Legend

- Site Boundary
- DP Plan Boundary
- Non-Residential
- Core
- Communal Open Space
- Public Open Space
- Hardscape
- Road

Figure 33 Indicative Apartment Layout - Option 2

ADG Open Space Compliance

The following diagram and below table summarise the solar access analysis to the active open spaces and communal open spaces to each residential lots.

	DEEP SOIL ZONE		
LOT AREA (SQM)	Deep Soil Zone - ADG Compliance (sqm)	Deep Soil Zone - ADG Compliance (%)	Total Deep Soil Zone (sqm)
16,110	**1,128**	**7%**	**1,656**

Table 6 Deep Soil Provison

AREA (SQM)	COMMUNAL OPEN SPACE			
	PRINCIPAL USABLE	OTHER	TOTAL AREA (SQM)	% OF SITE
Lot Area	-	-	16,110	**100**
Ground	1,668	1,656	**3,324**	**20.6**
Above Ground	2,024	-	**2,024**	**12.5%**
TOTAL	**3,692**	**1,656**	**5,348**	**33.2%**

Table 7 Communal Open Space Solar Amenity Analysis

Figure 34 Indicative ADG Compliance - Option 2

ADG Solar and Cross Ventilation Compliance

Preliminary testing indicates ADG solar amenity and cross ventialation can be achieved. Detailed design required for further analysis.

Legend

- Site Boundary
- DP Plan Boundary
- Preliminary 2hrs+ Solar Access achieved
- Preliminary Cross Ventilation achieved (first 9 storeys)

Figure 35 Indicative Solar Analysis - Option 1

Figure 36 Indicative ADG Compliance - Option 2

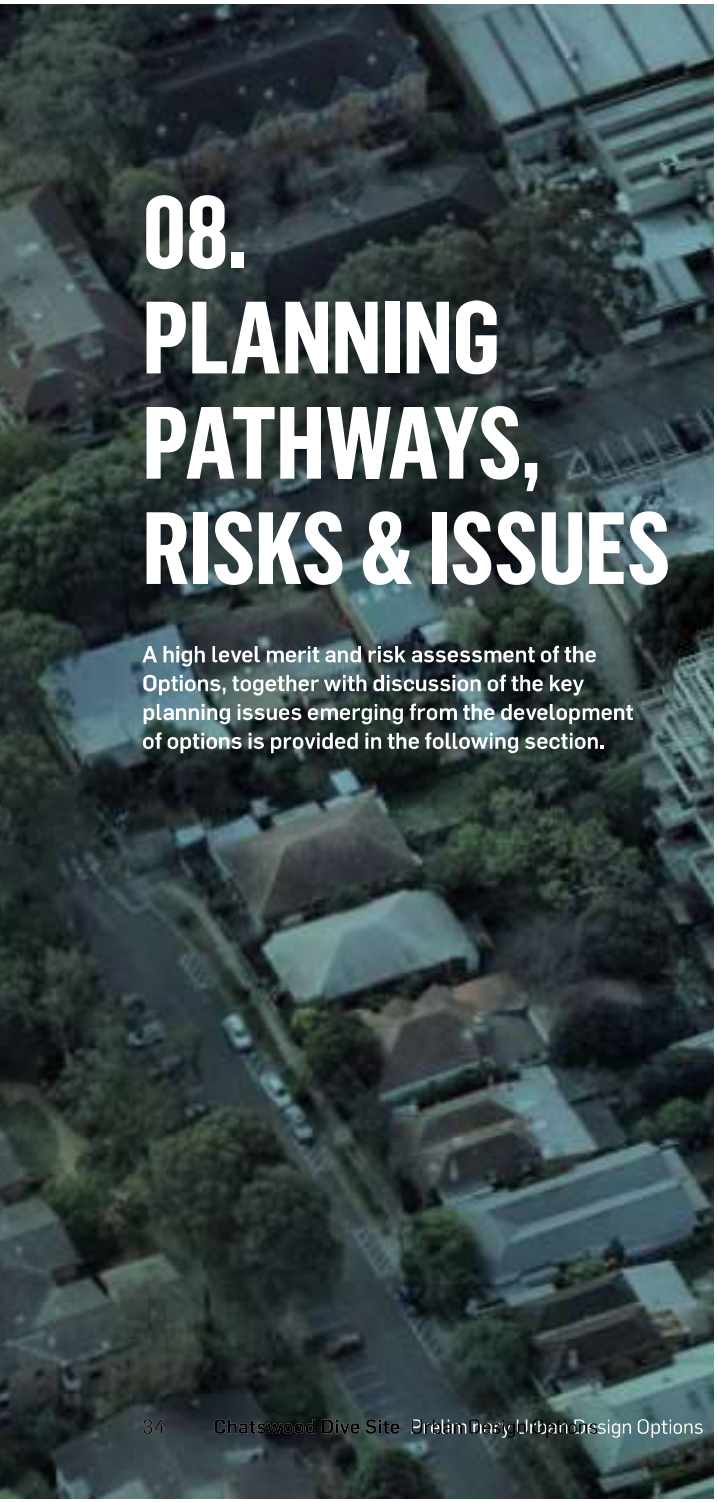
Indicative Development Staging

The development staging generally follows a north to south sequence. Specifically:

- Stage 1 – Upfront delivery of public open space
- Stage 2 – Establish presence to Pacific Highway
- Stage 3 – Manage close out of construction access.
  Potential intersection upgrade

It is assumed that construction access will be provided via existing access from Mowbray Road.

Figure 37 Indicative Staging Plan - Option 2



08. PLANNING PATHWAYS, RISKS & ISSUES

A high level merit and risk assessment of the Options, together with discussion of the key planning issues emerging from the development of options is provided in the following section.

Planning Approval Pathways and Risks

Option 1 – Regionally Significant Development Application

Approval Pathway

- Option 1 would be classified as *regionally significant development* and assessed by Willoughby City Council and determined by the Sydney North Planning Panel.

Planning Risk

- Option 1 would likely have Council support for approval, as it falls within the height and FSR controls specified for the site.
- It is noted that Option 1 involves the retention of Mowbray House, which aligns with the heritage interpretation plan previously prepared for the site.
- Notwithstanding other concerns relating traffic, parking and site access which would need to be appropriately addressed, Option 1 would pose the least amount of risk of the two options.

Timeframes for Determination

- Approximately 12-18 months, noting that this is highly variable.

Alternative Options

- Should Landcom seek to establish infill affordable housing or Build to Rent housing on the site, alternative planning pathways, i.e. State significant development, would be available under the Housing SEPP.

Option 2 – Planning Proposal

Approval Pathway

- Option 2 presents as very dense, however the revised version of Option 2 addresses some key issues, including the retention of Mowbray House and building heights that step downwards towards the south of the site
- Option 2 would require a planning proposal to vary the controls on the site to achieve the desired development outcome.

Planning Risk

- Council would likely object to any planning proposal which sought to vary controls that were only adopted in June 2023. The controls for the site including height and FSR were recommended as part of additional Urban Design work undertaken by GMU. There is considerable risk to this approach.

Timeframes for Determination

- Approximately 14 months for Planning Proposal gazettal and subsequent DA between 12-18 months, therefore minimum of 26-32 months (2+ years), noting that this timeframe is highly variable.

Alternative Options

- Notwithstanding the risks identified above, given the anticipated development yields and delivery of new housing there could be benefit in investigating whether this site could be including as part of the recently adopted State Significant Rezoning Policy (September 2024).
- For details regarding a Planning Proposal to rezone to R4 (Option 3), see Appendix 2 Planning Insights.

Key Planning Issues

Variation to Floorplate

Variation of the 700sqm floorplate as specified by Part L, Section 4.39(d) of the Willoughby DCP would be challenging as Council are keen to maintain compliance with relatively new DCP controls.

As noted above, DPHI and the GA would preference compliance with DCP provisions where possible through the design excellence process. Any variation to the floorplate requirement would require robust justification.

There may be a stronger argument to seeking additional building height to achieve the maximum permissible FSR via a clause 4.6 Variation rather than seeking floorplates greater than 700sqm. Extra height can maintain the slender tower objectives under the DCP and Chatswood CBD Strategy.

Urbis has recently been involved in a SSDA that included a minor variation to the 700sqm floor plate to 750sqm in the Chatswood Commercial Core, however this was for a BTR development where DPHI guidelines provide additional flexibility for matters including floorplates.

Traffic, Parking and Site Access

Access to the site from Nelson Street could be achievable, however Transport for NSW (TfNSW) may have concerns about traffic exiting Nelson Street to the Pacific Highway

The existing signalised intersection with Mowbray Road may be more preferable to TfNSW.

Council is very clear on enforcing a reduced parking provision across the area covered by the CBD Strategy as reflected in the Development Control Plan (DCP) controls. A lower car parking provision to reduce traffic/parking impacts is something that should be explored as part of any future redevelopment of the site, such as the following benchmark which seeks to progress mode shift to sustainable transport:

- Maximum 0.2 spaces per 1 bedroom unit
- Maximum 0.3 spaces per 2 bedroom unit
- Maximum 0.5 spaces per 3 bedroom unit
- Plus a common pool of unbundled parking capped at 40% of total spaces

However, it is noted that the above approach may not meet buyers expectations and have implications on sales. Based on the 2021 Census, average car ownership of people living in apartments in Willoughby LGA is 1 bed (0.7), 2 bed (1.0) and 3 bed (1.2). Urbis' feedback from agents/developers in St Leonards, where there are tight parking constraints in some projects, indicates ability to sell one bedroom units without parking and difficulties selling two and three bedroom units without a space.

Separate basements may be a preferable option as it would allow for flexibility in staging development (i.e. simply build one basement at a time in line with each stage). This would also assist in additional deep soil areas for tree planting however may result in additional construction costs as deeper basements may be required. Basement location and depths will also need to consider any offset requirements of Sydney Metro.

Variation to requirement for 17% of GFA to be non-residential

The non-residential requirement was a key component of the Chatswood CBD Strategy and LEP amendments in 2023.

Council have been very reluctant to accept any variation to this control noting that the definition of non-residential floorspace has been made intentionally broad to facilitate a wide range of uses.

As currently drafted the 17% non-residential GFA control applies to the total GFA which would include any bonus provisions under Housing SEPP. We note that DPHI have indicated that they are prepared to accept clause 4.6 variation to enable the 17% to apply to the base FSR. It is important to note that whilst DPHI have indicated this, no variations have been approved to date given the relatively recent adoption of the infill affordable housing bonus provisions.

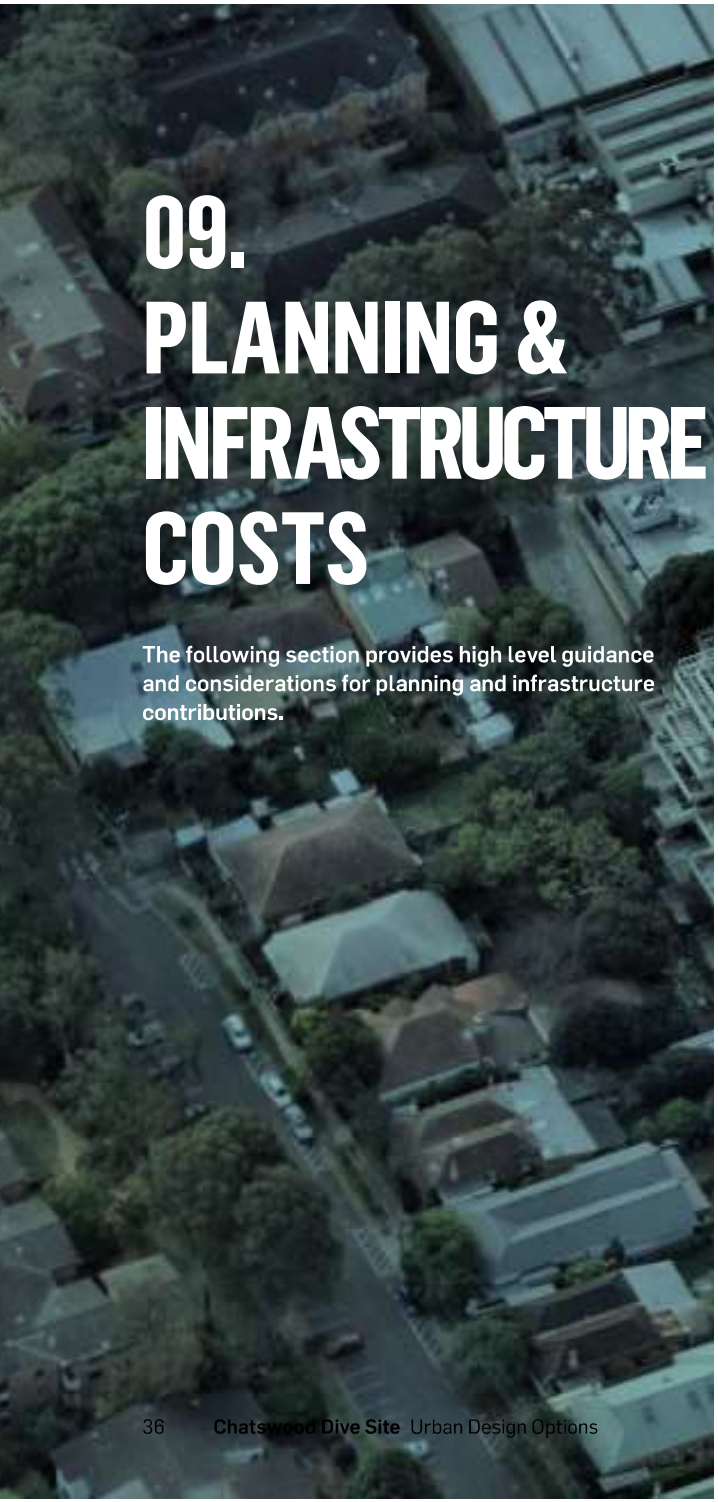
Council is currently reviewing their stance on commercial GFA in the Chatswood CBD however this review relates mainly to the CBD Core and is unlikely to broaden to the mixed-use areas.

Regarding a R4 rezoning to enable flexibility in non-residential GFA requirement, see Appendix 2 Planning Insights.

Mowbray House – Heritage Item

Approval to demolish the heritage item would be unlikely.

The heritage interpretation plan for the site retains Mowbray House as part of the plan.



09. PLANNING & INFRASTRUCTURE COSTS

The following section provides high level guidance and considerations for planning and infrastructure contributions.

Planning Costs

Urbis will be able to confirm DA lodgement and consultant costs upon receipt of the Estimated Development Cost (EDC) from Landcom.

Planning Circular PS 24-002 (27 February 2024) provides an outline of a single methodology for calculating 'estimated development cost' used in planning for various purposes, including for determining development approval pathways, calculating assessment fees and for applying development application (DA) requirements.

INDICATIVE PLANNING COSTS

- Detailed breakdown provided in Appendix 4.

Infrastructure Contributions

Infrastructure Contributions applicable to the site are:

1. **Regional contributions - Housing and Productivity Contributions (HPC)**

   The following components will apply:

   a. **Base component:**

Land Use	Contribution rate
All other residential accommodation (residential flat buildings and units)	$10,000 per dwelling / lot
Commercial	$30 per square metre of new gross floor area for commercial development
Retail	$30 per square metre of new gross floor area for retail development

   b. **Major Transport Component:** This component has been identified as a future contribution applying to areas near new Metro stations. No further details regarding areas of application and contributions rates have been announced at this stage.

Other Infrastructure Considerations

2. **Local contributions – S7.11 contributions**

   in accordance with the Willoughby Local Infrastructure Contributions Plan 2019 (unindexed rates shown below)

Dwelling Type	Contribution required per dwelling
Per bedsit, studio (Apartment Type) or 1 bedroom dwelling	$11,045.37
Per 2 bedroom dwelling	$15,544.09
Per 3 or more bedroom dwelling / Per lot	$20,000.00

3. **Sydney Water DSP contributions**
   - **a.** Drinking Water DSP
   - **b.** Wastewater DSP

Mowbray/Hampden Rd Intersection

Conversion of the temporary intersection of Mowbray and Hampden Roads is likely to be considered regional infrastructure since Mowbray Road is a classified state road.

While the construction of a permanent intersection does benefit more than one development (the site and Sydney Metro), the works in guideline for HPC are yet to be finalised and early feedback from DPHI indicates offsets against HPC contributions could be harder to obtain under the new contributions framework.

Based on currently available information, we consider it may be difficult to obtain contributions offset for the construction of this intersection. However, exhibition of a new Infrastructure Opportunities Plan and a new Works in Kind Guideline is expected towards the end of this year, or early next year, which could provide further clarity on this issue.

KEY INSIGHT:

- It may be difficult to obtain contributions offset against the HPC for the upgrade of Mowbray and Hampden Road intersection.

Public Park

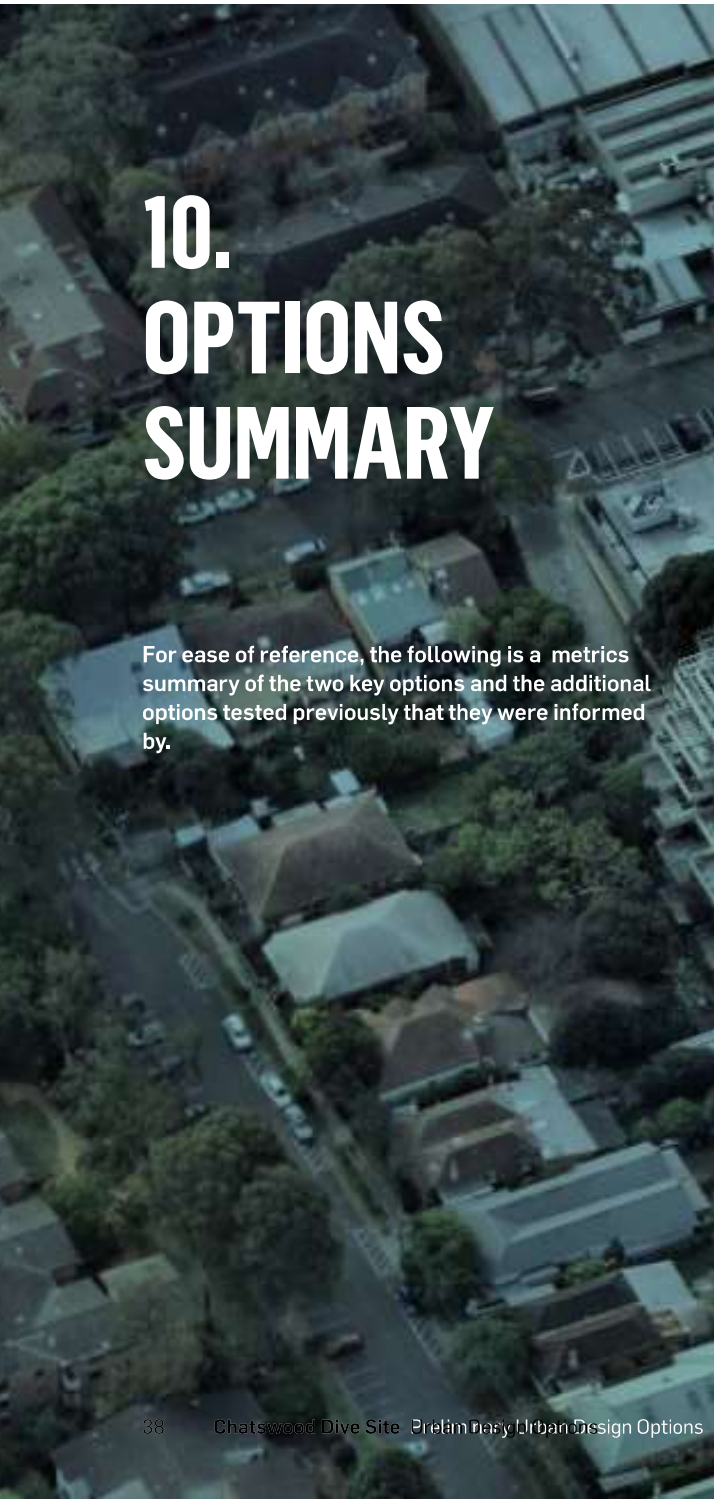
It is likely Council will push back against providing works in kind offsets against local contributions for the dedication of the public park by claiming the park will only satisfy the open space demand generated by future residents of the site.

However, Landcom can argue that provision of the park reduces the demand for open space generated by the development, and since S7.11 is a nexus dependent contribution, this reduction in demand should lead to a reduction in contribution payable. Furthermore, location of the park allows its use by residents of neighbouring developments.

We recommend Landcom seek to enter into a Works in Kind Agreement with Council for the works and land dedication related to the public park.

KEY INSIGHT:

- It may be possible to offset s7.11 contributions by entering into a Works in Kind Agreement with Council for the works and land dedication related to the public park.



10. OPTIONS SUMMARY

For ease of reference, the following is a metrics summary of the two key options and the additional options tested previously that they were informed by.

Table 8 Options Yield Summary

	Baseline Metrics	Option 1 – Base Case	Option 2 – Max 90m
Site Area (sqm)	17,500	17,500	17,500
FSR (n:1)	4.2	3.7	4.8
Residential GFA (sqm)	61,005	53,467	78,422
Non-Residential GFA (sqm)	12,495	11,663	5,574
Building Height (m)	53	53	90
Building Height (storeys)	16	16	27
No. of Dwellings	678	594 - 622	871-902
Planning pathway		Regionally significant development	Planning Proposal

11.
NEXT STEPS

This package represents a high-level investigation of the development potential of the site. There is need and scope for subsequent analysis, concept design development, testing, and refinement. Informed by the work to date, we suggest the following recommendations for the next steps in the process towards confirming development feasibility, technical studies briefs, and planning pathways.

Further Work

Further work and next steps will be guided by Landcom's needs following initial feasibility analysis.

Based on the findings of our work, potential further study include:

- **Urban Design Refinement:**
  - Ground plane and access
  - Distribution of dwelling mix across buildings / stages and vertically (low, medium and high).

- **Market Assessment:**
  - Commercial / Non-residential uses and mix

- **Traffic Assessment**
  - Nelson Street capacity
  - Mowbray Road and Hampden Road intersection capacity

APPENDIX 1 - YIELD TABLES

CHATSWOOD DIVE SITE
STATISTICAL SUMMARY (WIP)
CLIENT: LANDCOM
Date: 121124

OPTION 1 - BASE CASE (DCP COMPLIANT)

PER BUILDING	LOT AREA	DWELLING MIX & COUNT						FLOORSPACE Residential				FLOORSPACE Non-Residential					TOTAL ACHIEVABLE		Communal Open Space	
	sqm	No. of Storeys	Studio	1B	2B	3B	Total Units	GBA	GFA	NSA	No. Storeys	Retail	Comm	GBA	GFA	No. Storeys	GFA	No. Storeys (Height)	Area	% of Lot
BLD A	**2,954**	16	**12**	**18**	**70**	**14**	**114**	**13,477**	**10,108**	**8,592**	**14**	**1,842**	**1,842**	**3684**	**3131**	**2**	**13,239**	**16**	867	29%
Podium (GF-1)		*2*					-	-	-	-	-	*1,842*	*1,842*	*3,684*	*3,131*	*2*				
Tower - Lower (2-7)		*6*	*12*	*18*	*30*	*6*														
Tower - Upper (8-15)		*8*			*40*	*8*		*13,477*	*10,108*	*8,592*	*14*									
BLD B	**2,900**	18	**14**	**54**	**84**	**12**	**164**	**16,992**	**12,744**	**10,832**	**14**	**1,202**	**1,202**	**2,404**	**2,043**	2	**14,787**	**16**	896	31%
Podium - Commercial		*2*										*1,202*	*1,202*	*2,404*	*2,043*	*2*				
Podium - Residential (GF-1)		*2*	*8*	*4*	*2*															
Tower - Lower (2-7)		*6*	*6*	*18*	*42*	*12*														
Tower - Upper (8-15)		*8*		*32*	*40*			*16,992*	*12,744*	*10,832*	*14*									
BLD C	**1,986**	16	**-**	**48**	**64**	**16**	**128**	**15,167**	**11,375**	**9,669**	**14**			-	-		**11,375**	**14**	600	30%
Podium		*0*										-	-	-	-					
Tower (GF - 15)		*16*	*0*	*48*	*64*	*16*		*15,167*	*11,375*	*9,669*	*14*									
BLD D	**3,159**	16	**6**	**6**	**76**	**16**	**104**	**12,562**	**9,422**	**8,008**	**14**	**2,000**	**2,000**	**4,000**	**3,400**	2	**12,822**	**16**	768	39%
Podium (GF-1)		*2*										*2,000*	*2,000*	*4,000*	*3,400*	*2*				
Tower - Lower (2-7)		*6*	*6*	*6*	*36*			*12,562*	*9,422*	*8,008*	*14*									
Tower - Upper (8-15)		*8*			*40*	*16*														
BLD E	**2,348**	16	**-**	**28**	**70**	**14**	**112**	**13,091**	**9,818**	**8,346**	**14**	**1,363**	**1,363**	**2,726**	**2,317**	2	**12,135**	**16**	600	26%
Podium (GF-1)		*2*										*1,363*	*1,363*	*2,726*	*2,317*					
Tower (2-15)		*14*	*0*	*28*	*70*	*14*		*13,091*	*9,818*	*8,346*	*14*									
OTHER														**908**	**772**	**2**	**772**			
Mowbray House	1,911						-	-	-	-	-		*908*	*908*	*772*	*2*		2	1,036	54%
Public Open Space (North)	856																			
Roads/Road Widening	1,386						-	-	-	-	-									
Total	17,500		32	154	364	72	622	**71,289**	**53,467**	**45,447**	**70**	**10,972**	**11,880**	**13,722**	**11,664**	**10**	**65,130**		**4,767**	**27%**

Achieved Dwelling Mix (%) 5% 25% 59% 12% 100%
Achieved FSR 3.7 :1
Achieveable (based on preliminary internal layout studies) 622
Indicative Dwelling Yield (assuming avg. 90sm GFA per unit) 594

CAR PARKING
Minimum Car Parking Spaces Resi 190 Non-Resi 40
Maximum no. of Basements 1

Maximim Car Parking Spaces Resi 398 Non-Resi 106
Maximum no. of Basements 3

MINIMUM PARKING

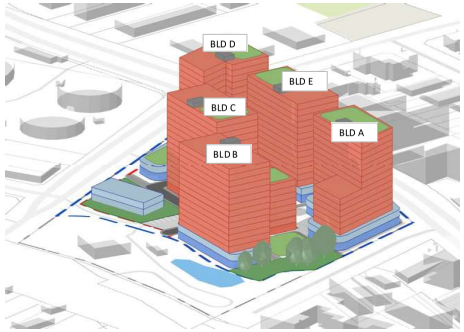
	Building Footprint	Residential							Non-Residential				Total Required		Total Provided		
	sm	Studio	1B	2B	3B	Visitor	Total	GBA	Retail	Comm	Total	GBA	Spaces	GBA	Spaces	GBA	Levels
BLD A	1,842	1.0	1.0	14.0	3.0	16.0	35	1,225	9	2	11	385	46	1,610	46	1,610	1
BLD B	1,770	1.0	5.0	16.0	3.0	23.0	48	1,680	6	1	7	245	55	1,925	55	1,925	1
BLD C	948	-	4.0	12.0	4.0	18.0	38	1,330	-	-	-	-	38	1,330	38	1,330	1
BLD D	1,942	1.0	-	15.0	4.0	14.0	34	1,190	10	2	12	420	46	1,610	46	1,610	1
BLD E	1,363	-	2.0	14.0	3.0	16.0	35	1,225	7	2	9	315	44	1,540	44	1,540	1
Mowbray House	-						-	-	-	1	1	35	1	35	1	35	-
MINIMUM CAR PARKING		**3**	**12**	**71**	**17**	**87**	**190**	**6,650**	**32**	**8**	**40**	**1,400**	**230**	**8,050**	**230**	**8,050**	

MAXIMUM PARKING

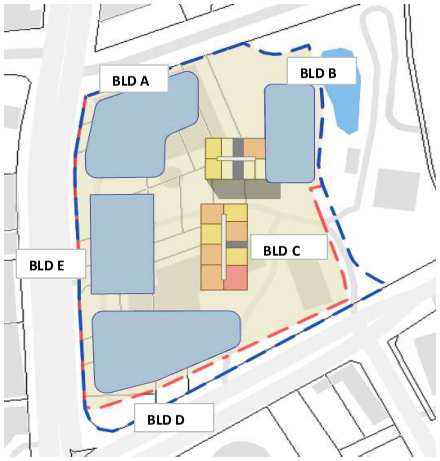
	Building Footprint	Residential							Non-Residential				Total Required		Total Provided		
	sm	Studio	1B	2B	3B	Visitor	Total	GBA	Retail	Comm	Total	GBA	Spaces	GBA	Spaces	GBA	Levels (Basement)
BLD A	1,842	6.0	9.0	35.0	7.0	16.0	73	2,555	26	4	30	1,050	103	3,605	103	3,605	2
BLD B	1,770	7.0	27.0	42.0	6.0	23.0	105	3,675	17	3	20	700	125	4,375	125	4,375	2
BLD C	948	-	24.0	32.0	8.0	18.0	82	2,870	-	-	-	-	82	2,870	82	2,870	3
BLD D	1,942	3.0	3.0	38.0	8.0	14.0	66	2,310	28	5	33	1,155	99	3,465	99	3,465	2
BLD E	1,363	-	14.0	35.0	7.0	16.0	72	2,520	19	3	22	770	94	3,290	94	3,290	2
Mowbray House	-						-	-	-	1	1	35	1	35	1	35	-
MAXIMUM CAR PARKING		**16**	**77**	**182**	**36**	**87**	**398**	**13,930**	**90**	**16**	**106**	**3,710**	**504**	**17,640**	**504**	**17,640**	

ASSUMPTIONS:

		Min.	Max.	
Parking Resi	Studio	0.1	0.5	
(Willoughby DCP)	1B	0.1	0.5	
	2B	0.2	0.5	
	3B	0.25	0.5	
Parking Resi Visitor		1.0	1.0	per 7 dwellings
Parking Non Resi	Retail	1.0	1.0	space per 200sm NLA minimum; per 70sm maximum
	Office	1.0	1.0	space per 670sm NLA minimum; per 400sm maximum
Avg. Carpark Area		35		sm
GBA to GFA	Resi	0.75		
	Comm	0.85		
	Retail	0.85		
GFA to NSA	Resi	0.85		
	Comm	0.95		
	Retail	0.95		



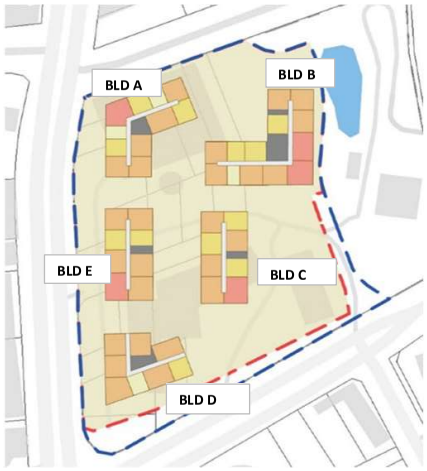
Podium



Podium (GF-1) **2 storeys**

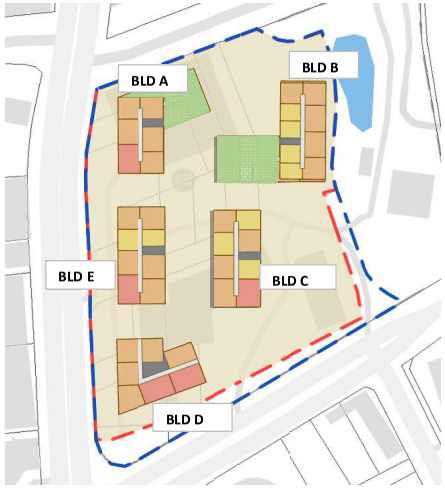
Non-Residential Use

Lower Levels



Tower - Lower (2-7) **6 storeys**

Upper Levels



Tower - Upper (8-15) **8 storeys**

Apartment Type	No. of Units	Mix Percentage (%)
Studio	32	5
1 Bed	154	25
2 Bed	364	59
3 Bed	72	11
TOTAL	622	100

CHATSWOOD DIVE SITE
STATISTICAL SUMMARY (WIP)
CLIENT: LANDCOM
Date: 121124

OPTION 2 - MAXIMUM

PER BUILDING	LOT AREA	DWELLING MIX & COUNT					FLOORSPACE Residential					FLOORSPACE Non-Residential					TOTAL ACHIEVABLE		Communal Open Space	
	sqm	No. of Storeys	Studio	1B	2B	3B	Total Units	Floorplate	GBA	GFA	NSA	No. Storeys	Retail	Comm	GBA	GFA	No. Storeys	GFA	No. Storeys (Height)	Communal	%
BLD A	**5,742**	27	**14**	**122**	**126**	**56**	**318**		**37,129**	**27,039**	**22,983**	**25**	**2,063**	**2,063**	**4,126**	**3,507**	**2**	**30,546**	**27**	1,504	26%
Podium (GF-1)		*2*	*2*	*2*	*12*	*2*		*1,154*	*2,308*	*1,731*	*1,471*	*2*	*2,063*	*2,063*	*4,126*	*3,507*	*2*				
Tower - Lower (2-7)		*6*	*12*	*48*	*24*	*36*		*2,393*	*14,358*	*10,769*	*9,153*	*6*									
Tower - Upper (8-26)		*18*		*72*	*90*	*18*		*1,077*	*19,386*	*14,540*	*12,359*	*18*									
Plant		*1*						*1,077*	*1,077*			*1*									
BLD B	**3,205**	25	**0**	**32**	**184**	**8**	**224**		**28,269**	**20,448**	**17,381**	**25**	**-**	**-**	**-**	**-**	**0**	**20,448**	**25**	889	28%
Podium (GF-7)		*8*		*32*	*56*	*8*		*1,400*	*11,200*	*8,400*	*7,140*	*8*			-	-					
Tower (8-24)		*16*			*128*			*1,004*	*16,064*	*12,048*	*10,241*	*16*									
Plant		*1*						*1,005*	*1,005*		-	*1*									
BLD C	**4,960**	37	**36**	**52**	**232**	**40**	**360**		**42,874**	**30,935**	**26,294**	**37**	**762**	**762**	**1,524**	**1,295**	**2**	**32,230**	**25**	1,256	25%
Podium (GF-1)		*2*	*6*	*6*	*16*	*6*		*2,027*	*4,054*	*3,041*	*2,584*	*2*	*762*	*762*	*1,524*	*1,295*	*2*				
Tower - Lower (2-7)		*6*	*18*	*30*	*60*	*18*		*2,305*	*13,830*	*10,373*	*8,817*	*6*									
Tower 1- Upper (8-21)		*16*		*16*	*96*	*16*		*958*	*15,328*	*11,496*	*9,772*	*16*									
Tower 2 - Upper (8-25)		*12*	*12*		*60*			*670*	*8,034*	*6,026*	*5,122*	*12*									
Plant		*1*						*1,628*	*1,628*		-	*1*									
OTHER	**3,593**													**908**	**908**	**772**	**2**	**772**	**2**		
Mowbray House	1,307						-	-	-	-	-	-		908	908	772	2			740	57%
Public Open Space (north)	900																				
Roads/Road Widening	1,386						-	-	-	-	-	-									
Total	**17,500**		50	206	542	104	**902**		**108,272**	**78,422**	**66,658**	**87**	**2,825**	**3,733**	**6,558**	**5,574**	**6**	**83,996**	**79**	4,389	25%

Achieved Dwelling Mix (%) **6% 23% 60% 12% 100%**
Achieved FSR **4.8** **:1**
Achieveable (based on preliminary internal layout studies) **902**
Indicative Dwelling Yield (assuming avg. 90sm GFA per unit) **871**

CAR PARKING
Minimum Car Parking Spaces **Resi** **285** **Non-Resi** **18**
Maximum no. of Basements 2

Maximim Car Parking Spaces **Resi** **556** **Non-Resi** **45**
Maximum no. of Basements 3

MINIMUM PARKING

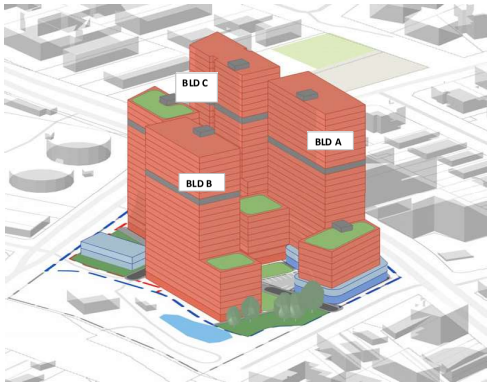
	Building Footprint	Residential							Non-Residential				Total Required		Total Provided		
	sm	Studio	1B	2B	3B	Visitor	Total	GBA	Retail	Comm	Total	GBA	Spaces	GBA	Spaces	GBA	Levels (Basement)
BLD A	3,280	1	12	25	14	45	97	3,395	10	3	13	455	110	3,850	110	3,850	1
BLD B	1,408	-	3	36	2	32	73	2,555	-	-	-	-	73	2,555	73	2,555	2
BLD C	2,685	3.0	5	46	10	51	115	4,025	3	1	4	140	119	4,165	119	4,165	2
Mowbray House	-					-	-	-	-	1	1	35	1	35	1	35	-
MINIMUM CAR PARKING		**4**	**20**	**107**	**26**	**128**	**285**	**9,975**	**13**	**5**	**18**	**630**	**303**	**10,605**	**303**	**10,605**	

MAXIMUM PARKING

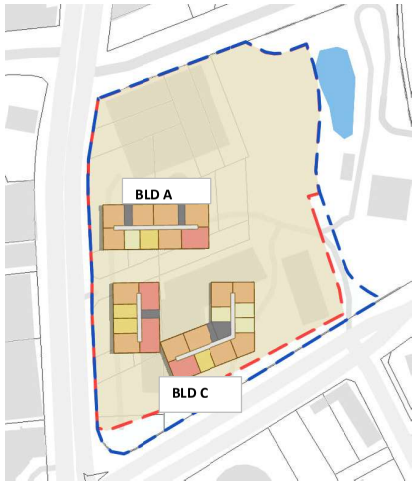
	Building Footprint	Residential							Non-Residential				Total Required		Total Provided		
	sm	Studio	1B	2B	3B	Visitor	Total	GBA	Retail	Comm	Total	GBA	Spaces	GBA	Spaces	GBA	Levels (Basement)
BLD A	3,280	7	61	63	5	45	181	6,335	29	5	34	1,190	215	7,525	215	7,525	2
BLD B	1,408	-	16	92	4	32	144	5,040	-	-	-	-	144	5,040	144	5,040	4
BLD C	2,685	18	26	116	20	51	231	8,085	10	-	10	350	241	8,435	241	8,435	3
Mowbray House	-						-	-	-	1	1	35	1	35	1	35	-
MAXIMUM CAR PARKING		**25**	**103**	**271**	**29**	**128**	**556**	**19,460**	**39**	**6**	**45**	**1,575**	**601**	**21,035**	**601**	**21,035**	

ASSUMPTIONS:

		Min.	Max.	
Parking Resi	Studio	0.1	0.5	
(Willoughby DCP)	1B	0.1	0.5	
	2B	0.2	0.5	
	3B	0.25	0.5	
Parking Resi Visitor		1.0	1.0	per 7 dwellings
Parking Non Resi	Retail	1.0	1.0	space per 200sm NLA minimum; per 70sm maximum
	Office	1.0	1.0	space per 670sm NLA minimum; per 400sm maximum
Avg. Carpark Area		35		sm
GBA to GFA	Resi	0.75		
	Comm	0.85		
	Retail	0.85		
GFA to NSA	Resi	0.85		
	Comm	0.95		
	Retail	0.95		



Podium

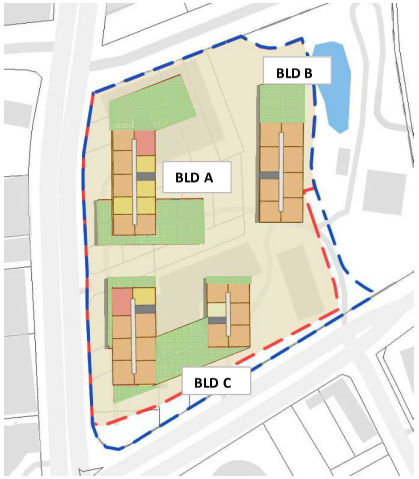


Podium (GF-1) **2 storeys**

Lower Levels

Tower - Lower (2-7) **6 storeys**

Upper Levels



Tower - Upper (8-26) **up to 18 storeys**

Please note Level 17 is a Plant Level (no dwellings)

Apartment Type	No. of Units	Mix Percentage (%)
Studio	50	5.5
1 Bed	206	23
2 Bed	542	60
3 Bed	104	11.5
TOTAL	902	100

APPENDIX 2 - URBIS PLANNING INSIGHTS & ETHOS URBAN PRELIMINARY DUE DILIGENCE REPORT

URBIS

ANGEL PLACE
LEVEL 8, 123 PITT STREET
SYDNEY NSW 2000

URBIS.COM.AU
Urbis Ltd
ABN 50 105 256 228

PLANNING INSIGHTS - CHATSWOOD DIVE SITE – 607 PACIFIC HIGHWAY

A planning merit and risk assessment of Options 1-3 is considered below.

Additionally, issues that apply to all three options and that were discussed during the project meeting on 25 October 2024 are unpacked below.

Planning Approval Pathways and risks

Regionally Significant Development Application - Option 1

Option 1 does not meet the relevant thresholds to be considered a State Significant Development Application (SSDA). Option 1 would be classified as regionally significant development and assessed by Willoughby City Council and determined by the Sydney North Planning Panel.

Option 1 would likely have Council support for approval, as it falls within the height and FSR controls specified for the site. It is noted that Option 1 involves the retention of Mowbray House, which aligns with the heritage interpretation plan previously prepared for the site. Likely timeframes for determination would be approximately 12-18 months, noting that this is highly variable.

Notwithstanding other concerns relating traffic, parking and site access which would need to be appropriately addressed, Option 1 would pose the least amount of risk of the three options.

State Significant Development Application – Option 2

Option 2 would involve the establishment of infill affordable housing on the site and would be classified as a SSDA that would be assessed by DPHI and determined by either the Minister of Planning or Independent Planning Commission.

Option 2 would be similar to Option 1, however would benefit from an additional 30% GFA bonus for the inclusion of affordable housing. Option 2 would remain compliant with relevant controls and would likely be determined in a similar timeframe to Option 1 (12-18 months).

Development Control Plan provisions do not technically apply to SSDA under the Planning Systems SEPP. However, both DPHI and the NSW Government Architect would seek close engagement with Council through drafting of any Design Excellence Strategy and Brief to inform a design excellence competition. Any variation to a DCP provision would require significant and robust justification. Both DPHI and the Government Architect preference keeping Council engaged in the decision making process to reduce the likelihood of a formal objection which would trigger a referral to the Independent Planning Commission for determination.

Option 2 would pose a greater level of risk compared to Option 1 as there is a higher likelihood Council may object to the proposal if they believe variation to any controls are being sought through the SSDA Pathway which bypasses council assessment.

URBIS

Planning Proposal - Option 3

Option 3 presents as very dense, however the revised version of Option 3 addresses some key issues, including the retention of Mowbray House and building heights that step downwards towards the south of the site

Option 3 would require a planning proposal to vary the controls on the site to achieve the desired development outcome.

If the Planning Proposal option was to be taken, there would be a possibility to seek land use change for part or all of the site, from MU1 to R4. The benefit of this would be to minimise the extent of non-residential floorspace that is required on the site in order to respond to the current market/ competition. It is noted that Council would likely rather the entire site be rezoned, unless a specific land use (that was not permissible under R4) was sought in a particular part of the site, such as Mowbray House.

The R4 zone permits a range of non-residential land uses including shop-top housing, which can provide for intent of retail / commercial activation as set out in the Chatswood CBD Planning and Urban Design Strategy 2036. Given that there are no specific requirements for non-residential GFA within the R4 zone, the amount of non-residential floorspace can be provided based on the supportable quantum in todays' market, which would be more feasible than under current controls. Further discission around the amount of non-residential GFA that would be considered by Council would only be achievable following the approval of the PP, which is the option with the greatest degree of risk.

Council would likely object to any proposal which sought to vary controls that were only adopted in June 2023. Whilst the controls for the site including height and FSR were recommended as part of additional Urban Design work undertaken by GMU, the zoning of the site as MU1 (and therefore subject to the 17% non-resi GFA control) was carefully considered by Council as aligning with their strategy for the Chatswood CBD. On an overall basis, there would be considerable risk to the PP pathway to rezone part or all the site to R4 High Density Residential.

Given that Council is currently reviewing controls regarding the provision of non-residential GFA in the Chatswood CBD through a recently exhibited discussion paper, there may be potential to further explore the timeframe of any expected changes. This could be a route to explore further if it aligns with Landcom's timeline for the site/project.

Depending on the outcomes of the discussion paper and feedback received, there may be future opportunities to discuss this matter with Council and DPHI.

Notwithstanding these risks, given the anticipated development yields and delivery of new housing there could be benefit in investigating whether this site could be including as part of the recently adopted State Significant Rezoning Policy.

Key Planning Issues

Floorplate

Variation of the 700m^2 floorplate as specified by Part L, Section 4.39(d) of the Willoughby DCP would be challenging as Council are keen to maintain compliance with relatively new DCP controls.

As noted above, DPHI and the GA would preference compliance with DCP provisions where possible through the design excellence process. Any variation to the floorplate requirement would require robust justification.

There may be a stronger argument to seeking additional building height to achieve the maximum permissible FSR via a clause 4.6 Variation rather than seeking floorplates greater than 700m^2. Extra height can maintain the slender tower objectives under the DCP and Chatswood CBD Strategy.

Urbis has recently been involved in a SSDA that included a minor variation to the 700m^2 floor plate to 750sqm in the Chatswood Commercial Core, however this was for a BTR development where DPHI guidelines provide additional flexibility for matters including floorplates.

Traffic, Parking and Site Access

Access to the site from Nelson Street could be achievable, however Transport for NSW (TfNSW) may have concerns about traffic exiting Nelson Street to the Pacific Highway

The existing signalised intersection with Mowbray Road may be more preferable to TfNSW.

Council is very clear on enforcing a reduced parking provision across the area covered by the CBD Strategy as reflected in the Development Control Plan (DCP) controls. A lower car parking provision to reduce traffic/parking impacts is something that should be explored as part of any future redevelopment of the site.

The Infill affordable housing provisions under the Housing SEPP provides parking rates for both the affordable housing and non-affordable housing components of a development. The non-affordable housing rates exceed Council's recently adopted rates in its DCP and would result in a higher number of spaces that could be provided if this pathway was pursued.

Separate basements may be a preferable option as it would allow for flexibility in staging development (i.e. simply build one basement at a time in line with each stage). This would also assist in additional deep soil areas for tree planting however may result in additional construction costs as deeper basements may be required. Basement location and depths will also need to consider any offset requirements of Sydney Metro.

Variation to requirement for 17% of GFA to be non-residential

The non-residential requirement was a key component of the Chatswood CBD Strategy and LEP amendments in 2023.

Council have been very reluctant to accept any variation to this control noting that the definition of non-residential floorspace has been made intentionally broad to facilitate a wide range of uses.

As currently drafted the 17% non-residential GFA control applies to the total GFA which would include any bonus provisions under Housing SEPP. We note that DPHI have indicated that they are prepared to accept clause 4.6 variation to enable the 17% to apply to the base FSR It is important to note that whilst DPHI have indicated this, no variations have been approved to date given the relatively recent adoption of the infill affordable housing bonus provisions.

Council is currently reviewing their stance on commercial GFA in the Chatswood CBD however this review relates mainly to the CBD Core and is unlikely to broaden to the mixed-use areas.

Mowbray House – Heritage Item

Approval to demolish the heritage item would be unlikely.

The heritage interpretation plan for the site retains Mowbray House as part of the plan.

Indicative Costs

Urbis will be able to confirm DA lodgement and consultant costs upon receipt of the Estimated Development Cost from Landcom.

The following Development Contributions apply to the site:

Local Development Contributions – Willoughby City Council Section 7:11 Contributions:

Dwelling Type	Contribution required per dwelling
Per bedsit, studio (Apartment Type) or 1 bedroom dwelling	$11,045.37
Per 2 bedroom dwelling	$15,544.09
Per 3 or more bedroom dwelling / Per lot	$20,000.00

State Development Contributions – Housing and Productivity Contribution

Land Use	Contribution rate
All other residential accommodation (residential flat buildings and units)	$10,000 per dwelling / lot
Commercial	$30 per square metre of new gross floor area for commercial development
Retail	$30 per square metre of new gross floor area for retail development

607 Pacific Highway, Chatswood

Preliminary Planning Due Diligence Advice

This planning advice comprises a desktop analysis of 607 Pacific Highway, Chatswood. We note that no Desktop Due Diligence Report has been provided by Property & Development NSW (**PDNSW**).

Executive Summary

Overview

- The site is situated on the corner of Pacific Highway and Mowbray Road and formed part of the Metro Dive site which was used to launch and support the tunnel boring machines for the Sydney Metro City & Southwest line.
- The overall site area is approximately 24,070 sqm. Of the site, approximately 22,544 sqm is zoned MU1, with the following development standards applied:
  - A maximum floor space ratio (FSR) of 4.2:1.
  - A maximum building height of 53 metres.
- We have assumed an approximate developable site area of 14,119 sqm. This is based on the following exclusions:
  - The eastern portion of the site is currently occupied by rail/metro infrastructure facilities associated with the Sydney Metro dive. From review of the Environmental Impact Statement for the Sydney Metro City & Southwest line, it our understanding that the rail/metro infrastructure facilities on this portion of the site will remain as part of the ongoing operation of the Sydney Metro.
  - Mowbray House (including a 10-metre curtilage) which is a listed heritage item of local significance.
  - The southern edge of the site which is zoned SP2 Infrastructure (Classified Road) and identified for land reservation acquisition for the widening of Mowbray Road.
- The Willoughby Development Control Plan 2013 (Willoughby DCP) identifies site specific controls for land in Chatswood CBD, including this site. Notably, this requires a future open space and an open-air through site link on the site. The design and proposed layout of these public domain elements should be considered as part of any design development of the site.
- Given the site specific requirements for additional public domain on this site, it is particularly important that design feasibility testing is undertaken to determine if the yields for the site are achievable. The yields suggested in this advice are indicative only.

Development assumptions & yield

Table 1 provides an overview of the established development assumptions and yield for the site, based on our review of the site area, planning controls and industry practice. The terms used below (which are consistent with the terms used by PDNSW) are defined in **Appendix A**.

Table 1 Summary of development yields and assumptions

Matter	Yield
Site area	~ 24,070 sqm **Note**: Approximately 22,544 sqm of the site is zoned MU1.
Developable site area	~14,119 sqm
Site coverage	60%

Matter	Yield
Commercial / retail floors	Up to 2 storeys
Storeys	15
Residential GFA assumed (sqm)	49,219 sqm
Commercial GFA assumed (sqm)	10,081 sqm
Residential NSA	41.836 sqm
GLAR (Net Area) Retail / commercial	8,569 sqm
No. residential dwellings	**557 dwellings**
No. parking spaces	**Total – 443 spaces** Based on the maximum residential parking rates within the Willoughby DCP. **Residential – 279 spaces** (as per maximum rate - 0.5 space per 2-bed dwelling) **Resident visitor parking – 79 spaces** (as per maximum rate – 1 space per 7 dwellings) **Non-residential (office/business/retail) – 85 spaces** • Retail (as per maximum rate - 1 space per 70 sqm) – 72 spaces • Office and business (as per maximum rate 1 space per 400 sqm) – 13 spaces **Note**: assumes 50/50 split of non-residential GFA between retail, and office and business.

Planning approval pathway, timeframes, costs and risks

The planning approval pathway will depend on the Estimated Development Cost (EDC) of the development. Based on the EDC estimates provided in this advice, the approval pathway will be **regionally significant development**, assessed by the Council, and determined by the Sydney North Planning Panel.

The timeframe for DA assessment and determination is highly variable and dependent on many factors. Recent DAs for large scale mixed use developments have taken 10 - 14 months to be determined by Willoughby Council or the Planning Panel.

The table below provides a summary of estimated costs for the redevelopment of the subject site. The assumptions that have guided these costs are explained in **Section 5.2** of this advice.

Table 2 Summary of Estimated Costs

Type	Estimated Costs
Consultant fees	~$1,000,000
DA lodgement fees	~$350,000 to $410,000
Development contributions	~$17,012,429

The planning approval risk for a mixed use development on the subject site is considered **low-medium risk** for a yield in the order of that outlined in **Table 1** above, subject to detailed design and compliance with relevant controls.

1.0 Site Overview

Matter	Site Details
Site address	607 Pacific Highway, Chatswood
Legal description	Lot 3//DP455907; Lot 4//DP455907; Lot 1//DP537580; Lot 2//DP537580; Lot 5//DP524631; Lot 6//DP66854; Lot 2//DP221896; Lot 4//DP 65670; Lot 5//DP 65670; Lot 6//DP65670; Lot 18//DP60346; Lot 1//DP243111; Lot 1//DP503447; Lot 2//DP1223080; Lot 3//DP961402; Lot 6//DP72759; Lot 1//DP216408; Lot 3//DP58646; Lot 1//DP508715; Lot 1//DP204133
Landowner	Sydney Metro
Easements	• E1-Easement for pipeline (N370192) affecting whole of Lot 1 DP221896. • E2-Easement for batter (H826581). • E3-Easement for drainage (BK.1888 No. 293). • E4-Easement for Drainage (C997733).
Local government area (LGA)	Willoughby
Site area	2.407 ha
Developable area	~14,119 sqm **Note**: Estimated developable area. Excludes land zoned SP2 Infrastructure, the heritage listed Mowbray House with 10m curtilage, and land occupied by the rail infrastructure facilities associated with the Metro dive (shown in **Figure 1**).
Existing development	The site is currently occupied by construction activities and rail infrastructure facilities associated with the construction and operation of the Sydney Metro, including heavy vehicles, site offices, storage and acoustic sheds. Notably, the eastern portion of the site is currently occupied by rail/metro infrastructure facilities associated with the Metro dive. From review of the Environmental Impact Statement for the Sydney Metro City & Southwest line, it our understanding that the rail/metro infrastructure facilities on this portion of the site will remain as part of the ongoing operation of the Sydney Metro. The heritage listed Mowbray House (local item I96) is also currently on the site.
Surrounding area	• North: Medium density residential buildings and a separated cycle lane connecting to Chatswood CBD • East: Railway line and bridge • South: Transmission tower, electrical substation and medium density housing • West: Medium and high density residential flat buildings, The Great Northern pub, commercial and retail uses.

Matter	Site Details

Figure 1 Subject Site

Source: Nearmap, 2023

2.0 Review of Planning Controls

This section reviews the planning controls that apply to the site. We have reviewed the following:

- *State Environmental Planning Policy (Housing) 2021*
- *State Environmental Planning Policy (Transport and Infrastructure) 2021*
- *Willoughby Local Environmental Plan 2012*
- *Willoughby Development Control Plan 2023*

2.1 State Environmental Planning Policy (Housing) 2021

In December 2023, amendments to the Housing SEPP were gazetted. The most significant change to the Housing SEPP includes the in-fill affordable housing amendment, which allows scalable bonuses of up to 30% additional height and floor space ratio that can be granted to developments that provide 10-15% affordable housing.

The new provisions apply to land in an **'accessible area' which includes land within 800m walking distance of a railway or light rail and within 400m walking distance of a regular bus route**. The site is located approximately 600m walking distance from both Chatswood Railway/Metro Station to the north and Artarmon Railway Station to the south. Whilst the 'walking distance' to these services would depend on future road connections within the site, for the purposes of this advice, we have assumed that the whole site would be eligible for the bonuses.

Key disqualifiers and provisions of the new policy include:

- A minimum of 10% affordable housing must be provided in order to receive a bonus.

- The height and floor space ratio bonuses effectively double the affordable housing contribution (i.e. 10% affordable housing incurs a 20% bonus, while 15% affordable housing incurs a 30% bonus).
- The floor space ratio bonuses apply to the whole of the development and not just the residential component, while the height bonus only applies to residential flat buildings and shop top housing (i.e. not other buildings on the site).
- Affordable housing must be provided for a minimum of 15 years and managed by a Community Housing Provider.
- Affordable housing provided as part of development because of a requirement under another environmental planning instrument or a planning agreement within the meaning of the Act cannot be counted towards the affordable housing component.
- Development will be deemed State Significant Development if the residential component has a capital investment value of $75 million in Greater Sydney.
- Local affordable housing contribution schemes will continue to apply (i.e. local requirements for Affordable Housing do not contribute to the 10%-15% Affordable Housing provided to achieve the bonuses).

The bonus provisions and non-discretionary development standards* are summarised below.

Table 3 Housing SEPP bonus provisions and non-discretionary development standards

Matter	Controls	Commentary
Affordable housing requirements for additional floor space ratio and height	• The maximum floor space ratio for development that includes residential development to which this division applies is the maximum permissible floor space ratio for the land plus an additional floor space ratio of up to 30%, based on the minimum affordable housing component calculated in accordance with subsection (2). • The minimum affordable housing component, which must be at least 10%, is calculated as follows: $\text{affordable housing component} = \frac{\text{additional floor space ratio (as a percentage)}}{2}$ • If the development includes residential flat buildings or shop top housing, the maximum building height for a building used for residential flat buildings or shop top housing is the maximum permissible building height for the land plus an additional building height that is the same percentage as the additional floor space ratio permitted under subsection (1).	For the purposes of maximising the site's development potential, we have assumed that 15% affordable housing would be provided to achieve the maximum 30% height and FSR bonus. Development that is eligible for 30% additional floor space ratio because the development includes a 15% affordable housing component, as calculated under subsection (2), is also eligible for 30% additional building height if the development involves residential flat buildings or shop top housing.
Minimum site area	450sqm	The site area is greater than 450sqm.
Minimum landscaped area	Lesser of: • 35sqm per dwelling • 30% of the site area	
Parking spaces for dwellings used for affordable housing	• for each dwelling containing 1 bedroom—at least 0.4 parking spaces, • for each dwelling containing 2 bedrooms—at least 0.5 parking spaces, • for each dwelling containing at least 3 bedrooms— at least 1 parking space,	
Parking spaces for dwellings not used for affordable housing	• for each dwelling containing 1 bedroom—at least 0.5 parking spaces, • for each dwelling containing 2 bedrooms—at least 1 parking space, • for each dwelling containing at least 3 bedrooms—at least 1.5 parking spaces,	

Matter	Controls	Commentary
Apartment size	The minimum internal area, if any, specified in the Apartment Design Guide for the type of residential development	The ADG provides a minimum internal area of 70sqm for 2 bedrooms dwellings. For the purposes of this advice, we have assumed a 75sqm apartment size.

*Non-discretionary development standards are standards that, if complied with, prevent the consent authority from requiring more onerous standards for the matters.

Proposed Mid-Rise Housing Reforms

The NSW Government publicly exhibited an *Explanation of Intended Effect: Changes to create low- and mid-rise housing* from 15 December 2023 to 23 February 2024. The EIE detailed proposed amendments to the Housing SEPP to incentivise and permit various low and medium density housing forms. The proposal identifies 'station and town centre precincts' where greater quantities of housing will be permitted via uplift to existing height and FSR controls.

The site would be within a 'station and town centre precinct' by virtue of being within 800m walking distance of the from both Chatswood Train Station to the north and Artarmon Train Station to the south.

The proposed height and FSR uplifts for residential flat buildings and shop top housing within station and town centre precincts depends on the distance of the site from the station/centre.

For sites within 400m of the stations/centres, the proposed controls are:

- Maximum building height of 21m
- Maximum FSR of 3:1

For sites that are 400m to 800m of the stations/precincts, the proposed controls are:

- Maximum building height of 16m
- Maximum FSR of 2:1

For the purposes of this advice, we have not applied the controls under this proposed reform as these do not exceed the current maximum FSR and height limit under the Willoughby Local Environmental Plan 2012 (LEP 2012) (refer to **Section 2.3** below)

2.2 State Environmental Planning Policy (Transport and Infrastructure) 2021

The site is located adjacent to the Pacific Highway which is a classified road. Therefore, section 2.120 of the Transport and Infrastructure SEPP would apply to the development. Section 2.120 requires the consent authority to consider the NSW Government's *Development Near Rail Corridors and Busy Roads – Interim Guideline*, gazetted in 2008. Therefore, an Acoustic Assessment would be required to accompany any future development application given the site's proximity to major roads.

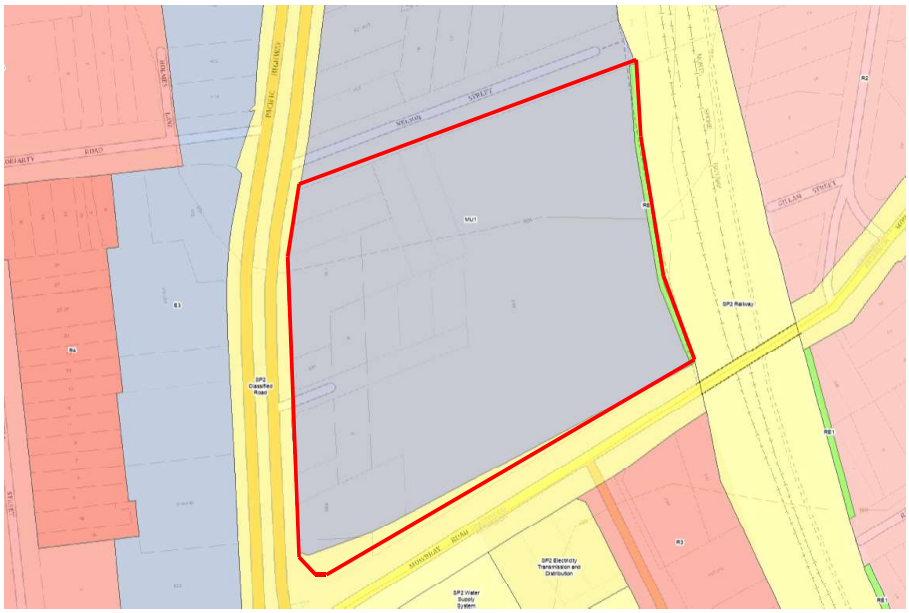
Specifically, section 2.120(3) contains criteria for residential accommodation, which would need to be considered in the design of any residential uses on the site, in consultation with an acoustic engineer. It states:

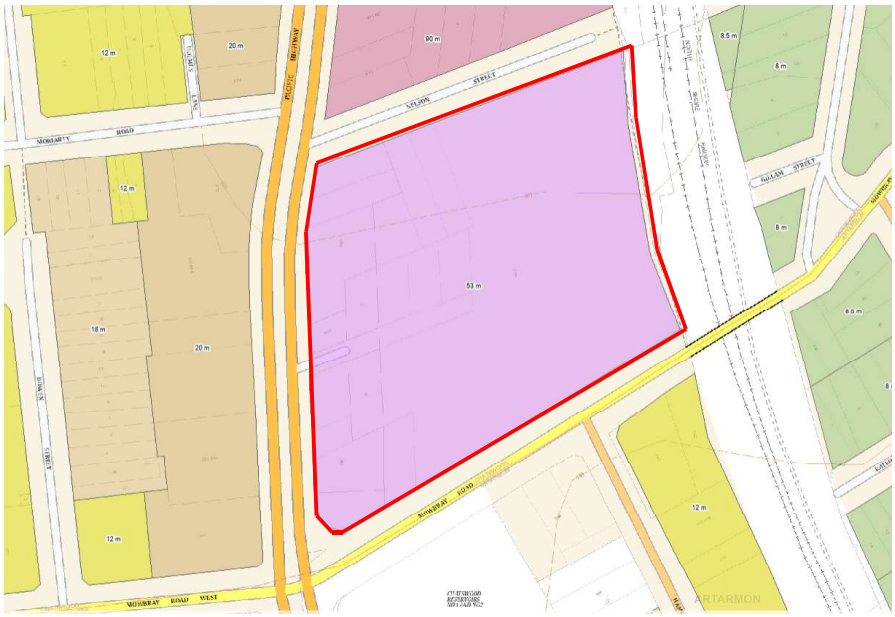
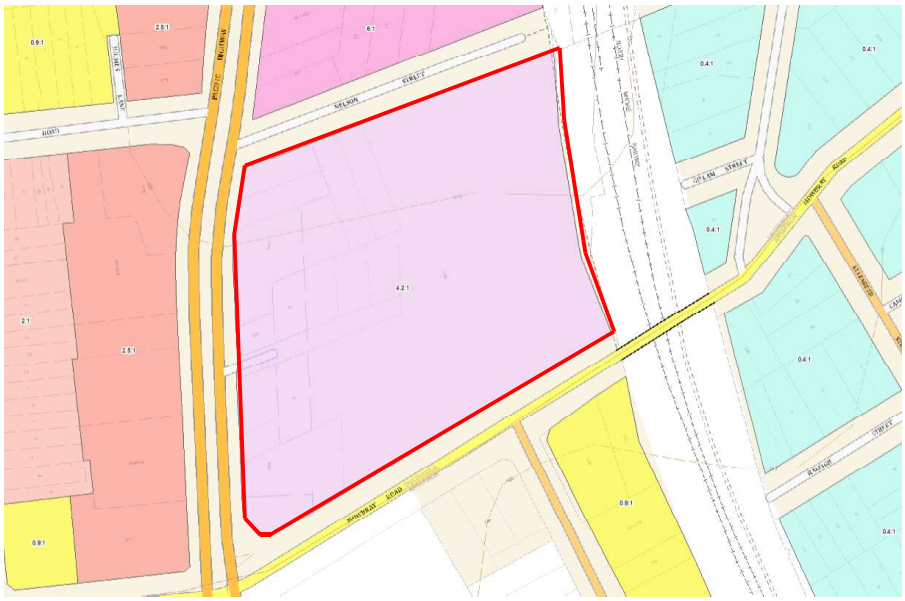
> ...
>
> *(3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded—*
>
> *(a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,*
>
> *(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.*
>
> ...

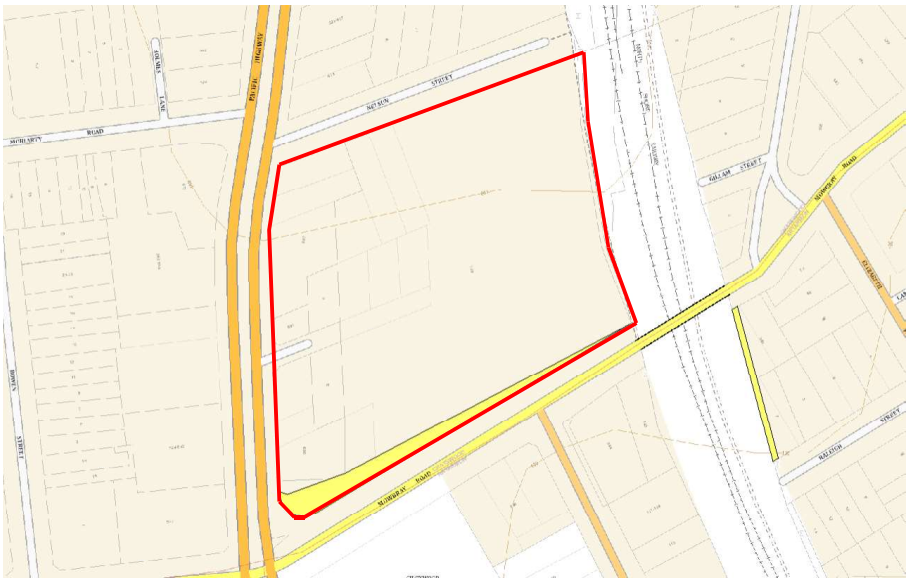
Further, section 2.119 states that where practicable, vehicular access should not be provided from a classified road and that traffic volumes from any development should not impact the ongoing operation of the classified road. Vehicular access from classified roads is not preferred, and any future development should seek to avoid direct vehicular access from Pacific Highway and Mowbray Road (i.e. provide access from Nelson Street and/or alternative). Further, the redevelopment of the site will see the generation of a substantial amount of traffic on these roads, and has previously been challenged on the grounds of impacts to public and private transport networks. These access considerations would need to be resolved in consultation with a Traffic Engineer.

2.3 Willoughby Local Environmental Plan 2012

Current LEP controls are set out below.

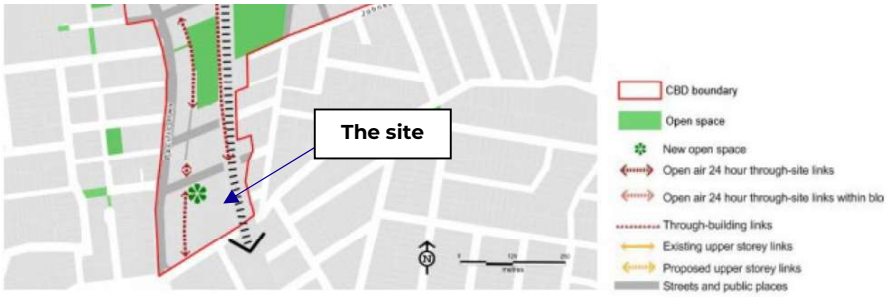
Matter	Details	Commentary
Zoning	MU1 Mixed Use	Applies to the majority of the site. Shop top housing is permitted with consent under this zone.
	SP2 Infrastructure (Classified Road)	Applies to the southern edge of the site fronting Mowbray Road. Permits Roads and purpose shown on Land Zoning Map (i.e. Classified Road).
	RE1 Public Recreation	Applies to eastern edge of the site. Permits a range recreational uses such as- recreational areas and recreation facilities.
		
Building height	53m	The maximum building height of 53 metres currently applies to the extent of site zoned MU1 and SP2. No maximum building height is applied to land zoned RE1 along the eastern edge of the site.

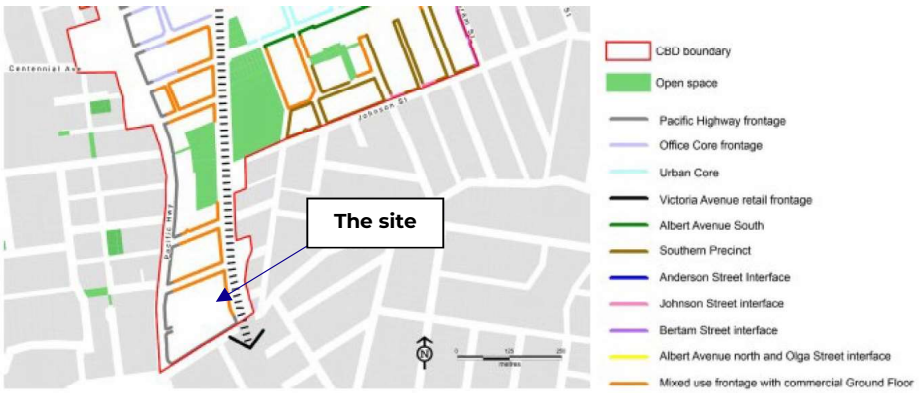
Matter	Details	Commentary
		
Floor space ratio (FSR)	4.2:1	The maximum FSR of 4.2:1 currently applies to the extent of site zoned MU1 and SP2. No FSR is applied to land zoned RE1 along the eastern edge of the site. 
Land Reservation Acquisition		Southern edge of the site zoned SP2 is also subject to Land Reservation acquisition (refer to figure below). The relevant acquisition authority is Transport for NSW. For this land, development consent cannot be granted to any development other than development for 'Roads'.

Matter	Details	Commentary
		
Heritage	Yes	The Site includes the following item of heritage significance: • #I96 Mowbray House and 10m curtilage (local) The Site is also surrounded by many items of heritage significance, including the following: • #I4 Chatswood Zone Substation No. 80, only including the building (local). • #I5 Two reservoirs, including the structures only (state). • #I107 Great Northern Hotel, including original interiors (local). • #I105 House at 2 Orchard Road, including original interiors (local). The Site is also in the vicinity of the Artarmon Heritage Conservation Area (C1) and the South Chatswood Heritage Area (C11). The two heritage conservations areas are to the east of the Site, separated by the existing rail corridor.
Acid sulfate soils	Class 5	-
Design Excellence	Design competition requirement applicable	Development consent must not be granted to a development over 35m in height within the Chatswood CBD unless a design competition has been undertaken and the development is the winner of the competition. For development over 12m but under 35m in height, the design will be subject to review by a design excellence panel.
Affordable Housing	10% of residential GFA	Sites within the Chatswood CBD will be subject to an affordable housing provision or equivalent monetary contribution of 10% of the accountable floor space.
Shop top housing in Zone MU1	Minimum 17% of non-residential GFA	Development consent for the purposes of shop top housing on land in Zone MU1 Mixed Use must not be granted unless the consent authority is satisfied at least 17% of the gross floor area of the building will be used for non-residential purposes.
Schedule 1 – Additional permitted use	Residential flat buildings permitted subject to conditions	For land zoned MU1 in the Chatswood CBD, development for the purposes of residential flat building is permitted with development consent if the consent authority is satisfied that: a) the ground level is used for non residential purposes and b) a minimum of 17% of the total FSR is provided for non residential purposes.

2.4 Willoughby Development Control Plan 2023

The key provisions of Part L: Place Based Plans of the Willoughby DCP are set out below.

Matter	Controls
Slender towers	• the maximum gross floor area at each level of a development should be no more than 700m2 for residential towers above the podium level in the mixed use zone • if there is more than one tower on the same site, towers are not to be linked above the podium. • towers are to operate independently regarding lifts and services.
Vehicular access	• Only one entry area into and exiting a site is permitted.
Greening Chatswood CBD	• all roofs up to 30m from the ground are to be green roofs (in particular podium roofs); • a minimum of 20% of the site is to be soft landscaping, which may be on the ground, podium, and roof top levels of buildings; soft landscaping must be a minimum depth of 600mm • 'green' walls are encouraged
Links and public realm	• All proposals must consider the potential for through links to public places. The DCP identifies the following on the site: - an open-air 24-hour through site link running north-south - new open space • All such links must be: - a minimum of 3m wide - provided with public rights of access and designed with adequate width, sympathetic landscaping and passive surveillance • Public realm or areas accessible by the public on private land is required to be included in all E2 and MU1 redeveloped sites. These must be: - designed to respond to context and nearby public domain - visible from the street and easily accessible - accompanied by public rights of way or similar to achieve a permanent public benefit 
Front setback	**Pacific Highway frontage–** applies to Pacific Highway and Mowbray Road frontage: • minimum 4m setback at ground level from front boundary (with exception of heritage sites) • maximum 7m street wall height • minimum 6m setback above street wall to tower **Mixed use frontage with commercial ground floor –** applies to Nelson St and rail corridor frontage: • 6m–14m maximum street wall height at front boundary • minimum 3m setback above street wall to tower **Note**: On corner sites where different setbacks and street frontage height precincts meet, the greater setback and lower street wall height required on the primary frontage is to continue around the corner for a minimum distance of 6m. All towers above podiums in the E2 Commercial Core and MU1 Mixed Use zone are to be setback from all boundaries with a minimum 1:20 ratio of the setback to building height. This means if a building is 53 metres, a minimum setback from the side boundary of 2.65m is required for the entire tower on any side.

Matter	Controls
	
Pacific Highway – green setback	• The eastern side of the Pacific Highway must provide a 4m wide deep soil zone setback • Willoughby City Council is seeking an unobstructed shared pedestrian and cycle path along the eastern side of the Pacific Highway (within Chatswood CBD). Dimensions for the path are to be based on: - a 1.5m wide landscape verge, and - a 3m wide shared path. • The shared path may encroach on the 4m wide deep soil zone setback on a site, but if this is the case, a public right of way will be required.
Car parking rates *Note: Part F of Willoughby DCP*	Minimum and maximum parking rates as per below apply to development in Chatswood CBD under the Willoughby DCP. **Residential** • Minimum rate - - 0.1 spaces per studio/ 1-bedroom flat - 0.2 spaces per studio/ 2-bedroom flat - 0.25 spaces per studio/ 3+ bedroom flat • Maximum rate - 0.5 space per 1, 2, 3 or more bedroom units **Resident visitor parking** • 1 space per 7 dwellings **Non-residential (office/business/retail)** • Retail - Minimum rate – 1 space per 200 sqm - Maximum rate - 1 space per 70 sqm • Office and business – - Minimum rate – 1 space per 670 sqm - Maximum rate 1 space per 400 sqm

3.0 Strategic Planning Overview

Matter	Details
Strategic direction – Regional A Metropolis of Three Cities	A Metropolis of Three Cities is the NSW Government's overarching plan for growth in Sydney over the next 20 years. The Site is located within the Eastern Harbour City within the Chatswood Strategic Centre. The plan notes that the Chatswood Strategic Centre is subject to significant rail projects and that the most intense development is evident in Chatswood due to its location along several rail corridors. The Chatswood Strategic Centre is also identified as an asset and commercial office precinct along the Eastern Economic Corridor.
Strategic direction – District Northern District Plan	The Northern District Plan is a guide for implementing the Greater Sydney Region Plan at a district level, structured around the strategies for infrastructure, liveability, productivity, sustainability and implementation. The District Plan acknowledges the aging population and its implications on the changing needs of the Northern District. Chatswood is identified as one of the main Strategic Centres within the economic corridor and is a major asset as one of the ten office precincts in Greater Sydney. More specifically, the Chatswood Strategic Centre comprises a mix of uses including retail, office, residential as well as community and health. The Centre has a highly successful retail focus, providing one of the largest shopping precincts in Greater Sydney.
Strategic direction – Local Willoughby Local Strategic Planning Statement (LSPS).	The Willoughby Local Strategic Statement (LSPS) sets a 20-year vision with priorities and actions for land-use planning in the Willoughby LGA. The vision considers the economic and social needs of the area and how the LGA will change in the future. This plan is organised into 10 directions from the Greater Sydney Commissions' Greater Sydney Region Plan and North District Plan provide the framework for priorities and actions. The LSPS identifies that the Chatswood CBD as a strategic centre that is valuable for its connectivity through rail and bus, its commercial core, high density residential buildings and as an active retail and cultural destination.
Proximity to public infrastructure	• 1km from Chatswood Public School • 1.2km from Artarmon Primary School and Artarmon Public School • 900m from Artarmon Day Hospital • 1km from Chatswood Private Hospital • 1km from Westfield Chatswood
Proximity to existing / proposed major transport nodes	• 600m from Chatswood Train Station and Metro Station • 600m from Artarmon Train Station

4.0 Development Yields and Assumptions

This section provides our commentary on the development assumptions for the site. **Table 4** outlines standard development assumptions that have been used to calculate the development yields outlined in

Table 5.

The calculation for the site is based solely on FSR controls because the WLEP 2012 requires a minimum 17% of GFA to be non-residential GFA and the site is at a scale which would likely deliver more than one building or tower. With these considerations, it is difficult to estimate yield based on the HOB controls.

Table 4 Standard assumptions

Matter	Efficiency / size
% of GBA as GFA	75%
% of GFA as NLA	85%
Residential unit size	75sqm

Table 5 Development yields

Matter		Commentary
Site area	24,070 sqm	Approximately 22,544 sqm of the site is zoned MU1.
Developable area	~14,119 sqm	Excludes land zoned SP2 Infrastructure, the heritage listed Mowbray House with 10m curtilage, and land occupied by the rail infrastructure facilities associated with the Metro dive.
Site coverage	50%	Assumed a conservative 50% to allow for the open-air through site link, front setbacks and new open space as envisioned for the Chatswood CBD under Part L of the Willoughby DCP.
Total height/storeys	15	This assumes 3.5m per floor.
Commercial / retail floors	2	Assumed up to 2 storeys of non-residential uses to meet the minimum requirement for 17% of the overall FSR as required by the Willoughby LEP.
GBA – Non-Residential	N/A	-
GBA – Residential	N/A	-
Non-Residential GFA under HOB	N/A	-
Residential GFA under HOB	N/A	-
Total GFA under FSR	59,300 sqm	*Based on site area zoned MU1 x FSR (14,119 sqm x 4.2)*
Non-Residential GFA (sqm) under FSR	10,081 sqm	*Minimum 17% of total GFA*
Residential GFA (sqm) under FSR	49,219 sqm	*Total GFA – minimum non-residential GFA.* Yield calculations are based on this number.
Residential NSA	41,836 sqm	This is 85% of the assumed GFA.
Development yield		
GLAR (Net Area) Retail / commercial	8,569 sqm	This is 85% of the assumed non-residential GFA.
No. residential dwellings	**557**	-

Matter		Commentary
No. parking spaces	443	**Total – 443 spaces** Based on the maximum residential parking rates within the Willoughby DCP. **Residential – 279 spaces** As per maximum rate - 0.5 space per 2-bed dwelling **Resident visitor parking – 79 spaces** As per maximum rate – 1 space per 7 dwellings **Non-residential (office/business/retail) – 85 spaces** • Retail (as per maximum rate - 1 space per 70 sqm) – 72 spaces • Office and business (as per maximum rate 1 space per 400 sqm) – 13 spaces **Note**: assumes 50/50 split of non-residential GFA between retail, and office and business.

5.0 Planning Approval Pathway, Costs & Risks

5.1 Planning Approval Pathway & Timeframes

The planning approval pathway will depend on the Estimated Development Cost (EDC) of the development.

- EDC of more than $30 million = regionally significant development, determined by the Sydney North Planning Panel.
- EDC of $30 million or less = Willoughby Council planning officers under delegation, or the Willoughby Local Planning Panel.

Colliers has advised that the potential construction cost of a mixed use development on the site would be in the order of $455,000 to $530,000 per apartment, and $3,000 to $3,500 per sqm of retail GFA[1]. This is a preliminary figure only. Based on this estimate and our estimated consultant fees of $1,000,000, the total EDC would be **approximately $280 million to $326 million**.

Therefore, the planning approval pathway would be a DA to Willoughby Council, determined by the Sydney North Planning Panel.

The timeframe for DA assessment and determination is highly variable and dependent on many factors. Recent DAs for large scale mixed use developments have taken **10 - 14 months** to be determined by the Planning Panel.

5.2 Likely Costs

The planning approval process will be subject to various potential costs including:

- Consultant fees;
- Consent authority DA lodgement fees; and
- Development contributions.

Consultant fees

This is highly variable and could be in the order of $1,000,000.

Consent authority DA lodgement fees

This depends on the EDC of the proposed development. Based on the estimates provided above, DA lodgement fees could be in the range of $350,000 to $410,000.

Development contributions

There are two likely sources of development contributions – local and regional. A summary of estimated contributions is provided in **Table 6** below. These figures are based on an estimated yield of 890 apartments.

Table 6 Estimated development contributions

Contributions type	Contributions plan	Rate	Total $
Local development contributions	Willoughby Local Infrastructure Contributions Plan	$20,000 Per 3 or more bed dwelling / Per Lot	$11,140,000
Housing and Productivity Contribution**	N/A	$10,000 per dwelling	$5,570,000
		$30 per square metre of new commercial/retail GFA	$302,429
Total			***$17,012,429**

* Indexed to March 2024
** Introduced on 1 October 2023

[1] Site remediation is not accounted for in Colliers indicative construction costs.

5.3 Approval Risk

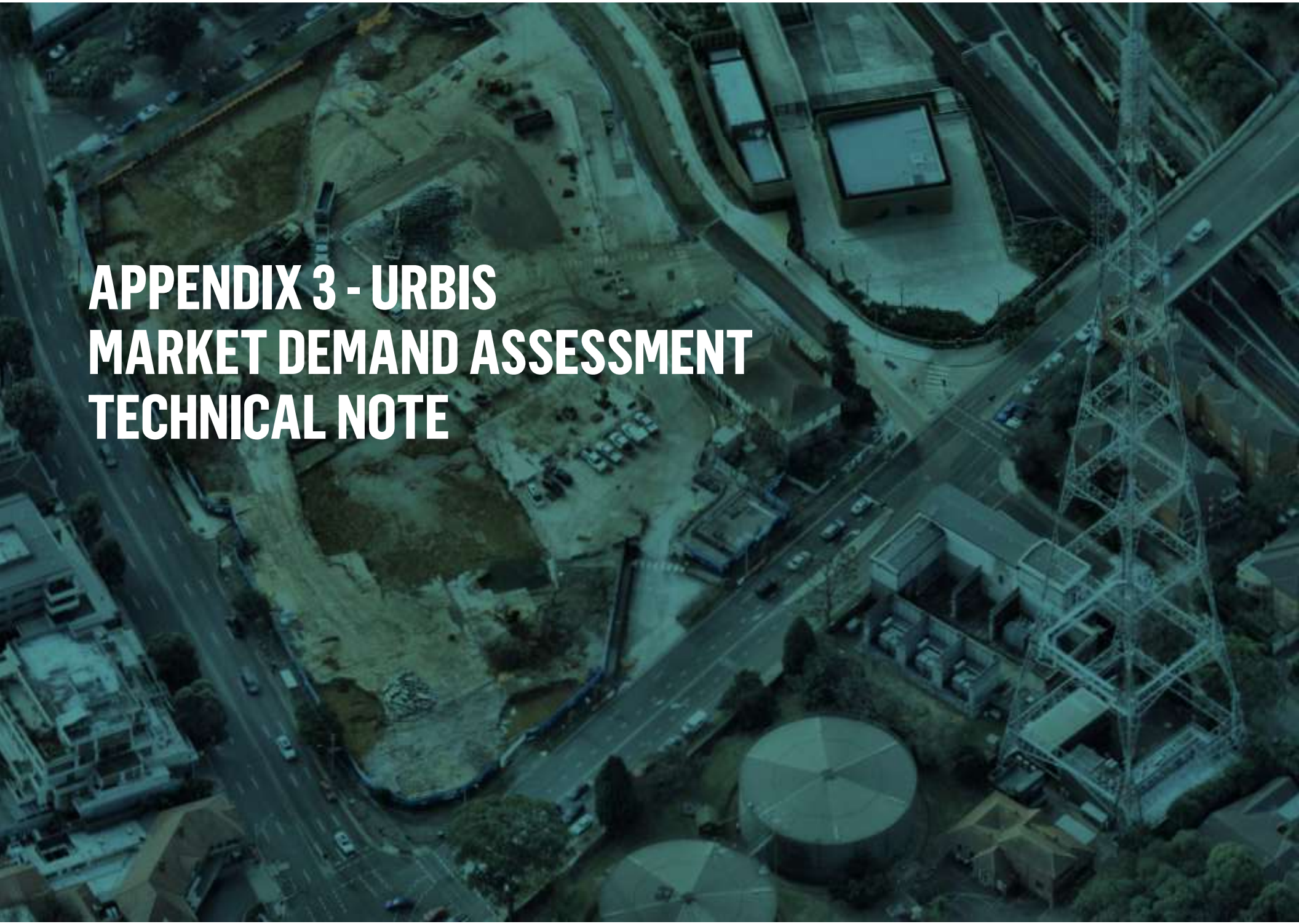
The planning approval risk for a mixed use development on the subject site is considered **low-medium risk** for a yield in the order of that outlined in **Section 4.0** above, subject to detailed design and compliance with relevant controls. This is based on the following factors:

- **Public domain requirements**: The Willoughby DCP requires a future open space and an open-air through site link on the site. The design and proposed layout of these public domain elements should be considered as part of any design development for mixed use on the site. which will likely be a key consideration as part of a future DA for the site. Given the site specific requirements for additional public domain on this site, it is particularly important that design feasibility testing is undertaken to determine if the yields for the site are achievable. The yields suggested in this advice are indicative only.
- **Heritage:** The site contains Mowbray House which is a listed heritage item of local significance. The building and its 10-metre curtilage which would need to be considered as part of a future DA. A Heritage Impact Statement would therefore be required to accompany a future DA.
- **Traffic and access**: Pacific Highway and Mowbray Road are classified roads. Vehicular access would therefore be a key consideration in any future Development Application. The site benefits from its frontage to Nelson Street, which appears to be the most suitable location for vehicular site access. A Traffic Report would be required at the DA stage to determine the acceptability of this arrangement as well as any impacts on the surrounding road network.
- **Land reservation acquisition for Mowbray Road widening**: A portion of the site is identified for land reservation acquisition for the widening of Mowbray Road. The relevant acquisition authority is Transport for NSW. It is anticipated that a future DA for the development of the site would need to consider the proposed arrangements for the acquisition or dedication of this land.
- **Residential amenity**: The amenity of future dwellings would be a key consideration in any development assessment. Issues such as overshadowing, solar access, cross ventilation, noise and privacy due to the proximity of the site to the Rail Corridor and the intersection of Pacific Highway and Mowbray Road would need to be mitigated. An assessment would also be required against the Apartment Design Guide to demonstrate that an acceptable level of amenity is achieved.
- **Proximity to rail/metro infrastructure and facilities**: Given the site is located immediately adjacent to the rail corridor, consideration would need to be given to the extent of excavation required, as well as the usage of cranes and other construction equipment to ensure that rail/metro operations are not adversely impacted by the proposal. Noise intrusion and vibration would also be a key consideration under the Transport & Infrastructure SEPP.
- **Contamination**: From review of the Environmental Protection Authority's contaminated land record, 607 Pacific Highway was formerly used as a petrol station. Given the potential for the existence of contaminants on the site, it is recommended that a preliminary site investigation is undertaken to determine whether the land is a suitable for a residential purpose.
- **Air quality**: Given the site's proximity to the railway line, an assessment against potential air quality impacts will likely need to be undertaken at the DA stage.

Appendix A – Definitions

This appendix provides an explanation of the terms that have been used in this document to arrive at an approximate development yield for the site.

Term	Definition
Assumed GFA (sqm)	The lower of: • maximum GFA under HOB; and • maximum GFA under FSR.
GBA	Gross Building Area. This has been calculated based on site coverage x the number of storeys.
GFA (sqm)	Gross floor area, as defined in the Standard Instrument Local Environmental Plan (LEP).
GFA under FSR (sqm)	This is equivalent to GFA as commonly understood in the development industry. It has been calculated by multiplying site area by the FSR control.
GFA under HOB (sqm)	This figure is calculated by applying an efficiency ratio (e.g., 75% or 85%) to GBA. It is not the same as GFA as it does not factor in the "development efficiency".
NLA / NSA (sqm)	NLA = Net lettable area. NSA = Net saleable area. This is calculated by applying an efficiency ratio to the "Assumed GFA".
Site coverage (sqm)	This number represents the area of the site that is covered by buildings.



APPENDIX 3 - URBIS MARKET DEMAND ASSESSMENT TECHNICAL NOTE

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CHATSWOOD DIVE SITE MARKET ANALYSIS

INTRODUCTION

Landcom is investigating a mixed-use development at the Chatswood Dive Site at 607 Pacific Highway, Chatswood. Urbis have been engaged to undertake high-level apartment and commercial market research to inform a recommended land use mix for the proposed development. This letter outlines the key findings of the analysis and recommended mix for the project.

RESIDENTIAL MARKET ANALYSIS

Demographic Trends

- Based on Australian Bureau of Statistics (ABS) migration data, the majority of new residents to Chatswood have come from the Lower North Shore of Sydney and overseas. As such, for the purpose of this assessment, we have defined a Study Area extending from Roseville in the north, to St Leonards in the south, Artarmon in the west and Willoughby in the east. This aligns relatively closely to the Willoughby local government area (LGA).
- The NSW Department of Planning and Environment population projections outline projected growth of over 7,000 residents between 2026-2041 for the Willoughby LGA. This growth will drive demand for new housing in Chatswood and the wider LGA.
- The number and proportion of retirees (aged 65+ years) is projected to record strong growth over the next 15 years. This segment of the market is arguably the strongest at the moment as they are less impacted by higher interest rates. This population aging will drive more demand from downsizers looking for larger (2+ bedroom) apartments.
- Younger professionals (aged 25-39 years) are also a growth cohort for the LGA. This cohort will drive demand for relatively smaller (1-2 bedroom) apartments in Chatswood, which offers excellent access to amenity and public transport to major employment centres.
- Half of households in the Chatswood suburb were renting in 2021, compared to 46.6% in the Study Area and 37.1% in Greater Sydney. This highlights the willingness of households in the area to rent and could justify the inclusion of Build to Rent (BTR) in the development.

Table 1: Population by Age, Willoughby LGA

Age	2026	2031	2036	2041	Change
0-14	13,445	12,727	12,585	12,685	**-760**
15-24	10,394	10,926	10,055	9,510	**-883**
25-39	18,541	19,983	21,015	21,261	**2,719**

Age	2026	2031	2036	2041	Change
40-54	17,631	17,937	18,210	18,732	**1,100**
55-64	8,684	9,072	9,256	9,551	**868**
65+	13,383	14,847	16,204	17,496	**4,112**
Total	**82,079**	**85,493**	**87,326**	**89,235**	**7,156**

Source: NSW Department of Planning and Environment

- The table below outlines the NSW Department of Planning and Environment's household structure projections. The largest growth is projected for couple only households, which includes empty nestors and younger couples. This growth highlights the anticipated demand for 2 and 3 bedroom apartments to meet the needs of couples and downsizers.
- The number of lone person households is also projected to grow, which will drive demand for 1 bedroom units from first home buyers.

Table 2: Household Structure, Willoughby LGA

Household	2026	2031	2036	2041	Change
Couple Only	8,121	8,909	9,398	9,747	**1,626**
Couple with Children	10,695	10,888	11,127	11,472	**777**
Group Household	1,649	1,801	1,853	1,831	**182**
Lone Person	7,657	8,357	8,923	9,441	**1,784**
Other Family	1,023	1,093	1,115	1,121	**98**
Single Parent	2,805	2,948	3,067	3,195	**391**
Total	**31,950**	**33,998**	**35,483**	**36,808**	**4,857**

Source: NSW Department of Planning and Environment

Competition

The table below outlines the apartment pipeline (projects with 25+ units) in the Study Area. There is only one project currently under construction in Chatswood highlighting the limited activity in the market due to current challenges around construction costs and interest rates. The majority of supply is still in the earlier stages of planning highlighting the uncertainty about if and when it will progress.

Overall, there are around 6,600 proposed apartments in the Study Area, of which over 2,600 are in Chatswood.

There a few BTR projects in the Study Area that are in the earlier planning stages which highlights the interest in areas such as St Leonards and Chatswood. The competition for BTR will need to be monitored to determine the potential for BTR as part of the development.

Table 3: Apartment Pipeline – Number of Units

Stage	Chatswood Suburb	Study Area Total	BTR Total
Under Construction	49	1,018	0
Presales	140	558	0
Development Approval	193	845	0
Development Application	1,340	2,639	898
Early Planning	911	1,525	626
Total	**2,633**	**6,585**	**1,524**

Note: Projects with 25+ units
Source: Urbis

The following table and the profiles in the Appendix outline the apartment mix across a range of projects in Chatswood and surrounding suburbs with key findings including:

- There are three projects currently selling in Chatswood. These are relatively smaller projects (with around 50-75 units in each) and are largely targeting the downsizer market with a relatively high proportion of two and three bedroom apartments.
- Nine by Mirvac in Willoughby is a larger project with around 400 apartments in the first two stages. Due to its larger size, Mirvac has an apartment mix targeting a broad buyer profile ranging from first home buyers to investors to downsizers. This includes a higher proportion of one and two bedroom apartments that are attractive to singles, couples and investors.
- There is generally more one bedroom apartments in the St Leonards area with these projects attracting more professionals working in the Sydney CBD and surrounds

Table 4: Project Unit Mix

Project Name	Suburb	Units	S	1	2	3+
Ethos Chatswood	Chatswood	49	0%	4%	33%	63%
Hammond Greens	Chatswood	64	0%	7%	33%	60%
The Bryson Chatswood	Chatswood	76	0%	11%	56%	33%

Project Name	Suburb	Units	S	1	2	3+
NINE by Mirvac - Stage 1 & 2	Willoughby	230	0%	20%	49%	31%
Audrey St Leonards	St Leonards	84	0%	33%	35%	32%
The Newlands	St Leonards	329	0%	20%	60%	20%
The Landmark Quarter	St Leonards	232	0%	22%	62%	16%
The Landmark	St Leonards	429	32%	41%	10%	17%
St Leonards Square	St Leonards	526	8%	20%	60%	12%
Eighty Eight by JQZ	St Leonards	654	0%	30%	60%	9%
Average			**5%**	**25%**	**51%**	**19%**

Source: Urbis

Recommended Mix

The following table outlines our recommended apartment mix for the project based on our market analysis. Key findings include:

- It is recommended that the development could include a mix of Build to Sell (BTS) and/or BTR apartments, depending on the appetite of the developer. A BTR developer would generally be looking for 150+ apartments to provide the economies of scale for a viable operation.
- The demographic analysis (growth in lone person households, couples, retirees) highlights the need for a range of apartments from studios to larger apartments. With professional couples and downsizers the key buyer segments for the project, it is recommended that the majority of apartments be two bedroom apartments. Based on demographic trends and the competitive profiles, the table below provides an overall mix for the development. It is noted that:
  - A BTS development targeting a more premium downsizer market would have a relatively higher proportion of three bedroom units than the mix below.
  - A BTR development would likely have a higher proportion of one bedroom apartment than the mix below.
- The table below provides an indication of average internal apartment areas based on competitor profiles and recent trends. These areas are generally above the ADG minimums which reflects the trend towards slightly larger apartments to provide space for WFH and to meet the desires of the downsizer market.
- Based on the profiles, the table below provides an indicative price range for BTS apartments though it is noted that these will be impacted by a number of factors such as design, positioning, build quality, economic drivers and other factors.

Table 5: Recommended Unit Mix – BTS Apartments

Unit Type	Profile Average	Urbis Recommendation	Average Internal Area (sq.m)	Price Range ($2024)
Studio	5%	~5%	43	$850,000 - $900,000
1 Bed	25%	~25%	60	$1,100,000 - $1,500,000
2 Bed	51%	~60%	80	$1,600,000 - $2,400,000
3 Bed	19%	~10%	105	$2,400,000 - $3,000,000*

Note: Excluding sub-penthouses and penthouse
Source: Urbis

COMMERCIAL MARKET ANALYSIS

Benchmarking

Urbis has benchmarked commercial floorspace in residential/ mixed-use developments in Sydney with similarities to the subject site. The developments with significant floorspace are generally closer to train stations and have the scale to support a supermarket, which then acts as an anchor for additional retail/service tenants.

Table 6: Commercial Benchmarking

Project	Commercial GFA (sqm)	Units	GFA per Unit	Commercial Space
Meriton Eastgardens	1,250	2,000	0.6	2 x cafes, grocer, 2 x child care centres, 3 x leasing offices
Nine by Mirvac	1,350	442	3.1	two proposed food and beverage tenancies across 300 sq,m, a 1,050 sqm retail/commercial building
The Retreat - Lidcombe	3,300	655	5.0	Supermarket and specialty shops
Lachlans Line	6,000	900	6.7	Coles Supermarket with supporting retail/services - Snap Fitness, Snap Car Wash, Totally Male Barber and Ocean Nails to a wide range of food & beverage establishments.

Project	Commercial GFA (sqm)	Units	GFA per Unit	Commercial Space
St Leonards Square	7,500	539	13.9	Offices accounting for 4,300 sq.m. Virgin Active has 1,150 sq.m

Source: Urbis

Commercial Uses Supportability

Urbis has provided a high level view of supportable commercial floorspace on the site based on benchmarking, local competition and locational characteristics. Overall, the competition from nearby centres will limit demand from convenience retail / services and office. The high-level assessment indicates that 4,300 – 6,300 sq.m of commercial floorspace could be supportable though this would need to be assessed further by a comprehensive market assessment.

More destinational retail, such as showroom space, has the potential to be included along the Pacific Highway frontage (which would have strong visibility to passing traffic) subject to being sufficient parking that is easily accessible.

Table 7: Commercial Land Use Supportability

Commercial Use	Supportability	GFA (sq.m)	Comment
Supermarket / Grocer	Low	0	A small supermarket or grocer will unlikely be viable on the site. Onside residents are too low to support an operator and significant competition nearby at Chatswood, St Leonards and Artarmon will capture the majority of local spending.
Convenience Retail	Low	200 - 300	Without an anchor supermarket/grocer, convenience retail and services are likely to be limited (potentially a couple of tenants such as café, hairdresser, dentist etc.)
Showroom Retail	Moderate	3,000 – 4,000	Potential interest from destinational brand(s) and furniture showrooms etc. if they are fronting Pacific Highway and there is sufficient parking that is easily accessible. There is competition from the nearby Artarmon Homemaker precinct and along Pacific Highway, which may constrain the opportunity. As such, a more detailed market assessment would be recommended to understand potential demand.

Commercial Use	Supportability	GFA (sq.m)	Comment
Gym	Moderate	100 - 200	Potential for a smaller gym(s) such as boxing/UFC/pilates etc though would not attract a larger tenant (such as Fitness First, Virgin etc) that would look for spaces closer to major train stations.
Child Care	Moderate/ High	500 - 800	Onsite residents are anticipated to be able to support a child care centre on the site.
Office	Low	0 – 500	Not really supportable as a lot of vacant office floorspace in better locations closer to Chatswood and St Leonards stations. Could potentially be an opportunity for some space for tutoring etc. though will face competition from nearby centres.
Micro Brewery	Moderate	400 – 500	Potential as there are not many micro-breweries in the area. Difficult to assess as success/supportability of breweries are very operator dependant.
Total		**4,300 – 6,300**	

Source: Urbis

Kind regards,

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Appendix: Project Profiles

PROFILE 1: ETHOS CHATSWOOD

Developer	Central Element
Location	753 Pacific Highway and 15 Ellis Street, Chatswood
Council Area	Willoughby
Location Characteristics	• 300 m to Chatswood Train Station and Interchange • 400 m from Chatswood CBD • 230 m from Chatswood Public School • 550 m from Chatswood High School • 5 km from North Sydney • 10 km from Sydney CBD
Completion	Under Construction (est. completion June 2025)
Project Launch	August 2022
Status	Now Selling / Under Construction
Total Units	49 apartments

Property Description	A mixed-use development comprising a total of 49 luxury residential apartments and retail suites to be contained within a 17-storey building above basement car parking. We note that two (2) apartments have been allocated as Affordable Housing.

Apartment Type	Mix (no.)	Mix (%)	Internal Size (sq.m)^	Price Range*	Average Achieved Rates ($/sq.m)^
1 Bed, 1 Bath	2	4%	62	$1,200,000	$19,355
2 Bed, 1 Car	16	33%	79-110	$1,700,000-$2,700,000	$21,519-$24,545
3 Bed, 2 Car	31	63%	107-148	$2,700,000-$4,950,000	$24,545-$33,446
3 Bed Penthouse			131-166	$6,300,000-$8,800,000	$40,476-$47,826
Take-up Rates	To May-24, the take-up rate was 1.6 units per month. This was when 70% of the units in the development were sold.				

*Note: *Asking prices as of September 2024 and sales over the past three months where available.*
Source: Urbis Essentials, Cordell, Ethos Chatswood Project Website, Near Maps, Urbis

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PROFILE 2: THE LANDMARK QUARTER, ST LEONARDS

Developer	New Hope Group
Location	8 Marshall Avenue, 2 Holdsworth Avenue, St Leonards
Council Area	Willoughby
Location Characteristics	• 350 m to St Leonards Train Station • 420 m to the future Crows Nest Metro Station • 400 m to Royal North Shore Hospital • 960 m to Greenwich Public School • 1.0 km to Cammeraygal High School • 200 m to Shopping Centre Mall 88
Completion	Stages from 2026 to 2029
Project Launch	February 2023
Status	Presales
Total Units	232 (211 apartments)
Property Description	• Apartments and Townhomes. Three towers of 19-storeys, 15-storeys and 12-storeys. • Apartments feature natural stone benchtops, double vanities, timber flooring, gas fireplace

Apartment Type	Mix (no.)	Internal Size (sq.m)	Price Range*	Indicative Ave. ($/sq.m)
1 Bed, 1 Bath, 0 Car	46	~60^	~$860,000	$14,333
1 Bed, 1 Bath, 1 Car		~89^	~$1,490,000	$16,742
2 Bed, 0 Car #	131	~81^	~$1,530,000	$18,889
2 Bed, 2 Bath, 1 Car		81-88	$1,690,000-$1,900,000	$18,636-$26,609
3 Bed, 3 Bath, 2 Car	34	115-160	$2,870,000-$3,820,000	$22,625-$28,122
Parking	Carparking over 4 levels for a total of 309 vehicles, 82 bicycles and 23 motorcyles. This equates to a car parking provision of 1.3 spaces per unit.			
Ancillary Facilities	Features include a Gym, Oasis Pool, Sauna and Hot Spa, Park, Kid's Playground, Recreational Areas, Outdoor Dining and BBQ Areas, Nature Walk, Dog Wash Station, Cinema Room, Private Dining and Game Room			
Take-up Rates	According to the agent, ten sales were completed during the launch			
Buyer Profile	According to the agent, there was a mix of owner-occupiers and investors.			

LAUNCH SALES

Type	Qty	Internal Size (sq.m)	Sale Date	Price	Avg. $/Sq.m
2 Bed	7	80-88	Mar-23	$1,600,000-$2,190,000	$22,249
3 Bed	3	115-116	Mar-23	$3,060,000-$3,500,000	$28,122

Note: Individual sales were not available. A summary of the 10 sales from launch day is included in the table.
*^ Unable to source ranges * Price ranges based on sales and asking prices where sales were unable to be sourced.# The number of bathrooms was unavailable as this product was no longer for sale.*
Source: CBRE, Belle Property

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PROFILE 3: AUDREY, ST LEONARDS

Developer	Hyecorp Property Group
Location	13-19 Canberra Avenue, St Leonards
Council Area	Willoughby
Location Characteristics	• 450 m to St Leonards Train Station • 250 m to the future Crows Nest Metro Station • 750 m to Royal North Shore Hospital • 980 m to Greenwich Public School • Onsite Café and Daycare
Completion	March 2025
Project Launch	July 2022
Status	Under Construction
Total Units	84 (81 apartments)
Property Description	• One tower of 12-storeys. Apartments feature: • Fully integrated dishwasher • Bespoke kitchen with MIELE appliances, stone benchtops and splashbacks • Incentive program rebates for 1 and 2-bedroom units

Type	Mix (no.)	Internal Size (sq.m)	Price Range*	Indicative Ave. ($/sq.m)
1 Bed, 1 Bath, Study, 0 Car	27	~53	$860,000-$960,000	$16,226
1 Bed, Study, 1 Car		60-68	$975,000-$1,100,000	$16,176-$16,250
2 Bed + S/MPR, 2 Bath, 1 Car	28	79-94	$1,525,000-$1,800,000	$19,043-$19,355
3 Bed, 2 Bath, 1 Car	26	97-98	$1,820,000-$2,350,000	$18,763-$20,102
Parking	4 levels of basement car parking for 136 vehicles to include 95 residential, 17 visitor, 7 childcare staff, 12 childcare visitor, 1 retail, 2 car share, 2 car wash, 10 motorcycle & 36 bicycle spaces. Additional car parking may become available to be purchased for $75,000			
Ancillary Facilities	Features include an indoor pool and spa, personal training studio, cinema, music room, private dining room, rooftop terrace with BBQ facilities.			
Take-up Rates	As of August 2023, the project was 73% sold, a sales rate of around five sales per month since the project launch.			
Buyer Profile	According to the agent, the buyer profile has more owner-occupiers than some of the other developments in the area.			

*Note: Apartment analysis only * Price ranges based on sales and asking prices where sales were unable to be sourced.*
Source: Urbis Essentials, Pricefinder, RP Data and Cordell

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PROFILE 4: THE NEWLANDS STAGE 1 (VERDANT, GLADE AND VIRIDIS) , ST LEONARDS

Developer	Top Spring Australia Property & Development Services
Location	21 Canberra Avenue, St Leonards
Council Area	Lane Cove
Location Characteristics	• 460 m to St Leonards Train Station • 750 m to Royal North Shore Hospital • 900 m to Greenwich Public School • 340 m to shopping centre Mall 88
Completion	2025
Project Launch	Verdant - September 2022, Viridis - April 2023 Glade - August 2023
Status	Presales
Total Units	207 (196 apartments and 11 Terraces)
Property Description	• Stage 1 consists of three midrise buildings. Verdant 10-storeys (99 units), Viridis 8-storeys (62 units) and Glade 6 storeys (46 units). Apartments feature: • integrated appliances • natural stone benchtops • premium wool carpets and timber flooring

Type	Mix (no.)	Internal Size (sq.m)	Price Range*	Indicative Ave. ($/sq.m)
1 Bed, 1 Bath, Study, 0 Car	40	51-54	$865,000-$930,000	$16,321-$16,887
1 Bed, 1 MPR, 1 Car		54-60	$1,040,000-$1,080,000	$18,305-$19,259
2 Bed + S/MPR, 2 Bath, 1 Car	117	76-105	$1,430,000-$1,785,000	$18,333-$19,833
3 Bed, 2 Bath, 1 Car*	39	96-177	$1,800,000-$2,700,000	Ave. $21,008
Parking	The entire Newlands development includes 372 on-site car spaces, 66 easy-access parking spaces, 25 motorcycle spaces, 121 bicycle spaces and 6 car share spaces. Shared bicycle and car service.			
Ancillary Facilities	Green spine a 5,700 sq.m private oasis includes swimming pool, Childrens playground, outdoor fitness space, wellness park and BBQ areas. Rooftop terraces, private dining spaces, indoor Gym and infrared sauna			
Take-up Rates	81 units at 8 units per month sold since project launch, 15 sold per month over the June quarter 2023. Incentives were available until end June 2023 of $15,000 rebates for 2-beds and $7,500 for 1-bed			
Buyer Profile	According to the agent, the buyer profile is mixed between investors and owner occupiers, with slightly more investors overall.			

RECENT SALES

No.	Type	Internal Size (sq.m)	Sale Date	Price	$/Sq.m
9 -A503	2 Bed, 2 Bath	NA	Aug-23	$1,635,250	NA
9-B302	2 Bed, 2 Bath	NA	Jul-23	$1,640,000	NA
10-G04	3 Bed, 2 Bath	104	Apr-23	$2,420,000	$23,269
9-B306	3 Bed, 2 Bath	130	Apr-23	$2,700,000	$20,769
10-G03	2 Bed, 2 Bath	75	Apr-23	$1,465,000	$19,533
11-B603	2 Bed, 2 Bath	84	Apr-23	$1,700,000	$20,238
11-B305	1 Bed, 1 Bath	54	Apr-23	$873,000	$16,167
B405	1 Bed, 1 Bath	NA	Feb-23	$795,000	NA

*Note: Excludes Terraces. * Price ranges based on sales and asking prices where sales were unable to be sourced.*
Source: Urbis Essentials, Pricefinder, RP Data, Domain, Agent and Cordell

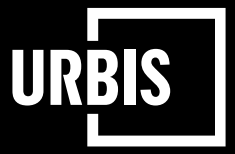
APPENDIX 4 - PLANNING COSTS

Indicative Option Yields

	Dwelling Yield	Residential GFA	Non-Residential GFA
Option 1 – Base Case Regional DA	32 x studio 154 x one-bedroom 364 x two-bedroom 72 x three-bedroom **Total: 622 x units**	53,467 sqm	11,663 sqm
Option 2 – Maximum Planning Proposal	50 x studio 206 x one-bedroom 542 x two-bedroom 104 x three-bedroom **Total: 902 x units**	78,422 sqm	5,574 sqm

Planning Costs

	Indicative Fee	S7.11 Contribution	S7.12 Contribution	HPC	CIC
Option 1. **Regional DA**	$20,667 + $1.19 for each $1,000 by which the EDC exceeds $10,000,000	32 x studio: $353,451 154 x one-bed: $1,700,986 364 x two-bed: $5,658,016 72 x three-bed: $1,440,000 **Total: $9,152,453**	**3% of the total EDC**	Dwellings (622) x $10,000 Non-resi GFA (11,663) x $30 **Total: $6,569,890**	N/A *
Option 2. **Planning Proposal**	$200,000 *	N/A [Payable at a future DA stage – as per below methodology]	N/A [Payable at a future DA stage – as per 3% of the total EDC]	N/A [Payable at a future DA stage – as per the below methodology]	Maximum resi GFA under existing FSR (4.2:1): ▪ Site area** x 4.2 (-17% non-resi) = 49,218 sqm Maximum resi GFA under proposed FSR. (6:1): ▪ Site area** x 6 (-17% non-resi) = 70,312 sqm **21,094 sqm x $900 = $18,984,600**
Methodology	*Willoughby Fees and Charges Schedule 2024 – 2025*	*Willoughby Local Infrastructure Contributions Plan 2019* Per studio/1-bed: $11,045.37 Per 2-bed: $15,544.09 Per 3-bed: $20,000	*Willoughby Local Infrastructure Contributions Plan 2019* 3% of the total EDC	HPC Rates: Residential: $10,000 per unit Commercial: $30 per sqm GFA Retail: $30 per sqm GFA	*Willoughby Planning Agreement Policy* (28 March 2022) **CIC rate** is calculated as difference between: ▪ Maximum resi GFA under existing FSR control; and ▪ Maximum resi GFA under proposed FSR control. **CIC** = CIC rate x $900 per sqm additional GFA
Comments	* Fee for Precinct Planning Proposals (”significant and highly complex and involve consideration of Precinct wide planning outcomes”)	**Mixed use development will be subject to whichever yields the greater amount (S7.11 or S7.12).**			* We have yet to see the CIC apply to DAs on land rezoned under the Chatswood CBD Strategy (i.e. not subject to a site-specific planning proposal). ** Site area is understood to be 14,119 sqm


URBIS

swood Dive Site - erty Snapshot

Category	Item	Details
Property Particulars	Address	Cnr Pacific Hwy and Mowbray Road, Chatswood
	LGA	Willoughby
	Land Owning Agency	Sydney Metro
	Lot/DP	3-4//DP455907, 1-2//DP537580, 5//DP524631, 6//66854, Part 2//221896, 4-6//65670, 18//60346, 1//243111, 1//503447, 2//1223080, 3//961402, 6//72759, 1/216408, 3//58646, 1//508715, 1//204133
	Site Area	~22,748 sqm
	Leases	N/A
	Accessibility	Within 400m of a well serviced bus stop.
Current Use	Site Description	Site is currently occupied by Sydney Metro to support construction of the Sydney Metro Chatswood. Construction is nearing completion, and it is anticipated approximately 66% of the site will be surplus to Sydney Metro's requirements.
	Current Use	Metro construction site
	Restrictions	Nil
Planning Controls	Zoning	MU1 Mixed Use, SP2 Infrastructure, RE1 Recreation
	FSR	4.2:1
	HOB	53m

Recommendation
Proceed to preliminary due diligence

Sydney Metro Underground Corridor Protection Technical Guidelines

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Appendix B. Development Application lodgement checklist

Appendix C. Glossary

Appendix D. Competent Person

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Date:	April 2021
Version:	2
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Division:	Operations, Customer & Place Making
Reviewer:	Geoff Bateman – Technical Advisor, Sydney Metro
Review date:	As required

1 Introduction

The structural stability and operation of existing Sydney Metro underground infrastructure needs to be protected, including running tunnels, station caverns and shafts. Any new development near existing Sydney Metro underground infrastructure has the potential to impact on the structural stability and operations of this infrastructure. Similarly, developments proposed near planned metro underground infrastructure have the potential to impact on the feasibility of future metro construction.

Sydney Metro under delegation from Transport for NSW (TfNSW) has an obligation to review the development applications of proposed developments near to Sydney Metro underground infrastructure, both planned and existing, to ensure impacts are appropriately assessed and managed. This guideline document has been developed to provide the requirements and technical guidance to assist developers with their assessment of development induced effects and the associated risks.

New civil infrastructure developments by NSW Government will be subject to an interface agreement and are not subject to the requirements of this guideline document.

2 Purpose of this document

This guideline document provides the technical requirements to assess and manage the risks associated with proposed developments near existing and future Metro underground infrastructure. This document is based and builds on the ASA Standard T HR CI 12051 ST Developments Near Rail Tunnels.

The purpose of this guideline document is to assist external developers in the planning, design, construction (including associated temporary works) and operation of proposed development near underground metro rail infrastructure. This guideline supports the requirements of the rail authority under relevant planning instruments including the *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP), *State Environmental Planning Policy (Major Infrastructure Corridors) 2020* and *State Environmental Planning Policy (Western Sydney Aerotropolis) 2020* to protect the safety, structural integrity and the safe and effective operation of existing or proposed rail infrastructure facilities from adjacent developments.

2.1 Scope

This guideline document covers proposed developments near the following existing, under construction and future metro lines:

- Metro North West Line including Sydney Metro converted Epping to Chatswood Rail Line (ECRL)
- Sydney Metro - City & Southwest
- Sydney Metro - West
- Sydney Metro - Western Sydney Airport and
- Other future Sydney Metro corridors.

It generally applies to proposed developments near Sydney Metro running tunnels and other underground infrastructure such as: cross passages between running tunnels; station caverns and adits; crossover caverns; station boxes and shafts; nozzle enlargements; services facility shafts; spur tunnel junctions; and dive/portal structures. Information regarding existing and planned new metro infrastructure can be sourced from Sydney Metro (refer to Section 11 for contact details).

There are different rail authorities for different rail corridors. If the proposed development requires referral or concurrence from other transport cluster agencies (TfNSW or Sydney Trains) separate documentation related to their rail infrastructure must be provided and will generally be dealt with separately.

3 Reference documents

The following documents have been referenced to prepare this document:

3.1 Transport for NSW standards

- T HR CI 12051 ST Developments Near Rail Tunnels.
- TS 20001 System Safety for New or Altered Assets
- T HR CI 12070 ST Miscellaneous Structures
- T HR CI 12075 ST Airspace Developments
- T HR CI 12080 ST External Developments
- T HR EL 12002 GU Electrolysis from Stray DC Current

3.2 Legislation and guidelines

- the Environmental Planning and Assessment Act 1979
- the Heritage Act 1977
- State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP)
- State Environmental Planning Policy (Sydney Region Growth Centres) 2006
- State Environmental Planning Policy (Major Infrastructure Corridors) 2020 (MIC SEPP)
- State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 (WSA SEPP)
- Development Near Rail Corridors and Busy Roads 2008 – Interim Guidelines – Department of Planning, NSW Government
- Interim Construction Noise Guidelines (NSW EPA, 2009)
- Noise Policy for Industry (2017)

3.3 Other reference documents

- CIRIA C760, Guidance on Embedded Retaining Wall Design, 2017
- AS 2187: Part 2-2006 ‘Explosives – Storage and Use – Part 2: Use of Explosives’
- BS 7385 Part 2-1993 ‘Evaluation and measurement for vibration in buildings Part 2'
- Australian and International Standards referenced in any of the Transport for NSW standards and legislation and guidelines listed above

A Glossary of terminology and definitions used within this document is provided in Appendix C.

4 Protection reserves

Reference should be made to applicable legislation for a legal definition of rail corridor and rail infrastructure facilities. The definition of rail infrastructure facilities can be found in the Infrastructure SEPP.

Protection reserves define the extent of zones that have been established to protect existing metro infrastructure and protect the feasibility of planned metro infrastructure from adjacent proposed development.

For the purpose of assessing the effects of adjacent proposed developments, underground metro infrastructure includes, but is not limited to, the following:

- running tunnels and interconnecting cross passages
- station caverns and adits
- crossover caverns
- station boxes and shafts
- nozzle enlargements
- spur tunnel junctions
- services facility shafts and
- dive and portal structures.

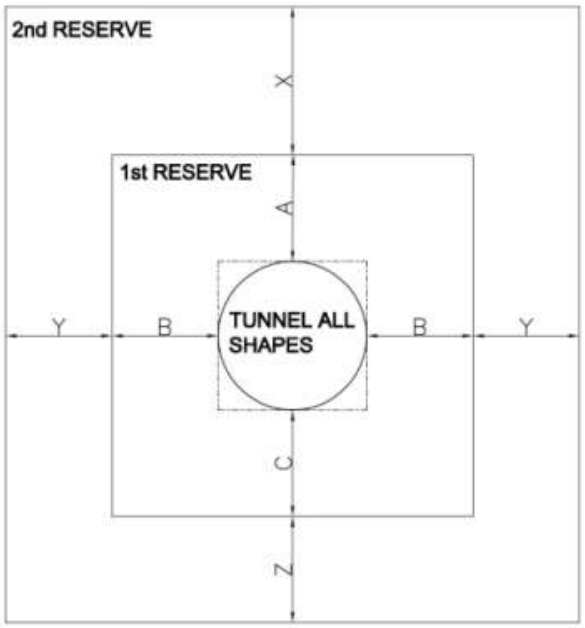
Appendix A includes descriptions of Sydney Metro infrastructure for each of the existing and future metro lines. These descriptions provide an overview of the metro alignments and general location of the underground elements for each section.

Protection reserves are defined in this document. Developers must establish the reserve zones based on the requirements provided within this document and ensure that the design and construction meet the stated requirements.

4.1 Protection reserves

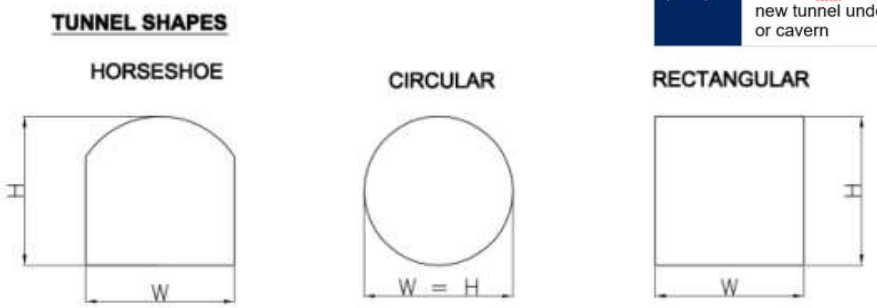
Protection reserves are categorised as either the 'first reserve' or 'second reserve'. Figure 4.1 and Figure 4.2 represent the zones that form the first reserve and the second reserve around metro underground infrastructure. Section 4.2 outlines the formula for calculating the first reserve. Section 4.3 outlines the formula for calculating the second reserve.

The location of the substratum and Sydney Metro infrastructure is required to calculate the first and second reserves (refer to Section 6.1 on how to obtain this information).



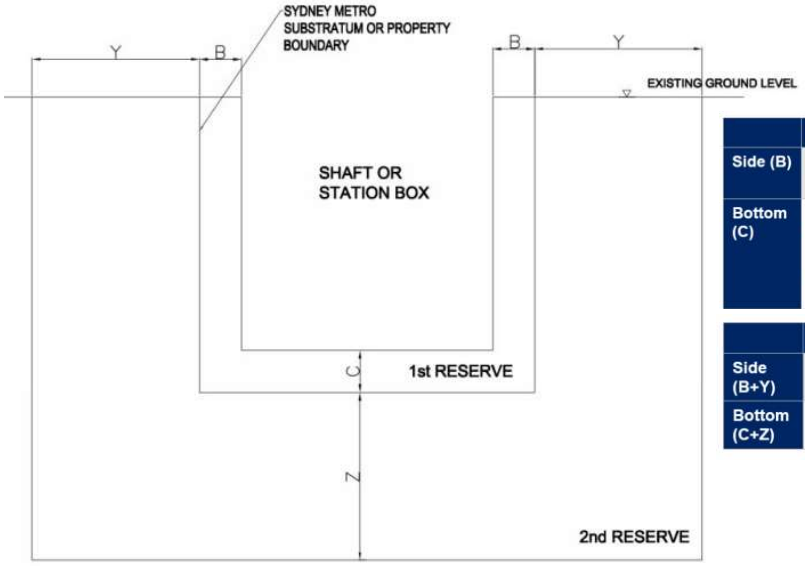
	First reserve dimensions (m)
Top (A)	The greater of the following: • 5 m from the crown of tunnel or cavern or • Support zone based on 1/3* tunnel width plus 1 metre (1/3*W+1) or • Extent of Sydney Metro substratum above crown
Side (B)	The greater of the following: • 5 m from side wall of tunnel or cavern or • Lateral extent of Sydney Metro substratum
Bottom (C)	The greater of the following: • 5 m below the invert of the tunnel or cavern or • Extent of Sydney Metro substratum below invert

	Second reserve dimensions (m)
Top (A+X)	The greater of the following: • 1.5 x (W+H) or • A + 25 or • Where 'W' and 'H' are width and height of the existing rail tunnel
Side (B+Y)	The greater of the following: • W or • B + 25
Bottom (C+Z)	C + 1.5 x (W_n + H_n) Where 'W_n' and 'H_n' are width and height of new tunnel under the existing metro tunnel or cavern



Note: all dimensions are taken from the excavated profile of tunnels and caverns

Figure 4.1 Protection reserves for metro tunnels and caverns



	First reserve dimensions (m)
Side (B)	• Lateral extent of Sydney Metro substratum or property boundary
Bottom (C)	The greater of the following: • 5 m below the invert of the shafts or boxes or • Extent of Sydney Metro substratum below invert

	Second reserve dimensions (m)
Side (B+Y)	• B + 25
Bottom (C+Z)	• C + 25

Figure 4.2 Protection reserves for shafts and station boxes

4.2 First reserve

The first reserve encompasses the ground that immediately surrounds the underground metro infrastructure. This zone represents the area that must not be encroached upon by any proposed development and its construction.

The limits of this zone are indicated in Figure 4.1 and Figure 4.2. These limits are determined based on an appreciation of general ground support principles and the substratum acquired for the Sydney Metro.

Table 4.1 Definition of first reserve for tunnels and caverns

Boundary (Dimension Reference as shown in Figure 4.1)	Reserve dimensions (m)
Top (A)	The greater of the following: • 5 m from the crown of tunnel or cavern or • Support zone based on 1/3* tunnel width plus 1 metre (1/3*W+1) or • Extent of Sydney Metro substratum above crown
Side (B)	The greater of the following: • 5 m from side wall of tunnel or cavern or • Lateral extent of Sydney Metro substratum
Bottom (C)	The greater of the following: • 5 m below the invert of the tunnel or cavern or • Extent of Sydney Metro substratum below invert

Note: References to the tunnel are to the outer edge of the tunnel lining. Refer to Appendix A on details of tunnel diameter.

Table 4.2 Definition of first reserve for shafts and station boxes

Boundary (Dimension Reference as shown in Figure 4.2)	Reserve dimensions (m)
Side (B)	• Lateral extent of Sydney Metro substratum or property boundary
Bottom (C)	The greater of the following: • 5 m below the invert of the shafts or boxes or • Extent of Sydney Metro substratum below invert

4.3 Second reserve

The second reserve zone surrounds the first reserve and covers the areas where proposed developments have the potential to adversely impact on the performance of the support elements of underground infrastructure, metro operations or the feasibility of planned metro infrastructure.

Any proposed developments that take place within the second reserve require an engineering assessment of the works to demonstrate that induced effects on the underground rail infrastructure are acceptable to Sydney Metro, in accordance with the performance requirements outlined in Section 9 of this document.

The limits that apply to the second reserve are summarised in Table 4.3 and Table 4.4 below.

Table 4.3 Definition of second reserve for tunnels and caverns

Boundary (Dimension Reference as shown in Figure 4.1)	Reserve dimensions (m)
Top (A+X)	The greater of the following: • 1.5 x (W+H) or • A + 25 or • Where 'W' and 'H' are width and height of the existing rail tunnel
Side (B+Y)	The greater of the following: • W or • B + 25
Bottom (C+Z)	C + 1.5 x (W_n + H_n) Where 'W_n' and 'H_n' are width and height of new tunnel under the existing metro tunnel or cavern

Note: References to the tunnel are to the outer edge of the tunnel lining. Refer to Appendix A on details of tunnel diameter.

Table 4.4 Definition of second reserve for shafts and boxes

Boundary (Dimension Reference as shown in Figure 4.2)	Reserve dimensions (m)
Side (B+Y)	• B + 25
Bottom (C+Z)	• C + 25

The following factors have been considered to establish the extent of the second reserve:

- potential stress and displacement influence zones associated with external developments that consider the expected zone of negligible ground stress changes due to construction
- extent of shear displacement of horizontal rock defect or bedding and joints during construction
- potential groundwater drawdown influence zone and
- vibration influence zone.

4.4 Construction restrictions placed on protection reserves

Table 4.5 provides the construction restrictions that are applied to each reserve zone as shown in Figure 4.1 and Figure 4.2.

Table 4.5 Construction restrictions

Types of construction	First reserve	Second reserve
Excavation for basements, footings	Not allowed	• Excavations less than 2.0 m depth from surface level, assessment not required. • Excavation greater than 2.0 m depth, assessment required.
Shallow footings or pile foundations	Not allowed	Allowed, subject to load restrictions. Assessment required.
Tunnels and underground excavations	Not allowed	Allowed, subject to assessment.
Ground anchors	Not allowed	Allowed, subject to assessment.
Demolition of existing subsurface structures	Not allowed	Allowed, subject to assessment.
Penetrative subsurface investigations e.g. boreholes, instrumentation	Allowed away from support zone. Assessment required.	Allowed, subject to assessment (refer to Section 7.1 for requirements)

5 Potential impacts from developments

5.1 General

The scope of this guideline includes proposed construction above, below or alongside the existing or future metro infrastructure, that is located within the protection reserves and construction that is located outside these protection reserves, but still has the potential to cause construction-induced groundwater drawdown and vibration that may affect underground metro infrastructure.

Proposed developments near metro infrastructure must be planned, designed, constructed and maintained to ensure the protection of existing and future metro infrastructure including effects on:

- the safety and structural integrity of the tunnels and associated infrastructure by development related loads, induced ground displacement or structural lining movement and
- the safe and effective operation of the network including the operational capacity, maintenance and the efficiency of the network during any stage of the proposed development.

Development related loads and ground displacements could have the potential to cause deformation of existing tunnels and other associated structures and, in extreme situations, could cause structural failure and collapse. The tunnel and cavern support elements and the surrounding ground need to be protected to avoid movement of structural lining which could cause structural instability, groundwater ingress and encroachment of support into rail functional areas, such as rolling stock kinematic envelopes.

The following sections discuss those aspects of developments where construction restrictions are placed within the second reserve and includes safety and environmental considerations.

5.2 Construction restrictions

The following key construction activities are permitted within the second reserve, but have the potential to affect metro infrastructure, as such restrictions may apply to construction activity within the second reserve:

- excavation for basements and shafts – above / beside or below
- shallow footing or pile foundation – above / beside or below
- tunnels and underground excavations – above / beside or below
- ground anchors – above / beside or below
- demolitions of existing structure – above or beside
- geotechnical investigations / instrumentation – above / beside or below.

Whilst these restrictions focus mainly on impacts to existing underground infrastructure, in many cases they may be equally applicable to future metro infrastructure. The intent of construction restrictions for future metro infrastructure is to ensure that the feasibility of future metro construction and operations is not adversely affected by new developments and their construction.

The construction of new developments must take into account:

- the construction constraints, particularly live road and rail operating conditions

- noise and vibration restrictions and track possession constraints that are inherent to working near to an operating rail environment and
- access requirements that may be necessary for inspection and maintenance purposes.

5.2.1 Open excavations

Open excavations can be above and/or to the side of underground metro infrastructure and could potentially:

- alter the in-situ stress regime in the ground that directly affects support elements of underground infrastructure and other sensitive infrastructure and
- reduce the structural support provided by the surrounding rock where the rockmass provides active support.

Temporary and permanent anchors can be used to support open excavations, underground excavations and provide uplift resistance for construction cranes and basements. High stress concentrations around ground anchors can affect the surrounding ground locally and potentially impact on the stability of the rockmass and existing underground structures.

A range of excavation methods are available to excavate ground for new developments. Activities such as rock breaking, pile driving and rock drilling/cutting works have the potential to impose temporary loads and excessive noise and vibration on metro infrastructure. Vibration can dislodge rock wedges on existing metro tunnels and caverns, as well as impose additional non-uniform load patterns on the support of metro tunnels and caverns.

Ground improvement works such as grouting and ground freezing can affect existing metro tunnel and cavern structures. Grouting can block water drainage paths and impose excessive hydrostatic loads on tunnel and cavern support. Specialised techniques such as ground freezing can cause volume increase that can impose loads on nearby tunnel and cavern support.

In addition, excavation activities will induce ground borne vibration with the potential to affect metro infrastructure.

5.2.2 Foundations

Additional pressures from shallow spread footings and piled foundations designed to support proposed developments could potentially increase the stresses in the permanent concrete structural linings of metro tunnels and caverns and the surrounding rockmass. The effects of the foundation loads must be considered, including opportunities to redistribute bearing pressures away from the protection reserves to minimise the impacts.

Of interest are the changes in stress distribution from foundations within the ground above or surrounding existing (or future metro) underground infrastructure, as a consequence of development construction. Issues of potential concern relate to increase in vertical or horizontal pressures beneath foundation elements, increases in shear stress along known existing bedding planes in the rockmass and uplift pressures below the invert of metro underground infrastructure.

Ground borne vibration from activities such as pile driving or bored piles installation and sheet pile installation must be considered.

5.2.3 Underground excavation

Underground excavations include the construction of adjacent rail and road tunnels (above, to the side and below), utility tunnels, cable conduits, drainage pipes, and pedestrian walkways and underpasses. Such underground excavations could potentially significantly alter the in-situ stress field in the surrounding ground resulting in stress concentrations, stress relief and displacements. These changes can significantly affect the existing metro tunnel and cavern support elements.

In cases where underground excavations are designed to be drained structures (that is, the structural lining and ground support of tunnel and caverns are built to support the ground but permit groundwater to flow into the excavation) consideration must be given to the groundwater drawdown that this will cause and the impacts that this will have on nearby metro infrastructure.

Ground borne vibration caused by tunnelling must also be considered.

5.2.4 Demolition

The demolition of any existing buildings or basements may affect existing metro underground infrastructure and cause disruption to metro operations. Where necessary, measures may be needed to protect metro assets during demolition works of existing buildings and structures.

5.2.5 Geotechnical investigations

Development activity requires geotechnical and subsurface investigations that can include drill holes, geophysical exploration, in-situ tests and permeability tests. During construction, instrumentation holes such as inclinometers, piezometers and extensometers can be drilled to measure the ground reaction and the impacts.

Importantly, the drilling of boreholes and installation of instrumentation must be planned to avoid existing metro infrastructure and avoid disruption to metro operations.

5.3 Safety

Developments near underground metro infrastructure must address the following aspects of safety in respect of the metro and its operation at any stage of the life cycle of that development:

- structural safety
- operational safety
- fire safety
- inspection and maintenance and
- floor protection.

Consideration must be given to maintenance and to future users of the development. Importantly, new development must not obstruct emergency access to metro infrastructure and any maintenance access requirements.

Approvals from Sydney Metro are required to enter into the metro assets for dilapidation survey, installation of instruments, monitoring and visual inspections. Persons carrying out these activities must be accompanied by safety personnel from Sydney Metro or from Sydney Metro approved organisations when entering metro tunnels.

5.4 Protection of environment

The developer must take into account the environmental impacts that can affect the metro with a view to minimising any effects during the whole life cycle of development. Typical considerations for developments in the urban environment are as follows:

- stormwater management
- noise and vibration
- air quality, particularly dust
- traffic impacts
- visual impact and amenity
- ability and ease to maintain and 'retro-fit' improvements over time
- disposal and re-use at life cycle end
- ecological impact due to draw-down
- groundwater contamination and
- construction materials to be as low toxicity as possible.

5.5 Transport planning, place making and precinct activation

Sydney Metro is committed to ensuring that its rail corridors and infrastructure provide opportunities for development, place making and integration with the local precincts.

Sydney Metro manages metro operations to deliver integrated, reliable, customer-focused and efficient services, for the current and future metro network, precincts and corridors. It is focussed on developing an integrated metro network with connected and thriving precincts, achieving urban amenity, commercial viability and supporting corridor growth.

Better Placed [1]and Movement and Place [2]are the leading state government design policies for design and place principles for consideration.

[1] https://www.governmentarchitect.nsw.gov.au/policies/better-placed

[2] https://www.governmentarchitect.nsw.gov.au/guidance/movement-and-place

6 Development applications and construction

Proposed development may trigger the requirement for referral for comment or concurrence from Sydney Metro. An urban planner will be able to advise when legislation is triggered to require comments or concurrence. TfNSW has delegated its rail authority functions in relation to the Sydney Metro corridors to Sydney Metro. Different documentation is required at different stages to enable Sydney Metro to confirm the potential impact on Sydney Metro corridors.

Documentation must be provided as part of the development application package lodged with the consent authority to demonstrate that induced effects will be acceptable to Sydney Metro infrastructure. Sydney Metro may also request documentation and supporting information at the design, construction and operation stages of the proposed development.

Staged developments must include appropriate levels of technical and design requirements to be lodged with the initial development application, along with documentation that defines how the phased construction period will be managed, including a design change process for concurrence of potential future design changes.

6.1 Pre-development application

This guideline document provides information on what needs to be considered for proposed developments in the vicinity of the Sydney Metro rail corridor and ideally should be distributed to the development team. Appendix B provides a check list of the documents required to be included in the lodgement package. The latest version of this guideline document can be downloaded from Sydney Metro's website[3].

The following can be carried out or made reference to in order to determine corridor protection zones and the location of the Sydney Metro infrastructure and substratum (if relevant):

- Request the location of the Sydney Metro infrastructure for the proposed development site (refer to Section 11 for Sydney Metro contact details).
- Stratum information (where available) can be obtained through:
    - The owners who were notified of the location of the stratum as part of the acquisition process and
    - The survey plans of acquisition registered with Land Registry Services, NSW (a registered surveyor should be able to assist with this) and
    - Dial Before You Dig Service

It is recommended that experienced and qualified specialists be engaged early as part of your development team.

The information provided in this guideline should enable developers to lodge the required documentation with their development application without the need for a meeting with Sydney Metro. However, it is understood that in some situations where the development is located directly over Sydney Metro infrastructure that developers may want to have a meeting to discuss their preliminary design. In this situation a request should be sent to Sydney Metro for a meeting (refer to Section 11 for Sydney

[3] www.sydneymetro.info

Metro contact details). Sydney Metro may recover costs associated with meeting with the developer.

The following documents should be provided prior to the meeting for comment and discussion during the meeting:

- location of site layout
- existing easements/stratum on land and for the metro underground infrastructure
- architectural layout showing the general arrangement of the development
- plans and drawings of existing metro infrastructure obtained from Sydney Metro that show protection reserve boundaries based on this guideline document
- section view and plan view of the proposed development (including the reduced level of basements) and protection reserves and
- site investigation plans (if they involve drilling within the protection reserves).

6.2 Development application lodgement

Where legislation requires referral or concurrence in relation to Sydney Metro rail corridors for proposed developments the developer must submit the following documents as part of their development application package:

- a detailed survey plan prepared by a NSW registered surveyor, which accurately defines the boundaries between the development, the rail corridor (including first and second reserve), rail infrastructure and any Sydney Metro easements (including right of ways) or stratums, covenants and caveats.
- cross section drawings showing the rail corridor (including first and second reserve), and proposed basement and/or foundation excavation. All measurements contained within the cross-section drawings must be verified by a registered surveyor.
- geotechnical investigation report with details in accordance with Section 7.1 of this guideline document
- impact assessment report with details in accordance with Section 7.2 of this guideline document
- risk assessment report in accordance with Section 7.3 of this guideline document
- instrumentation and monitoring plan with details in accordance with Section 10 of this guideline document and
- noise, vibration and electrolysis studies and control measures if available, in accordance with Section 7 of this guideline document, otherwise this will be required prior to construction certificate.

6.2.1 Concept development application lodgement

Concept development applications set out concept proposals for the development of a site, and for which detailed proposals for the site or for separate parts of the site are to be the subject of a subsequent development application or applications. Sydney Metro will consider the likely impact of the concept proposals (and any first stage of development included in the application).

Where legislation requires referral or concurrence in relation to Sydney Metro rail corridors for proposed developments the developer must lodge the following documents as part of their concept development application package:

- geotechnical desktop study and concept foundation design that meet the standards and requirements of Sydney Metro
- a detailed survey plan prepared by a NSW registered surveyor, which accurately defines the boundaries between the development, the rail corridor (including first and second reserve), rail infrastructure and any Sydney Metro easements (including right of ways) or stratums, covenants and caveats and
- cross-section drawings showing the rail corridor (including first and second reserve), proposed basements, locations of lifts and recommended type of foundation adjacent to the rail corridor; all measurements contained within the cross section drawings must be verified by a registered surveyor.

Subsequent detailed development applications will need to be consistent with this guideline document and will be reviewed by Sydney Metro when they are referred to Sydney Metro.

6.3 Post development application approval

Based on the information provided to support the development application Sydney Metro may require the developer to provide the following information and documentation at the following stages of project development as conditions of consent.

6.3.1 Prior to construction

The following documents may need to be submitted prior to construction commencement:

- detailed ground and vibration monitoring plan including trigger levels, action plans and remedial measures, details of the instrumentation and baseline monitoring readings (refer to Section 10)
- construction schedule, construction management plan including sequence plan identifying impacts
- construction layout of equipment relative to metro infrastructure
- final detailed Safe Work Method Statements (refer to Section 8)
- temporary safety plans and measures
- temporary works plan, temporary access, vehicle, plant and equipment such as cranes (including mobile cranes) and stockpiling
- noise, vibration and electrolysis studies and control measures
- a rail related risk assessment and management plan
- list of machinery to be used during excavation/construction
- groundwater control plans, environmental aspects including contamination
- design loadings and certified drawings for construction related works that affect metro infrastructure
- agreed interface activities plan with Sydney Metro and
- condition and dilapidation survey reports of all metro infrastructure affected by the development (refer to Section 8.2).

6.3.2 During construction

The following documentation may need to be submitted to Sydney Metro at agreed intervals by the developer, during the development construction phase:

- monitoring report at agreed intervals, which includes monitoring results and assessment by the geotechnical or structural consultant
- notification of work progress at agreed intervals, which is applicable during excavations, foundations and support installations, superstructure construction up to the ground level
- interim dilapidation survey reports as appropriate
- any changes to the design and construction methods for approval by Sydney Metro and
- rock face mapping, inspection and assessment reports.

6.3.3 After construction completion and prior to issue of occupation certificate

Sydney Metro may request the following documentation from the developer, after completion of the construction:

- one set of as-built structural and foundation plans signed by a qualified person
- one set of as-built drawings for ground anchors and other support details near the affected metro infrastructure
- monitoring summary report
- copy of the geotechnical mapping report carried out during excavation works
- dilapidation survey report conducted after construction completion (refer to Section 8.2)
- structural safety report
- operational safety report and
- current mitigation verification report, including maintenance base line measurements referenced to measured locations (refer to Section 9.4).

7 Engineering investigations and assessments

The developer must prepare the following documentation in support of their development application during the course of the development process:

- geotechnical investigation report
- engineering impact assessment report
- risk assessment report
- dilapidation survey report
- drainage report
- noise and vibration report
- electrolysis report and
- a summary report that presents the main conclusion and results from the above reports.

This section of this guideline document provides an explanation of the information that needs to be included in these reports to enable Sydney Metro to ascertain the relative impact of the development on existing and future Sydney Metro underground infrastructure. In terms of the engineering investigations and assessments undertaken for future metro infrastructure, the intent of these is to ensure the feasibility of future metro construction is not adversely affected by new developments and their construction.

The main aim of these assessments and investigations is to demonstrate that there will be no adverse effects arising from the proposed development within the defined protection reserves. The acceptability of the effects predicted (as determined through investigation and assessment) must be viewed against the performance requirements described in Section 9 of this guideline document, as well as compliance with relevant standards and codes.

The secondary aim is to provide confidence that any proposed development is 'fit for purpose'. This is to ensure that the development owner and tenants do not have unrealistic expectations in regards to the impacts of noise and vibration that they may be exposed to as a result of Sydney Metro operations and maintenance.

The developer should approach Sydney Metro for information that defines the extent of existing and future metro infrastructure in order to undertake these investigations and assessments.

7.1 Geotechnical investigation

The developer must carry out detailed geotechnical investigations of the soil or rock strata above, alongside and below existing and future Sydney Metro underground infrastructure, as appropriate, to establish the existing ground conditions within the area affected by the proposed development. Geotechnical investigations must be undertaken by suitably qualified and experienced consultant. The results of the investigation must be presented in a geotechnical investigation report.

The intent of these geotechnical investigations must be as follows:

- Provide information that enables a geological model to be developed. Based on this model, sections must be prepared that illustrate the ground conditions in and around the interface of the proposed development with the Sydney Metro underground infrastructure of concern.

- Establish any likely in-situ stress conditions within the soils and underlying rockmass surrounding the interface.
- Describe any potential presence of critical geological features such as bedding planes, joints and dykes.
- Present an interpretation of relevant rock and soil properties based on the results and any in-situ and laboratory testing that has been undertaken. If no in-situ or laboratory testing has been carried out, industry established rock and soil properties can be adopted with supporting justification.
- Provide an interpretation of the existing groundwater regime within and surrounding the interface.
- Identify and describe the presence of any human-made features within the development site.

The scope of the geotechnical investigation undertaken to support the development application may comprise the following:

- drilled boreholes
- in-situ testing
- geological mapping and
- geophysical exploration.

Whilst the installation of instrumentation and the drilling of investigation boreholes is permissible within the first and second reserve of the rail corridor, they should be located and orientated to avoid the supporting systems of existing metro underground infrastructure. This will require a detailed study of existing arrangements to demonstrate that risk to the underground infrastructure is appropriately managed for acceptance by Sydney Metro prior to the drilling of boreholes.

If boreholes 2m or deeper are to be drilled within the first or second protection reserves Sydney Metro is to confirm no objection to boreholes prior to drilling. The following information is to be provided to Sydney Metro:

- Proposed borehole location plan and cross sections, verified by a registered surveyor, showing:
- the distances from the boreholes to the tunnel reserve boundaries (first and second reserves)
- the distances from the sub-stratum boundary and
- borehole details (e,g. diameter and depth).
- A copy of the Safe Work Method Statement for the proposed works including a requirement to notify Sydney Metro if the driller encounters any indications that Sydney Metro underground infrastructure may has been encountered (e.g. sudden increase or decrease in ground resistance to drilling, interception of voids, sudden loss of water within boreholes) then Sydney Metro is to be immediately contacted on one of the Sydney Metro project enquiry numbers:
- Sydney Metro – City & Southwest – 1800 171 386
- Metro North West Line – (02) 9854 4805
- Sydney Metro – West – 1800 612 173
- Sydney Metro – Western Sydney Airport – 1800 717 703.
- Any other requirements consistent with Section 7.1 of these guidelines.

Please allow two weeks for confirmation of no objection to boreholes from Sydney Metro. All boreholes must be carefully grouted to their full depth with a bentonite and cement grout mixture upon completion.

As a minimum the geotechnical investigation report will need to present the following information:

- borehole location plan, borehole logs, test results, geological mapping, photographic documentation and other relevant information
- description of the soil profile of the area
- critical geological features such as bedding planes, joints and dykes
- other relevant data from geotechnical investigation
- rock and soil properties, laboratory and in-situ test results
- existing in-situ stress states in soils and rocks
- groundwater levels
- detailed geotechnical model for the analysis including geotechnical design parameters
- comments on foundation design, methods of shoring and excavation and
- a copy of all plans, geotechnical data, operations and maintenance records with any qualifications and limitations provided by Sydney Metro to the developer.

7.2 Engineering impact assessment

The developer must carry out an engineering analysis and impact assessment to demonstrate that the effects of the proposed development on tunnels and underground facilities will not cause unacceptable adverse impacts on future or existing Sydney Metro infrastructure. The engineering assessment must be carried out by Competent Persons with appropriate qualifications and experience in tunnel design and analysis. In some cases, Sydney Metro may request the developer to arrange independent verification of the engineering analysis and impact assessment based on the project complexity and the potential effects on metro infrastructure.

The results of the analysis and assessment must be presented in an engineering report. The engineering assessment report must be prepared and endorsed by a Competent Person and submitted to Sydney Metro.

The engineering analysis and impact assessment must take into account any other adjacent development activities planned for the future or that are taking place at the time of analysis. This information can be obtained from Sydney Metro.

Depending on the complexity of the development, a two-dimensional or three-dimensional numerical modelling (finite element [FE] or finite difference [FD]) may be required to demonstrate that induced effects on the rail infrastructure will be acceptable to Sydney Metro through predicting the effects on the underground construction at different stages of construction and the eventual or current operation of the metro. The modelling must also consider the effects of associated temporary works, such as construction loading (e.g. demolition, tower cranes and material stockpiling).

If undertaken, numerical modelling must fulfil the following requirements:

- be based on a realistic geological model derived from the subsurface information gathered through the geotechnical investigation and

- must incorporate critical geological features that may be present, such as bedding planes, weak layers, joints and other discontinuities.

If necessary, the results from this numerical modelling may need to be validated during construction by comparison with the results from the field monitoring of installed instrumentation.

As a minimum the impact assessment report must include the following:

- Details of the scope of the development.
- Verified survey plans by a NSW registered surveyor that show the location of the proposed development in relation to the metro easements, protection reserves and the planned or existing metro alignment including track centre lines and details of the underground structures.
- The metro underground infrastructure must be shown in plan and various sections with the inclusion of the protection reserves as defined in this guideline document to clearly illustrate the comparative position of the development in relation to the existing or planned metro infrastructure. They must also extend to the expected physical zone of influence, which is the extent to which the development is expected to affect the surrounding ground.
- Detailed drawings depicting structural layout, foundation layout, foundation loads, drainage plans, temporary works such as dewatering, shoring and anchoring and permanent works of the proposed development.
- Structural drawings that show the designs for shoring, as recommended by the geotechnical consultant engaged by the developer.
- Predicted displacements of existing or planned metro underground infrastructure (if constructed prior to the proposed development) due to proposed development at various stages, namely pre-construction (including demolition), excavation, development construction and post-construction.
- Predicted displacements, stresses and structural actions as imposed on the structural support of metro infrastructure structure at various stages of construction, namely pre-construction (including demolition), excavation, development construction and post-construction. In most cases this support will be in the form of watertight structural concrete linings.
- Structural assessments of these predicted effects on existing and planned metro infrastructure (if constructed prior to the proposed development). This must include as appropriate the structural integrity of underground support (such as structural linings), track beds, existing drainage structures, waterproofing measures and structural clearances.
- Appropriate sensitivity analysis to ensure that the predictions are not adversely affected by reasonable variations in input parameters and different conditions that can occur during all stages of development construction.
- Assessment of the effects of construction techniques and methodology on the underground metro infrastructure.
- Provide discussion on any design assumptions, qualifications or limitations that have been applied. This discussion must indicate how these have been considered as part of the sensitivity analysis and then integrated as identified risks as part of the risk assessment (as discussed below).
- Recommendations regarding any planned preventive or remedial action that may be required to limit development induced impacts on metro infrastructure.
- Noise and vibration assessment report (refer Section 8.6).

- Stray currents report, including a risk assessment (refer to Section 9.4).
- Certification that the proposed development will not induce unacceptable adverse effects on metro infrastructure.

7.3 Risk assessment

Developers have a legal duty to eliminate risks to ensure safe rail operations so far as is reasonably practicable (SFAIRP). As such developers must identify all reasonably foreseeable safety risks and hazards to the metro or its operations and eliminate these risks where reasonably practicable and where it does not minimise each risk SFAIRP.

The identified risks and their SFAIRP demonstration must be documented in a manner that can be provided as assurance evidence to Sydney Metro. TS 20001 System Safety for New or Altered Assets describes the assurance for changes impacting rail or transport assets. Reference should also be made to T HR CI 12075 ST when preparing the risk assessment.

A rail related risk assessment report must be prepared and submitted for consideration and approval by Sydney Metro in accordance with the safety management system for Sydney Metro and address/include the following:

- safety in design that covers and the whole of asset life cycle, including all stages of construction
- identify all hazards and risks to the development and metro facilities including metro support elements and other infrastructure
- present the risk identification process that has been adopted which considers the entire asset life cycle of the metro infrastructure
- apply and present a risk ranking in accordance with the Sydney Metro safety management system
- confirm that all risks can and will be managed so far as is reasonably practicable (SFAIRP) and
- present the controls that are needed to manage risks from the proposed development to metro infrastructure; these may include early warning criteria for monitoring. The risk of the proposal to Sydney Metro infrastructure will be reflected in the amount of public liability insurance required as a condition of consent.

7.4 Dilapidation survey

As part of an engineering assessment, dilapidation surveys of existing metro infrastructure may be requested by Sydney Metro to be submitted as part of the development application prior to the issue of a construction certificate. If required by Sydney Metro, the developer must arrange, with Sydney Metro, for a dilapidation survey to be undertaken of metro infrastructure in proximity to the development. The existing condition of the metro infrastructure must be established and agreed and considered as part of the risk assessment.

7.5 Drainage report

Where relevant Sydney Metro may request that a drainage report is prepared that details the proposed means of drainage that will be adopted to manage the collection of water, including groundwater, within basement levels of the proposed development.

7.6 Noise and vibration assessment

The developer must submit a noise and vibration impact assessment report prepared by a qualified person as part of the development application or prior to a construction certificate. The noise and vibration impact assessment report must:

- demonstrate that the development is designed, and will be constructed and maintained to avoid damage or other interference which may occur as a result of airborne and ground borne noise and vibration effects that may emanate from the rail corridor during rail construction and from the railway operations and
- determine the effects of any noise or vibration impacts on the metro infrastructure and its operations arising from the proposed development during demolition, excavation and construction (including any machinery causing heavy vibration levels) and its operation after completion and
- Assess any cumulative impacts with Sydney Metro operations, or any adverse impact to a soundscape that Sydney Metro has specifically designed for (ie. Station promenades and concourses).

Refer to Section 9.3 for further details regarding performance criteria to be considered.

Vibration impacts should be considered in the monitoring plan referred to in Section 10.

7.7 Electrolysis assessment

The developer must submit an electrolysis report as part of the development application or prior to a construction certificate, prepared by a suitably qualified consultant, to assess the requirements for electrolysis effects on the development infrastructure from metro operation and to address whether preventative measures are required.

7.8 Summary report

A summary report should be provided to demonstrate that the proposed works will not have adverse impacts on Sydney Metro infrastructure and include the supporting results from the reports described above.

7.9 Independent verification

Depending on the details of the proposed development and the proximity of planned or future metro infrastructure, Sydney Metro may request that independent verification of the engineering analysis and impact assessment be carried out. If required, this independent verification must be arranged by the developer.

The independent verification must be carried out by a Competent Person from an organisation that is independent of the organisation that prepared the engineering analysis. The independent verification organisation will be subject to the approval of Sydney Metro.

The independent verification must include detailed engineering proof checking of all aspects of the engineering analysis and impact assessment including any proposed temporary works.

The independent verification organisation must prepare a report that describes its verification activities and includes certification that the proposed development will produce no unacceptable adverse effects on existing metro infrastructure. The

independent assessment report must be submitted to Sydney Metro with the engineering assessment report.

8 Construction requirements

8.1 General

All metro property must be fully protected during construction of the development and all site work (including clearances to metro tracks and protection reserves) must comply with the requirements outlined in this guideline document, as well as other relevant TfNSW standards relating to air space developments, external developments and tunnels, and safe working requirements.

All construction carried out on metro property must comply with the requirement of the relevant authorities and legislation including workplace health and safety (WHS) requirements and environmental requirements.

8.2 Dilapidation survey

If required by Sydney Metro before construction of the development can commence and an occupation certificate can be issued, a joint inspection of the existing metro near the proposed development may be requested by Sydney Metro. If requested the survey must be carried out by representatives of the developer and Sydney Metro. The existing condition of the metro infrastructure must be agreed and recorded. Additional joint inspections may be required during construction.

The extent of metro infrastructure that must be surveyed will be determined by Sydney Metro.

Detailed dilapidation reports must be submitted to Sydney Metro describing conditions before commencement of the works and after completion of the works.

The dilapidation report must include the following as a minimum:

- details of existing visible defects
- dimensions of existing visible cracks
- photos of visible defects with labels that indicate their locations and
- signs of wetness, staining and seepage from existing visible defects.

This inspection must establish the extent of any existing exposed visible cracks, such as those observed on the surface of concrete linings which support metro tunnels and caverns. These visible cracks must be suitably marked and identified to enable any deterioration to be monitored.

8.3 Risk assessments

Prior to commencing any works, risk assessment reports issued in support of development applications must be updated based on the detailed design at construction. The updated risk assessment report must consider any modifications to the design and the impact these may have on identified risks.

Safe Work Method Statements (SWMS)s must also be prepared that include, as a minimum, the following:

- detailed work methods including the incorporation of the controls as stated in the risk assessment plan and
- an emergency response plan.

The developer must submit the SWMS and updated risk assessment report to Sydney Metro for approval.

8.4 Demolition works and construction impacts

The demolition of any existing buildings or basements must be planned in such a way that no adverse risk is imposed on existing metro underground infrastructure. The developer is required to take every possible action to minimise imposed risks and is required to meet the costs of any protection of the metro infrastructure and any incurred disruption to metro rail operations.

The impact of any proposed underground demolition work (including de-stressing, unloading and resulting ground vibrations) must be assessed to ensure that there are no adverse effects on metro infrastructure. If large-scale demolition works are involved, then the developer is required to install a vibration monitoring system to monitor vibration levels near adjacent metro infrastructure.

Hydraulic rock breakers must not be used within five metres of any existing metro infrastructure without Sydney Metro approval.

The developer is required to arrange a structural investigation by appropriately qualified person to address the impacts.

Refer to T HR CI 12075 ST for further details.

8.5 Excavation works

The developer must submit the following for Sydney Metro's approval prior to commencing excavation for the development:

- an engineering assessment report which through the use of numerical modelling techniques (if required) demonstrates that the excavation will not cause any adverse effect on the underground metro infrastructure
- design reports that detail the shoring system that support excavations must be provided to Sydney Metro prior to construction and must include evidence of independent verification certification
- a detailed monitoring plan for ground deformation, tunnel convergence, stress, crack width monitoring, vibration monitoring and reporting protocol for each party
- risk assessment and contingency plans and
- detailed work method statements which include hold points at various stages of excavation and are linked to the acceptance of monitoring results.

The following requirements apply to excavation and piling works at construction:

- the position of underground metro infrastructure (outer walls) and protection reserves must be marked clearly on the ground for easy identification
- all piling contractors must be made aware of the existing underground metro infrastructure adjacent to construction site
- Sydney Metro must be informed of the progress of piling and excavation works on a regular basis and
- the results of field monitoring undertaken during excavation or piling works must be assessed by a suitably qualified person and reported to Sydney Metro at an agreed frequency.

Depending on the requirement identified in the Impact Assessment Report, Sydney Metro will require the presence of a Competent Person during excavation to carry out visual verifications of substrata, geological mapping and an assessment of monitoring results.

The developer must submit the monitoring results together with the geotechnical consultant's assessment to Sydney Metro at agreed frequencies and stages of construction. A Sydney Metro nominated observer may be involved with the monitoring.

Monitoring must continue until construction of the building structure or superstructure is complete. With prior agreement with Sydney Metro, monitoring frequencies may be decreased when the basement construction is completed. Monitoring must continue after the completion of the construction activities, until no changes occur in three consecutive monitoring cycles. Sydney Metro must be informed before termination of the monitoring activities.

8.6 Noise and vibration

The effects of noise and vibration on existing metro infrastructure and on the proposed development must be considered as part of the design and construction of proposed developments.

The construction of the proposed development must be carried out such that the effects of noise and vibration on nearby metro structures and facilities are minimised.

During development construction vibration monitoring may be required of the underground metro support, such as concrete linings. Refer to section 9.3 for information regarding vibration Alert and Alarm levels.

If the vibration levels exceed tolerable limits, then the developer must modify the construction methodology in such a way that the vibration limits are satisfied.

8.7 Contaminants and hazardous materials

The storage of potential contaminants and hazardous materials within the protection reserves will be subject to Sydney Metro approval. A risk assessment and appropriate safety precautions must be provided for storage of potential contaminants within any of the protection reserves, where there is potential for the contaminants to migrate to or come in contact with the metro underground infrastructure. This assessment must address the potential impact on the durability of concrete, grout, resin, steel, waterproofing gaskets and membranes and any other material forming the permanent works of the metro underground infrastructure.

The storage of potential contaminants and hazardous materials may be permitted if the results from the risk assessment demonstrate that the risk to the metro underground infrastructure can be appropriately managed.

9 Performance requirements

The design and construction of the development must be carried out with full recognition of the potential effects that could be imposed on the performance of the existing metro or the feasibility of the future metro. As an overarching principle the development must not affect the stability and integrity of the metro infrastructure and its safe operation. Broadly, the developer must ensure that the development and its construction do not adversely affect the performance of metro infrastructure in respect of the following:

- amenity
- aesthetics
- structural integrity
- durability
- function
- user/customer benefits
- safety during construction and operation and
- environmental performance.

It should be noted that throughout the developer's activities, the developer must monitor the actual effects of construction against design predictions and in accordance with the project-specific construction phase monitoring requirements.

Aspects of the development and its construction which could potentially adversely affect the metro infrastructure include the following:

- loading or unloading from the development
- ground deformation resulting from excavations and external loading
- induced vibrations during construction and operation
- ground borne noise impacts
- electrolysis from earth leakage currents
- discharge of stormwater from the development
- changes to groundwater levels affecting design assumptions
- loss of support to any underground metro facility (including rockbolts and anchors)
- temporary structures and
- load from anchors.

This section details the design and performance requirements that must be adhered to by the developer in order to address these issues. Reference should also be made to documents listed in Section 3 of this guideline.

9.1 Structural integrity

Development induced load and displacements must not have any short or long term adverse effects on the support structure or support system of metro infrastructure.

The construction of development structures over and/or adjacent to metro underground structures must be suitably designed to take into account the presence

of the existing metro infrastructure and future construction of metro infrastructure. Construction work methods must be developed as part of the design process.

The effects on metro support elements and other metro infrastructure at any stage of the whole life cycle of the development must be assessed to ensure that the works must remain compliant with relevant standards. These structural elements include, but not limited to:

- concrete (precast, in-situ or sprayed) linings
- load bearing columns, walls, slabs and roof beams
- rock pillar supports
- permanent rock anchors (or bolts)
- track slabs
- drainage structure
- shafts and
- underground stations.

Of particular interest is the possibility of increases in structural actions, such as axial loading and flexural bending, to support elements and structural linings of metro underground infrastructure, as a consequence of development loading.

9.1.1 Imposed loading

Any temporary or permanent works adjacent to the metro could be subject to the influence of train loading and as such they will need to be assessed in accordance with AS 5100 for live load surcharge. Parts of the development that could be affected must be designed to comply with T HR CI 12070 ST Miscellaneous Structures, T HR CI 12075 ST Airspace Developments and T HR CI 12080 ST External Developments.

Permanent works adjacent to metro infrastructure must take into account the design actions resulting from any proposed future metro construction. Sydney Metro should be contacted to confirm the location of planned future metro infrastructure.

9.1.2 Induced movement

Displacement of metro infrastructure as induced by the development must not affect the operational functionality and durability of the metro infrastructure. Also, the developer must consider the possibility that future metro construction may induce movement on the development.

The following displacement limits apply (refer to Appendix A for infrastructure details):

- For metro cast in-situ cavern and tunnel concrete linings, the allowable total movement in any direction is 10 mm and differential movement in any plane is 10 mm or 1:2000, whichever is less.
- For metro running tunnels that are supported by a precast concrete segmental lining, the allowable total movement in any direction is 10 mm and differential movement in any plane is 10 mm or 1:2000 whichever is less. The main purpose of these limits is to ensure that the watertightness of the lining through joints is not compromised as consequence of gasket decompression and/or damage.
- Shear movement across rock bedding as induced by the development activities must not exceed 10 mm where permanent rock bolts, installed as part of the metro infrastructure support system, intersect these bedding planes.

Any development activity, whether beneath or adjacent to contained metro tracks, that has the potential to cause track displacement must comply with the requirements of SPC 207 Track Monitoring Requirements for Undertrack Excavation. The track must be monitored and managed in accordance with the requirements stated in SPC 207 for monitoring, notification and intervention levels and emergency procedures.

9.1.3 Induced cracking

The extent of dilapidation surveys undertaken (and described previously in this guideline document) of metro infrastructure must be determined based on predictions of deformation and the load influence zone imposed by the proposed development. The survey must establish the extent of any existing visible cracks, where the extent of the cracks refers to their apparent length and apparent width. Where present these cracks must be suitably marked and identified to enable any deterioration during and after the construction to be monitored.

The following technical criteria must be met regarding visible cracking, including the presence of pre-existing visible cracks on the face of metro concrete structures:

- No new visible cracking of metro concrete structures is allowed to be induced by the development and its construction. Compliance with this requirement must be confirmed by performing impact assessments during the design stage.
- Any existing visible cracks must not increase by more than 0.2 mm in width or increase in length by more than 300 mm in total over the stages of development construction.
- The configuration of visible cracks must not result in concrete spalling or affect the safe operation of the metro system.
- In the event that water seepage is observed (previously absent) through the visible cracks during development construction then Sydney Metro will, on behalf of the developer, seal the visible cracks by grouting the visible cracks until this seepage ceases.
- Engineering analysis and assessment undertaken for the development (as discussed within this guideline document) must take into account the presence of existing visible cracks of metro infrastructure.

The monitoring of existing visible cracks and critical structural elements during construction must form part of the overall monitoring plan.

9.2 Excavation and groundwater

Excavation for the development and all associated retaining works (along with other ground disturbance works associated with the proposed development) must not affect the safety and operational integrity of the metro or cause the destabilisation of metro infrastructure. The methods of excavation employed are of particular relevance in this regard, especially where methods employ chiselling, percussive pile driving or similar methods. Importantly, explosives must not be used for the splitting and removal of rock and excavation.

Typical issues associated with excavation works include slippage, slumping, creation of fissures or cracks, rock or earth falls, exacerbated ground movements, water inflows, cracking of supporting structural elements and in extreme cases structural failure. Excavation works must be undertaken in a manner that minimises the risk of such occurrences.

Sections of temporary shoring installed to support excavations for the development must have a minimum service life of 3 years, if their stability has the potential to affect

metro infrastructure. Shoring systems must be designed by a competent person and independently verified by a qualified person as approved by Sydney Metro unless Sydney Metro advises otherwise in writing. Allowance should be provided for minimum unplanned excavation in accordance with CIRIA C760 Guidance on Embedded Retaining Wall Design, 2017.

Ground anchors are not allowed within the first reserve zone. Any ground anchors within the second reserve must be assessed for their effect on metro underground infrastructure. Anchors must not be tested to the extent that the testing loads applied could cause collapse or failure, or both, in the surrounding soil and rock structure.

Assessment of metro infrastructure from development excavation must also consider the loading that cranes (including their foundation anchorage) will impose within the excavation on metro infrastructure.

Construction near metro underground infrastructure can also impact the local groundwater regime. These impacts have the potential to cause adverse loading of the infrastructure, not contemplated and thus designed for over the design life of the metro. Critically, watertightness and waterproofing must not be adversely affected or damaged.

The developer must carry out an engineering assessment of the impact of any changes to the groundwater regime that the development could cause. Issues of concern that have the potential to impact on metro infrastructure include the following:

- The development and its construction that could create a water barrier that dams groundwater flow above the metro underground infrastructure.
- Any groundwater ingress into excavations associated with the development that could cause dewatering of the local water table. Importantly, dewatering must not commence without prior approval from Sydney Metro.

Consequently, the engineering assessment must address any temporary dewatering (at any stage of the development) to demonstrate that effects on underground metro infrastructure are acceptable.

9.3 Noise and vibration

The noise from construction and rail operation must be considered against statutory and project noise vibration limit requirements. Sydney Metro does not accept liability for the generation of noise and vibration from normal railway operations (including track maintenance), or for its transmission into developments above or adjacent to rail tunnels.

When designing developments above or adjacent to rail tunnels (existing or planned), consideration must be given to operational and construction vibration; as well as ground or structure borne noise emissions in accordance with Developments Near Rail Corridor and Busy Roads – Interim Guideline, Department of Planning, NSW Government 2008 and T HR CI 12051 ST Developments Near Rail Tunnels.

Consideration should be given to whether Clause 87 of the Infrastructure SEPP is triggered for impacts of rail noise or vibration on non-rail development. If triggered measures should be outlined to ensure consistency with the requirements.

9.3.1 Considerations during development construction

In planning development construction, the following requirements apply for vibration impacts on structures and assets.

Structural damage (buildings)

Sydney Metro refers to Australian Standard AS2187: Part2-2006 'Explosives – Storage and Use – Part 2: Use of Explosives', which recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2 – 1993 'Evaluation and measurement for vibration in buildings Part 2' as they "are applicable to Australian conditions".

The Standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated.

The recommended limits for transient vibration to ensure minimal risk of cosmetic damage to reinforced or framed structures and industrial and heavy commercial buildings apply to Sydney Metro infrastructure.

Sources of vibration that are considered in the standard include demolition, piling, ground treatments (e.g. compaction), construction equipment, tunnelling and industrial machinery.

Continuous rock-breaking/hammering and sheet piling, vibratory rollers, excavators and the like can give rise to dynamic magnification due to resonance.

An adjusted peak particle component velocity (PPV) of 20 mm/s at 4 Hz and above applies to any development that occurs within 25 m horizontally from first reserve of Sydney Metro infrastructure as a conservative vibration damage screening level. An Alert level of 15 mm/s shall apply for monitoring and management purposes.

Atypical construction methods should be assessed on a case-by-case basis with reference to the Standards.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) would be compared with the guidance vibration velocity limits.

Buried services

Buried structures and utilities such as gas pipelines and fibre optic cables are to be assessed on a case-by-case basis.

An acoustic consultant shall be engaged by the construction contractor and would liaise with the structure of utility's owner in order to determine acceptable vibration levels.

Vibration-sensitive equipment

Where it is has been identified that vibration sensitive scientific instruments are likely to be in use inside Sydney Metro premises, objectives for the satisfactory operation of the instrument would be sourced from manufacturer's data.

It may be beneficial for the project if baseline vibration measurements are carried out at the building where vibration-sensitive equipment is located. These baseline measurements will determine what existing ambient vibration levels are. The site-specific equipment criteria would need to be agreed with the occupant/users of the equipment as well as Sydney Metro.

9.3.2 Considerations for operational noise and vibration impacts

The developer is required to obtain accurate information to assess and appropriately mitigate operational noise and vibration impacts from rail operations. The developer is required to obtain all available information which will enable a thorough assessment of actual or potential rail noise and vibration which could affect the development site. This includes but is not limited to:

- number of train events expected in a 15hr-Day (7am to 10pm) and 9hr-Night (10pm to 7am) period, in the typical busiest weekday. This information may be obtained from the relevant Sydney Metro Environmental Impact Statement (EIS) or for operational Sydney Metro sites from the Operational Noise and Vibration Review (available from sydneymetro.info). The assessment should include future operations as well as existing operations.
- the event noise and vibration levels from each train. This information may be obtained from the relevant Sydney Metro EIS or for operational Sydney Metro sites from the Operational Noise and Vibration Review (available from sydneymetro.info), but supplementary information should be obtained from measurements at the existing rail tunnel (if it is operational), or at a similar rail tunnel (e.g. other tunnel locations in the Sydney Metro network).
- location of noise/vibration sensitive Sydney Metro equipment. This information may be obtained from the relevant Sydney Metro EIS or for operational Sydney Metro sites from the Operational Noise and Vibration Review (available from sydneymetro.info). It will include stations where staff, tenants and customers are to be protected from noise and vibration impacts.
- location of noise/vibration generating metro infrastructure. This information may be obtained from the relevant Sydney Metro EIS or for operational Sydney Metro sites from the Operational Noise and Vibration Review (available from sydneymetro.info). For operational Sydney Metro sites, a site survey and inspection would identify the location and type of noise and vibration generating items, including substations and railway stations with outdoor public address systems. For Sydney Metro corridors in development where an EIS is not available the developer will need to make informed assumptions. Government announcements about projects may assist the developer in obtaining high level information about the number of trains to expect at maximum capacity and indicative location of tunnels and stations.
- for construction assessments of impacts on sensitive receivers (for example, staff in stations), the Interim Construction Noise Guidelines (2009) shall apply for operational noise impacts, the assessment shall reference the Noise Policy for Industry (2017) and any other guidelines or policies which relate to the specific development.

9.4 Stray currents and electrolysis

When designing developments above or adjacent to underground metro infrastructure consideration must be given to operational stray currents that may be present. The risk assessment must also consider the potential presence of stray currents.

Sydney Metro does not accept liability for the generation of stray currents from an operating electrified railway.

The potential effects of stray electrical currents and electrolysis in the electrified area of the metro network must be considered in accordance with T HR CI 12080 ST and T HR EL 12002 GU during the design of the development.

A suitable test program must be established during the early design phase to quantify a stray current signature for the development site prior to undertaking enabling works. Suitable stray current mitigation strategies must be integrated into the design of the development.

Following construction, stray current testing must be carried out to verify that electrolysis mitigation strategies are proven to be effective, which includes undertaking a comparison with the pre-development stray current signature. This

information must also be used to establish maintenance baselines for the life of the development.

10 Monitoring

Monitoring is undertaken to validate design assumptions for developments and to quantify that impacts being generated are within acceptable limits.

The structural performance of the metro underground infrastructure must be monitored as necessary during construction of the proposed development to verify predicted displacements, stress levels in structural elements and vibration levels. The monitoring regime must be developed by a qualified tunnel/geotechnical engineering consultant.

Monitoring plans must be submitted to Sydney Metro for review and approval prior to the commencement of construction. The Monitoring plan must include but is not limited to:

- All vibration-generating works from demolition through excavation and landscaping (e.g. vibratory rollers) should be considered.
- Activities should be nominated which require vibration/crack/movement monitoring and where the monitoring locations will take place.
- A response regime outlining the process to manage “Alert” (coming close to the limit) and “Alarm” (equal to or over the limit) and a contingency plan/s to prevent damage to Sydney Metro infrastructure. This should include the process for how the developer’s consultant will assess the monitoring results continually and submit monitoring assessment reports to Sydney Metro for review.

The tables below indicate the circumstances where various types of monitoring are required. These requirements must be provided as a minimum.

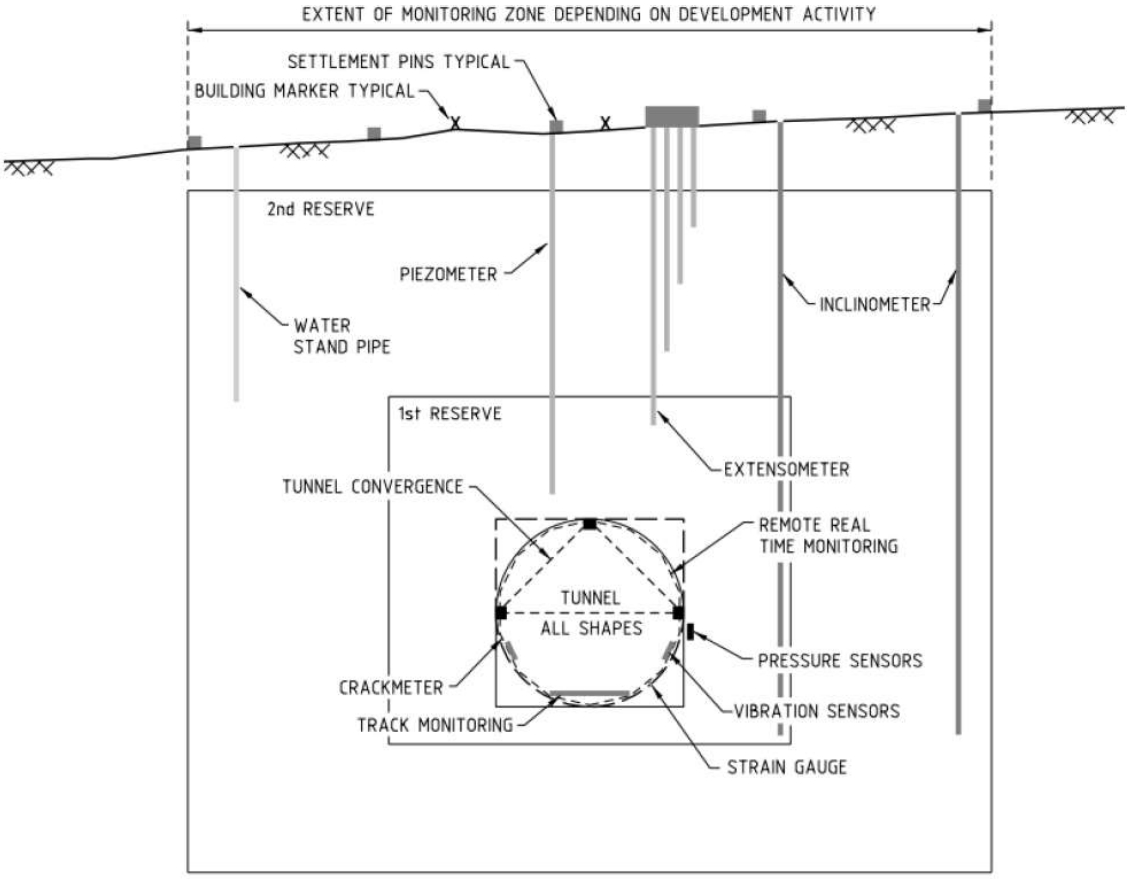
Figure 10.1 provides typical extents that monitoring must be provided in each case.

Table 10.1 Minimum monitoring requirement for development activities near rail tunnels – In ground

Type of instrument	Deep open excavations	Foundation works – shallow or deep	New underground excavation or new tunnel
Inclinometer	Yes	Yes	Yes
Water standpipe	If required by Sydney Metro	If required by Sydney Metro	If required by Sydney Metro
Piezometer	Yes	If required by Sydney Metro	Yes
Extensometer	Yes	If required by Sydney Metro	Yes
Ground settlement markers	Yes	Yes	Yes
Building settlement markers	Yes	Yes	Yes

Table 10.2 Minimum monitoring requirement for development activities near rail tunnels – within existing rail tunnels

Type of instrument	Deep open excavations	Foundation works – shallow or deep	New underground excavation or new tunnel
Tunnel convergence	Yes	Yes	Yes
Tiltmeter	Yes	If required by Sydney Metro	Yes
Crackmeter	Yes	Yes	Yes
Vibration sensor	Yes	Yes	Yes
Rail track monitoring (distortion)	Yes	If required by Sydney Metro	Yes
Strain gauges in lining	If required by Sydney Metro	If required by Sydney Metro	If required by Sydney Metro
Pressure cells in lining	If required by Sydney Metro	If required by Sydney Metro	If required by Sydney Metro
Real time monitoring such as EL beams, optical prism laser scanning	If required by Sydney Metro	If required by Sydney Metro	If required by Sydney Metro



Note: instrumentation not to intrude into the first reserve unless agreed by Sydney Metro

Figure 10.1 Typical instrumentation layout

During construction of the Sydney Metro infrastructure it may not be feasible to grant access to tunnels for the purpose of installing monitoring equipment. If access to Sydney Metro infrastructure is not granted, then the developer and Sydney Metro shall determine an alternative monitoring location which can be used to represent or derive conditions in the tunnel.

Baseline data for each monitoring parameter must be established before commencement of development construction. The developer must provide as a minimum, three sets of monitoring data to establish a baseline prior to excavation.

The equipment that is used for remote monitoring (particularly for alarm or warning systems) must have proven reliability in similar applications.

Any alarm or warning system should have a visual and audible alarm system to activate and to stop all works as necessary and notify relevant personnel, such as the site manager, geotechnical consultant and nominated Sydney Metro representative.

Depending on the project complexity, physical inspections of existing metro infrastructure may be required on a regular basis during critical stages of construction. If necessary, these inspections should be undertaken jointly with the developer and Sydney Metro representative (including a representative from the metro operator as necessary).

11 Sydney Metro contact and information for developers

Sydney Metro has a dedicated email address for queries relating to development of land in or near Sydney Metro infrastructure. The contact details and information points are outlined in Table 11.1 below.

Table 11.1 Sydney Metro contact and information points

Activity	Detail
Sydney Metro email address	SydneyMetroCorridorProtection@transport.nsw.gov.au
Sydney Metro website	Sydneymetro.info
NSW Major Projects including Sydney Metro planning documents	https://www.planningportal.nsw.gov.au/major-projects

Appendix A – Sydney Metro infrastructure details

Metro North West Line

Sydney's Metro North West Line is the first dedicated metro line to be constructed for the metro and extends for 36 kms from Chatswood through to the north west. The Metro North West Line incorporates 13 km of track and rail infrastructure between Epping and Chatswood that has been modified and segregated to form part of the Sydney Metro.

This Guideline is relevant for the 28 km tunnel section of the Metro North West Line from Chatswood to Bella Vista and Metro underground infrastructure in other locations.

The following are key features of the Metro North West Line.

Epping to Tallawong

- 23 km of new track and rail infrastructure delivered through approximately 15 km of twin tunnels and 4 km of elevated structure, with the remaining 3 km of rail infrastructure provided at-grade with some sections in cutting.
- Eight new stations are located at Cherrybrook, Castle Hill, Hills Showground, Norwest, Bella Vista, Kellyville, Rouse Hill and Tallawong.
- The stations at Castle Hill, Showground and Norwest are contained within cut and cover concrete boxes, whilst stations at Cherrybrook and Bella Vista follow an open cut station configuration. Stations at Kellyville and Rouse Hill are elevated. Tallawong station is the only station that is at grade.
- The approximately 15 km of twin running tunnels have an internal diameter of approximately 6.2 m and an external diameter of approximately 7.0 m and have been excavated predominantly through shale and sandstone mostly using tunnel boring machines (TBMs). The tunnels are supported using a precast concrete segmental lining except for the mined tunnels between the Epping Service Facility and Epping Station where in-situ concrete has been used.

- There are 61 cross passages between running tunnels at approximately 240m centres. These cross passages have been mined and are supported using a permanent cast in-situ concrete lining.
- There are services shafts at Epping and Cheltenham area which are cut and cover structures. These shafts are supported using permanent cast in-situ concrete lining.
- Other structures includes nozzle enlargement at the ends of stations at Castle Hill, Hills Showground and Norwest. These have been mined and are supported using a permanent cast in-situ concrete lining.
- A 159 m long mined crossover cavern is immediately east of Castle Hill Station. The cavern has a span of 21 m wide and has a height that varies from 14 m to 17 m. The cavern is supported by a permanent cast in-situ concrete lining.

Epping to Chatswood (Existing ECRL)

- The 13 km length of existing track and rail infrastructure between Epping and Chatswood, previously known as the Epping to Chatswood Rail Link (ECRL), has been converted to form part of the Sydney Metro system.
- The underground infrastructure comprises twin single track tunnels with an excavation diameter of 7.2 m and four underground stations completed in 2008.
- The underground station structures at North Ryde, Macquarie Park and Macquarie University consist of large span platform caverns typically of about 19 m in span and 13 m in height, together with concourse caverns, access tunnels, adits, shaft and associated plant and equipment rooms. The station caverns have been excavated in mainly competent, horizontally bedded sandstone and shales permanently supported using composite linings consisting of rock reinforcement in the form of rock bolts and shotcrete.
- Epping Station comprises two platform caverns connected by cross passages and accessed through escalator tunnels, lift shafts and two large plant room ventilation shafts. This station is located beneath the existing surface station.
- The running tunnels were excavated by rock tunnel boring machines (TBMs) and underground stations and associated structures were excavated using roadheaders, rock hammers and rock saws. The running tunnel support consists of temporary primary support using rock bolts and shotcrete, and final support using unreinforced cast-in-situ concrete lining, nominally 200 mm thick. A section of the running tunnels was lined with shotcrete for construction reasons. The invert of the tunnel consists of precast reinforced segments with a floating track slab.

Sydney Metro – City & Southwest

The Sydney Metro City & Southwest project includes a new 30km metro line extending metro rail from the end of the Metro North West Line at Chatswood, under Sydney Harbour, through new CBD stations and southwest to Bankstown.

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.

A future extension of Sydney Metro - City & Southwest is proposed from Bankstown to Liverpool.

This Guideline is relevant for the underground sections from Chatswood to Sydenham and Metro underground infrastructure in other locations.

The following are key features of this planned section of the metro system.

Sydney Metro – City

- The city section consists of a short section of surface track from Chatswood Station to the dive and portal structure then underground infrastructure that extends under St Leonards, Crows Nest, North Sydney and Sydney Harbour and then beneath the Sydney CBD to Central and Waterloo and through to Sydenham where the metro comes to the surface at a portal and dive structure at Marrickville.
- New stations will be located at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo. New underground metro platforms will be built at Central Station.
- Twin running tunnels of approximately 14 km in length (portal to portal) were excavated using TBMs and supported using a precast concrete segmental lining to create a watertight environment. The tunnels predominantly align through siltstone and sandstone, except below the Sydney Harbour where TBM tunnelling was required through marine ground sediments for a length of around 170 m.

- A total of 57 mined cross passages are located between running tunnels at regular intervals, with spacing of around 240 m centres. The cross passages were excavated using mechanical methods and supported using a tanked permanent lining, formed using cast in-situ concrete. A services shaft connects with a cross passage at Artarmon. The shaft is supported by permanent cast in-situ concrete lining.
- Waterloo Station, Barangaroo Station, Crows Nest Station and the underground metro platforms at Central Station are cut and cover box structures that contain island platforms. The station is typically 24 m in width and range from 200 m to 215 m in length. Pitt Street Station and Martin Place Station have binocular platform caverns that connect with two entrance and services shaft structures, whilst Victoria Cross Station has a single span cavern with an island platform, which also connects with two entrance and services shaft structures.
- At Martin Place Station and Pitt Street Station the platform caverns range in length from 193 m to 246 m and have spans of approximately 12 m with an approximate height of 11 m. At the Victoria Cross Station, the platform cavern is approximately 174 m in length and has a span of 23 m with a height of 13 m. All the caverns and adits were excavated using mechanical methods and supported using a tanked permanent lining, formed using cast in-situ concrete.
- A mined cross over cavern which is 226 m in length was constructed immediately north of Barangaroo Station. This cavern has an internal span of 23 m wide and a height that varies from 14 m to 17 m. The cavern will be supported using a tanked cast in-situ concrete lining.
- Mined tunnel enlargements that are up to around 17 m in length are provided to house tunnel ventilation equipment at either end of the Victoria Cross Station caverns, the northern end of the rail crossover at Barangaroo, the southern end of Waterloo Station and at the northern end of Crows Nest Station. The nozzle enlargements were excavated using mechanical methods and supported using a tanked permanent lining, formed using cast in-situ concrete.
- Dive structures and portal structures are located at Marrickville and Chatswood. A stabling yard is located at the Marrickville portal site.

Sydney Metro – Southwest (all infrastructure is at grade or elevated)

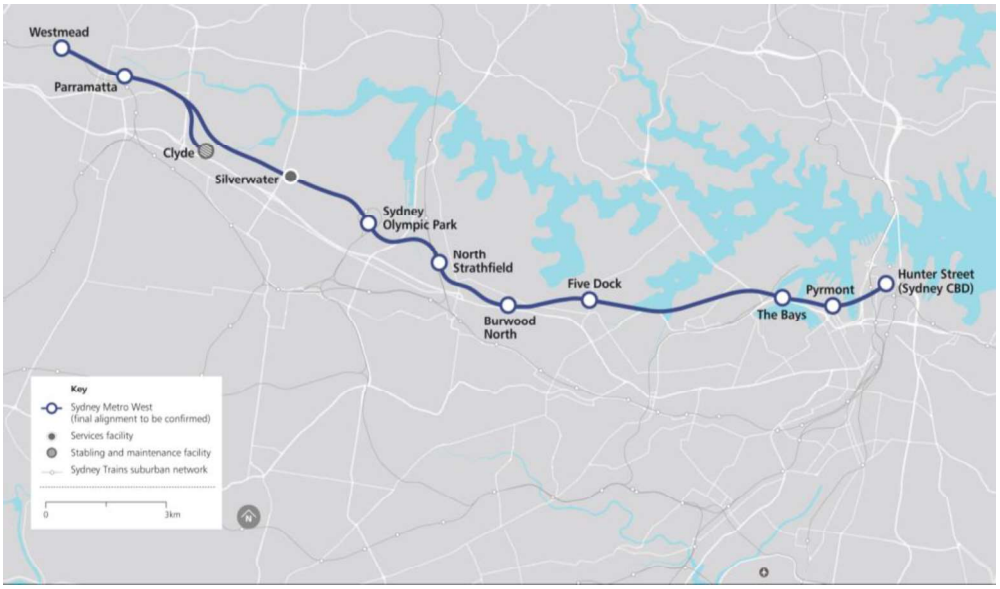
- This section of the metro is currently part of the T3 Bankstown Line, but will be converted to metro standards from Sydenham to Bankstown.
- The extension of Sydney Metro in the south west will involve upgrading the existing Sydney Trains operated T3 Bankstown Line and associated rail corridor from just beyond Sydenham Station through to Bankstown Station to enable the conversion to Sydney Metro operations.
- Eleven existing stations at Sydenham, Marrickville, Dulwich Hill, Hurlstone Park, Canterbury, Campsie, Belmore, Lakemba, Wiley Park, Punchbowl and Bankstown will be upgraded to improve accessibility for customers and meet the standards required for metro operations.
- Reference should be made to the Sydney Metro At Grade and Elevated Sections Corridor Protection Guidelines for protection requirements regarding Sydney Metro – Southwest.

Sydney Metro – West

The Sydney Metro - West project will support a growing city and deliver world-class metro services to more communities. This new underground railway will connect Greater Parramatta and the Sydney CBD. This once-in-a-century infrastructure investment will transform Sydney for generations to come, doubling rail capacity between the two CBDs, linking new communities to rail services and supporting employment growth and housing supply.

The locations of nine proposed metro stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street in the Sydney CBD. Further planning and design work is underway to determine the location of new metro stations at Pyrmont and in the Sydney CBD.

This Guideline is relevant for the entire Sydney Metro West alignment as it is all underground.



The following are currently key features of this planned section of the metro system.

Westmead to The Bays

- It is anticipated that tunnelling would occur from two Tunnel boring machine (TBM) launch and support sites at Westmead metro station construction site and The Bays Station construction site. Two TBMs would be launched from each of these construction sites to be dismantled and retrieved at the Sydney Olympic Park metro station construction site.
- Twin running tunnels more than 20 km in length would be excavated using TBMs and supported using a precast concrete segmental lining to create a watertight environment. The tunnels would have a circular cross-section with an internal lined diameter of about six metres and an excavated diameter of about seven metres.
- Cross passages would be provided between running tunnels at regular intervals, with a maximum spacing of around 240 m. The cross passages will be excavated

using roadheaders and rock hammers and supported using a watertight permanent lining, formed using cast insitu concrete.

- Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North and The Bays would be cut-and-cover stations.
- Five Dock would be constructed as a binocular mined cavern station.
- A dive structure and tunnel portal would be constructed at Rosehill within the Clyde stabling and maintenance construction site to provide for a future connection from the Clyde stabling and maintenance facility to the mainline tunnels. Underground connecting tunnels would be excavated by road header from the tunnel portal to the mainline tunnels.

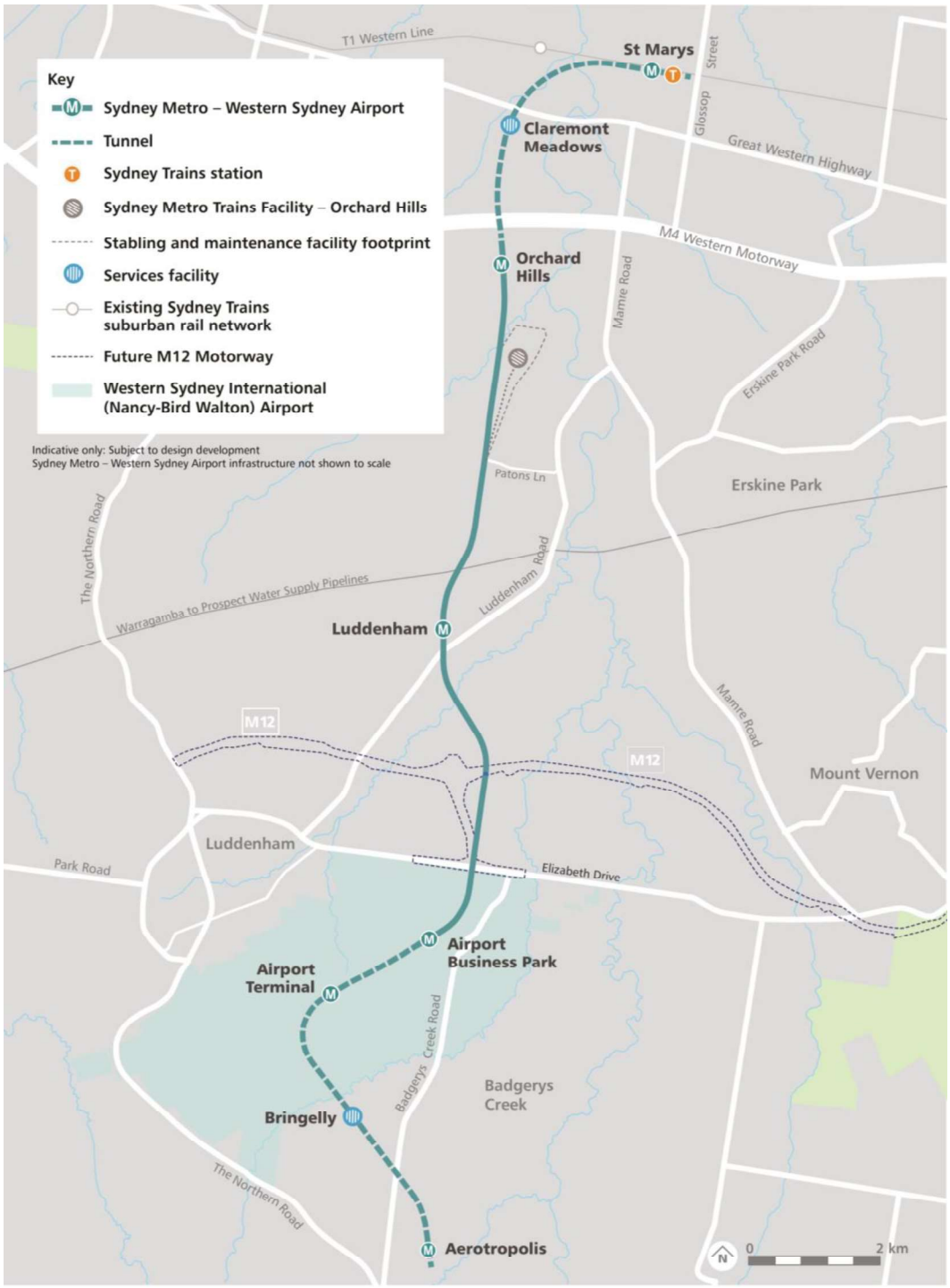
Sydney Metro – Western Sydney Airport

Sydney Metro - Western Sydney Airport will extend from St Marys in the north connecting to stations at Orchard Hills, Luddenham, Airport Business Park, Airport Terminal and the Western Sydney Aerotropolis (the area proposed to be named Bradfield). The new metro railway line would include a combination of tunnel, surface and viaduct sections.

These Guidelines are relevant for the underground sections as shown below and Metro underground infrastructure in other locations.

The following are key features of this planned section of the Metro system.

- The new metro railway line would be approximately 23 kms in length.
- Twin running tunnel excavation is likely to be carried out using TBMs and supported using a precast concrete segmental lining to create a watertight environment. The tunnels would have a circular cross-section with an internal lined diameter of about six metres and an excavated diameter of about seven metres.
- Cross passages will be provided between running tunnels at regular intervals, with a maximum spacing of around 240 m. The cross passages will be excavated using roadheaders and rock hammers and supported using a watertight permanent lining, formed using cast insitu concrete.
- A stabling and maintenance facility would be required and will be located in Orchard Hills to the south of Blaxland Creek and east of the proposed project alignment with access via Patons Lane.
- A dive structure and tunnel portal would be required at any location where the rail line transitions from below ground to surface and is subject to design development.


Key
Sydney Metro – Western Sydney Airport
Tunnel
Sydney Trains station
Sydney Metro Trains Facility – Orchard Hills
Stabling and maintenance facility footprint
Services facility
Existing Sydney Trains suburban rail network
Future M12 Motorway
Western Sydney International (Nancy-Bird Walton) Airport
Indicative only: Subject to design development
Sydney Metro – Western Sydney Airport infrastructure not shown to scale
T1 Western Line
St Marys
Street
Glossop
Great Western Highway
Claremont Meadows
M4 Western Motorway
Orchard Hills
Mamre Road
Erskine Park Road
Erskine Park
Patons Ln
The Northern Road
Warragamba to Prospect Water Supply Pipelines
Luddenham Road
Luddenham
M12
Mamre Road
Mount Vernon
Luddenham
Park Road
Elizabeth Drive
Airport Business Park
Airport Terminal
Badgerys Creek Road
Badgerys Creek
Bringelly
The Northern Road
Aerotropolis
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0
2 km

Proposed future extensions would connect Sydney Metro - Western Sydney Airport with Tallawong in the north west, Macarthur in the south and Westmead to the Northeast.

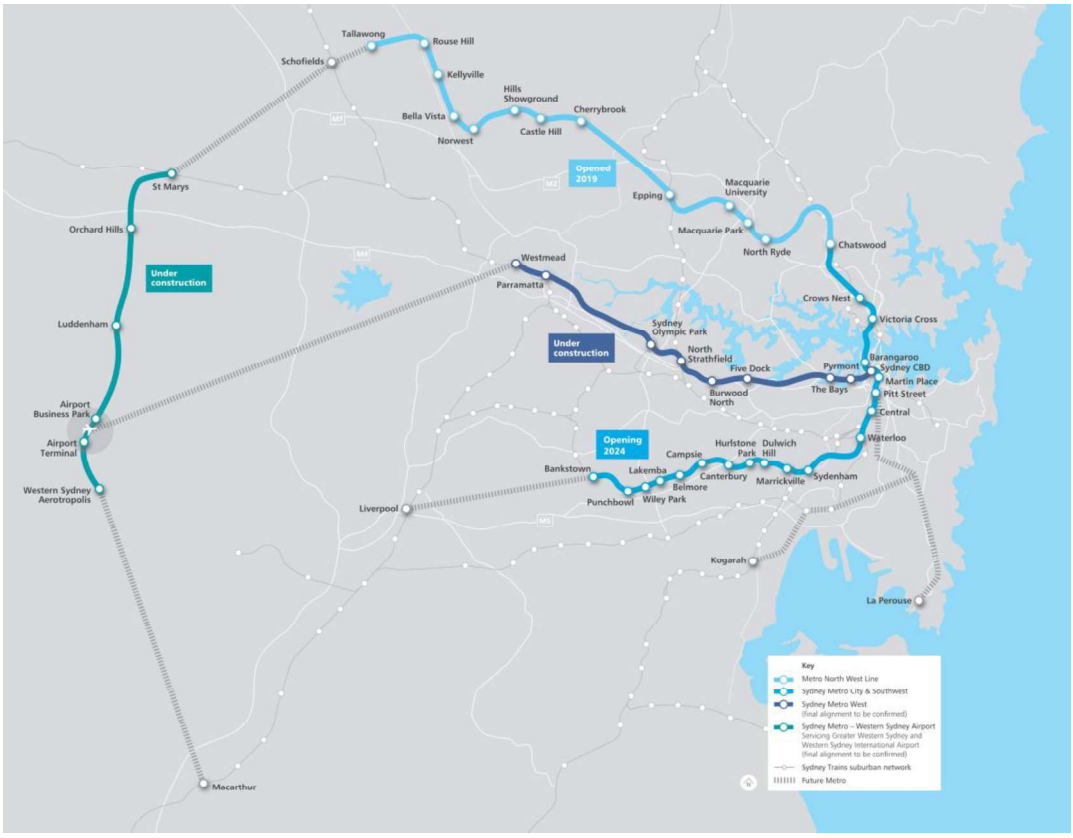


Figure A.1 Sydney Metro network – existing and future

It is intended that these Guidelines will be applicable to future Sydney Metro corridors located underground as they are announced. The Sydney Metro website [4]has further information about future Sydney Metro corridors.

[4] www.sydneymetro.info

Appendix B – Development application lodgement checklist

Where legislation requires referral or concurrence in relation to Sydney Metro rail corridors for proposed developments the developer must lodge the following documents as part of their development application package:

Item	Description	Check
Survey		
1.	Detailed survey plan prepared by a NSW registered surveyor, which accurately defines the boundaries between the development, the rail corridor (including first and second reserve), rail infrastructure and any Sydney Metro easements (including right of ways) or stratums, covenants and caveats.	☐
2.	Copy of the current land title including all easements (including rights of way), covenants and caveats.	☐
Architectural and Engineering Drawings		
3.	Geotechnical and structural reports/drawings that meet the Standards and requirements of Sydney Metro. The geotechnical report must be based on actual borehole testing conducted on the portion of the site that is closest to the rail corridor and include: • an analysis of the potential impact of demolition, excavation and operation of the development; • demolition and excavation induced vibration impacts on the rail corridor and rail infrastructure; and • potential loadings of the development on the rail corridor and rail infrastructure.	☐
4.	Structural design documentation for the development which demonstrates that: • the foundation design ensures that all loads from the development are transferred and induced effects on the underground rail infrastructure are acceptable to Sydney Metro; and • any deformation induced by bulk excavation will not have adverse impacts on the rail corridor, rail infrastructure or rail easements.	☐
5.	Cross sectional drawings showing the rail corridor (including first and second reserve), sub soil profile, proposed basement and/or foundation excavation and structural design of the development's sub-ground support adjacent to the rail corridor. All measurements contained within the cross sectional drawings must be verified by a registered surveyor.	☐
Engineering reports		
6.	Geotechnical investigation report with details in accordance with Section 7.1 of this guideline document.	☐

Item	Description	Check
7.	Impact assessment report with details in accordance with Section 7.2 of this guideline document.	☐
8.	Construction methodology for the development, including details of the structural support to be provided to the development and rail corridor during excavation and operation of the development. The construction methodology must not propose any rock anchors/bolts (whether temporary or permanent) within Sydney Metro's land or easements during construction or operation of the development.	☐
9.	Risk assessment report in accordance with Section 7.3 of this guideline document.	☐
10.	Noise, vibration and electrolysis studies and control measures in accordance with Section 7.6 if available otherwise these will be required prior to construction certificate.	☐
Additional Information (depending on impact assessment, or prior to construction)		
11.	Detailed ground and vibration monitoring plan including trigger levels, action plans and remedial measures, details of the instrumentation and baseline monitoring readings (refer to Section 10).	☐
12.	Construction schedule, construction management plan including sequence plan identifying impact.	☐
13.	Construction layout of equipment relative to metro infrastructure.	☐
14.	Final detailed Safe Work Method Statements (refer to Section 8).	☐
15.	Temporary safety plans and measures.	☐
16.	Temporary works plan, temporary access, vehicle, plant and equipment such as cranes (including mobile cranes) and stockpiling.	☐
17.	Rail related risk assessment and management plan.	☐
18.	List of machinery to be used during excavation/construction.	☐
19.	Groundwater control plans, environmental aspects including contamination.	☐
20.	Design loadings and certified drawings for construction related works that affect metro infrastructure.	☐
21.	Agreed interface activities plan with Sydney Metro.	☐
22.	If required by Sydney Metro, detailed dilapidation survey report in accordance with Section 7.4 of this guideline document.	☐
23.	If required by Sydney Metro, condition and dilapidation survey reports of all metro infrastructure affected by the development (refer to Section 8.2).	☐

Appendix C - Glossary

Abbreviation	Explanation
Alarm	Equal to or over the limit.
Alert	Coming close to the limit.
Competent Person	Refer to Appendix D for the process to determine a Competent Person. An individual who has the means and ability to undertake design, checking and verification activities to a recognised standard with the appropriate combination of technical knowledge, skills and relevant experience. A Competent Person will be required to provide a factual curriculum vitae, statement of qualifications, experience and supporting documentation that provides evidence of competence which will be subject to review and acceptance by Sydney Metro.
Designer	Competent Person responsible for undertaking a detailed design and analysis that demonstrates the effects of changed conditions on Sydney Metro Infrastructure arising as a consequence of a proposed Development. Competence definitions for Designer are set out in Appendix D.
Design Checker/Designer	Competent Person responsible for checking that a design is correct. Competent Person responsible for preparing a design solution to meet specified requirements. Competence definitions for Design Checker/Designers are set out in Appendix D.
Design Verifier/Design Checker	Competent Person responsible for independently verifying a discipline-specific design complies with relevant standards and is safe and fit for purpose. Competent individual responsible for checking that the design is correct. Competence definitions for Design Verifier/Design Checker are set out in Appendix D.
Developer	The person or organisation responsible for the new construction and/or alteration works.
Development	The term “Development” in this document means new construction and/or alteration works that change the existing asset configuration and could affect existing or future underground metro infrastructure. These works may include demolitions, alterations of existing structures, basements, foundations, anchors, temporary and permanent groundwater drawdown, pipe jacking, site investigations, tunnel and retaining wall constructions.

Abbreviation	Explanation
Infrastructure SEPP	State Environmental Planning Policy (Infrastructure) 2007
IV	Independent Verification
Metro underground infrastructure	For the purpose of assessing the effects of adjacent proposed developments, underground metro infrastructure includes, but is not limited to, the following: • running tunnels and interconnecting cross passages • station caverns and adits • crossover caverns • station boxes and shafts • nozzle enlargements • ventilation shafts and • dive and portal structures.
MIC SEPP	State Environmental Planning Policy (Major Infrastructure Corridors) 2020
NSW	New South Wales
Qualified Person	A person who is registered as a professional engineer or an architect or a surveyor under any law relating to the registration of engineers or architects or surveyors, as the case may be, and who under law is allowed to practice of carry on the business of a professional engineer or architect or a surveyor.
SEPP	State Environmental Planning Policy
Stratum	A right to use for a specific purpose land owned by others. The easement can be limited in either height or depth or width or all. This is also referred to as easement land.
Substratum	Land owned by Sydney Metro which is below surface level.
Support Zone	Zone where tunnel supports are located. Tunnel support can comprise permanent concrete linings, rockbolts and anchors, ground improvement measures such as grouted zones, rock pillar stich bolts, steel sets, lattice girders, brick lining, cast-in-situ lining, shotcrete lining and waterproof membranes.
SWMS	Safe Work Method Statement
TBM	Tunnel boring machine
Temporary works	Mobile cranes, scaffolding and other items which may exert temporary loading.

Abbreviation	Explanation
TfNSW	Transport for NSW
Underground Structures	Any engineering works below the surface of the ground
WSA SEPP	State Environmental Planning Policy (Western Sydney Airport) 2020

Appendix D – Competent Person

The tables below are based on the Sydney Metro Competency Management Plan and are provided to indicate the levels of competency that would be acceptable to Sydney Metro.

Minimum competency levels

Role	Straightforward /Low risk	Moderately complex Moderate risk	Complex/ High risk	Extremely complex/Very high risk
Engineering assurance	Level 3	Level 3	Level 4	Level 4
Design verifier	Level 2	Level 4	Level 4	Level 4
For Design Checker	Level 1	Level 2	Level 3	Level 3
Designer	Level 1	Level 2	Level 2	Level 3
Technical Manager	Level 2	Level 2	Level 2	Level 2

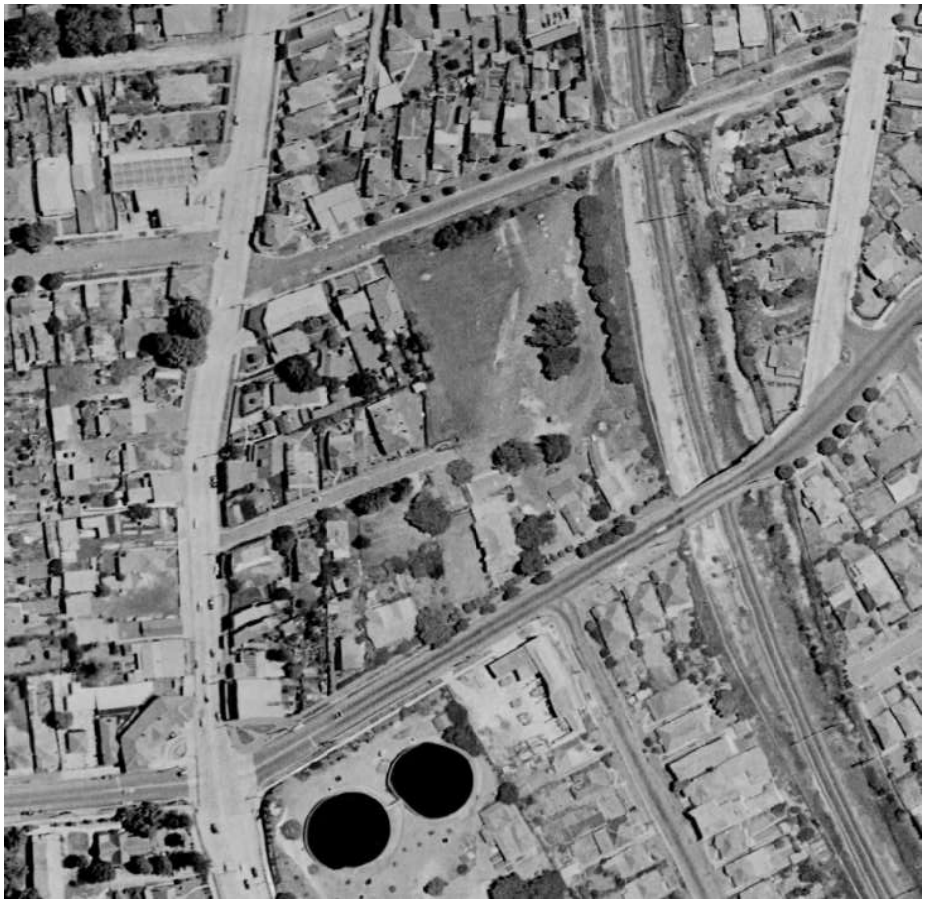
Levels of Complexity and Risk shall be approved by Sydney Metro.

Competence Levels

Four competence levels are identified from Level 1 – the most junior to Level 4 – the most experienced. Criteria and definition of each level is described below.

Level	Description
Level 1 – Qualified practitioner (supervised)	The Qualified Practitioner possesses basic knowledge of at least 80% of the systems within the practice area, including the principles around functional analysis, design, acceptance and application. They shall have received formal education and will work under the supervision of a designated Practitioner at a greater level of proficiency. Minimum requirements are discipline specific tertiary degree or equivalent Industry Certification within the Australian Qualifications Framework (AQF) and five years general work experience relevant to the discipline.
Level 2 – Experienced practitioner	The Experienced Practitioner possesses the basic knowledge of a Qualified Practitioner, with additional detailed knowledge and understanding of one or more practice areas. Knowledge must include safety implications and key functional aspects, failure mechanisms across multiple modes of operation and use, and lifecycle considerations such as maintainability, availability and reliability. They shall have had direct experience of applying their knowledge in a number of projects, preferably including in the rail sector. Minimum requirements are as a Qualified Practitioner, with additional five years' experience relevant to one or more practice areas, and evidence of relevant continued professional development equivalent to the requirements of Engineers Australia Continuing Professional Development (CPD) requirements or equivalent professional body.
Level 3 – Senior practitioner	The Senior Practitioner possesses the knowledge and experience of an Experienced Practitioner, with additional experience supervising or guiding less experienced practitioners, and/or a leadership role in the area(s) of practice. Minimum requirements are as an Experienced Practitioner with additional five years' experience relevant to one or more practice areas, with Chartered professional accreditation such as Chartered Professional Engineers (CPEng), as conferred by Engineering Australia or ability to demonstrable equivalent level of relevant and continued professional development.
Level 4 – Expert practitioner	The Expert Practitioner possesses the technical knowledge, experience and accreditation of a Senior Practitioner, with additional substantial experience applying domain knowledge across a range of comparable projects and a demonstrable record of successfully leading other engineers or practitioners, of managing technical risk, and leading safety in engineering practice in their area or specialisation. The Expert Practitioner will have established a recognised profile within a relevant industry association. Minimum requirements are as a Senior Practitioner with additional five years' experience relevant to one or more practice areas, and evidence of relevant, continued professional development or maintaining professional accreditation.

Appendix B
Historical Maps



Notes:

1.

JBS&G / Landcom

Sydney Metro Chatswood Dive DD

607 Pacific Highway

Residential and Recreational
1943 (left) and 1955 (right)

PSM5710	APPENDIX B.1

Notes:

1.

JBS&G / Landcom

Sydney Metro Chatswood Dive DD

607 Pacific Highway

Commercial / Industrial
1965 (left) and 2005 (right)

PSM5710	APPENDIX B.2

Notes:

1.

JBS&G / Landcom

Sydney Metro Chatswood Dive DD

607 Pacific Highway

Pre-Sydney Metro Works
2014 (left) to 2017 (right)

PSM5710	APPENDIX B.3

Notes:

1.

JBS&G / Landcom

Sydney Metro Chatswood Dive DD

607 Pacific Highway

Sydney Metro Construction Works
2017 (left) to 2023/24 (right)

PSM5710	APPENDIX B.4

Notes:

1.

JBS&G / Landcom

Sydney Metro Chatswood Dive DD

607 Pacific Highway

Post-Sydney Metro Construction Works
2024 (left) to 2025 / Current (right)

PSM5710	APPENDIX B.5

Appendix C
Site Investigation Collation

ID	Investigation Type	Date	Depth (m)	Easting	Northing	Elevation (mAHD)	Contractor	Reference
SRT_BH037	Borehole	12/7/2016	25.12	331657.9	6258012.0	104	DP/GA	1650773-041-R_Rev3 GDR
SRT_BH038	Borehole	6/7/2016	25.31	331666.6	6257987.4	103	DP/GA	1650773-041-R_Rev3 GDR
SRT_LD687	Large Diameter Auger Hole	19/10/2016	3.60	331621.7	6258086.8	103	DP/GA	1650773-041-R_Rev3 GDR
SRT_LD688	Large Diameter Auger Hole	19/10/2016	3.45	331529.9	6258121.1	102	DP/GA	1650773-041-R_Rev3 GDR
JCG-CPT-1201	CPT	7/8/2017	9.16	331621.8	6258059.7	104	GA	1784301-041-R-Rev0-GFR
JCG-CPT-1202	CPT	7/8/2017	13.50	331619.1	6258121.4	102	GA	1784301-041-R-Rev0-GFR
JCG-CPT-1203	CPT	7/8/2017	11.48	331610.4	6258164.7	102	GA	1784301-041-R-Rev0-GFR
SRT_BH025	Borehole	21/9/2015	25.00	331615.5	6258143.5	102	DP/GA	1784301-041-R-Rev0-GFR
SRT_BH026	Borehole	25/9/2015	29.96	331603.3	6258046.0	104	DP/GA	1784301-041-R-Rev0-GFR

Notes:

1.

JBS&G / Landcom

Sydney Metro Chatswood Dive DD

607 Pacific Highway

Site Investigation Collation

PSM5710 | APPENDIX C

BOREHOLE: SRT BH037

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 1 OF 4 REV: C

CLIENT: Transport for NSW
PROJECT: Sydney Metro City and Southwest
LOCATION: Mowbray Road Artarmon
PROJECT No PCS 00013/10701

COORDS: 331657.9 m E 6258012.0 m N MGA94 56
SURFACE RL: 104.40 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 25.12 m

DRILL RIG: Hanjin DB8
CONTRACTOR: Terratest
LOGGED: PGH / MM DATE: 12/7/16
CHECKED: HB DATE: 19/7/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
NDD			0	0.10 104.30				CI	FILL: Silty CLAY brown, with some glass fragments	W		FILL
									Sandy Silty CLAY medium to high plasticity, red-brown, with some iron cemented bands			RESIDUAL SOIL
ADT	M	GWNO	1		S14948 DS 1.30-1.50 m Rec = 200/200 mm S14949 U60 1.50-1.85 m Rec = 350/350 mm PP 1.85 m >600 kPa S14951 DS 2.00-2.50 m Rec = 500/500 mm					M	VSt	
			2									
			3		S14950 U60 3.00-3.35 m Rec = 350/350 mm PP 3.35 m >600 kPa S14952 DS 3.50-3.80 m Rec = 300/300 mm							
	H		4	4.00 100.40					SHALEY CLAY medium plasticity, grey, with high strength ironstone bands		H	WEATHERED ROCK
									For Continuation Refer to Sheet 2			
			5									
			6									
			7									
			8									
			9									
			10									

REVISION C

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BOREHOLE: SRT BH037

SHEET: 2 OF 4 REV: C

CLIENT: Transport for NSW
PROJECT: Sydney Metro City and Southwest
LOCATION: Mowbray Road Artarmon
PROJECT No PCS 00013/10701

COORDS: 331657.9 m E 6258012.0 m N MGA94 56
SURFACE RL: 104.40 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 25.12 m

DRILL RIG: Hanjin DB8
CONTRACTOR: Terratest
LOGGED: PGH / MM DATE: 12/7/16
CHECKED: HB DATE: 19/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4	4.40		Continuation of Sheet 1				
HQ3	No Water Loss	100	0 (100)	5	100.00		CLAY medium plasticity, grey, with high strength ironstone bands and with some siltstone bands	EW			
				6	6.90						
		100	0 (100)	7	97.50		SILTSTONE pale grey, thinly laminated at 0°	MW		7.07 m: J, 35°, Pl, Sm, Sn 7.28 m: J, 15°, Pl, Sm-Ro, Sn 7.44 m: J, 80°, Pl, Sm-Ro, Sn 7.60-7.63 m: DS, 0°, clay, 30 mm	
								HW			
				8	7.83 96.50		CORE LOSS				
							SILTSTONE pale grey, thinly laminated at 0°	EW - HW			
								MW		8.30-8.35 m: B, 5°, Pl, Ro, Sn 8.35 m: J, 50°, Pl, Sm, Sn	
				9	9.00 95.40		CORE LOSS				
		80	0 (80)		9.28 95.12		SILTSTONE pale grey, thinly laminated at 0°	MW		9.45 m: J, 45°, Pl, Sm, Sn 9.50 m: J, 40-45°, Pl, Sm, Sn 9.74 m: J, 72°, Pl, Sm, Sn 9.80 m: J, 75°, Pl, Sm, Sn	
				10							

REVISION C

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BOREHOLE: SRT BH037

		SHEET: 3 OF 4	REV: C
CLIENT: Transport for NSW	COORDS: 331657.9 m E 6258012.0 m N MGA94 56	DRILL RIG: Hanjin DB8	
PROJECT: Sydney Metro City and Southwest	SURFACE RL: 104.40 m DATUM: AHD	CONTRACTOR: Terratest	
LOCATION: Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH / MM	DATE: 12/7/16
PROJECT No PCS 00013/10701	HOLE DEPTH: 25.12 m	CHECKED: HB	DATE: 19/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
HQ3	No Water Loss	80	0 (80)	10	10.30		SILTSTONE pale grey, thinly laminated at 0°	EW			
		100	80 (100)		94.10		LAMINITE grey siltstone (60%) thinly laminated with fine grained, pale grey sandstone (40%)	MW FR		10.88 m: B, 0°, Pl, Sm-Ro, Sn 11.40 m: B, 1°, Pl, Sm, Sn 11.54 m: J, 44°, Pl, Sm, Cn	
				12	12.00 92.40		SILTSTONE grey, with some fine grained sandstone laminations			11.90 m: J, 40°, Pl, Sm-Ro, Sn	
					12.50 91.90		CORE LOSS				
		90	40 (90)	13	12.85 91.55		SILTSTONE grey, with some fine grained sandstone laminations	FR		13.33 m: J, 85°, Pl-St, Sm-Ro, Cn, length 250 mm 13.64 m: B, 0°, Pl, Sm, Cn	
				14						14.10 m: DS, 0°, clay, 10 mm	
				15						15.23 m: J, 60°, Pl, Ro, Cn	
		100	92 (100)	16						15.96 m: J, 10°, Pl, Ro, Cn 16.12 m: J, 20°, Pl, Ro, Cn	
				17						16.53 m: J, 0-20°, Un, Ro, Cn 16.59 m: J, 20°, Pl, Ro, Cn 16.60 m: J, 30°, Pl, Ro, Cn 16.67 m: J, 10°, Pl, Ro, Cn 16.75 m: J, 30°, Pl, healed 16.87 m: J, 40°, Pl, Ro, Cn 16.89 m: J, 0-20°, Un, Ro, Cn 17.20 m: J, 60°, Pl, Ro, Cn 17.30 m: J, 60-80°, Un, Ro, Cn	
					17.75 86.65		LAMINITE grey siltstone (60%) laminated with fine grained, pale grey sandstone (40%)				
		100	80 (100)	18						18.21 m: B, 0°, Un, Ro, Cn 18.48 m: J, 60°, Pl, Ro, Cn 18.72 m: J, 50°, Pl, Ro, Cn 18.81 m: J, 50°, Pl, Ro, Cn	
				19						S14953; 19.45 m	
					19.80 84.60					19.80 m: J, 0°, Un, Ro, clay Cn, 5 mm	
				20							

REVISION C

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BOREHOLE: SRT BH037

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 4 OF 4 REV: C

CLIENT: Transport for NSW
PROJECT: Sydney Metro City and Southwest
LOCATION: Mowbray Road Artarmon
PROJECT No PCS 00013/10701

COORDS: 331657.9 m E 6258012.0 m N MGA94 56
SURFACE RL: 104.40 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 25.12 m

DRILL RIG: Hanjin DB8
CONTRACTOR: Terratest
LOGGED: PGH / MM DATE: 12/7/16
CHECKED: HB DATE: 19/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
HQ3	No Water Loss	100	80 (100)	20	20.20 84.20		SILTSTONE grey	EW FR		20.10 m: J, 20°, Pl, Ro, Cn 20.14 m: J, 30°, Pl, Ro, Cn 20.24 m: J, 20°, Pl, Ro, Cn 20.29 m: J, 20°, Pl, Ro, Cn 20.35 m: J, 40°, Pl, Ro, Cn 20.40 m: J, 40°, Pl, Ro, Cn 20.55 m: J, 30°, Pl, Ro, Cn 20.59 m: J, 30°, Pl, Ro, Cn 20.72 m: J, 30°, Pl, Ro, Cn 20.76 m: J, 20°, Pl, Ro, Cn 20.90 m: J, 30°, Pl, Ro, Cn 21.10 m: J, 30°, Pl, Ro, Cn	
					20.90 83.50		LAMINITE fine grained sandstone (60%), with grey siltstone (40%) laminations, disturbed bedding horizontal bedding				
		100	100 (100)	21						S14954; 21.85 m 21.97 m: J, 30°, Pl, Ro, Cn	
				22							
				23						23.24 m: J, 60°, Pl, calcite, healed	
				24							
		100	100 (100)	25	25.12 79.28		END OF BOREHOLE @ 25.12 m TARGET DEPTH GROUTED			24.64 m: J, 40°, Pl, Ro, Cn 24.75 m: J, 60°, Pl, Ro, Cn	
				26							
				27							
				28							
				29							
				30							

REVISION C

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CORE PHOTOGRAPHS: SRT BH037

SHEET: 1 OF 3 REV: C

CLIENT:	Transport for NSW	COORDS: 331657.9 m E 6258012.0 m N MGA94 56	DRILL RIG: Hanjin DB8
PROJECT:	Sydney Metro City and Southwest	SURFACE RL: 104.40 m DATUM: AHD	CONTRACTOR: Terratest
LOCATION:	Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH / MM DATE: 12/7/16
PROJECT No	PCS 00013/10701	HOLE DEPTH: 25.12 m	CHECKED: HB DATE: 19/7/16

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

CORE PHOTOGRAPHS: SRT BH037

SHEET: 2 OF 3 REV: C

CLIENT:	Transport for NSW	COORDS: 331657.9 m E 6258012.0 m N MGA94 56	DRILL RIG: Hanjin DB8
PROJECT:	Sydney Metro City and Southwest	SURFACE RL: 104.40 m DATUM: AHD	CONTRACTOR: Terratest
LOCATION:	Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH / MM DATE: 12/7/16
PROJECT No	PCS 00013/10701	HOLE DEPTH: 25.12 m	CHECKED: HB DATE: 19/7/16

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

CORE PHOTOGRAPHS: SRT BH037

SHEET: 3 OF 3 REV: C

CLIENT:	Transport for NSW	COORDS: 331657.9 m E 6258012.0 m N MGA94 56	DRILL RIG: Hanjin DB8
PROJECT:	Sydney Metro City and Southwest	SURFACE RL: 104.40 m DATUM: AHD	CONTRACTOR: Terratest
LOCATION:	Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH / MM DATE: 12/7/16
PROJECT No	PCS 00013/10701	HOLE DEPTH: 25.12 m	CHECKED: HB DATE: 19/7/16

VISION

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BOREHOLE: SRT BH038

		SHEET: 1 OF 4	REV: C
CLIENT: Transport for NSW	COORDS: 331666.6 m E 6257987.4 m N MGA94 56	DRILL RIG: Hanjin DB8	
PROJECT: Sydney Metro City and Southwest	SURFACE RL: 103.10 m DATUM: AHD	CONTRACTOR: Terratest	
LOCATION: Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH	DATE: 6/7/16
PROJECT No PCS 00013/10701	HOLE DEPTH: 25.31 m	CHECKED: HB	DATE: 12/7/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
NDD			0	103.05				CI	Silty CLAY (TOPSOIL) brown, with some rootlets	M		
									Silty clay red brown and grey			
				1.00	DS 0.80-1.00 m Rec = 200/200 mm							
			1	102.10	Rec = 450/450 mm SPT 1.00-1.45 m 5, 7, 10 N=17			CI	Silty clay medium to high plasticity, red and grey, ironstone bands		VSt	
	M											
					DS 1.70-2.00 m Rec = 300/300 mm							
			2		S14945 U 2.00 m S14946 U75 2.00-2.45 m Rec = 300/450 mm DS 2.30-2.50 m Rec = 200/200 mm Rec = 450/450 mm SPT 2.50-2.95 m 4, 13, 24 N=37							
AST		GWNO	3							M (<<PL)		
	H										H	
			4		DS 4.00-4.45 m Rec = 450/450 mm Rec = 450/450 mm SPT 4.00-4.45 m 9, 24, 24 N=48							
			5									
					Rec = 450/450 mm SPT 5.50-5.95 m 15, 25, 13 N=38							
				5.90					SILTSTONE fine grained, layered, dark grey, very thinly laminated highly weathered, very low strength			
			6						For Continuation Refer to Sheet 2			
			7									
			8									
			9									
			10									

REVISION C

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BOREHOLE: SRT BH038

		SHEET: 2 OF 4	REV: C
CLIENT: Transport for NSW	COORDS: 331666.6 m E 6257987.4 m N MGA94 56	DRILL RIG: Hanjin DB8	
PROJECT: Sydney Metro City and Southwest	SURFACE RL: 103.10 m DATUM: AHD	CONTRACTOR: Terratest	
LOCATION: Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH	DATE: 6/7/16
PROJECT No PCS 00013/10701	HOLE DEPTH: 25.31 m	CHECKED: HB	DATE: 12/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
				5							
				6	6.00		Continuation of Sheet 1				
					97.10		CORE LOSS				
					6.23						
					96.87		SILTSTONE fine grained, layered, dark grey, very thinly laminated	MW		6.30 m: J, 35°, Pl, Sm, Sn 6.55-6.65 m: J, 70°, Pl, Sm, Cn	
				7				EW			
								SW			
								MW			
HQ3	No Water Loss	91	24 (91)	8						8.20 m: J, 50°, Pl, Sm, clay infill, 100 mm	
					8.75						
					8.86		CORE LOSS				
		69	69 (69)	9	94.24		SILTSTONE layered, dark grey, very thinly to thinly laminated from 9.1 to 9.39 m: siltstone clasts up to 70 mm with slump features	SW			
					9.10						
					94.00			FR			
		100	94 (94)	10							

REVISION C

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BOREHOLE: SRT BH038

		SHEET: 3 OF 4	REV: C
CLIENT: Transport for NSW	COORDS: 331666.6 m E 6257987.4 m N MGA94 56	DRILL RIG: Hanjin DB8	
PROJECT: Sydney Metro City and Southwest	SURFACE RL: 103.10 m DATUM: AHD	CONTRACTOR: Terratest	
LOCATION: Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH	DATE: 6/7/16
PROJECT No PCS 00013/10701	HOLE DEPTH: 25.31 m	CHECKED: HB	DATE: 12/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
HQ3	No Water Loss	100	94 (94)	10			SILTSTONE layered, dark grey, very thinly to thinly laminated	FR			
				11						11.25 m: J, 80°, Pl, Sm, Cn, 140 mm length	
				12						12.08 m: J, 85°, Pl, Sm, Cn 12.14 m: J, 70°, Pl, Sl, Cn	
		100	90 (90)	13						12.68 m: J, 70°, Pl, Sm, Cn, 100mm length	
										13.19 m: J, 43°, Pl, Sm, Cn, (x2) curved	
				14						13.46 m: J, 40°, Pl, Sm, Cn	
		100	100 (100)	15							
				16							
				17	17.30 85.80		LAMINITE layered, dark and pale grey, thinly laminated siltstone, (50%) siltstone and fine grained sandstone (50%)				
				18						18.25 m: J, 60°, St, Sm, Cn	
		100	93 (97)	19				EW FR		18.83 m: J, 20°, Sm, Vr 18.90-18.96 m: DS, 0°, clay	
										19.68 m: L, 45°, Pl, Sm, Cn	
				20							

REVISION C

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BOREHOLE: SRT BH038

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 4 OF 4 REV: C

CLIENT: Transport for NSW
PROJECT: Sydney Metro City and Southwest
LOCATION: Mowbray Road Artarmon
PROJECT No PCS 00013/10701

COORDS: 331666.6 m E 6257987.4 m N MGA94 56
SURFACE RL: 103.10 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 25.31 m

DRILL RIG: Hanjin DB8
CONTRACTOR: Terratest
LOGGED: PGH DATE: 6/7/16
CHECKED: HB DATE: 12/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
HQ3	No Water Loss	100	93 (97)	20			LAMINITE layered, dark and pale grey, thinly laminated siltstone, (50%) siltstone and fine grained sandstone (50%)	FR			
					20.45 82.65		20.45m - 20.55m : lenticular bedding				
				21							
				22							
		100	100 (100)	23							
					23.36 79.74		below 23.36m : siltstone 30% sandstone 70%				
				24							
		100	100 (100)	25							
					25.31 77.79		END OF BOREHOLE @ 25.31 m				
				26							
				27							
				28							
				29							
				30							

REVISION C

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

CORE PHOTOGRAPHS: SRT BH038

		SHEET: 1 OF 3	REV: C
CLIENT: Transport for NSW	COORDS: 331666.6 m E 6257987.4 m N MGA94 56	DRILL RIG: Hanjin DB8	
PROJECT: Sydney Metro City and Southwest	SURFACE RL: 103.10 m DATUM: AHD	CONTRACTOR: Terratest	
LOCATION: Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH	DATE: 6/7/16
PROJECT No PCS 00013/10701	HOLE DEPTH: 25.31 m	CHECKED: HB	DATE: 12/7/16

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

CORE PHOTOGRAPHS: SRT BH038

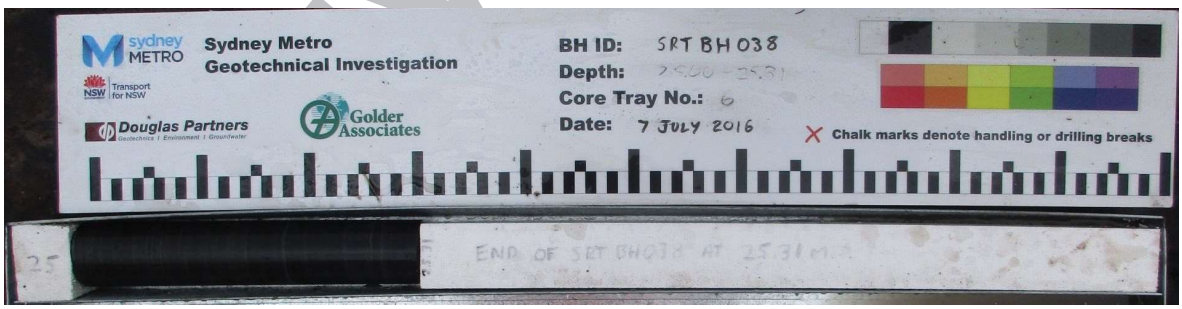
		SHEET: 2 OF 3	REV: C
CLIENT: Transport for NSW	COORDS: 331666.6 m E 6257987.4 m N MGA94 56	DRILL RIG: Hanjin DB8	
PROJECT: Sydney Metro City and Southwest	SURFACE RL: 103.10 m DATUM: AHD	CONTRACTOR: Terratest	
LOCATION: Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH	DATE: 6/7/16
PROJECT No PCS 00013/10701	HOLE DEPTH: 25.31 m	CHECKED: HB	DATE: 12/7/16

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

CORE PHOTOGRAPHS: SRT BH038

SHEET: 3 OF 3 REV: C

CLIENT:	Transport for NSW	COORDS: 331666.6 m E 6257987.4 m N MGA94 56	DRILL RIG: Hanjin DB8
PROJECT:	Sydney Metro City and Southwest	SURFACE RL: 103.10 m DATUM: AHD	CONTRACTOR: Terratest
LOCATION:	Mowbray Road Artarmon	INCLINATION: -90°	LOGGED: PGH DATE: 6/7/16
PROJECT No	PCS 00013/10701	HOLE DEPTH: 25.31 m	CHECKED: HB DATE: 12/7/16



This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

BOREHOLE: SRT LD687

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 1 OF 1 REV: C

CLIENT: Transport for NSW
PROJECT: Sydney Metro City and Southwest
LOCATION: Ausgrid Chatswood Depot Mowbray Road
PROJECT No PCS 00013/10701

COORDS: 331621.68 m E 6258086.77 m N MGA94 56
SURFACE RL: 102.86 m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 220 mm HOLE DEPTH: 3.60 m

DRILL RIG: Commachio 220
CONTRACTOR: Terratest
LOGGED: PGH DATE: 19/10/16
CHECKED: HB DATE: 24/10/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	H	NGWO	0.0	0.05 102.81					ASPHALT			ROAD SURFACE
				0.20 102.66	DS 0.10-0.20 m Rec = 100/100 mm				FILL: GRAVEL dark grey and grey, angular basalt gravel (roadbase)			BASECOURSE
HA	M			0.30 102.56	DS 0.20-0.30 m Rec = 100/100 mm				FILL: GRAVEL coarse grained, to 15 mm, angular, black, (slag)			FILL - SLAG
					DS 0.30-0.40 m Rec = 100/100 mm			CI	Silty CLAY medium plasticity, orange brown			RESIDUAL SOIL
NDD			0.5		DS 0.40-0.50 m Rec = 100/100 mm DS 0.50-0.60 m Rec = 100/100 mm DS 0.60-0.70 m Rec = 100/100 mm							
			1.0		BDS 1.00-1.80 m Rec = 800/800 mm Rec = 450/450 mm SPT 1.00-1.45 m 4, 4, 5 N=9							
			1.5		DS 1.40-1.50 m Rec = 100/100 mm DS 1.50-1.60 m Rec = 100/100 mm DS 1.60-1.70 m Rec = 100/100 mm					D	St	
ADT	M		2.0		BDS 2.00-2.80 m Rec = 800/800 mm DS 2.00-2.10 m Rec = 100/100 mm							
				2.40 100.46					at 2.4m: ironstone gravel			
			2.5		DS 2.50-2.60 m Rec = 100/100 mm DS 2.60-2.70 m Rec = 100/100 mm							
					BDS 2.80-3.60 m Rec = 800/800 mm							
	H		3.0		Rec = 450/450 mm SPT 3.00-3.45 m 5, 6, 8 N=14						VSt - H	
			3.5	99.26					END OF BOREHOLE @ 3.60 m			
			4.0									
			4.5									
			5.0									

REVISION C

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BOREHOLE: SRT LD688

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 1 OF 1 REV: C

CLIENT: Transport for NSW
PROJECT: Sydney Metro City and Southwest
LOCATION: Ausgrid Chatswood Depot Mowbray Road
PROJECT No PCS 00013/10701

COORDS: 331529.92 m E 6258121.09 m N MGA94 56
SURFACE RL: 101.93 m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 220 mm HOLE DEPTH: 3.45 m

DRILL RIG: Commachio 220
CONTRACTOR: Terratest
LOGGED: PGH DATE: 19/10/16
CHECKED: HB DATE: 24/10/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT			0.0	101.89	DS 0.10-0.20 m Rec = 100/100 mm				ASPHALT FILL: GRAVEL dark grey and grey, angular basalt (roadbase)			ROAD SURFACE BASECOURSE
				0.30								
HA				101.63	DS 0.30-0.40 m Rec = 100/100 mm				FILL: Silty CLAY medium plasticity, brown			FILL
			0.5	0.50 101.43	DS 0.50-0.60 m Rec = 100/100 mm DS 0.60-0.70 m Rec = 100/100 mm DS 0.70-0.80 m Rec = 100/100 mm			CI	Silty CLAY medium plasticity, orange brown			RESIDUAL SOIL
ADT	M M	GWNO	1.0		DS 1.00-1.10 m Rec = 100/100 mm DS 1.20-1.30 m Rec = 100/100 mm DS 1.30-1.50 m Rec = 200/200 mm Rec = 450/450 mm SPT 1.50-1.95 m 4, 4, 5 N=9					D	St	
			1.5									
			2.0		BDS 2.00-2.50 m Rec = 500/500 mm DS 2.00-2.10 m Rec = 100/100 mm							
			2.5	2.50 99.43	DS 2.50-2.60 m Rec = 100/100 mm			CI	Silty CLAY medium plasticity, grey and red, with ironstone gravel			
	M-H		3.0		Rec = 450/450 mm SPT 3.00-3.45 m 5, 6, 8 N=14							
			3.5	98.48					END OF BOREHOLE @ 3.45 m			
			4.0									
			4.5									
			5.0									

REVISION C

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CONE PENETRATION TEST

CLIENT: JHCPBGJV

PROJECT: SYNDEY METRO - CHATSWOOD

LOCATION: 355 MOWBRAY RD, CHATSWOOD

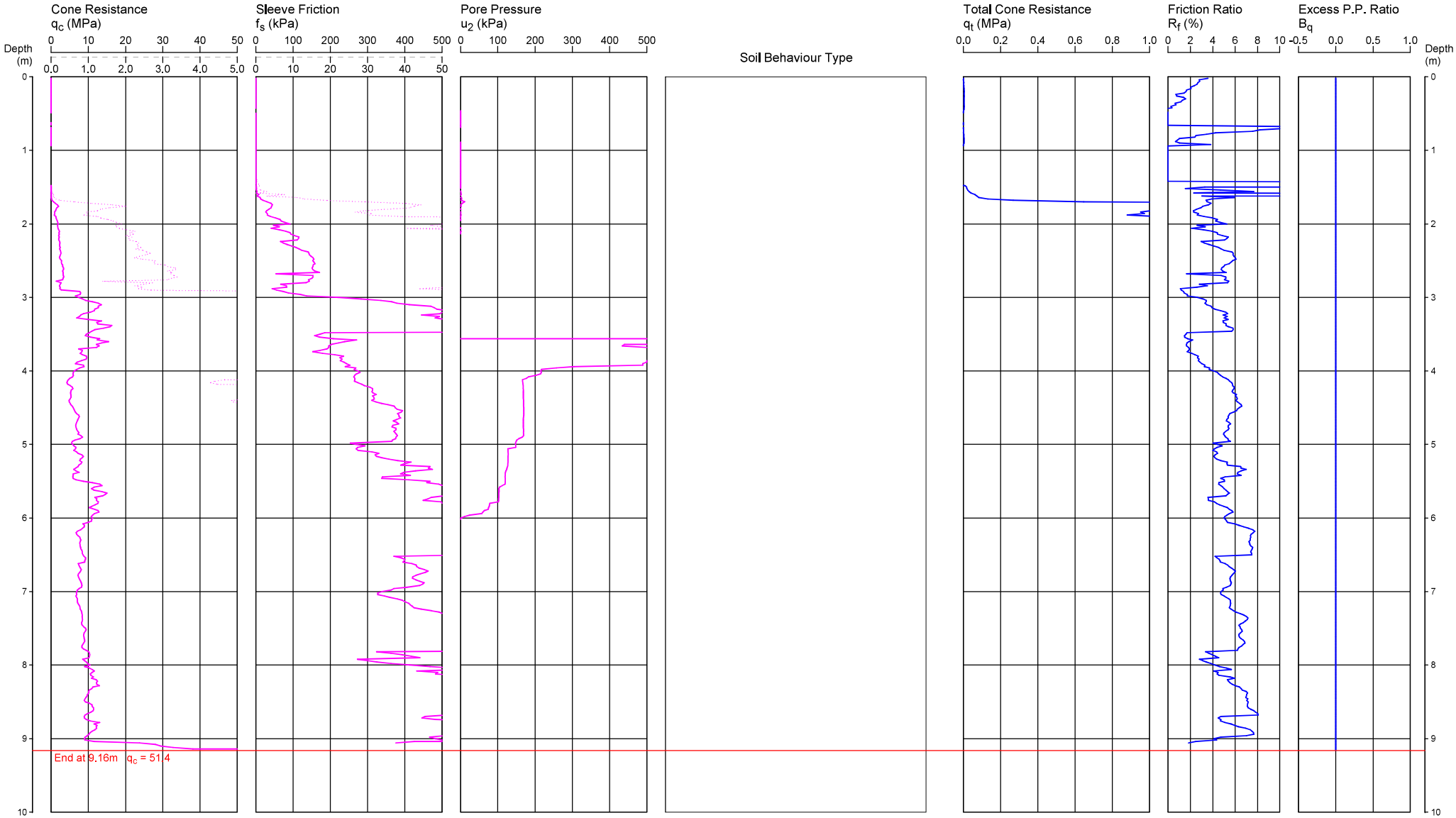
REDUCED LEVEL: 103.855 m AHD

COORDINATES: 331621.757E 6258059.708N GDA94

JCG-CPT-1201

DATE 07/08/2017

PROJECT No: 84729.01



REMARKS: NON-DESTRUCTIVE EXCAVATION TO 1.5 m DEPTH PRIOR TO TESTING;
DUMMY CONE USED TO PENETRATE FILLING TO 1.8 m DEPTH;
TEST DISCONTINUED DUE TO REFUSAL;
NO GROUNDWATER OBSERVED AFTER WITHDRAWAL OF RODS;

File: P:\CONE DATA\Cone Jobs\2017\08\84729.01 CHATSWOOD\JCG-CPT-1201.cpt
Cone ID: 120539 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2
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GROUND TEST PTY LIMITED

CONE PENETRATION TEST

CLIENT: JHCPBGJV

PROJECT: SYNDEY METRO - CHATSWOOD

LOCATION: 355 MOWBRAY RD, CHATSWOOD

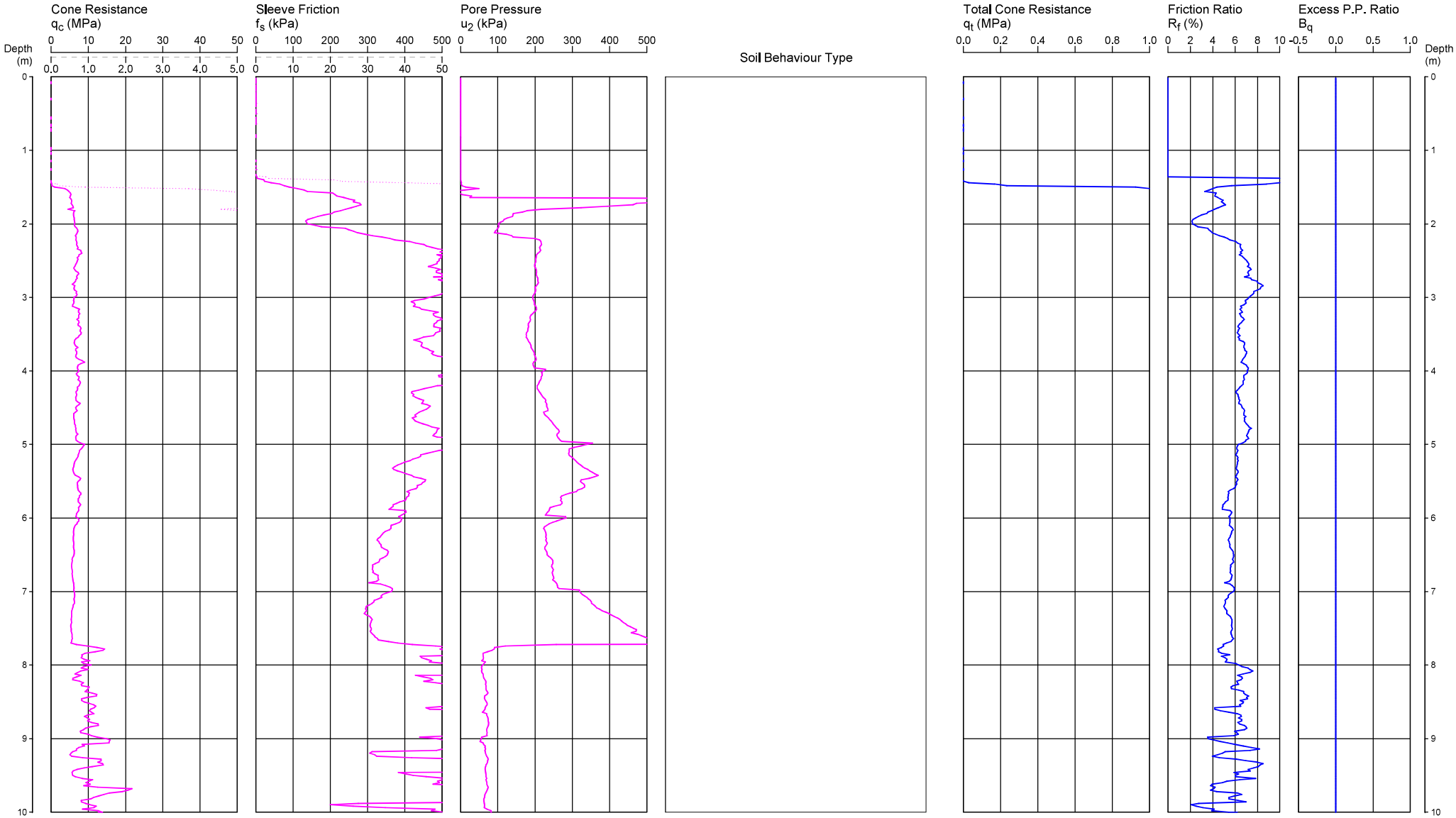
REDUCED LEVEL: 102.473 m AHD

COORDINATES: 331619.071E 6258121.364N GDA94

JCG-CPT-1202

DATE 07/08/2017

PROJECT No: 84729.01



REMARKS: NON DESCTRUCTIVE EXCAVATION TO 1.5 m DEPTH;
TEST DISCONTINUED DUE TO LIMIT OF THRUST;
NO GROUNDWATER WAS OBSEREVED AFTER WITHDRAWAL OF RODS;

File: P:\CONE DATA\Cone Jobs\2017\08\84729.01 CHATSWOOD\JCG-CPT-1202.cpt
Cone ID: 160917 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2

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GROUND TEST PTY LIMITED

CONE PENETRATION TEST

CLIENT: JHCPBGJV

PROJECT: SYNDEY METRO - CHATSWOOD

LOCATION: 355 MOWBRAY RD, CHATSWOOD

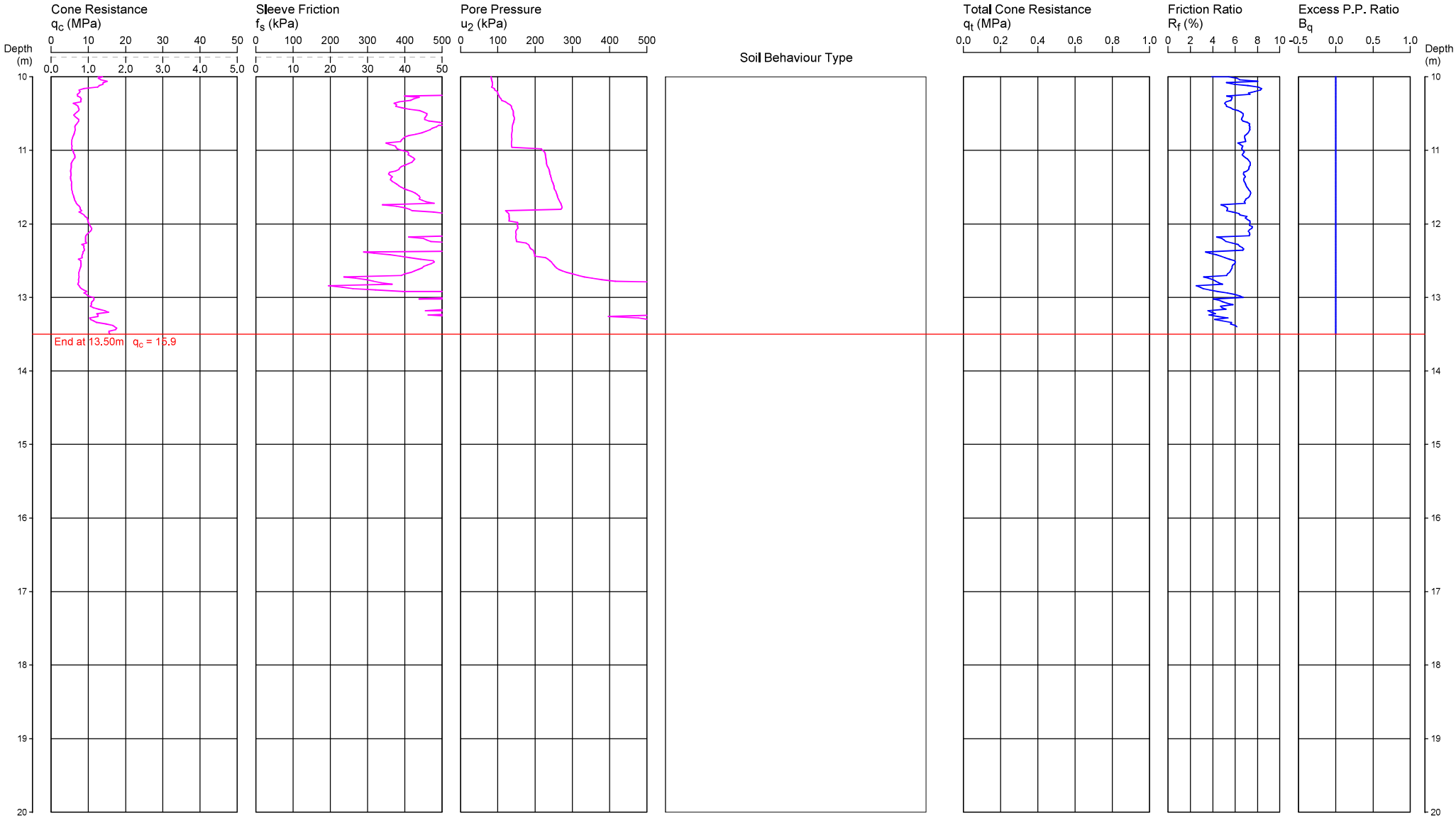
REDUCED LEVEL: 102.473 m AHD

COORDINATES: 331619.071E 6258121.364N GDA94

JCG-CPT-1202

DATE 07/08/2017

PROJECT No: 84729.01



REMARKS: NON DESCTRUCTIVE EXCAVATION TO 1.5 m DEPTH;
TEST DISCONTINUED DUE TO LIMIT OF THRUST;
NO GROUNDWATER WAS OBSEREVED AFTER WITHDRAWAL OF RODS;

File: P:\CONE DATA\Cone Jobs\2017\08\84729.01 CHATSWOOD\JCG-CPT-1202.cpt
Cone ID: 160917 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2

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GROUND TEST PTY LIMITED

CONE PENETRATION TEST

CLIENT: JHCPBGJV

PROJECT: SYNDEY METRO - CHATSWOOD

LOCATION: 355 MOWBRAY RD, CHATSWOOD

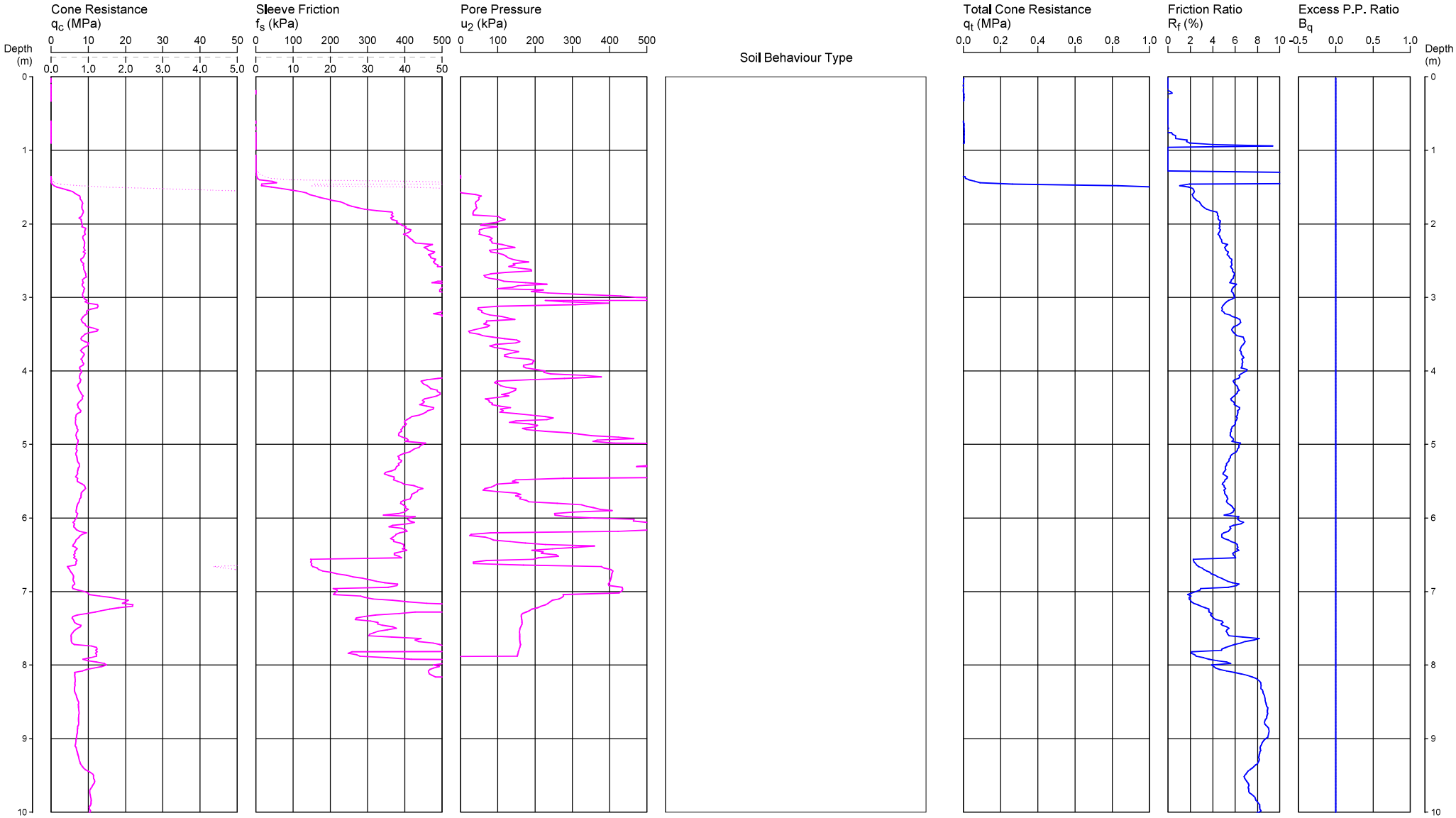
REDUCED LEVEL: 102.024 m AHD

COORDINATES: 331610.441E 6258164.654N GDA94

JCG-CPT-1203

DATE 07/08/2017

PROJECT No: 84729.01



REMARKS: NON DESCTRUCTIVE EXCAVATION TO 1.5 m DEPTH;
TEST DISCONTINUED DUE TO REFUSAL;
NO GROUNDWATER WAS OBSEREVED AFTER WITHDRAWAL OF RODS;

File: P:\CONE DATA\Cone Jobs\2017\08\84729.01 CHATSWOOD\JCG-CPT-1203.cpt
Cone ID: 120539 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: JHCPBGJV

PROJECT: SYNDEY METRO - CHATSWOOD

LOCATION: 355 MOWBRAY RD, CHATSWOOD

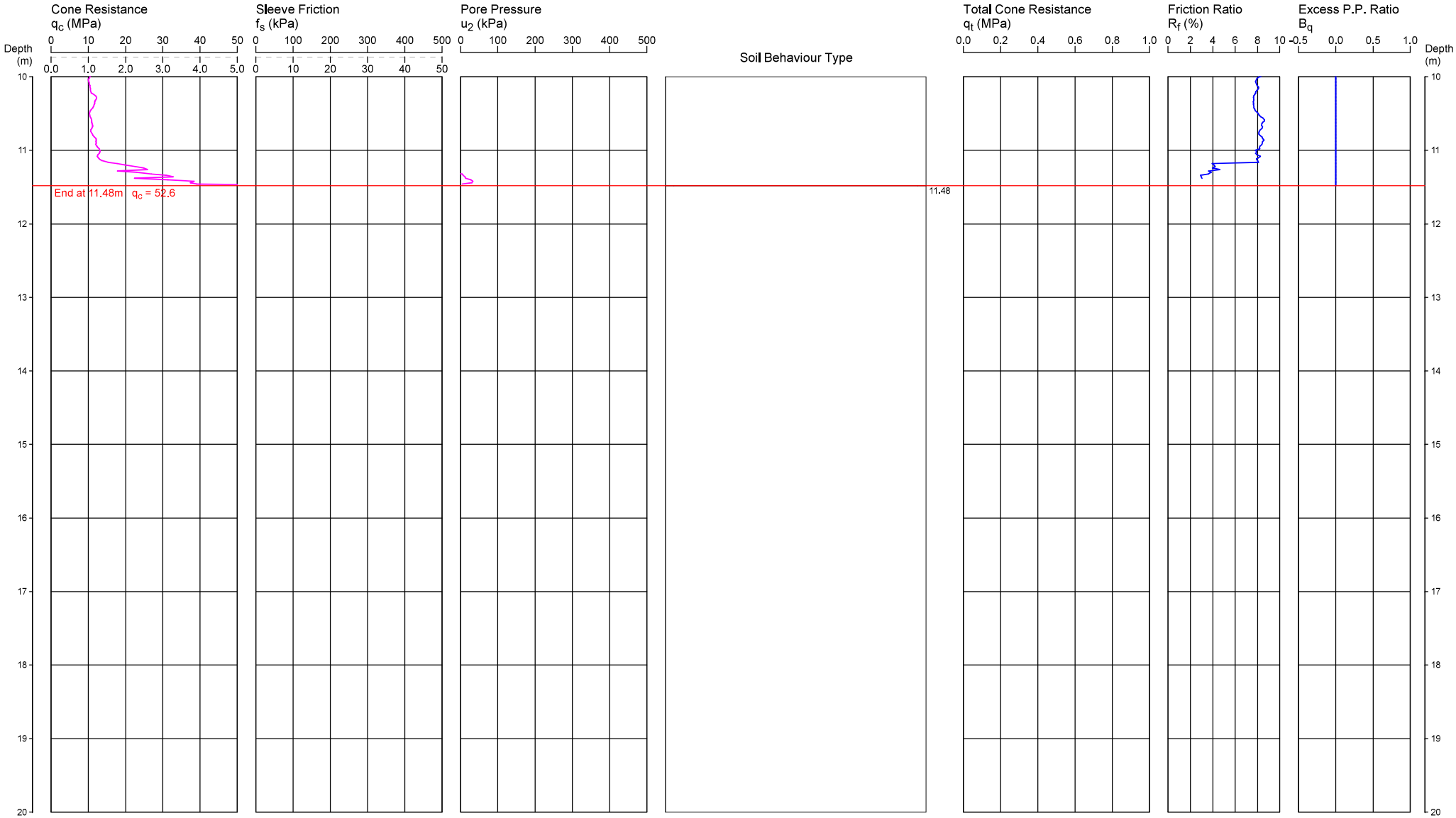
REDUCED LEVEL: 102.024 m AHD

COORDINATES: 331610.441E 6258164.654N GDA94

JCG-CPT-1203

DATE 07/08/2017

PROJECT No: 84729.01



REMARKS: NON DESCTRUCTIVE EXCAVATION TO 1.5 m DEPTH;
TEST DISCONTINUED DUE TO REFUSAL;
NO GROUNDWATER WAS OBSEREVED AFTER WITHDRAWAL OF RODS;

File: P:\CONE DATA\Cone Jobs\2017\08\84729.01 CHATSWOOD\JCG-CPT-1203.cpt
Cone ID: 120539 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2

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BOREHOLE: SRT BH025

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 1 OF 4 REV: D

CLIENT: Transport for New South Wales
PROJECT: SRT Geotechnical Investigation Services
LOCATION: Ausgrid Chatswood Depot Mowbray Road
PROJECT No PSC No.00013/10464

COORDS: 331615.5 m E 6258143.5 m N MGA94 56
SURFACE RL: 102.30 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 25.00 m

DRILL RIG: Explora
CONTRACTOR: Groundtest
LOGGED: AP START: 16/9/15
CHECKED: HB/LM FINISH: 21/9/15

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
NDD	H		0	102.30				CI-CH	Silty CLAY medium to high plasticity, mottled red brown and grey, (inferred from NDD hole)			RESIDUAL SOIL
			1	1.20								
WB	M-H	GWNO	1	101.10				CI-CH	Silty CLAY medium to high plasticity, mottled red brown and grey, with some fine to medium subangular ironstone gravel	M (<PL)	H	
			2		Rec = 420/420 mm SPT 2.55-2.97 m 14, 22, 19/120mm N>41							
			3		Rec = 450/450 mm SPT 3.70-4.15 m 9, 16, 17 N=33							
			4									
			5		Rec = 450/450 mm SPT 5.20-5.65 m 11, 17, 25 N=42							
			6									
			7		Rec = 450/450 mm SPT 6.70-7.15 m 11, 14, 19 N=33							
			8	8.20								
				94.10	Rec = 420/420 mm SPT 8.20-8.62 m 13, 24, 25/120mm N>49			CI-CH	Silty Gravelly CLAY medium to high plasticity, mottled grey and red brown, ironstone gravel			
			9	9.40								
				92.90				CI-CH	Silty CLAY medium to high plasticity, mottled red brown and grey, with some fine to medium subangular ironstone gravel			
			10		Rec = 260/260 mm SPT 9.70-9.96 m							

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BOREHOLE: SRT BH025

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 2 OF 4 REV: D

CLIENT: Transport for New South Wales
PROJECT: SRT Geotechnical Investigation Services
LOCATION: Ausgrid Chatswood Depot Mowbray Road
PROJECT NoPSC No.00013/10464

COORDS: 331615.5 m E 6258143.5 m N MGA94 56
SURFACE RL: 102.30 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 25.00 m

DRILL RIG: Explora
CONTRACTOR: Groundtest
LOGGED: AP START: 16/9/15
CHECKED: HB/LM FINISH: 21/9/15

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
WB	M-H	GWNO	10		16, 25/110mm N>25			CI-CH	Silty CLAY medium to high plasticity, mottled red brown and grey, with some fine to medium subangular ironstone gravel	M (<PL)	VSt-H	RESIDUAL SOIL
				10.90 91.40								
			11		Rec = 240/240 mm SPT 11.20-11.44 m 17, 25/90mm N>25				SILTSTONE fine grained, pale grey, horizontally bedded			
									For Continuation Refer to Sheet 3			
			12									
			13									
			14									
			15									
			16									
			17									
			18									
			19									
			20									

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BOREHOLE: SRT BH025

CLIENT: Transport for New South Wales	COORDS: 331615.5 m E 6258143.5 m N MGA94 56	SHEET: 3 OF 4	REV: D
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 102.30 m DATUM: AHD	DRILL RIG: Explora	
LOCATION: Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	CONTRACTOR: Groundtest	
PROJECT NoPSC No.00013/10464	HOLE DEPTH: 25.00 m	LOGGED: AP	START: 16/9/15
		CHECKED: HB/LM	FINISH: 21/9/15

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				10							
				11	11.45		Continuation of Sheet 2				
HQ3		100	0 (100)	12	90.85		SILTSTONE fine grained, pale grey and red brown, horizontally bedded, iron stained	EW			
		100	0 (100)	13	13.83						
		100	10 (100)	14	88.47		LAMINITE orange grey and dark grey, 70% siltstone, 30% sandstone	MW		14.33 m: B, 0-5°, Un, Sm, Cn 14.37 m: B, 0-5°, Un, Sm, Cn 14.55 m: B, 0°, Pl, Sm, iron Sn	
				15						15.11 m: B, 0-5°, Un, Sm, Cn 15.20 m: B, 0-5°, Un, Sm, Cn 15.24 m: B, 0-5°, Un, Sm, Cn	
				16						15.64 m: B, 0°, Un, Sm, Cn 15.76 m: B, 0°, Un, Sm, iron Sn 15.84 m: B, 0°, Un, Sm, iron Sn 15.92 m: B, 0°, Un, Sm, iron Sn 16.00 m: B, 0°, Un, Sm, iron Sn	
					16.20						
		95	80 (95)		16.34		CORE LOSS				
				17	85.96		SILTSTONE dark grey, with 10% sandstone laminations	MW		16.50 m: CS, rock fragments, 10mm 16.61 m: SS, rock fragments and clay, 8mm 17.31 m: SS, rock fragments, 30mm 17.49 m: SS, rock fragments and clay, 30mm 17.54 m: J, 0-45°, Un, Sm, Cn 17.59 m: CS, rock fragments and clay, 50mm 17.80 m: B, 0°, Pl, Sm, Sn, iron stained 17.90 m: J, 80°, Pl-Un, Sm, Vr, clay	
				18				EW			
					18.69			MW		18.60 m: J, 90°, Un, Sm, Cn	
					18.88		CORE LOSS				
		95	75 (95)	19	83.42		SILTSTONE dark grey, with 10% sandstone laminations	FR			
				20						19.76 m: B, 0°, Pl-Un, Sm, Cn	

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BOREHOLE: SRT BH025

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 4 OF 4 REV: D

CLIENT: Transport for New South Wales
PROJECT: SRT Geotechnical Investigation Services
LOCATION: Ausgrid Chatswood Depot Mowbray Road
PROJECT NoPSC No.00013/10464

COORDS: 331615.5 m E 6258143.5 m N MGA94 56
SURFACE RL: 102.30 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 25.00 m

DRILL RIG: Explora
CONTRACTOR: Groundtest
LOGGED: AP START: 16/9/15
CHECKED: HB/LM FINISH: 21/9/15

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
HQ3		95	75 (95)	20			SILTSTONE dark grey, with 10% sandstone laminations	FR		20.00 m: J, 30°, Pl, Sm, Cn 20.20 m: J, 10-15°, Pl, Sm, Cn 20.24 m: J, 10-15°, Pl, Sm, Cn 20.42 m: J, 10-15°, Pl, Sm, Cn	
				21						21.10 m: J, 65°, Pl, Sm, Cn 21.25 m: SS, 25°, St, rock fragments, 10mm	
					22.00					21.51 m: J, 15°, Pl, Sm, Cn 21.54 m: J, 15°, Pl, Sm, Cn 21.61 m: J, 30°, Pl, Sm, Cn 21.72 m: SS, 10°, rock fragments, 15mm 21.88 m: J, 30°, Pl, Sm, Cn	
				22	22.11		CORE LOSS			22.00 m: J, 30°, Pl, Sm, Cn 22.17 m: B, 10°, Pl, Sm, Cn 22.27-22.30 m: possibly broken by drilling	
		95	85 (95)		80.19		SILTSTONE dark grey, with 10% sandstone laminations	FR		22.60 m: J, 40°, Pl, Sm, Cn 22.62 m: J, 40°, Pl, Sm, Cn 22.64 m: J, 40°, Pl, Sm, Cn	
				23						23.30 m: J, 40°, Pl, Sm, Cn	
										23.50 m: J, 75°, Pl, Sm, Cn 23.55 m: CS, 10°, rock fragments, 30mm 23.63 m: J, 20°, Pl, Sm, Cn 23.76 m: SS, rock fragments 23.82 m: J, 30°, Pl, Sm, Cn 23.88 m: J, 60°, Pl, Sm, Cn 24.00 m: J, 30°, Pl-Un, Sm, Cn	
		100	100 (100)	24						24.55 m: J, 80-90°, Pl-St, Sm, calcium Cn-Vr, 24.25 to 24.90m	
					25.00						
				25	77.30		END OF BOREHOLE @ 25.00 m TARGET DEPTH GROUTED				
				26							
				27							
				28							
				29							
				30							

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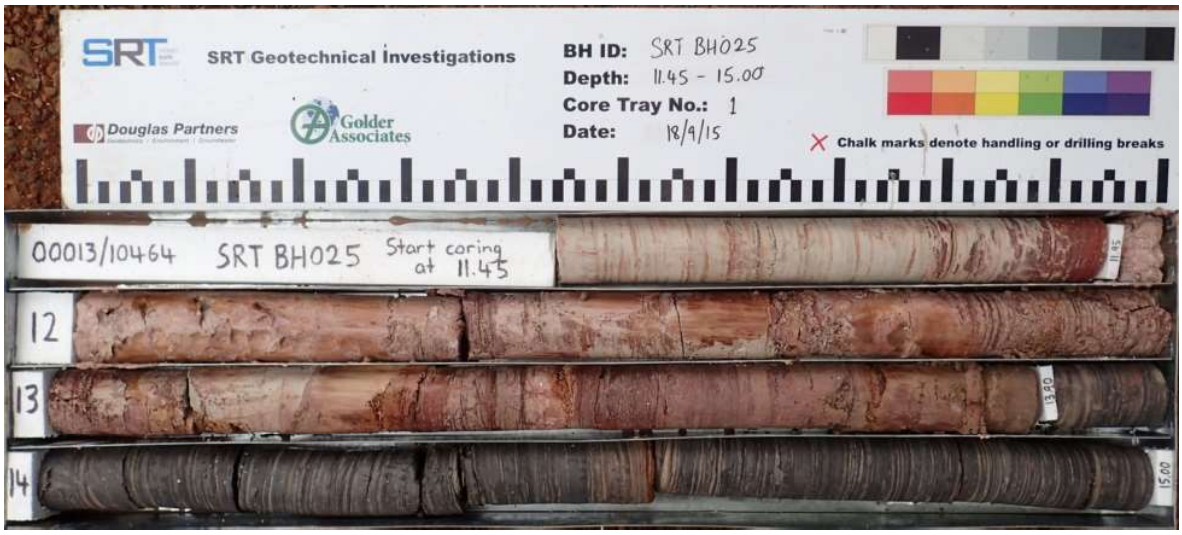
CORE PHOTOGRAPHS: SRT BH025

		SHEET: 1 OF 2	REV: D
CLIENT: Transport for New South Wales	COORDS: 331615.5 m E 6258143.5 m N MGA94 56	DRILL RIG: Explora	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 102.30 m DATUM: AHD	CONTRACTOR: Groundtest	
LOCATION: Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	LOGGED: AP	START: 16/9/15
PROJECT NoPSC No.00013/10464	HOLE DEPTH: 25.00 m	CHECKED: HB/LM	FINISH: 21/9/15



This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

CORE PHOTOGRAPHS: SRT BH025

		SHEET: 2 OF 2	REV: D
CLIENT: Transport for New South Wales	COORDS: 331615.5 m E 6258143.5 m N MGA94 56	DRILL RIG: Explora	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 102.30 m DATUM: AHD	CONTRACTOR: Groundtest	
LOCATION: Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	LOGGED: AP	START: 16/9/15
PROJECT NoPSC No.00013/10464	HOLE DEPTH: 25.00 m	CHECKED: HB/LM	FINISH: 21/9/15

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

BOREHOLE: SRT BH026

Golder Associates | Douglas Partners Geotechnics / Environment / Groundwater

SHEET: 1 OF 4 REV: D

CLIENT: Transport for New South Wales
PROJECT: SRT Geotechnical Investigation Services
LOCATION: Ausgrid Chatswood Depot Mowbray Road
PROJECT No PSC No.00013/10464

COORDS: 331603.3 m E 6258046.0 m N MGA94 56
SURFACE RL: 104.00 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 29.96 m

DRILL RIG: Explora
CONTRACTOR: Groundtest
LOGGED: AP START: 21/9/15
CHECKED: HB/LM FINISH: 25/9/15

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
NDD			0	103.95					PLAIN SPAYED SEAL			ROAD SURFACE
				0.50					Sandy CLAY grey brown, possibly sand, (inferred only - due to non-destructive excavation in upper stratigraphy)			FILL
				103.50				CI-CH	Silty CLAY red brown, (inferred only - due to non-destructive excavation in upper stratigraphy)			RESIDUAL SOIL
			1	1.50								
				102.50					Gravelly Silty CLAY medium to high plasticity, mottled grey and red brown, fine subangular ironstone gravel			
			2									
					Rec = 450/450 mm SPT 2.60-3.05 m 12, 18, 21 N=39							
			3									
					Rec = 250/250 mm SPT 3.70-3.95 m 24, 25/100mm N>25							
			4									
			5		Rec = 450/450 mm SPT 5.20-5.65 m 10, 15, 24 N=39							
WB	M-H	GWNO	6							M (c PL)	H	
			7		Rec = 410/410 mm SPT 6.70-7.11 m 15, 21, 25/110mm N>46							
			8									
					Rec = 420/420 mm SPT 8.20-8.62 m 12, 16, 25/120mm N>41							
			9									
				9.40								
	H			94.60					SILTSTONE fine grained, pale grey, iron stained, extremely weathered, extremely low strength			BEDROCK
					Rec = 250/250 mm SPT 9.70-9.95 m							
			10									

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BOREHOLE: SRT BH026

SHEET: 2 OF 4 REV: D

CLIENT: Transport for New South Wales
PROJECT: SRT Geotechnical Investigation Services
LOCATION: Ausgrid Chatswood Depot Mowbray Road
PROJECT NoPSC No.00013/10464

COORDS: 331603.3 m E 6258046.0 m N MGA94 56
SURFACE RL: 104.00 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 29.96 m

DRILL RIG: Explora
CONTRACTOR: Groundtest
LOGGED: AP START: 21/9/15
CHECKED: HB/LM FINISH: 25/9/15

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7							
				8							
				9							
				10	9.95		Continuation of Sheet 1				

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BOREHOLE: SRT BH026

CLIENT:	Transport for New South Wales	COORDS: 331603.3 m E 6258046.0 m N MGA94 56	SHEET: 3 OF 4 REV: D
PROJECT:	SRT Geotechnical Investigation Services	SURFACE RL: 104.00 m DATUM: AHD	DRILL RIG: Explora
LOCATION:	Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	CONTRACTOR: Groundtest
PROJECT No	PSC No.00013/10464	HOLE DEPTH: 29.96 m	LOGGED: AP START: 21/9/15
			CHECKED: HB/LM FINISH: 25/9/15

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
HQ3	5% water loss	100	0 (100)	10	94.05		SILTSTONE pale grey and red brown, iron stained and occasional iron-cemented layers to 50mm	EW			
				11				HW			
				12	12.81						
		75	0 (75)	13	91.19 13.47		CORE LOSS				
					90.53		SILTSTONE pale grey and orange-brown, iron stained				
				14	14.70					14.27 m: J, 60°, St, Sm, iron Sn 14.47 m: B, 0-5°, Un, Sm, Cn 14.50 m: J, 15°, Un, Sm, Cn 14.64 m: B, 5°, Un, Sm, iron Sn	
		100	0 (100)	15	89.26		CORE LOSS SILTSTONE fine grained, dark grey, horizontally bedded, with occasional iron stained and sandstone laminations			15.30 m: J, 80°, Un, Sm, Cn, 15.20 to 15.37m	
				16	16.70					16.00 m: J, 80-90°, Pl-Un, Sm, Cn, 15.95 to 16.11m	
		100	75 (100)	17	87.30		LAMINITE dark grey and grey, 70% siltstone, 30% sandstone	FR			
				18	18.55					18.06 m: B, 0-5°, Un, Sm, Cn	
		100	80 (100)	19	85.45		18.55-18.75m: siltstone band			18.95 m: CZ, rock fragments, 20mm 19.15-19.20 m: CZ, broken on bedding 19.68 m: SS, rock fragments, clay Vr, 5 mm	
				20							

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BOREHOLE: SRT BH026

		SHEET: 4 OF 4	REV: D
CLIENT: Transport for New South Wales	COORDS: 331603.3 m E 6258046.0 m N MGA94 56	DRILL RIG: Explora	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 104.00 m DATUM: AHD	CONTRACTOR: Groundtest	
LOCATION: Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	LOGGED: AP	START: 21/9/15
PROJECT No PSC No.00013/10464	HOLE DEPTH: 29.96 m	CHECKED: HB/LM	FINISH: 25/9/15

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
HQ3	5% water loss	100	80 (100)	20			LAMINITE dark grey and grey, 70% siltstone, 30% sandstone	FR			
				21	21.00 83.00		80% siltstone, 20% sandstone			21.51 m: J, 60°, Pl-Un, Sm, Cn	
				22	22.00						
		95	65 (95)		81.92		CORE LOSS LAMINITE dark grey and grey, 80% siltstone, 20% sandstone	FR		22.27 m: J, 30°, Un, Sm, Cn 22.35 m: J, 20°, Un, Sm, Cn 22.51 m: J, 60°, Un, Sm, Cn 22.71-22.73 m: J, 30-50°, Un, Sm, Cn 22.84 m: J, 10°, Pl, Sm, Cn	
				23						23.18 m: J, 70°, Pl, Sm, Cn 23.37 m: J, 40°, Pl, Sm, Cn 23.55 m: J, 90°, Pl, Sm, Cn, 23.40 to 23.75m	
				24						24.20 m: J, 20-30°, Un-St, Sm, Cn 24.38 m: J, 20-30°, Un-St, Sm, Cn 24.50 m: J, 20-30°, Un-St, Sm, Cn 24.60 m: J, 20-30°, Un-St, Sm, Cn 24.70 m: CS, 0°, rock fragments, clay Vr, 10mm	
					24.90						
				25	79.10		SILTSTONE dark grey, some sandstone laminations			25.10 m: J, 80-90°, Pl-Un, Sm, calcium Vr	
					25.33						
		95	70 (95)		25.47 78.53		CORE LOSS SILTSTONE dark grey, some sandstone laminations	FR		25.65 m: J, 70°, Pl, Sm, Cn	
				26						26.05 m: J, 40-60°, Pl, Sm, Cn 26.18 m: J, 40-60°, Pl, Sm, Cn 26.22 m: J, 40-60°, Pl, Sm, Cn	
										26.60 m: SS, 0°, rock fragments, 30mm 26.63 m: J, 70-80°, Pl-St, Sm, Cn 26.76 m: SS, 5°, rock fragments, 30mm 26.94 m: J, 15°, Un, Sm, Cn	
	20% water loss			27	27.05						
					27.17 76.83		CORE LOSS SILTSTONE dark grey	FR		27.23 m: SS, 10-20°, rock fragments, 90mm 27.54 m: J, 5-10°, Un, Sm, Cn	
		95	70 (95)	28						28.00 m: J, 60-70°, Un, Sm, Cn 28.35 m: SS, 50°, rock fragments, 20mm 28.50 m: J, 80°, Pl-St, Sm, Cn 28.55 m: J, 80°, Pl-St, Sm, Cn	
				29						28.81-28.99 m: J, 30°, Un, Sm, Cn 28.88 m: J, 50°, Un, Sm, Cn 28.99 m: J, 50°, Un, Sm, Cn 29.12 m: J, 70°, Pl-Un, Sm, Cn 29.22 m: J, 35°, Pl, Sm, Cn	
		100	90 (100)							29.51 m: B, 0°, Pl, Sm, Cn	
				30	29.96		END OF BOREHOLE @ 29.96 m DAMAGE DUE TO RECOVERY METHOD				

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GAP gINT FN. F02a
RL3

CORE PHOTOGRAPHS: SRT BH026

		SHEET: 1 OF 3	REV: D
CLIENT: Transport for New South Wales	COORDS: 331603.3 m E 6258046.0 m N MGA94 56	DRILL RIG: Explora	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 104.00 m DATUM: AHD	CONTRACTOR: Groundtest	
LOCATION: Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	LOGGED: AP	START: 21/9/15
PROJECT NoPSC No.00013/10464	HOLE DEPTH: 29.96 m	CHECKED: HB/LM	FINISH: 25/9/15

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CORE PHOTOGRAPHS: SRT BH026

		SHEET: 2 OF 3	REV: D
CLIENT: Transport for New South Wales	COORDS: 331603.3 m E 6258046.0 m N MGA94 56	DRILL RIG: Explora	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 104.00 m DATUM: AHD	CONTRACTOR: Groundtest	
LOCATION: Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	LOGGED: AP	START: 21/9/15
PROJECT NoPSC No.00013/10464	HOLE DEPTH: 29.96 m	CHECKED: HB/LM	FINISH: 25/9/15

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CORE PHOTOGRAPHS: SRT BH026

		SHEET: 3 OF 3	REV: D
CLIENT: Transport for New South Wales	COORDS: 331603.3 m E 6258046.0 m N MGA94 56	DRILL RIG: Explora	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 104.00 m DATUM: AHD	CONTRACTOR: Groundtest	
LOCATION: Ausgrid Chatswood Depot Mowbray Road	INCLINATION: -90°	LOGGED: AP	START: 21/9/15
PROJECT NoPSC No.00013/10464	HOLE DEPTH: 29.96 m	CHECKED: HB/LM	FINISH: 25/9/15

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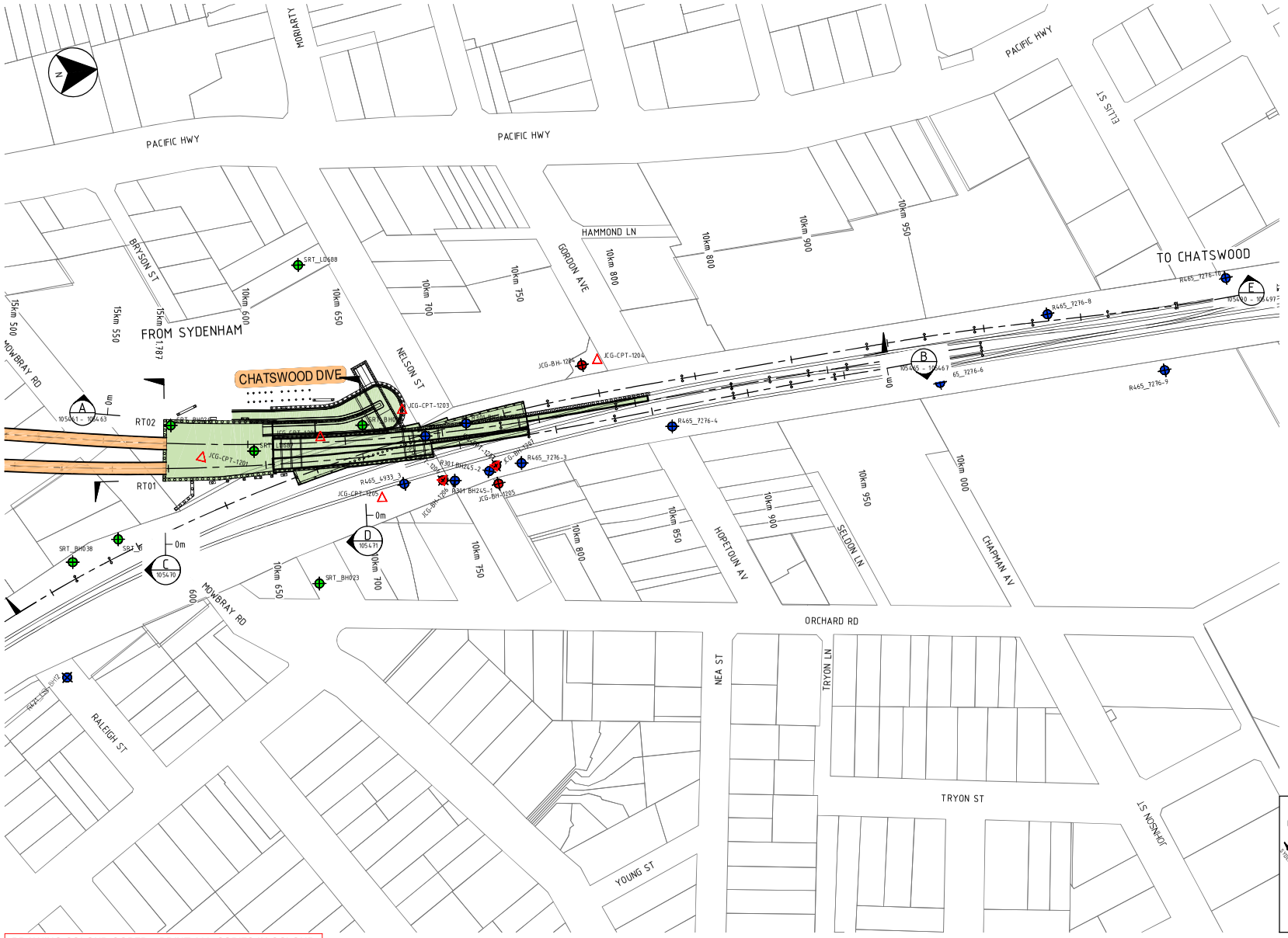
Appendix D
GIR Plan and Cross Sections



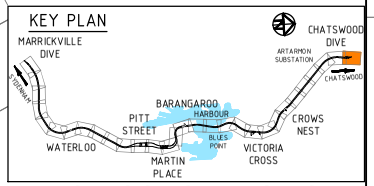
LEGEND

- TUNNEL ALIGNMENT CONTROL LINE
- RUNNING TUNNELS
- CROSS PASSAGES AND CROSS PASSAGES WITH SUMP
- STUB TUNNEL
- DIVE STRUCTURES
- STATION EXCAVATIONS
- NOZZLE ENLARGEMENTS
- CROSSOVER CAVERN
- STATION SHAFTS
- STATION CAVERNS
- STATION ADITS
- LIFT SHAFTS
- NEW METRO STATION
- EXISTING RAILWAY STATION

NOTES

1. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.
2. REFERENCE SHOULD BE MADE TO THE GIR FOR CONTEXT OF THESE SECTIONS RELATIVE TO OTHER SUBMISSION CONTENT.
3. SECTION E LOCATED ALONG NORTHERN CORRIDOR. SECTION E MARKS DO NOT INDICATE FULL EXTENT OF NORTHERN CORRIDOR.

KEY PLAN



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CHATSWOOD DIVE PLAN

FOR CONSTRUCTION

AMD	DESCRIPTION	DESIGNER SIGN./DATE	VERIFIED SIGN./DATE	APPROVED SIGN./DATE
00	ASSURED FOR CONSTRUCTION	BE/22/03/18	BR/22/03/18	BR/22/03/18

CO-ORDINATE SYSTEM: MGA | HEIGHT DATUM: AHD | SCALE: 1:1000

SCALES: 10 0 10 20 30 40m — 1 : 1000 FULL SIZE A1

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DRAWN	N.PHAM	22/03/18
DESIGNED	B.ESTRADA	22/03/18
DRG CHECK	E.NOCKOLDS	22/03/18
DESIGN CHECK	B.BOUVRAY	22/03/18
APPROVED	B.BOUVRAY	22/03/18

SYDNEY METRO CITY & SOUTHWEST

CHATSWOOD NORTHERN DIVE AND PRECINCT
GEOTECHNICAL & HYDROGEOLOGY
GEOTECHNICAL INTERPRETIVE REPORT
LOCATION PLAN

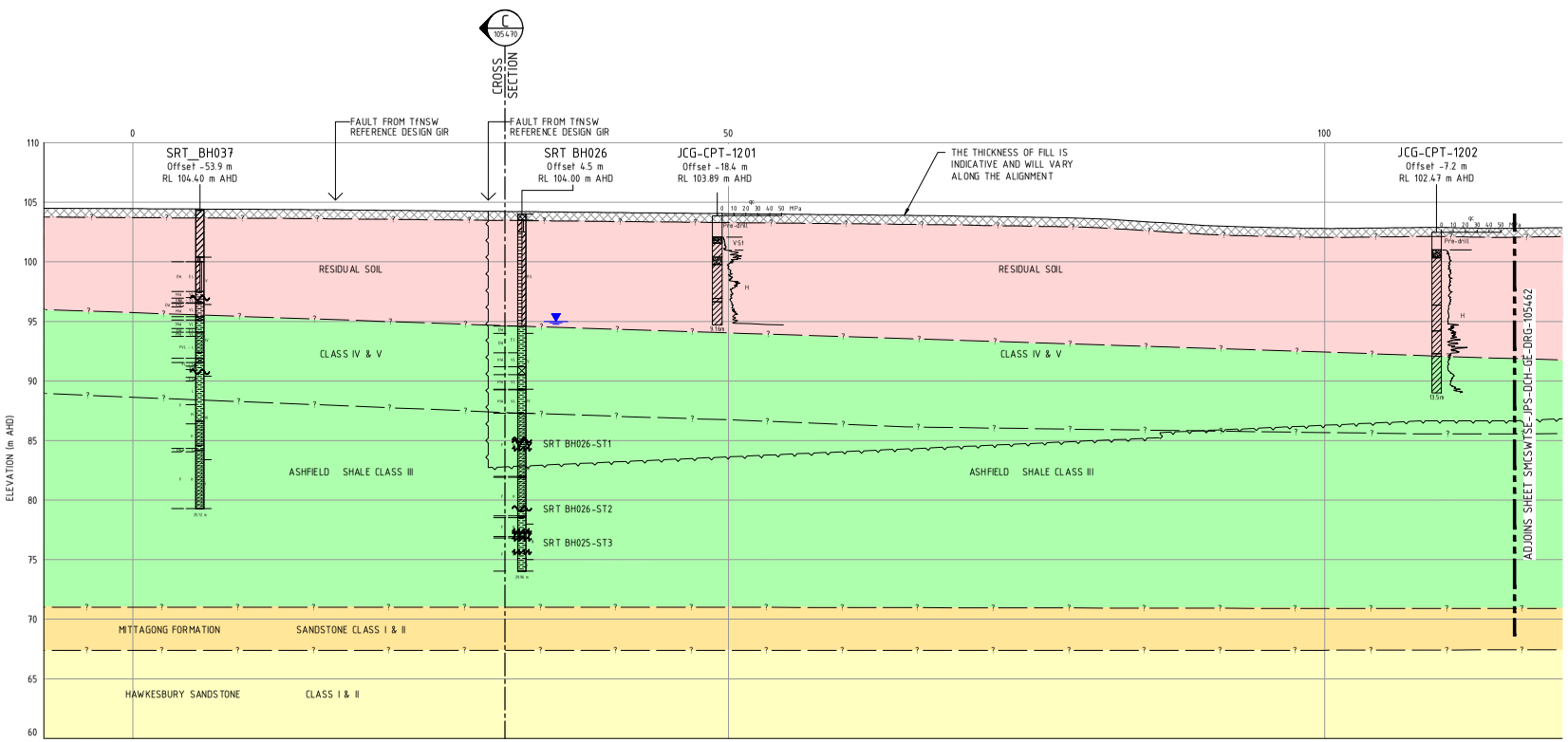
FILE No. | SHEET: 1 OF 1 | A1
STATUS: FOR CONSTRUCTION
DRG No. SMCSW/TSE-JPS-DCH-GE-DRG-105460 | 00 | EDMS No.

DF 801 *554

File Plotted: pw://dpe-kenfay.com:hp-pw/Documents/Projects/Sydney Metro City and Southwest/TSE/JPS - Pitt & Sullivan Meyrick / Corker/DCH - Chatswood Northern Dive and Precinct/GE - Geotechnical & Hydrogeology/DRG - Drawing/SMCSW/TSE-JPS-DCH-GE-DRG-105460

Plot Date & Time: 3/22/2018 1:35 PM

Plotted by: EDMUND WOODLOCK



CHATSWOOD LONG SECTION WEST

SECTION A 105460

1 : 200

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DRAWN	N.PHAM	22/03/18
DESIGNED	B.ESTRADA	22/03/18
DRG CHECK	E.NOCKOLDS	22/03/18
DESIGN CHECK	B.BOURRAY	22/03/18
APPROVED	B.BOURRAY	22/03/18

SYDNEY METRO CITY & SOUTHWEST
CHATSWOOD NORTHERN DIVE AND PRECINCT
GEOTECHNICAL & HYDROGEOLOGY
GEOTECHNICAL INTERPRETIVE REPORT
LONG SECTION - WEST

FILE No. | SHEET: 1 OF 3 | A1

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File Plotted pw://dhpw.aurecongroup.com/sites/pwdocuments/Projects/Sydney Metro City and Southwest/SCEJPS - Pete Sullivan Meyrick / Graham DCH - Chatswood Northern Dive and Precinct/GE - Geotechnical & Hydrogeology/DRG - Drawing/SMCSWTSE-JPS-DCH-GE-DRG-105461

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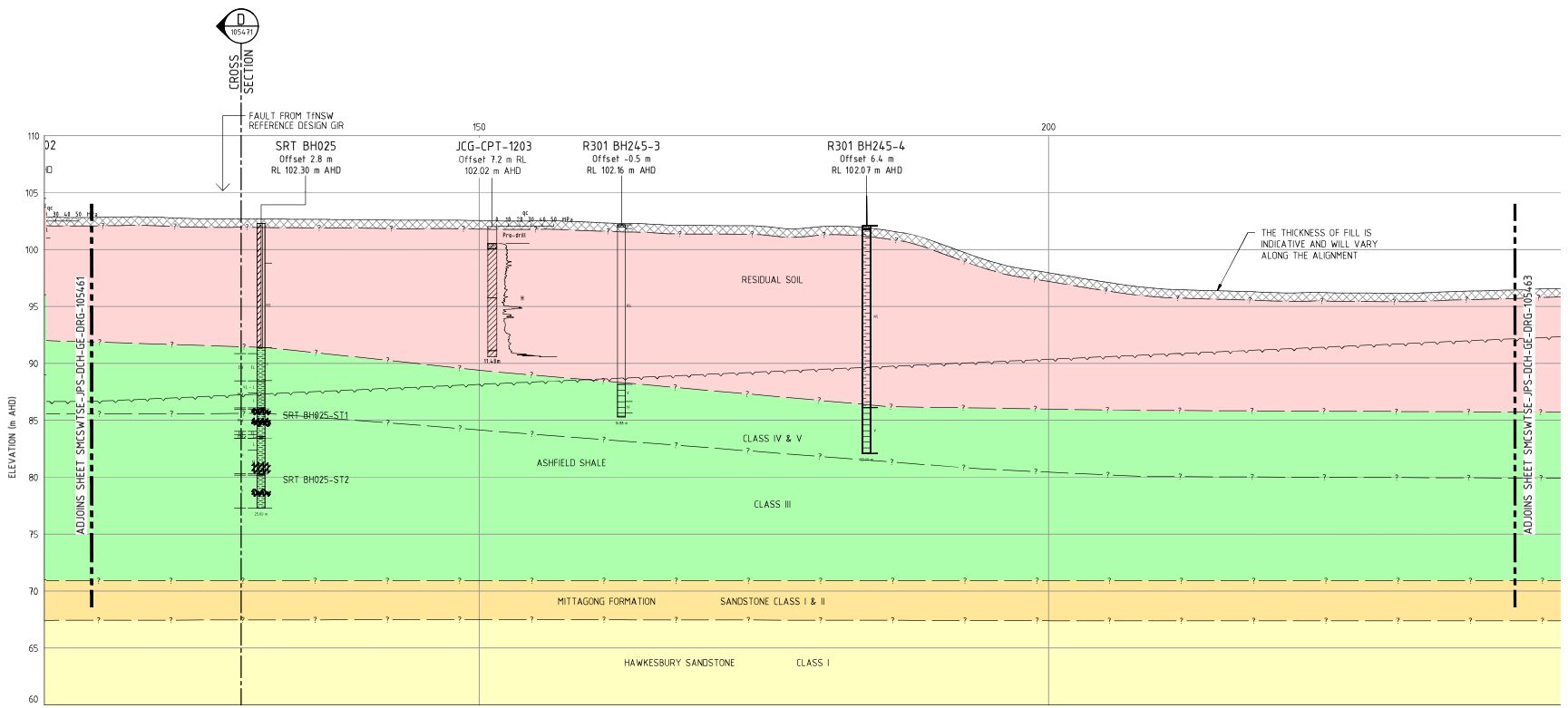
Plotted by EDMUND MCDOULDS



CHATSWOOD LONG SECTION WEST

SECTION A 105460

1 : 200

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FOR CONSTRUCTION

AMD	DESCRIPTION	DESIGNER SIGN/DATE	VERIFIED SIGN/DATE	APPROVED SIGN/DATE
00	ASSURED FOR CONSTRUCTION	BE/22/03/18	BR/22/03/18	BR/22/03/18

CO-ORDINATE SYSTEM: MGA | HEIGHT DATUM: AHD | SCALE: 1:200

SCALES: 2 0 2 4 6 8m

1 : 200 FULL SIZE A1

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DRAWN	N.PHAM	22/03/18
DESIGNED	B.ESTRADA	22/03/18
DRG CHECK	E.NOCKOLDS	22/03/18
DESIGN CHECK	B.ROUVRAY	22/03/18
APPROVED	B.ROUVRAY	22/03/18

SYDNEY METRO CITY & SOUTHWEST

CHATSWOOD NORTHERN DIVE AND PRECINCT

GEOTECHNICAL & HYDROGEOLOGY

GEOTECHNICAL INTERPRETIVE REPORT

LONG SECTION - WEST

FILE No. | SHEET: 2 OF 3 | A1

STATUS: FOR CONSTRUCTION

DRG No. SMCSWTSE-JPS-DCH-GE-DRG-105462 | 00 | EDMS No.

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Plot Date & Time: 3/22/2018 1:35 PM

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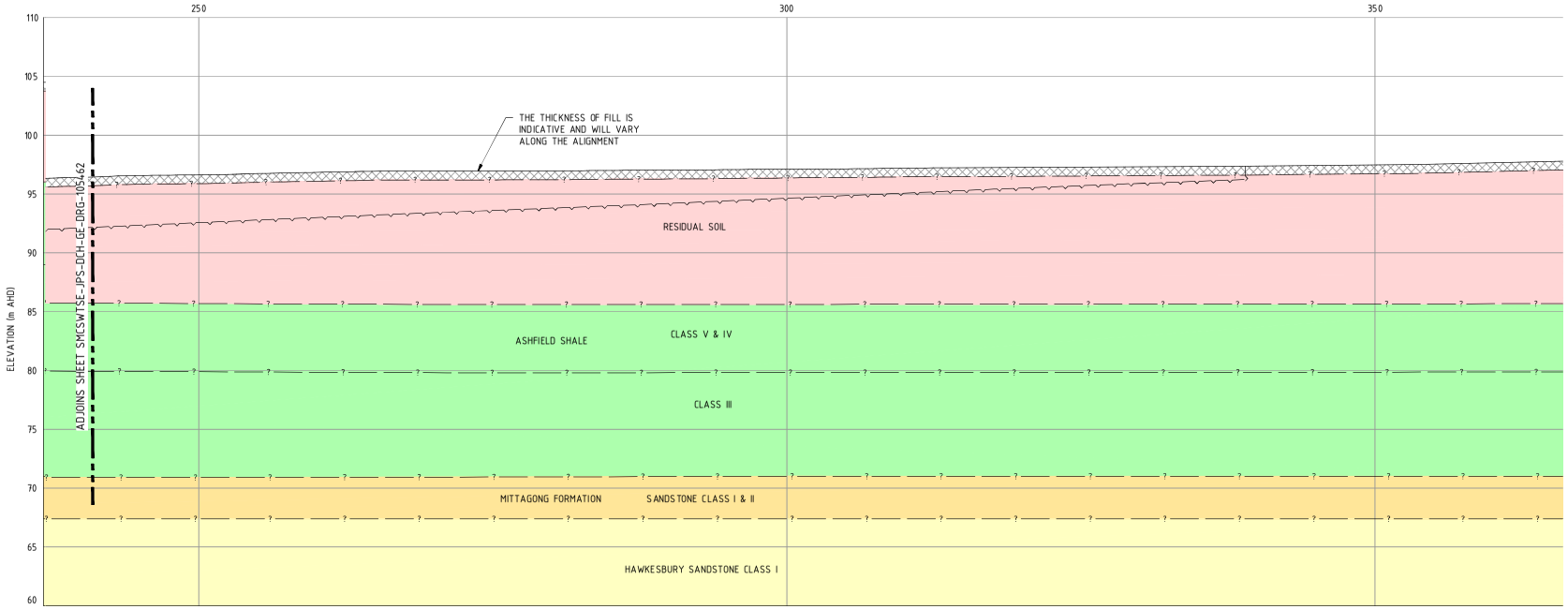

CHATSWOOD LONG SECTION WEST

SECTION A 105460

1 : 200

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FOR CONSTRUCTION

AMD	DESCRIPTION	DESIGNER SIGN/DATE	VERIFIED SIGN/DATE	APPROVED SIGN/DATE
00	ASSURED FOR CONSTRUCTION	BE/22/03/18	BR/22/03/18	BR/22/03/18

CO-ORDINATE SYSTEM: MGA | HEIGHT DATUM: AHD | SCALE: 1:200

SCALES: 2 0 2 4 6 8m

1 : 200 FULL SIZE A1

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DESIGNED	B.ESTRADA	22/03/18
DRG CHECK	E.NOCKOLDS	22/03/18
DESIGN CHECK	B.ROURAY	22/03/18
APPROVED	B.ROURAY	22/03/18

SYDNEY METRO CITY & SOUTHWEST

CHATSWOOD NORTHERN DIVE AND PRECINCT

GEOTECHNICAL & HYDROGEOLOGY

GEOTECHNICAL INTERPRETIVE REPORT

LONG SECTION - WEST

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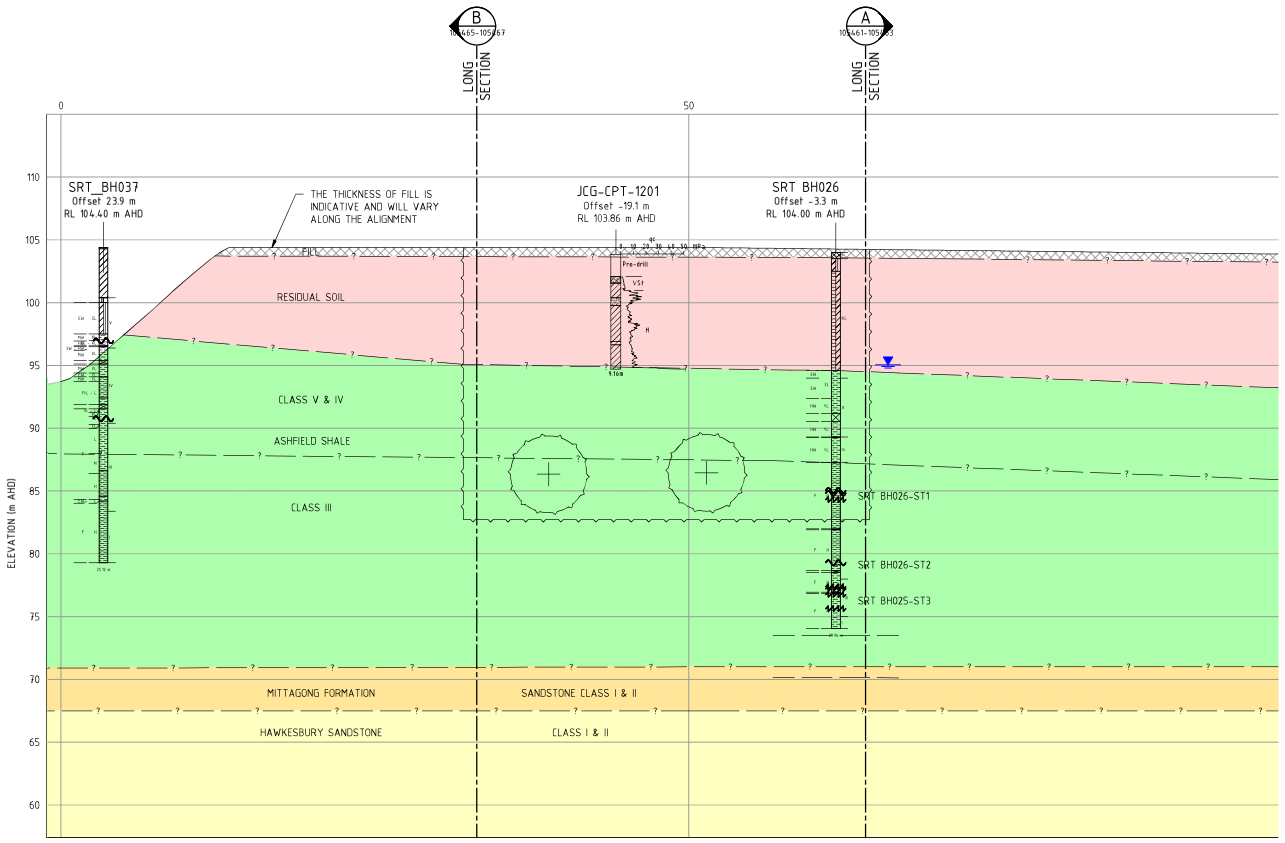

CHATSWOOD CROSS SECTION PORTAL

SECTION C 105460

1 : 200

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DRG CHECK	E.NOCKOLDS	22/03/18
DESIGN CHECK	B.ROUVRAY	22/03/18
APPROVED	B.ROUVRAY	22/03/18

SYDNEY METRO CITY & SOUTHWEST

CHATSWOOD NORTHERN DIVE AND PRECINCT

GEOTECHNICAL & HYDROGEOLOGY

GEOTECHNICAL INTERPRETIVE REPORT

CROSS SECTION - PORTAL

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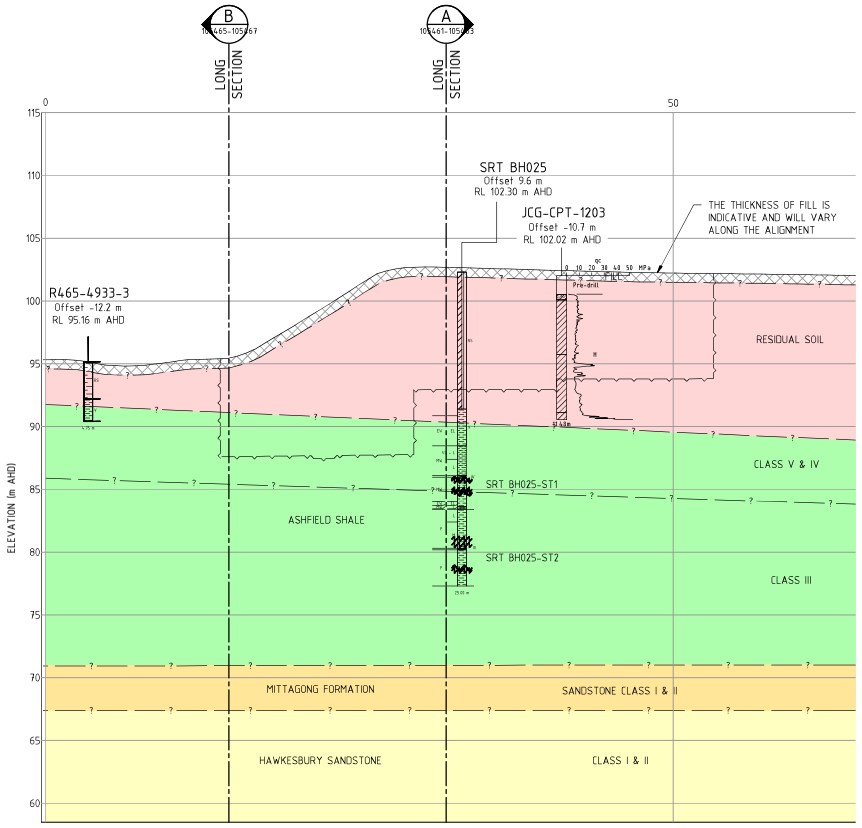

CHATSWOOD CROSS SECTION

SECTION D 105460

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DRG CHECK	E.NOCKOLDS	22/03/18
DESIGN CHECK	B.ROUVRAY	22/03/18
APPROVED	B.ROUVRAY	22/03/18

SYDNEY METRO CITY & SOUTHWEST

CHATSWOOD NORTHERN DIVE AND PRECINCT

GEOTECHNICAL & HYDROGEOLOGY

GEOTECHNICAL INTERPRETIVE REPORT

CROSS SECTION - SOUTH

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