
Specialist Advice

Report on Geotechnical Investigation

Proposed Residential Building

601 Pacific Highway, St Leonards NSW

Prepared for Stockland

Project 86230.01

18 March 2026

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

Signature

Date

Author

18 March 2026

Reviewer

18 March 2026



Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

Executive Summary

Stockland Development (Stockland) submitted an EOI for an SSDA and concurrent rezoning proposal on 17 January 2025 through the Housing Delivery Authority Pathway (HDA). At its Briefing on 19 February 2025, the HDA recommended to the Minister that the applicant's project be declared SSD, for the reason that it sufficiently satisfied the objectives and criteria of the HDA. The project was declared as SSD in the State Significant Development Declaration Order 2025 (No 2) (26 February 2025).

A request for SEARs was lodged on the 6th of June 2025 with SEARS received on the 4th of July 2025.

This geotechnical report has been prepared by Douglas and is submitted to the Department of Planning, Housing and Infrastructure (DPHI) in support of a State Significant Development Application (SSDA) (SSD-85848713) and concurrent rezoning proposal for a new mixed-use development at 601 Pacific Highway, St Leonards (the site).

The proposal seeks consent for the following:

- An amendment to the North Sydney Local Environmental Plan 2013 (NLEP 2013) to rezone the site from E2 Commercial Centre to MU1 Mixed Use and to amend the minimum non-residential floor space ratio development standard under Clause 4.4A from 20:1 to 1:1.
- Demolition of the existing 14 storey commercial office building that is currently on the site.
- Site excavation, remediation and other preparatory works.
- Construction and operation of a new 52 storey (RL264.50) mixed use shop top housing development, with a FSR of 20:1 (maximum GFA of 56,880m²), comprising:
 - o 538 dwellings including 508 Build-to-Sell apartments and 30 Affordable Housing apartments across a mix of apartment typologies.
 - o A contribution of 5% of the residential GFA toward Affordable Housing.
 - o Retail and commercial land uses at the ground and podium levels.
 - o Internal and external residential amenities provided throughout the building.
 - o Six levels of basement carparking, comprising a total of 300 car spaces, bicycle parking, loading bays, waste areas, plant, and back of house.
- Vehicular access to the basement via Atchison Street.
- Landscaping and Public Domain works.
- Reticulation of site services and infrastructure (electricity, telecommunication, water, and sewer connections).

This geotechnical report has been prepared to address the following relevant Secretary's Environmental Assessment Requirements (SEARs) set out in the Table 1 below.

Table 1: Secretary’s Environmental Assessment Requirements relevant to this report

SEARs	Report Reference
<p>12. Ground and Groundwater Conditions</p> <ul style="list-style-type: none"> Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site and including soil erosion. 	<p>Sections 2, 3, 4, 6, 9, 10</p>
<p>9. Transport</p> <ul style="list-style-type: none"> A Geotechnical report detailing the excavation of the site and support structures and consider proximity to the Sydney Metro corridor. The geotechnical report shall be prepared in accordance with Technical Direction GTD2020/001. 	<p>Section 2.1, 10.1, 10.2 and 10.6</p>

Table of Contents

	Page No
1. Introduction.....	1
2. Site Description	1
2.1 Sydney Metro Tunnels.....	3
3. Published data	4
3.1 Geology.....	4
3.2 Acid Sulphate Soils and Salinity.....	5
3.3 Hydrogeology	6
3.4 Previous Geotechnical Investigations on Nearby Sites	6
4. Results of Previous Nearby Works	6
5. Current Field Work Methods	7
6. Field work Results.....	8
6.1 Subsurface Profile	8
6.2 Groundwater	9
7. Laboratory Testing.....	10
8. Proposed Development.....	11
9. Geotechnical Model.....	11
9.1 Soil Profile.....	11
9.2 Rock Strata	12
10. Comments.....	13
10.1 Earthworks.....	13
10.2 Excavation Support.....	15
10.3 Foundations.....	19
10.4 Groundwater and Dewatering	20
10.5 Earthquake Design	21
10.6 TfNSW Considerations.....	21
11. Conclusion	22
12. Limitations.....	23

Appendix A: About This Report

Appendix B: Drawings

Appendix C: Borehole Logs

Appendix D: Permeability Test Results

Appendix D: Laboratory Test Results

Report on Geotechnical Investigation Proposed Residential Building 601 Pacific Highway, St Leonards NSW

1. Introduction

This report prepared by Douglas Partners Pty Ltd (Douglas) presents the results of a geotechnical investigation undertaken for a proposed residential building at 601 Pacific Highway, St Leonards NSW (the site). The investigation was commissioned by email instructing to proceed dated 04 November 2024 from Diego Eguiguren of Stockland and was undertaken in accordance with Douglas' proposal 86230.01.P.001.Rev2 dated 17/09/2024.

Based on the supplied architectural drawings prepared by Bates Smart, it is understood that the proposed development comprises the demolition of the existing 14-storey commercial building and construction of a new 52-storey mixed-used residential building with six basement levels. The existing basement has 4 partial basement levels in a gradually spiralling arrangement with the lowest basement level understood to be at about RL 81.3 m relative to Australian Height Datum (AHD). It is proposed to deepen the existing basement by about 8.3 m to RL 73 m AHD.

The current investigation was undertaken to provide information on the subsurface profile and groundwater levels to inform the design and planning of the proposed structure. The investigation included the drilling of six cored boreholes, groundwater well installation for permeability test and groundwater level monitoring, and laboratory testing of selected soil and rock samples. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

Douglas have also prepared the following reports for the project:

- Due Diligence Contamination Assessment (Ref.: 86230.01.R.002.Rev4, dated March 2026);
- Detailed Site Investigation (DSI) for contamination) (Ref.: 86230.03.R.002.Rev1, dated March 2026);
- Remediation Action Plan (RAP) (Ref.: 86230.03.R.001.Rev2, dated March 2026); and
- Groundwater Inflow Assessment (Ref: 86230.01.R.004.Rev2, dated March 2026).

This report must be read in conjunction with all appendices including the notes provided in Appendix A.

2. Site Description

The site is located on Cammeraygal country at 601 Pacific Highway, St Leonards within North Sydney (LGA). The site is legally described as Lot 71 in DP749690 and has a total area of 2,844m². The site is 4.5 km north of the Sydney CBD, 3 km from the North Sydney CBD, and within proximity to the centres of St Leonards, Chatswood, and Macquarie Park. The site is located 350 metres (walking distance) from St Leonards train station and approximately 400m (walking distance) from the Crows Nest Metro station.

A site aerial and location plan is provided at Figure 1 below.

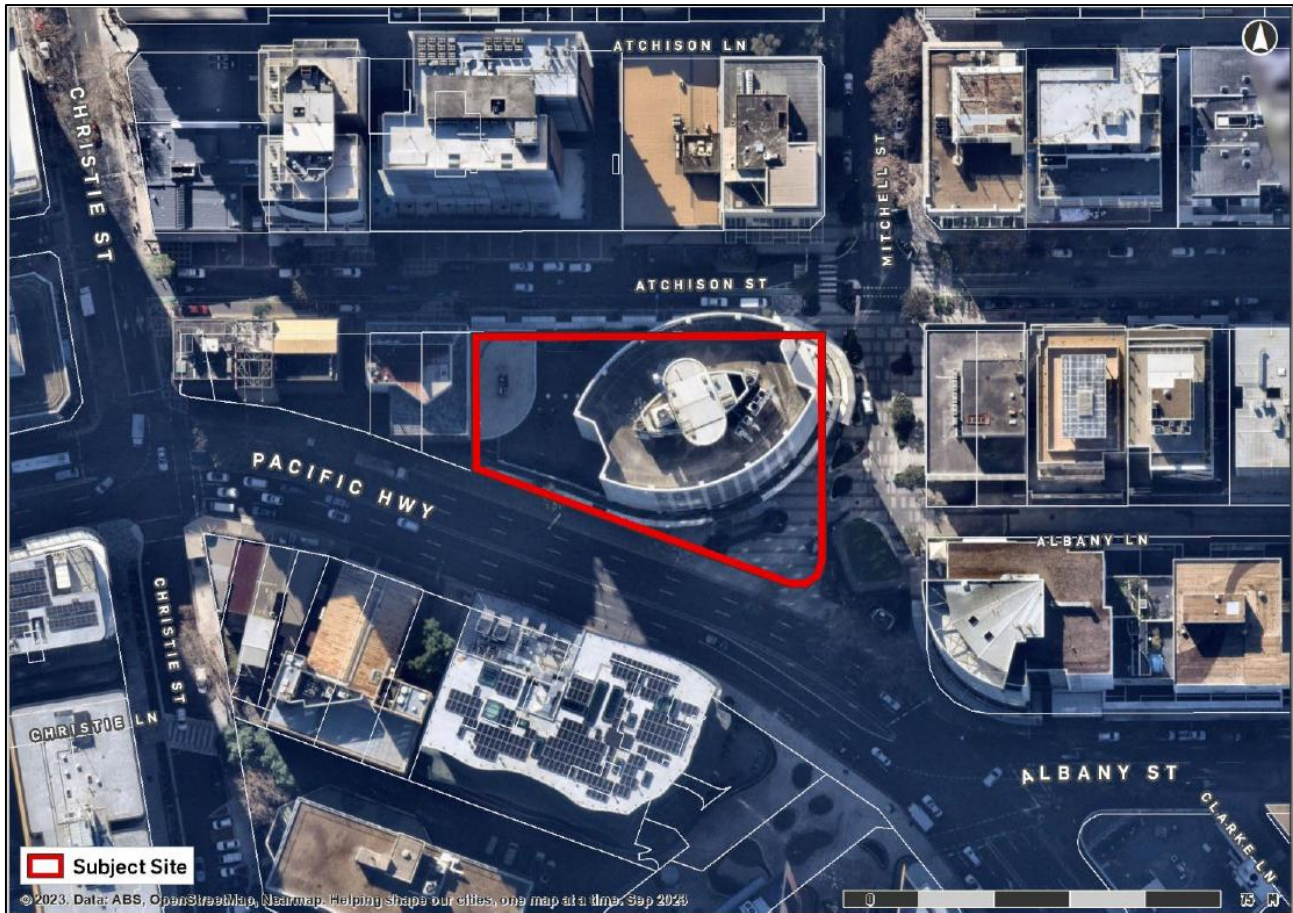


Figure 1: Site Location (provided by Urbis)

The site is bounded by a 7-storey commercial building with one level of basement carpark to the west, located at 619 Pacific Highway, and Mitchell Street to the east. Beyond Aitchison Street to the north is a 27-storey residential building understood to have a single level basement. Beyond Mitchell Street to the east is a five-storey commercial building with a basement car park.

Based on the available 'NSW 2 m Elevation Contours'; the site topography generally slopes down towards the west, with surface levels of approximately RL 93 m in the east, falling to RL 88 m in the west, relative to Australian Height Datum.

At the time of writing this report, the site is occupied by a 14-storey commercial building in the eastern portion of the site, and single level mixed-use retail in the western portion of the site, over the basement entrance. The basement levels comprise 4 partial basement levels in a gradually spiralling arrangement with the lowest basement level understood to grade from RL 82.4 m at its highest point, down to about RL 81.3 m at its lowest, measured during the initial surveying of the site. Based on the supplied existing basement drawings, it is understood that the basement retention system comprises a soldier pile wall. Shotcrete panels in the basement car park were observed and signs of minor cracking with seepage and iron staining noted.

The closest body of water to the site is Berrys Creek located approximately 750 m to the southwest, at a significantly lower elevation.

The site location is shown in Drawing 1, Appendix B.

2.1 Sydney Metro Tunnels

The *Sydney Metro Underground Corridor Protection Technical Guidelines* prepared by TfNSW (dated August 2025) provides comments and assessment criteria on Sydney Metro assets. The Technical Guidelines specify the “first reserve” boundary generally extends 5 m from the outer edge of the tunnel (or extent of Sydney Metro substratum above) and the “second reserve” boundary generally extends a further 25 m from the “first reserve” boundary .

It is understood from the supplied detailed survey plans provided by Sydney Metro, that the Sydney Metro corridor runs in a northwest-southeast direction below the site, with the entire of the site situated within the second protection reserve, and the first protection reserve running below the centre of the site. The protection reserves and tunnel alignments beneath the site are shown in Figure 1. The detailed survey plans prepared by LTS Lockley (Drwg. 52414 001BH) indicate that the first protection reserve is limited to RL 69.15 m AHD.

Based on the supplied architectural drawings, it is understood that the proposed six level basement finished floor level (FFL) will be at approximately RL 73.4 m, which is 4.25 m above the first protection reserve.

Liaison with Sydney Metro was undertaken to confirm the scope of the current geotechnical investigation and approvals were obtained via email dated 22 January 2025 on the locations and the target depths of the boreholes.

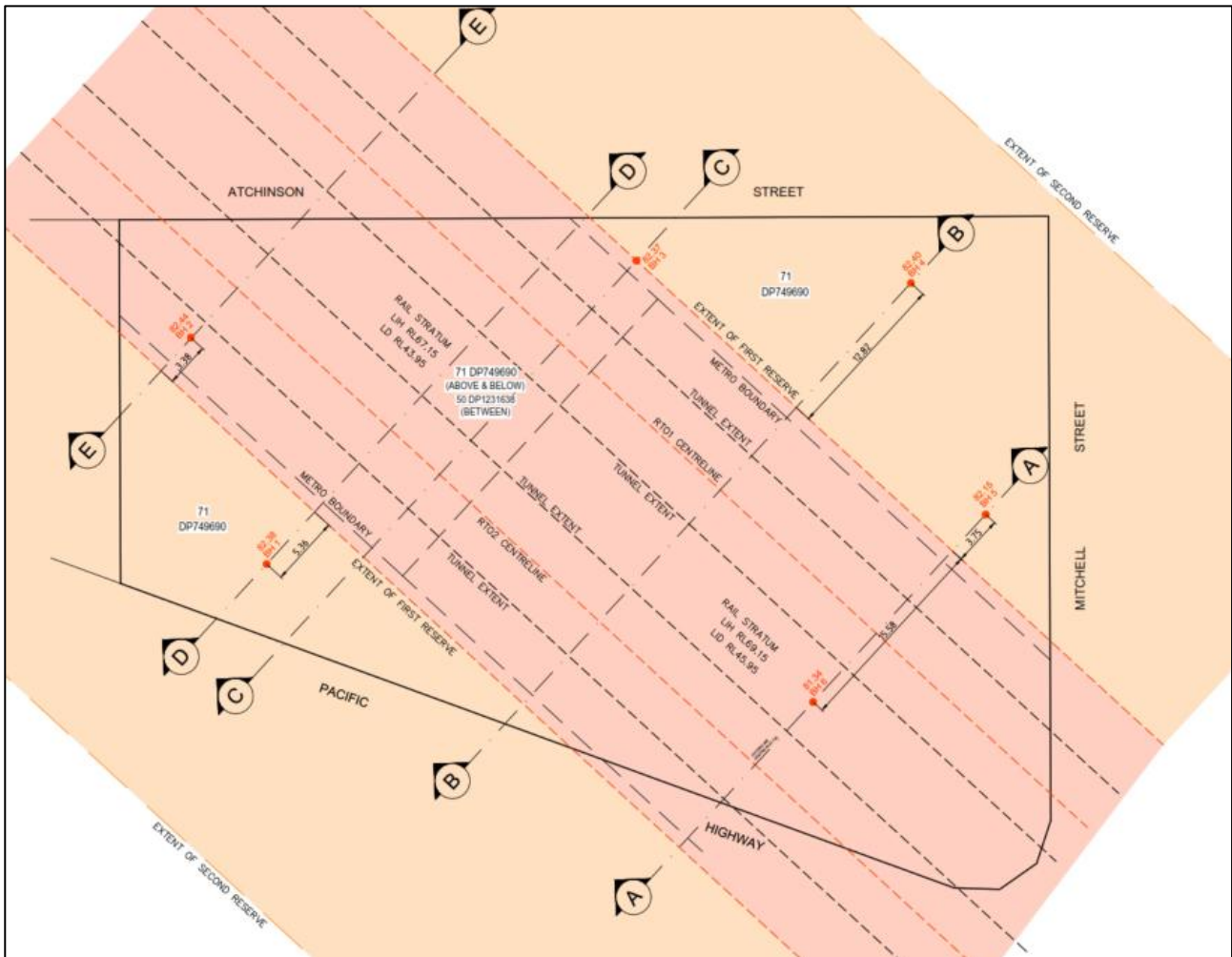


Figure 2 - Sydney Metro Tunnels and Protection Reserves beneath the site (LTS Lockley 52414 001BH)

3. Published data

3.1 Geology

Reference to the Sydney 1:100 000 Seamless Geology Sheet indicates that the site is underlain by the Ashfield Shale of the Wianamatta Group, described as black to dark-grey shale and laminite. Below the Ashfield Shale is the Hawkesbury Sandstone which typically comprises medium to coarse grained quartz sandstone with some shale and laminite bands or lenses. The Mittagong Formation is a transitional unit often found between the Ashfield Shale and Hawkesbury Sandstone and typically includes laminite and fine-grained sandstone of variable strength, ranging in thickness from about 2 m to 10 m.

Ashfield Shale is typically closely bedded and contains an orthogonal pair of steeply dipping (70° to 90°) joint sets striking NNE and ESE, spaced 0.5 m to 5 m. Random orientated, 30° to 45° dipping ubiquitous joints are also present. These joint sets persist through the Hawkesbury Sandstone, which is typically light to mid grey in colour and has massive and cross-bedded facies.

The Hawkesbury Sandstone normally has near-horizontal bedding partings spaced from less than 1 m to well over 3 m in places.

An extract from the geological map overlain by 2 m (AHD) contours is shown in Figure 2.



Figure 2 - Geological Map Extract

3.2 Acid Sulphate Soils and Salinity

Based on available mapping (NSW Acid Sulfate Soil Risk Mapping, 1998, by NSW Department of Environment and Climate Change and Mapping of Salinity Potential in Western Sydney, 2002, by NSW Department of Infrastructure, Planning and Natural Resources) the site is not within an area that is considered at risk of the occurrence of acid sulphate soils or soil salinity.

Furthermore, given the elevation, topography and geology of the site acid sulphate and highly saline soils are considered unlikely to be present at the site and further assessment is not required.

3.3 Hydrogeology

Based on the local topography, groundwater is anticipated to flow to the west.

One Water NSW registered groundwater bore with a current license is located approximately 420 m north of the site with a recorded standing groundwater level of 35 m depth or RL 37 m, referring to the available 'NSW 2 m Elevation Contours'. Shallower perched seepage may occur along the clay and rock surface and at strata boundaries and in defects in the rock mass.

It should be noted that groundwater levels may vary over time due to climatic and human influences and will temporarily rise following periods of prolonged rainfall.

3.4 Previous Geotechnical Investigations on Nearby Sites

Douglas has previously undertaken a number of geotechnical investigations for developments near the site between 2008 and 2023 as summarised below:

- September 2008 (Douglas reference no. 45742) – Geotechnical investigation at 9 - 11 Atchison Street, St Leonards which including drilling of one cored borehole to 18 m depth below ground level (BGL) for a 12-storey development with four basement levels.
- December 2012 (Douglas reference no. 73262.00) - Geotechnical Investigation at 18 - 22 Atchison Street, St Leonards, which involved the drilling of one cored borehole to 19 m depth for a multi storey development with five levels of basement. A groundwater well was installed for monitoring of groundwater levels during a limited period.
- January 2010 and August 2013 (Douglas reference no. 71470.00 and .02) - Geotechnical Investigation at 6 - 16 Atchison Street, comprising four cored boreholes to a maximum depth of 22 m BGL for a 25-storey building with six basement levels.
- September 2023 (Douglas reference no. 205925.01) – Geotechnical Investigation at 617-621 Pacific Highway, St Leonards, which involved the drilling of four cored boreholes to 27 m depth for a 50-storey development with up to six basement levels.

Douglas was also extensively involved with geotechnical consultancy services during a deep basement construction at 500 - 520 Pacific Highway. Douglas' services included installation of three 15 m deep groundwater wells and *in-situ* permeability assessment using Packer and slug testing. Two boreholes were also drilled and were logged to depths of about 30 m to install inclinometers along the site's boundary with Pacific Highway. The rock face and seepage flows were inspected progressively during excavation.

The geotechnical investigations undertaken on nearby sites have been used to assist in developing a geotechnical model for the subject site.

4. Results of Previous Nearby Works

A review of some of Douglas' previous investigations near the site, indicate that the general stratum underlying the area comprises Ashfield Shale (Siltstone / Shale and Laminite) to depths of about 5.7 m to 20 m (RL 78 m to RL 68 m), followed by Mittagong Formation then Hawkesbury Sandstone, which typically included medium to high strength, slightly fractured sandstone.

Previous groundwater monitoring has encountered groundwater at depths between 13 m (RL 75 m AHD) and 19.7 m (RL 64.0 m AHD) within the Ashfield Shale and Hawkesbury Sandstone.

Some observations from construction phase works on nearby projects included:

- Considerable water seepage noted during piling within the deeper shale profile at some locations;
- The results of packer tests were in a range of 6.9×10^{-8} and 1.2×10^{-6} m/s within the bedrock. The Packer tests indicated that the lower rock strata of the tested sections (high strength sandstone) were more permeable than typically expected for Hawkesbury Sandstone / Mittagong Formation;
- The results of the falling head permeability tests indicated that the fresh Hawkesbury Sandstone had a permeability between 1.2×10^{-5} and 1.2×10^{-6} m/s, whilst the highly weathered sandstone had a permeability of 2.4×10^{-8} m/s;
- Slug test results were in a range of 7.1×10^{-8} to 2.3×10^{-7} m/s for the weathered rock profile; and
- Zones of fractured / sheared rock and possible fault zones within high strength rock were observed at various depths of between 12 m to 22 m, which corresponded to the increase in the permeability of the rock mass at some locations.

5. Current Field Work Methods

The current field work involved the drilling of six cored boreholes within the lowest basement level at the locations shown on Drawing 1 in Appendix B. A summary of the field work is presented as follows:

- Borehole locations set out and surveying using an accredited surveyor of each location to determine the locations and surface levels within the basement relative to the Sydney Metro tunnel alignment;
- Scanning for underground services at each location using an accredited services locator with supervision by a geotechnical engineer from Douglas;
- Drilling of six boreholes using a tight access, low headroom, track-mounted drilling rig between 24 March and 10 April 2025. Boreholes were commenced with a diacore barrel to penetrate through the existing basement concrete slab, and then extended into the soil profile using solid flight augers to reached top of bedrock. The boreholes were then advanced to their target depths using NMLC diamond coring to obtain continuous core samples of the bedrock. Boreholes BH01 – BH03, BH05 and BH06 were drilled to depths of between 11.0 m and 15.0 m, approximately 5 m below the proposed lowest basement FFL and at least 1.0 m above the first protection reserve. BH04 was drilled to a depth of 31.5 m or RL 50.9 m AHD, to obtain data below the Sydney Metro Tunnel invert level;
- Point Load Index strength tests were undertaken at regular intervals along the rock core. Selected rock core samples were also tested at Douglas' NATA accredited laboratory for Unconfined Compressive Strength (UCS) testing;
- Groundwater monitoring wells were installed in boreholes BH01, BH03, and BH06 to 14.8 m, 12.1 m, and 11.1 m, respectively. The wells were purged on 9 and 10 April 2025;
- Supervision of the drilling, sampling and logging of the boreholes by an experienced engineering geologist;

- Falling head permeability tests involving introducing water to raise the water level and measuring the rate of discharge were carried out in the groundwater wells on 10 and 17 April 2025. Data loggers were installed in all wells on the same day to monitor the ground water level variations for a minimum period of three months and is currently on-going.

6. Field work Results

6.1 Subsurface Profile

The detailed subsurface conditions encountered are presented in the borehole logs in Appendix C along with notes defining descriptive terms and classification methods. Photographs of the recovered rock cores are also included.

The general subsurface profile encountered at the borehole locations may be summarised as follows:

CONCRETE

- Concrete slab at all borehole locations, measured to be between 130 mm and 180 mm thick. At BH01, the concrete slab comprised two slabs of 90 mm and 130 mm, with bedding sand separating the two. Reinforcement of 8 mm diameter was noted within the concrete slabs.

FILL

- Typically sandy clay and clayey sand with various proportions of igneous gravel within the shallow depths of the boreholes, with variable thickness in a range of 0.4 m to 2.4 m. The fill layer was observed to reduce in thickness in boreholes which were located in the deeper basement levels, with the thickest layer observed in BH01, and the thinnest in BH06.

SHALE BEDROCK

- Generally low to medium strength, fresh, dark grey shale (Ashfield Shale) encountered in all boreholes below the fill to depths between 4.1 m and 4.8 m. The shale was typically slightly fractured. Frequent joints dipping 30° to 70° were observed within the shale bedrock. Sub-horizontal crushed zones with clay infill were also noted within BH02 between 3.9 m and 4.7 m depth. Very low strength bands accompanied with crushed zones and joints dipping 35° to 60° were noted in BH05 between 2.7 m and 5.3 m depth in BH05.

SANDSTONE and LAMINITE BEDROCK

- Typically medium and medium to high strength, fresh to slightly weathered, pale grey and grey fine to medium grained sandstone and laminite (Mittagong Formation), and pale grey medium to coarse grained sandstone (Hawkesbury Sandstone) to depths of about 10.4 m and 17.0 m. Zones of very low and low strength rock were noted within the laminite bedrock at BH01 at depths of 5.0 m, 7.5 m, and 8.5 m. The rock was typically slightly fractured to

unbroken. Sub-vertical joints dipping 70° to 90° were observed within BH03 between 7.2 m and 9.5 m depth.

HIGH STRENGTH SANDSTONE ROCK

- Medium to high strength and high strength, fresh, pale grey to grey, fine to medium grained sandstone and laminite (Mittagong Formation), grading to fresh, high strength, medium to coarse grained sandstone (Hawkesbury Sandstone) to the termination depth of boreholes. A very high strength band was noted within BH01 between 14.3 m and 14.8 m depth. The high strength rock was typically unbroken. A low to medium strength, fractured zone was noted in BH04 between 26.2 m and 30.5 m depth.

POSSIBLE THRUST FAULTS

- The low to medium strength rock and crushed zones with joints dipping 15° to 25°, observed in BH04 between 26.2 m and 30.5 m depth, were accompanied with significant loss of drilling fluid, indicating a possible presence of a thrust fault.

6.2 Groundwater

No groundwater was observed during augering of the boreholes. The use of water as a drilling fluid during diamond coring precluded measurement of the groundwater level during the drilling of the boreholes. The results of the ground water level monitoring from the installed wells are summarised in Table 2 below.

Table 2: Summary of Groundwater Level Measurements

Borehole	Measured Groundwater Depth (m) and RL [<i>m AHD</i>]		
	9 April *	17 April *	7 July
BH01	11.0 [71.4]	10.83 [71.6]	11.12 [71.3]
BH03	9.0 [73.4]	6.73 [75.7]	8.17 [74.2]
BH06	N.D	3.40 [77.9]	6.13 [75.2]

Note: * Measurement may be influenced by purging and permeability testing completed 09/04/25 and 17/04/25
N.D – No data

After installation, the groundwater monitoring wells were purged of drilling fluid using a submersible pump on 9 and 10 April 2025.

Data loggers were installed in all wells between 9 April and 7 July 2025 to monitor the ground water level variations for a minimum period of three months.

A summary of the datalogger records during this reporting period is provided in Table 3.

Table 3: Summary of Datalogger Results during the Reporting Period

Borehole	Groundwater Readings (m) [RL m AHD]			
	Minimum	Maximum	Mean	Median
BH01	10.71 [70.78]	11.62 [71.69]	11.08 [71.32]	11.05 [71.35]
BH03	7.30 [73.88]	8.52 [75.10]	8.03 [74.37]	8.09 [74.31]
BH06	5.84 [75.08]	6.22 [75.46]	6.08 [75.22]	6.12 [75.18]

Notes: Data influenced by the permeability testing have been removed from this data set.

The results of permeability tests carried out by Douglas are given in Appendix E and are summarised in Table 4.

Table 4: Summary of Hydraulic Conductivity Test Results

Test Location	Screened Depth (m)	Test Method	Material	Hydraulic Conductivity (m/sec)
BH01	3.0 – 14.8	Falling Head	Shale & Sandstone / Laminite	2.3×10^{-7}
BH03	0.5 – 12.1	Falling Head	Shale & Sandstone / Laminite	4.3×10^{-9}
BH03	0.5 – 12.1	Falling Head	Shale & Sandstone / Laminite	5.6×10^{-9}
BH06	1.5 – 11.1	Falling Head	Shale & Sandstone / Laminite	2.8×10^{-7}

The results of the permeability testing undertaken during the current investigation for BH03 are up to approximately two orders of magnitude lower than some of the results from nearby previous investigations for the “weathered sandstone”. However, these values are consistent with the typical expected values for permeability in high strength, unfractured rock (Pells 2019).

7. Laboratory Testing

Selected samples of the rock core were tested in the laboratory to determine the Point Load Strength Index (IS_{50}) values to assist with the rock strength classification. The results of the testing are shown on the borehole logs at the appropriate depth. The IS_{50} values for the rock ranged from 0.12 MPa to 3.18 MPa, indicating that the rock samples tested were of very low to very high strength, with an average IS_{50} value of 1.0 MPa, corresponding to medium to high strength.

Six rock core samples were tested for Uniaxial Compression Strength (UCS) with modulus measurement. A summary of the results is presented in Table 5 below.

Table 5: Summary of UCS on rock core samples

Sample Source	Uniaxial Compressive Strength (MPa)	Young's Modulus (GPa)		Poisson's Ratio	
		Tangent	Secant	Tangent	Secant
BH01, (7.1 – 7.3m)	35.0	2.7	2.6	0.23	0.39*
BH02, (13.4 – 13.7m)	25.0	7.8	5.3	0.42*	0.21
BH03, (8.1 – 8.4m)	21.7	2.7	3.1	0.32	0.17
BH04, (25.0 – 25.4m)	27.8	9.0	8.0	0.39*	0.26
BH05, (7.6 – 7.9m)	43.0	5.9	5.7	0.34	0.19
BH06, (6.4 – 6.6m)	17.7	2.9	3.0	0.15	0.10

Notes: *These values are not within the normally expected range values for this material and should be disregarded.

8. Proposed Development

It is understood that the proposed development comprises the demolition of the existing 14-storey commercial building and construction of a new 52-storey mixed-use residential building with six basement levels. The sixth level basement FFL is understood to be RL 73 m AHD, with a bulk excavation level of RL 72.6 m, requiring additional excavation of up to about 8.3 m depth. Deeper detailed excavations are expected to be required for lift pits/cores and footings to about RL 70.8 m. Based on the supplied architectural drawings, it is understood that part of the existing soldier pile shoring wall will remain in some areas, and a secondary shoring system will be installed to support the existing wall and to provide retention of the additional basement levels.

The proposed basement set out in relation to the first and second protection reserves of the Sydney Metro necessitate a detailed engineering impact assessment, which will be undertaken by Douglas in a separate stage and will require review by TfNSW / Sydney Metro,

9. Geotechnical Model

The field work results (i.e. borehole logs) from the current and nearby previous investigations, where relevant, are summarised on interpreted geotechnical cross-sections in Appendix B (Drawings 2 - 4). These cross-sections show the interpreted layers of soil and rock units between the borehole locations. The interpreted boundaries shown on the sections are accurate only at the test locations and layers shown diagrammatically on the drawings are inferred, only. As noted on these cross-section drawings, subsurface conditions may vary away from the borehole locations. Also, it should be noted that bands of lower or higher strength rock may be present within the generalised rock layers.

9.1 Soil Profile

The shallow soil profile encountered in the boreholes below the existing basement generally included clayey sand and gravel fill to depths between 0.5 m and 2.6 m. This fill layer was observed to reduce in thickness in boreholes which were located deeper in the existing basement, with the thickest layer observed in BH01, and the thinnest in BH06. It is assumed that

the fill layer has been placed as fill beneath the basement slab and is therefore not expected to continue laterally beyond the existing basement walls and retaining structure.

The results of the previous nearby 205925.01 investigation indicate that the soil profile below street level, surrounding the site is likely to comprise sandy gravel and clayey sand fill to depths of up to 2.5 m, followed by very stiff to hard consistency, medium to high plasticity clay residual soil to depths in a range of 0.9 m to 1.5 m, or RL 81.2 m to RL 85.0 m. If the upper soil profile becomes important for the design of shoring / retention or other structures, additional investigation should be conducted at street level.

9.2 Rock Strata

The rock encountered in the cored boreholes has been classified in accordance with Pells et al (2019) "Classification of Sandstone and Shale in the Sydney Region: A Forty Year Review" Aust. Geomechanics Journal, June 2019. There are five classes of rock (I to V) based on strength, fracturing and the amount of defects such as sheared zones and clay seams. Class I rock is the best quality (high strength with very few defects) while Class V represents the lowest quality rock (very low strength and / or numerous defects) in the classification system.

The rock classes encountered in the boreholes have been generalised and are defined in Table 6. It is noted that in some cases, zones of higher or lower 'class' rock may be present at varying depths in the defined rock units.

Table 6: Summary of Defined Rock Units

Rock Unit / Classification	Description
Unit 1 – Generally low to medium strength shale (Class III)	Ashfield Shale – generally low to medium with some high strength zones, fresh shale, typically slightly fractured to unbroken ⁽¹⁾
Unit 2 – Medium strength laminite and sandstone (Class III)	Mittagong Formation – medium strength, fresh, fine to medium grained laminite and sandstone, typically slightly fractured with some fractured zones. Some low strength bands.
Unit 3 – Medium to high strength sandstone and laminite (Class II)	Mittagong Formation – medium to high strength, fresh, grey and pale grey, fine to medium grained sandstone and laminite
Unit 4 – High strength sandstone (Class II/I)	Hawkesbury Sandstone – High strength, fresh, pale grey, unbroken, medium to coarse grained sandstone ⁽²⁾

Notes: (1) Very low strength bands were encountered within Unit 1 in BH05 and high strength in BH04

(2) Fractured, medium strength sandstone (Class III) was noted between 26.5 m and 30.0 m in BH04

The interpreted depth and Reduced Level (RL) at the top of the various defined rock units is shown in and Table 7.

Table 7: Summary of Depths (and Reduced Levels) to Top of Various Rock Units

Borehole	Surface RL (AHD)	Depth [RL] to top of rock units (m)			
		Unit 1	Unit 2	Unit 3	Unit 4
BH01	82.4	2.6 [79.8]	4.5 [77.9]	8.7 [73.8]	12.0 [70.4]
BH02	82.4	1.1 [81.3]	4.7 [77.7]	6.0 [76.4]	13.4 [69.0]
BH03	82.4	0.7 [81.7]	4.8 [77.6]	7.9 [74.5]	N.E
BH04	82.4	0.6 [81.8]	4.2 [78.2]	9.4 [73.0]	17.0 ⁽¹⁾ [65.4]
BH05	82.2	1.3 [81.0]	4.8 [77.5]	6.9 [75.3]	N.E
BH06	81.3	0.5 [80.8]	4.0 [77.3]	4.5 [76.8]	N.E

Notes: (1) Fractured, medium strength sandstone (Class III) was noted between 26.5 m and 30.0 m in BH04
N.E – Not Encountered

Groundwater was measured at variable depths of between 3.4 m and 11.1 m (RL 71.3 m to RL 77.9 m). The variable water levels may be attributed to nearby drained basements and / or the Sydney Metro rail tunnels and suggest it may also be associated with perched seepage and not the permanent/regional groundwater table. It should be noted that the groundwater levels are affected by climatic conditions, rock mass permeability and available defects and will vary with time.

10. Comments

10.1 Earthworks

10.1.1 Excavation

Excavations to deepen the existing basement is expected to require the removal of fill, low to high strength shale then medium and high strength slightly fractured and unbroken laminite and sandstone.

Excavation of fill and low strength rock should be achievable using conventional earthmoving equipment, however, the assistance of rock hammering or ripping will generally be required for effective removal of any medium to high strength rock in the upper shale rock profile. Excavation of medium and high strength rock may require heavy ripping with a large bulldozer together with the use of large hydraulic rock breakers for effective removal of this material and rock saws, where necessary, to reduce the vibration impacts to the neighbouring structures.

Some of the unbroken, high strength rock may be effectively unrippable with very low productivity expected. Pre-splitting (consecutive drilled holes along the proposed excavation line)

or rock sawing may be required to break up this rock, prior to the use of rock hammering and bulldozers with ripping tynes.

The excavation rate that can be achieved, particularly within high strength rock, varies considerably and is dependent upon the degree of jointing in the rock, the rock strength, the type of machinery being used and the skill of the operator. It is suggested that bulk excavation tenderers be required to make their own assessment of the equipment required to carry out the work. Contractors may inspect the rock core samples at the Douglas' office in West Ryde prior to submitting final tenders (rock cores are generally kept for 6 months after drilling unless longer holding times are requested).

10.1.2 **Vibration**

During excavation, it will be necessary to use appropriate methods and equipment to keep ground vibrations at adjacent buildings and structures within acceptable limits. Excavations within soil and low strength rock are not expected to generate excessive vibrations. The use of heavy ripping and rock hammers in the deeper parts of the excavation and for demolition and removing the concrete slab may generate vibrations, which should be monitored.

Ground vibration can be strongly perceptible to humans at levels above 2.5 mm/s peak particle velocity (PPVi). This is generally much lower than the vibration levels required to cause structural damage to buildings. The Australian Standard AS2670.2-1990 "Evaluation of human exposure to whole-body vibrations - continuous and shock induced vibrations in buildings (1-80 Hz)" indicates an acceptable day time limit of 8 mm/s PPVi for human comfort.

Based on Douglas' experience and with reference to AS2670, it is suggested that a maximum PPVi of 8 mm/s (applicable at the foundation level of existing buildings/structures) be provisionally employed at this site for both architectural and human comfort considerations, although this vibration limit may need to be reduced if there are sensitive buildings, structures or equipment in the area.

In relation to rail tunnels, further advice on the vibration criteria will need to be sought from Sydney Metro/TfNSW. Based on our experience, it is anticipated that TfNSW may nominate a vibration limit of 12.5 mm/s for the rail tunnels, although this will need to be confirmed. Rock sawing, pre-splitting and the use of smaller equipment may be required as excavations approach the anticipated bulk excavation level.

As the magnitude of vibration transmission is site specific, it is recommended that a vibration trial be undertaken at the commencement of rock excavation or initial use of different excavation plant. The trial may indicate that smaller or different types of excavation equipment should be used for bulk (or detailed) excavation purposes.

10.1.3 **Dilapidation Surveys**

Dilapidation surveys should be carried out on adjacent buildings, pavements and infrastructure that may be affected by the excavation works. The dilapidation surveys should be undertaken before the commencement of any excavation work in order to document any existing defects so that claims for damage due to construction related activities can be accurately assessed.

10.1.4 Disposal of Excavated Material

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014). This includes fill and natural materials that may be removed from the site. Reference to Douglas' contamination report should be made for further information.

10.2 Excavation Support

10.2.1 Excavation Support and Vertical Rock Faces

Both temporary and permanent lateral support will be required during deepening of the existing basement for all vertical excavation faces within soil and the shale and laminite rock (Units 1 to 3). Details of the existing shoring wall and adjacent buildings and footings will need to be confirmed prior to detailed design of the shoring system for the new development scheme.

Based on the supplied architectural drawings, it is understood that the existing shoring will remain in place, and a new soldier pile wall will be constructed in front to support the additional two levels of basement. Prior to removal of the existing structure and basement floor slabs, it will be necessary to provide lateral support to the existing retaining structure with bracing or temporary anchors as these slabs are presumably supporting the existing basement walls.

Soldier piles for the deepened basement excavation could be installed spaced at approximately 2 m to 2.5 m centres and preferably founded at least 1 m or two pile diameters below the lowest bulk excavation level, or adjacent excavation for drainage trenches, pits or other utilities. More closely spaced piles may be required to reduce wall movements or prevent the collapse of materials in between the soldier piles.

At the completion of each 1.5 m to 2 m drop in excavation level, reinforced shotcrete infill panels should be constructed. It is suggested that shotcrete protection should be provided for Ashfield Shale and Mittagong Formation as it can be prone to deterioration with time. This requirement in Class II rock (where encountered) can be reassessed when the rock is exposed. At no stage should progressive vertical excavation proceed beyond 2 m without infill panel support being constructed. Regular inspections by a geotechnical professional should be carried out following each progressive drop in excavation level to confirm that the conditions encountered are consistent with the design assumptions.

It may be possible to terminate the shoring piles within unsupported medium to high strength sandstone/laminite (Units 3 and 4) above the bulk excavation level. In this case it will be important for a geotechnical engineer to assess the stability of the rock directly beneath each pile, and excavation may need to be completed in "hit and miss" panels. Consideration should also be given to the loads applied above any vertical rock cut (i.e. by shoring or footings) to ensure these loads are within the reduced capacity of the rock following excavation. The toe of the piles which terminate above bulk excavation level will also need to be restrained with rock bolts or anchors.

It is assumed that the existing shoring wall terminates below the existing lowest basement floor level and this aspect will require confirmation prior to bulk excavation. As excavation and piling progresses, the toe of the existing shoring wall piles will need to be restrained with rock bolts or anchors to provide additional passive support.

Suitably powered piling rigs will be required to penetrate the medium and high strength sandstone/laminite and this should be considered by the piling contractor. Consideration should also be given to the potential for groundwater inflow into the piles which may be heavy where fractured zones and faults are encountered and at strata boundaries. This may require the use of cleaning buckets and possibly tremmie pouring methods.

Medium strength or better sandstone (Unit 3 and 4 rock) will generally be stable when cut vertically provided there are no adversely oriented joints or other defects present. All vertical faces in rock should be inspected by an experienced geotechnical engineer at 1.5 m depth intervals to check for adversely inclined joints and to assess whether additional stabilisation measures (such as rock bolts or shotcrete) are required. A number of steeply dipping joints and clay infilled defects were encountered within the rock, which may affect the stability of the excavation faces if adversely orientated. The joints can form unstable rock slivers, blocks and wedges which may require additional support. Bedding planes and soft seams are also common in the Hawkesbury Sandstone, including high strength rock. Thick seams and fractured zones may require shotcrete and rockbolt support to protect these areas over the long term. These defects can also affect the stability and footing performance of adjacent buildings. Excavated faces in medium strength or stronger sandstone can therefore only be considered self-supporting once mapping has confirmed that they are not adversely affected by discontinuities or soft seams.

10.2.2 Earth Pressures for Shoring Design

Preliminary design of shoring systems may be based on the earth pressure coefficients provided in Table 8. 'Active' earth pressure coefficient (K_a) values may be used where some wall movement is acceptable. 'At Rest' earth pressure coefficient (K_o) values should be used where the wall movement needs to be limited. These parameters do not take into account stress relief which must also be considered.

Table 8: Recommended Design Parameters for Shoring Systems

Unit/Material	Unit Weight (kN/m ³)	Earth Pressure Coefficient		Ultimate Passive Earth Pressure (kPa)
		Active (K_a)	At Rest (K_o)	
Fill	19	0.4	0.6	$K_p = 2.5$
Residual Clay	20	0.35	0.5	$K_p = 2.0$
Class III Shale (Unit 1)	22	0.25	0.4	2000
Class III Laminite and Sandstone (Unit 2)	23	0*	0.1	3000
Class II / I Laminite and Sandstone (Units 3 and 4)	24	0*	0*	4000

Notes: The values above assume a level surface behind the wall
 *It is assumed that the rock mass is free of adversely dipping joints and seams
 It should also be noted that the K_a and K_o designs will not prevent stress relief movement

For braced walls or where two or more rows of anchors are used, the shoring can be designed using a rectangular or trapezoidal earth pressure distribution. For preliminary design purposes, a trapezoidal earth pressure distribution with a maximum pressure calculated based on $4H$ kPa where H is equal to the retained height of soil and Ashfield Shale (Unit 1) may be assumed. The maximum pressure should be increased to $6H$ to $8H$, depending on the sensitivity of any structures behind the shoring wall, where wall movement needs to be reduced. In each case the maximum pressure generally acts over the central 60% of the wall height, reducing to zero at the top and base.

The design of temporary (and possibly permanent) support will also need to consider the possibility that moderately to steeply dipping joints in the weathered rock and Ashfield Shale will 'daylight' near the base of the excavation or top of Class III or better sandstone leading to wedges of rock requiring support by the temporary (and permanent) shoring/ retaining structures. For the temporary case, the required forces are generally provided by temporary 'tie-back' ground anchors and prudent, conservative design of deep excavations in shale generally involves shoring piles extending below the bulk excavation level to provide passive restraint to the shoring/retaining walls. As a guide, an anchor force equal to $4.2H^2$ kN per metre length of wall would be required for a continuous 45 degree joint daylighting at the base of the Ashfield Shale, and this often governs the shoring/anchor design for deep excavations in jointed shale. This assumes anchors at 10 degrees and the anchor load increases with increased inclination.

Additional surcharge loads such as new and existing footings, existing shoring walls, construction loads, etc., must be allowed for in the design.

The earth pressure loading described above does not include either earthquake loads or hydrostatic pressures. Unless positive drainage measures are incorporated to prevent water pressure build-up behind the walls, allowance for the hydrostatic head associated with a groundwater level rising to at least a metre above the highest measured groundwater level should be allowed for in the design, noting that groundwater monitoring in the installed wells is still ongoing and will be reported progressive.

Consideration should also be given to the assessment of a 'burst water main' sensitivity case, in which the full hydrostatic pressure is applied to the shoring wall. Such an event is considered of low probability but could potentially be of high consequence, should it occur. Therefore, assessment of the proposed shoring system and lateral restraint for such a case may be prudent as a precaution against such events.

Passive resistance for piles founded below the base of the bulk excavation may be based on the ultimate passive pressures given in Table 8. A factor of safety of at least 2 should be applied to limit wall movements. The passive restraint of the first 0.5 m of rock socket below the bulk excavation level (or base level of any adjacent excavations along the excavation/wall line) should be ignored. The minimum socket depth should be equal to the greater of two pile diameters or 1.0 m below the lowest level of any nearby excavation (including any detailed excavations), but subject to analysis.

Detailed design of the shoring should be carried out using software such as Plaxis or similar that is capable of modelling soil structure interaction and ground movements on adjacent areas.

10.2.3 Ground Movement and Stress Relief

Horizontal movements due to stress relief of the Hawkesbury Sandstone and Mittagong Formation and to a lesser extent the Ashfield Shale will occur during the excavation works. Based on published literature and Douglas' experience, the lateral deflections associated with stress relief in rock may be in the order of 0.05% to 0.2% of the excavation height, depending on the various factors such as rock strength, orientation of the face, a degree of fracturing. The predicted deflections would generally be greatest at the centre of the excavated faces and would reduce with distance from the excavation face/boundary.

It is unlikely to be practicable to provide restraint (i.e., anchoring) for the relatively high in-situ horizontal stresses associated with stress relief movements. Therefore, it is recommended that appropriate allowance be made for movements of this order in construction and planning

10.2.4 Anchor Design

Post-stressed ground anchors, rock bolts and dowels (support elements) can be used to laterally support existing walls, new shoring, underpinning works or unstable rock blocks and wedges. Anchors will also be required to restrain the toe of any existing shoring piles (proposed or existing) not suitably socketed below the bulk excavation level.

Encroaching the Sydney Metro First Protection Reserve is not generally permitted. As such, all support elements must be designed to be limited within the Second Protection Reserve and this will still require assessment and approval from Sydney Metro.

Anchors could also be used vertically as hold down anchors although the proximity of the Sydney Metro First Protection Reserve may limit this option. Support elements used for lateral support should be bonded in the stronger rock, inclined as required, but preferably not steeper than 30° below horizontal. Table 9 provides ultimate bond stresses for anchors design.

Table 9: Recommended Bond Stresses for Rock Anchor Design

Material	Ultimate Bond Stress (kPa)
Class III Shale (Unit 1)	300
Class III Laminite and Sandstone (Unit 2)	1000
Class II Laminite and Sandstone (Unit 3)	1500
Class II / I Sandstone (Unit 4)	2000

These values should be confirmed by pull-out tests prior to installation of support elements. Ultimately, it is the contractor's responsibility to ensure that the correct design values (specific to the support system and method of installation) are used and that the support element holes are carefully cleaned prior to grouting.

After temporary support elements have been installed, it is recommended that they are tested to 125% of their nominal Working load. Where stress relief or further unavoidable movement of the shoring is expected, it is recommended that the support elements are locked-off between 60% and 80% of their Working loads to accommodate the additional movement and subsequent

increase in stress in the support elements. Consideration should, however, be given to the immediate design requirements. The capacity of the anchor may have to be increased if a lower initial lock-off is not feasible. Checks should be carried out to confirm that the load in the support elements has been maintained and that losses due to creep effects or other causes have not occurred.

Shorter support elements (i.e., rockbolts, dowels and pins) may be required to support any unstable rock wedges, slivers or blocks. Short dowels and pins may be required to support feather edges where sub-parallel joints intersect the face. Shotcrete with mesh (or fibrecrete) may be required where beds/seams of extremely weathered and very low strength rock are encountered within higher strength sandstone, secured with anchors, rockbolts, dowels or pins, as required. Care should be exercised to ensure that anchors are installed progressively during excavation and stressed prior to excavation of the next drop to ensure that stability is maintained at all times

It is anticipated that the new structure will support the existing and newly constructed shoring walls over the long term and therefore the support elements are expected to be temporary only. The use of permanent rockbolts and ground anchors, if required, will need careful attention to corrosion protection. It should be noted that permission will be required from adjacent property owner prior to installing rockbolts / ground anchors below their land. Due consideration should also be given to below-ground excavations, services, etc.

10.3 Foundations

Based on available information it is likely that medium to high strength sandstone and laminite (Class III or better) will be exposed at the base of the excavation. Typical parameters for the design of foundations on laminate and sandstone, based on the classification methods of Pells et al. (2019) are provided in Table 10, and are subject to spoon testing/proof coring, where required. Shaft adhesion values for uplift (tension) in piles may be taken as being equal to 70% of the values for compression, provided that adequate socket roughness is achieved.

Consideration should be given to downgrading of the bearing pressure if weak seams are likely to be present within the zone of influence of the footings (e.g., 30 mm clay seam encountered at RL 70.5 m AHD in BH03). Some allowance for downgraded bearing pressures following spoon testing should also be made, which may include deepening footings or redesigning larger (i.e. broader) footings.

Table 10: Recommended Parameters for Foundation Design

Foundation Stratum	Allowable Bearing Pressure (Serviceability)		Ultimate Bearing Pressure		Young's Modulus (MPa)
	End Bearing (MPa)	Shaft Adhesion (Compression) (kPa)	End Bearing (MPa)	Shaft Adhesion (Compression) (kPa)	
Unit 2 – Class III Laminite and Sandstone	3.5	350	20	800	800

Foundation Stratum	Allowable Bearing Pressure (Serviceability)		Ultimate Bearing Pressure		Young's Modulus (MPa)
	End Bearing (MPa)	Shaft Adhesion (Compression) (kPa)	End Bearing (MPa)	Shaft Adhesion (Compression) (kPa)	
Unit 3 – Class II Sandstone and Laminite	6.0	600	60	100	1500
Unit 4 – Class II/I Sandstone	8.0	1000	120	2000	2000

Note: Shaft adhesion applicable to the design of bored piles, uncased over the rock socket length, where adequate sidewall cleanliness and roughness are achieved

Foundations proportioned on the basis of the allowable bearing pressures in Table 10 would be expected to experience total settlements of less than 1% of the pile diameter or footing width under the applied working load, with differential settlements between adjacent columns expected to be less than half of this value. Footings designed using the ultimate values in Table 10 will also need to consider serviceability criteria which will probably govern the design.

To use an allowable bearing pressure value for design of greater than 3.5 MPa, spoon testing in 33% of footings will be required. If bearing pressures greater than 6 MPa are used in design, then spoon testing in all footings will be required. For spoon testing, a 50 mm diameter hole is drilled below the base of the footing to a depth of 1.5 times the footing width, followed by testing to check for the presence of weak layers or clay bands.

Consideration should be given to the existing footings for the neighbouring building to the west of the site, as it is likely to be within the zone of influence of the proposed excavation. The zone of influence may be taken as a 45° line drawn up from the base of the proposed bulk excavation level. An assessment of the bearing capacity beneath these neighbouring footings should be undertaken to ensure the foundation remains within their Serviceability design limits and what if any support or underpinning may be required, if any. During bulk excavation, progressive inspections of the excavated face below the neighbouring footings will be necessary in 1.0 m drops to check whether there are defects or adversely dipping joints that may affect the neighbouring foundation performance.

All foundations should be inspected by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters, and proof (core) drilled or spoon tested as appropriate. If weak seams or defects are encountered, footings may need to be deepened until suitable foundation material is reached. Alternatively, the footing can be enlarged, or redesigned for a lower bearing pressure.

10.4 Groundwater and Dewatering

Groundwater was measured in the wells on the site at variable depths. In BH01 and BH03, groundwater was measured at depths between 7-11 m depth (RL 75.4 to RL 71.4) which is within medium and medium to high strength Mittagong Formation, slightly above and below the proposed basement at RL 73 m. In BH06, groundwater was measured at a depth of about 3.4 m (RL 77.9 m) which was within medium strength Ashfield Shale. The shallower groundwater is

likely to be perched seepage trapped within fractures and joints in rock mass and based on experience in the area, is likely to drain and reduce in the long term. Douglas has been involved with similar and deeper basements nearby that have been excavated through Ashfield Shale and into the Hawkesbury Sandstone. Some seepage occurred at varying depths, but significant ongoing groundwater flows were not observed.

During construction and in the long term, it is anticipated that seepage into the excavation should generally be readily controlled by perimeter drains connected to a "sump-and-pump" system. A drained basement is technically feasible and will require permanent subfloor drainage below the basement floor slab to direct seepage to the stormwater drainage system. However, a drained basement and pumping to the stormwater system will be subject to approval from Council and relevant authorities. It may be necessary to carry out more detailed testing and analysis to estimate inflows and demonstrate minimal impact to surrounding groundwater systems and property (prepare a Groundwater Impact Assessment report). Given that the measured groundwater level is generally within rock, it is expected that minor seepage flows associated with a drained basement would have no significant impact to surrounding groundwater systems or property.

It is possible that iron oxides will precipitate from any seepage, possibly leading to a build-up of an iron-oxide sludge. Allowance for periodic cleaning of such sludge should be made in the long-term maintenance requirements.

Reference should be made to Douglas Groundwater Inflow Assessment report (86230.01.R.004.Rev2, dated March 2026) for further comments on the groundwater impact of the proposed development.

10.5 Earthquake Design

A Hazard Factor (Z) of 0.08 would be appropriate for preliminary design in accordance with Australian Standard AS 1170.4 - 2007 *Structural design actions – Part 4: Earthquake actions in Australia*.

Based on the results of the previous investigation undertaken on the site adjacent (Ref.: 205925.01 – *Geotechnical Investigation at 617-621 Pacific Highway, St Leonards*), the site sub-soil class is expected to be Class C_e due to the depth to competent rock adjacent to the site. It is recommended that further geotechnical investigation be undertaken at street level to confirm the depth to bedrock, to more accurately classify the site sub-soil class.

It is recommended that the structure is not designed to rely on any passive resistance from the excavated rock faces surrounding the site as there is the potential for the removal of this rock by future neighbouring developments.

10.6 TfNSW Considerations

10.6.1 Excavation Requirements

Based on the supplied architectural drawings, it is understood that the proposed basement excavation will be entirely within the 2nd Protection Reserve of the Sydney Metro tunnel. As such, a detailed impact assessment and review by TfNSW will be required. The detailed assessment of

the interaction between the proposed basement excavation (and building construction) and the existing Sydney Metro tunnels will need to be carried out by 3D numerical modelling.

A detailed monitoring plan will also be required during the construction including a minimum of two inclinometers along Pacific Highway, and survey monitoring to assess vertical and horizontal movements during the excavation. The survey should commence prior to excavation to provide a baseline and should continue every 1.5 m drop of the excavation. TfNSW may require dilapidation surveys for the tunnels depending on the final layout and depth of the excavation.

10.6.2 Anchoring Requirements

TfNSW Technical Direction GTD 2020/001 (dated 2 July 2020) and Sydney Metro Underground Corridor Protection Guidelines (dated 1 August 2025) outlines the requirements for installing ground anchors as part of the excavations close to TfNSW infrastructure. The applicable requirements are as follows:

- Anchors are generally not permitted within the First Protection Reserve of Sydney Metro tunnels;
- Only temporary ground anchors will be permitted within the Second Protection Reserve of Sydney Metro tunnels (subject to assessment);
- Ground anchors are to be designed and tested in accordance with AS 5100;
- Temporary ground anchors must have a minimum design life of two years. Where ground anchors are required for more than 18 months they must be designed as permanent anchors. A safety factor of 3 should be applied to ultimate bond stress values as provided in Table 9 to obtain permanent allowable bond stress;
- No anchor forming part of the works must be stressed to greater than 75% of the tendon ultimate tensile strength under either Working load or test load;
- No part of any ground anchor must be less than two metres below the surface within the State road reserve and TfNSW easement; and
- Once the anchors are no longer required to carry load, all structural connection between the anchors and the proposed development must be removed.

10.6.3 Foundation Requirements

Sydney Metro guidelines generally requires that no footings be located above a 45 degrees line extended up from the invert level of the rail tunnels (i.e., Influence Zone). However, these requirements have been developed to cover all sites, including those with deep soils and can be negotiated based on the site-specific assessment. Detailed numerical modelling would be required to assess the potential impact of proposed footing on the rail infrastructure. The numerical assessment would require detailed (geotechnical) numerical modelling to be undertaken during the detailed design stage and once the proposed column / footing layout has been developed.

11. Conclusion

Based on the findings of the geotechnical investigation, the site is generally considered suitable for the proposed development from a geotechnical perspective, provided the comments and

advice outlined within Section 10 of this report are considered within the design of the development.

12. Limitations

This report provides specialist advice only and no part of it is considered a Regulated Design under the Design and Building Practitioner Act 2020 (NSW).

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at 601 Pacific Highway, St Leonards NSW in line with Douglas' proposal dated 17/09/2024 and acceptance received from Diego Eguiguren of Stockland dated 19/11/2024. The work was carried out under contract No. CW96547 dated 15/11/2024. This report is provided for the exclusive use of Stockland for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after Douglas' field testing has been completed.

Douglas' advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical and groundwater components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope of work for this report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition

materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials.

Appendix A

About this Report

Terminology, Symbols and Abbreviations

Soil Descriptions

Rock Descriptions

Sampling, Testing and Excavation Methodology

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at

the time of construction as are indicated in the report; and

- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

continued next page

About this Report

Site Anomalies

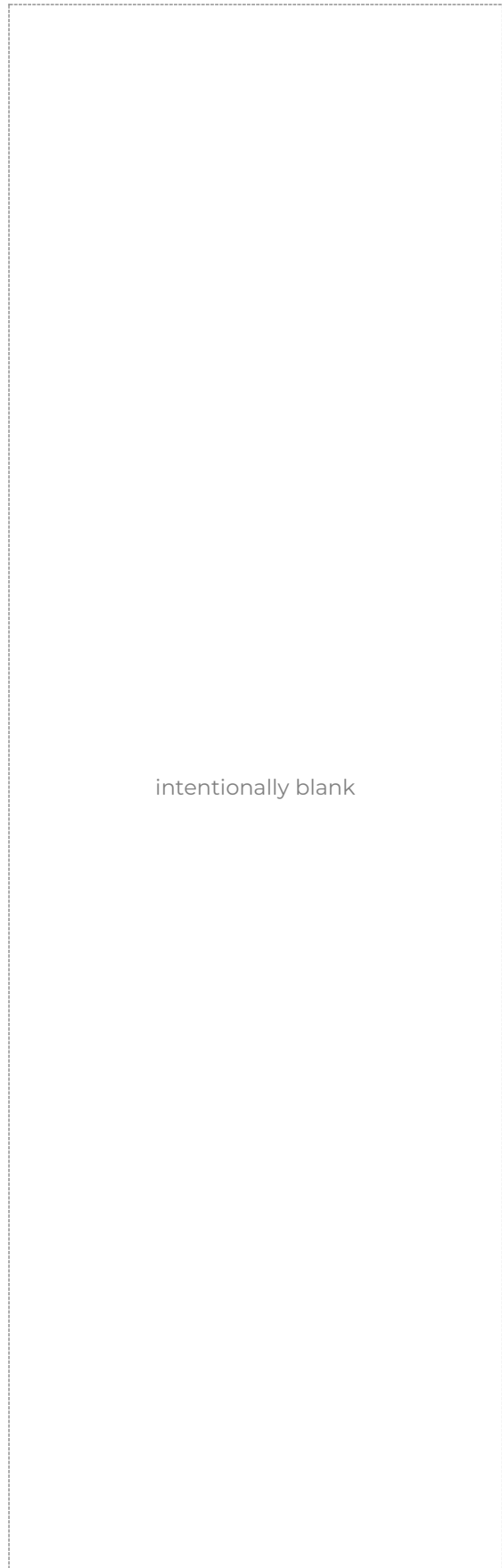
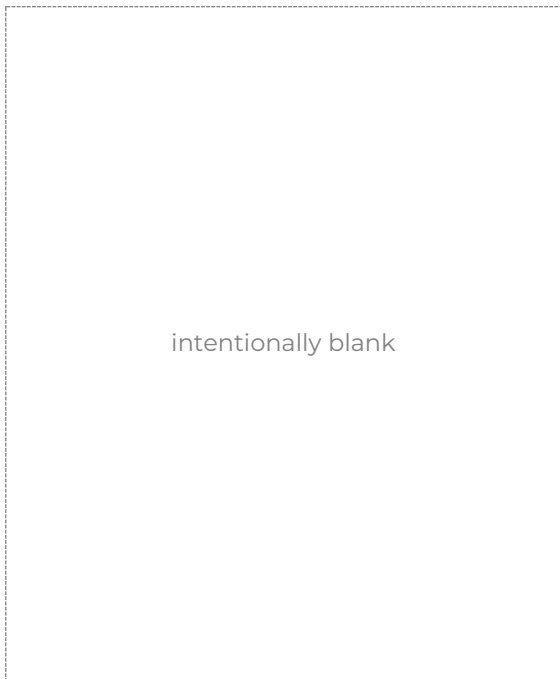
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.





Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style **XW**. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	KL
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	UK
No data	Information required to allow classification of the property was not available. For example, if drilling is commenced from the base of a hole predrilled by others	ND
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example, providing a description of the strength of a concrete pavement	NA

Graphic Symbols

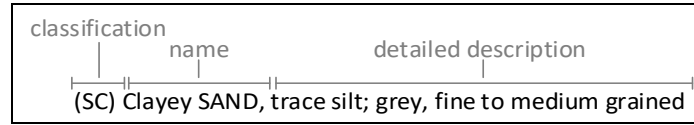
Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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Introduction

All materials which are not considered to be “in-situ rock” are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:



The “classification” comprises a two character “group symbol” providing a general summary of dominant soil characteristics. The “name” summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either “fine grained” (also known as “cohesive” behaviour) or “coarse grained” (“non cohesive” behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as “oversize”	
Cobble	63 - 200		
Gravel ¹	2.36 - 63	Coarse	>65%
Sand ¹	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

¹ – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer “component proportions” below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a “Sandy CLAY”, this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a “primary”, “secondary”, or “minor” component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	Definition ¹	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor ²	Present in the soil, but not significant to its engineering properties	All other components	All other components

¹ As defined in AS1726-2017 6.1.4.4

² In the detailed material description, minor components are split into two further sub-categories. Refer “identification of minor components” below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, “INTERBEDDED Silty CLAY AND SAND”.

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component ¹	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

¹ – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type	Particle size (mm)	
	Gravel	Coarse
	Medium	6.7 - 19
	Fine	2.36 - 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	"oozes" when agitated	w=LL
	Wet of liquid limit	"oozes"	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code **NDF**, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example **(VS)**.

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as “extremely weathered material” in reports and by the abbreviation code **XWM** on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than ‘very low’ as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be “oversize” may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with “MIXTURE OF”.





Rock Strength

Rock strength is defined by the unconfined compressive strength, and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $I_{s(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Unconfined Compressive Strength (MPa)	Point Load Index ¹ $I_{s(50)}$ MPa	Abbreviation Code
Very low	0.6 - 2	0.03 - 0.1	VL
Low	2 - 6	0.1 - 0.3	L
Medium	6 - 20	0.3 - 1.0	M
High	20 - 60	1 - 3	H
Very high	60 - 200	3 - 10	VH
Extremely high	>200	>10	EH

¹ Rock strength classification is based on UCS. The UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site. The point load Index ranges shown above are as suggested in AS1726 and should not be relied upon without supporting evidence.

The following abbreviation codes are used for soil layers or seams of material “within rock” but for which the equivalent UCS strength is less than 0.6 MPa.

Scenario	Abbreviation Code
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The properties of the material encountered over this interval are described in the “Description of Strata” and soil properties columns.	SOIL
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The prominence of the material is such that it can be considered to be a seam (as defined in Table 22 of AS1726-2017) and the properties of the material are described in the defect column.	SEAM

Degree of Weathering

The degree of weathering of rock is classified as follows:

Weathering Term	Description	Abbreviation Code
Residual Soil ¹	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.	RS
Extremely weathered ¹	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible	XW
Highly weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.	HW
Moderately weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.	MW
Slightly weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.	SW
Fresh	No signs of decomposition or staining.	FR
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.	DW

¹ The parent rock type, of which the residual/extremely weathered material is a derivative, will be stated in the description (where discernible).

Degree of Alteration

The degree of alteration of the rock material (physical or chemical changes caused by hot gasses or liquids at depth) is classified as follows:

Term	Description	Abbreviation Code
Extremely altered	Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.	XA
Highly altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching or may be decreased due to precipitation of secondary materials in pores.	HA
Moderately altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.	MA
Slightly altered	Rock is slightly discoloured but shows little or no change of strength from fresh rock	SA
Note: If HA and MA cannot be differentiated use DA (see below)		
Distinctly altered	Rock strength usually changed by alteration. The rock may be highly discoloured, usually by staining or bleaching. Porosity may be increased by leaching or may be decreased due to precipitation of secondary minerals in pores.	DA

Degree of Fracturing

The following descriptive classification apply to the spacing of natural occurring fractures in the rock mass. It includes bedding plane partings, joints and other defects, but excludes drilling breaks. These terms are generally not required on investigation logs where fracture spacing is presented as a histogram, and where used are presented in an unabbreviated format.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$RQD \% = \frac{\text{cumulative length of 'sound' core sections} > 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e., drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

These terms may be used to describe the spacing of bedding partings in sedimentary rocks. Where used, these terms are generally presented in an unabbreviated format

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Rock Descriptions

Terminology
Symbols
Abbreviations

Defect Descriptions

Defect Type

Term	Abbreviation Code
Bedding plane	B
Infilled seam	IS
Cleavage	CV
Crushed zone	CZ
Decomposed seam	DS
Fault	F
Joint	JT
Lamination	LAM
Parting	P
Shear zone	SZ
Vein	VN
Drilling/handling break	DB , HB
Fracture	FC

Rock Defect Orientation

Term	Abbreviation Code
Horizontal	H
Vertical	V
Sub-horizontal	SH
Sub-vertical	SV

Rock Defect Coating

Term	Abbreviation Code
Clean	CN
Coating	CT
Healed	HE
Infilled	INF
Stained	SN
Tight	TI
Veneer	VNR

Rock Defect Infill

Term	Abbreviation Code
Calcite	CA
Carbonaceous	CBS
Clay	CLAY
Iron oxide	FE
Manganese	MN

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Rock Defect Shape/Planarity

Term	Abbreviation Code
Curved	CU
Irregular	IR
Planar	PR
Stepped	ST
Undulating	UN

Rock Defect Roughness

Term	Abbreviation Code
Polished	PO
Rough	RF
Slickensided	SL
Smooth	SM
Very rough	VR

Defect Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

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Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:

SAMPLE			DEPTH (m)	TESTING	
SAMPLE REMARKS	TYPE	INTERVAL		TEST TYPE	RESULTS AND REMARKS
	SPT		1.0 1.45	SPT	4,9,11 N=20

Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Bulk sample	B
Core sample	C
Disturbed sample	D
Sample from SPT test	SPT
Environmental sample	ES
Gas sample	G
Undisturbed tube sample	U ¹
Water sample	W
Piston sample	P
Core sample for unconfined compressive strength testing	UCS
Material Sample	MT

¹ – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y = x blows for y mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(L)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

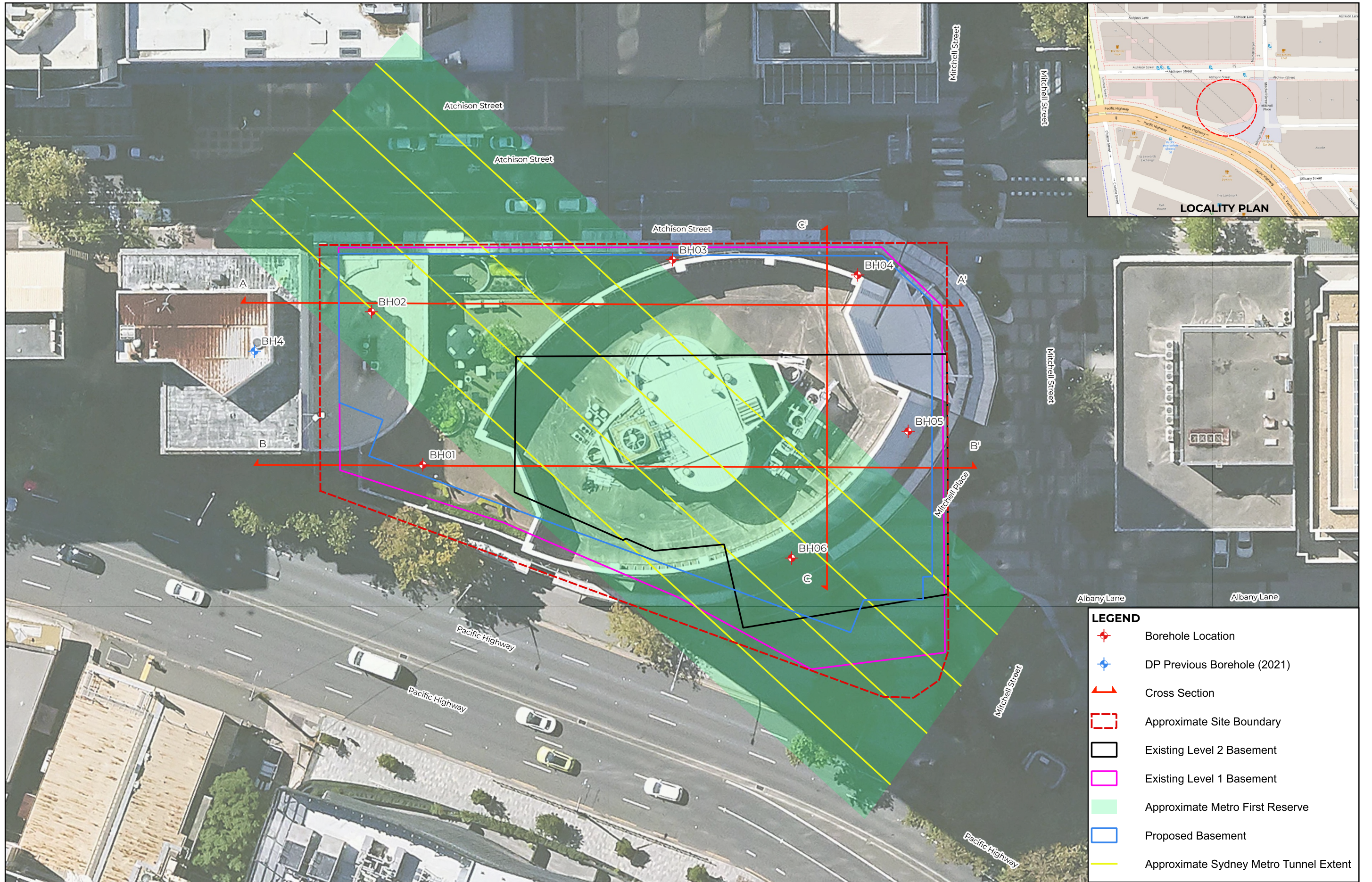
The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Toothed bucket	TB ¹
Mud/blade bucket	MB ¹
Ripping tyne/ripper	R
Rock breaker/hydraulic hammer	RB
Hand auger	HA ¹
NMLC series coring	NMLC
HMLC series coring	HMLC
NQ coring	NQ3
HQ coring	HQ3
PQ coring	PQ3
Push tube	PT ¹
Rock roller	RR ¹
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD ¹
Sonic drilling	SON ¹
Vibrocore	VC ¹
Wash bore (unspecified bit type)	WB ¹
Existing exposure	X
Hand tools (unspecified)	HAND
Predrilled	PD
Diatube	DT ¹
Hollow flight auger	HSA ¹
Vacuum excavation	VE

¹ – numeric suffixes indicate tool diameter/width in mm

Appendix B

Drawings



LEGEND

- ◆ Borehole Location
- ◆ DP Previous Borehole (2021)
- ▶ Cross Section
- Approximate Site Boundary
- Existing Level 2 Basement
- Existing Level 1 Basement
- Approximate Metro First Reserve
- Proposed Basement
- Approximate Sydney Metro Tunnel Extent

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0	INITIAL ISSUE	22.05.2025	EC

SCALE: 1:400 @ A3

Douglas
PARTNERS
OFFICE: SYDNEY
96-98 Hermitage Rd, West Ryde NSW 2114
(02)9809 0666

CLIENT:
Stockland Commercial Property

NOTE:
1: Basemap from Metromap (Dated 13.03.2025)

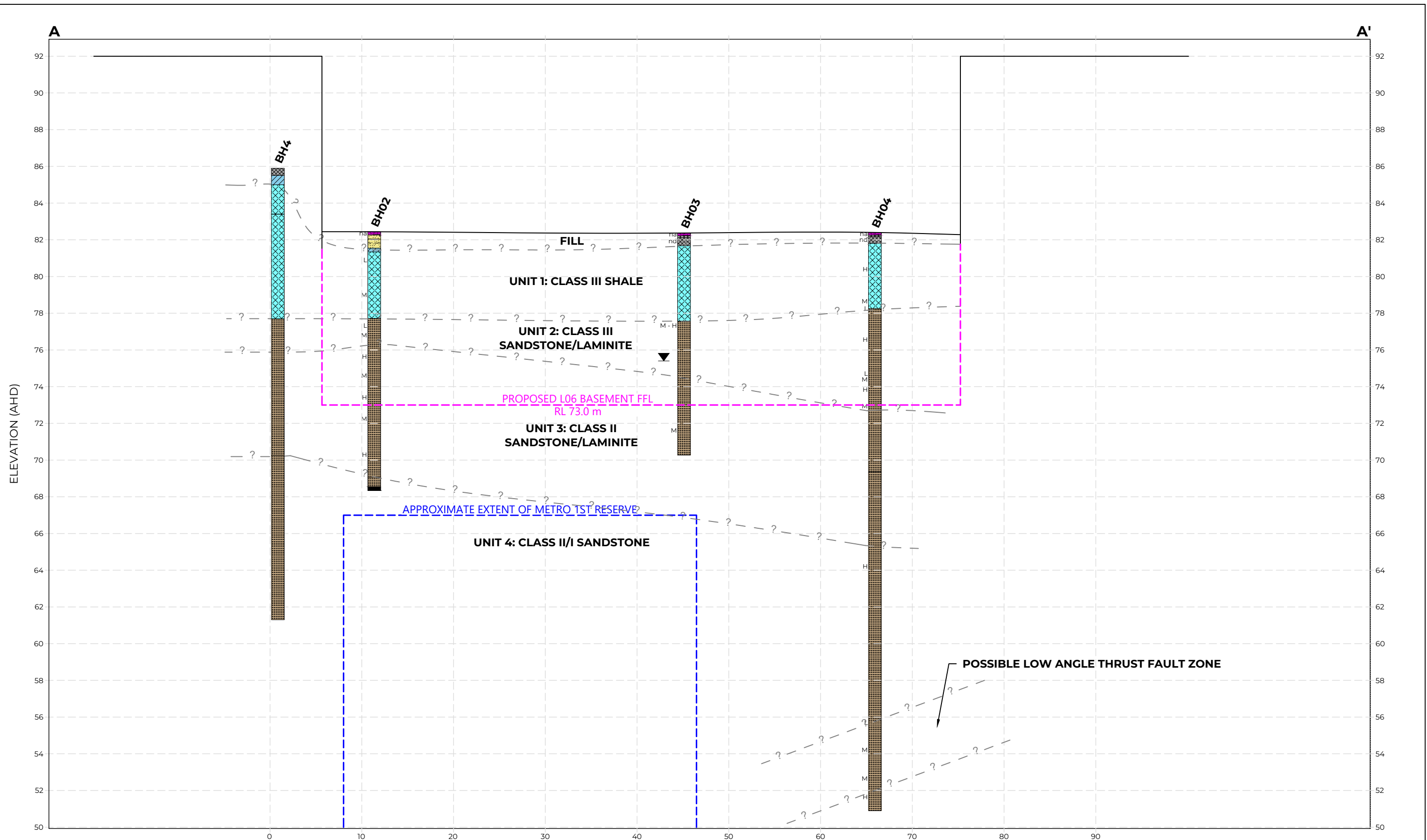
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 56

PROJECT NAME:
Proposed Commercial Building
PROJECT ADDRESS:
601 Pacific Highway, St Leonards

DRAWING TITLE:
Test Location Plan

PROJECT NO:
86230.01
DRAWING NO:
1
REVISION:
0

\\dfsyrnas2\Projects\86230.01 - ST LEONARDS - 601 Pacific Highway - geo\7.0 Drawings\7.2 Out\86230.01.D.002-004_Rev0_Cross Sections A-C.dwg



LEGEND		TESTS / OTHER	
	CLAY		FILL
	CONCRETE		SANDSTONE
	NO CORE		Clayey SAND
	Gravelly SAND		SILTSTONE
	Groundwater Level		Interpreted geotechnical boundary

ROCK STRENGTH	COMPACTION (anthropogenically modified soil)
VL- Very Low	na - Not applicable
L - Low	nd - No data
M - Medium	pc - Poorly compacted
H - High	mc - Mostly compacted
	wc - Well compacted
	vc - Variably compacted

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0	INITIAL ISSUE	24.10.2025	EC

SCALE: 0 2 4 6 8 10 15 20
1:400 @ A3
Vertical Exaggeration = 2.0

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96-98 Hermitage Rd, West Ryde NSW 2114
(02) 9809 0666

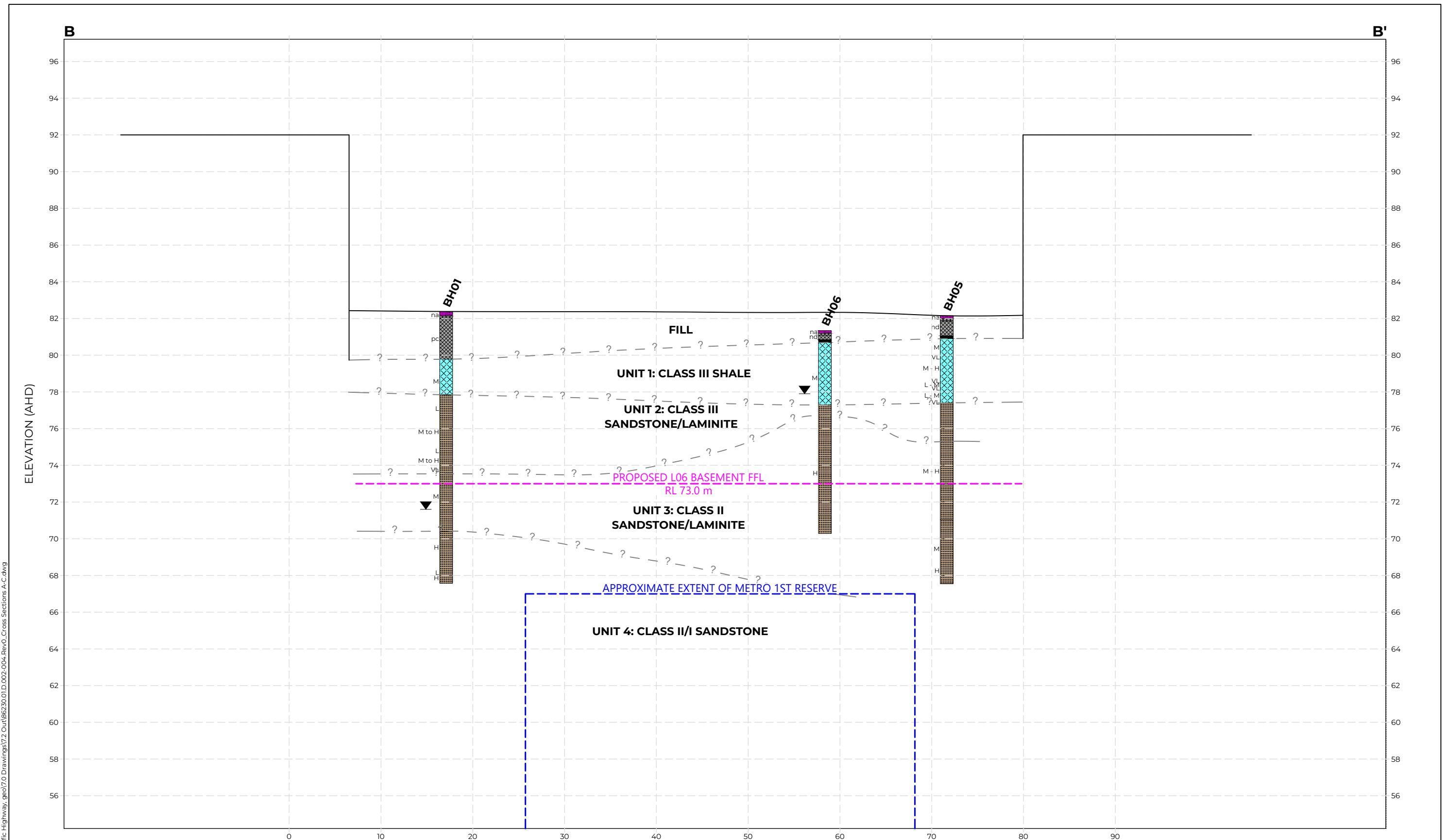
CLIENT:
Stockland Commercial Property

NOTES
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

PROJECT NAME:
Proposed Commercial Building
PROJECT ADDRESS:
601 Pacific Highway, St Leonards

DRAWING TITLE:
Geological Cross Section A-A'

PROJECT No:	86230.01
DRAWING No:	2
REVISION:	0



LEGEND

CONCRETE	SANDSTONE
NO CORE	SILTSTONE
FILL	Groundwater Level

TESTS / OTHER
 - ? - - - Interpreted geotechnical boundary

ROCK STRENGTH
 VL- Very Low
 L - Low
 M - Medium
 H - High

COMPACTION (anthropogenically modified soil)
 na - Not applicable
 nd - No data
 pc - Poorly compacted
 mc - Mostly compacted
 wc - Well compacted
 vc - Variably compacted

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0	INITIAL ISSUE	24.10.2025	EC

SCALE: 0 2 4 6 8 10 15 20
 1:400 @ A3
 Vertical Exaggeration = 2.0

OFFICE: SYDNEY
 96-98 Hermitage Rd, West Ryde NSW 2114
 (02) 9809 0666

CLIENT:
Stockland Commercial Property

NOTES
 1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
 2. Summary logs only and should be read in conjunction with detailed logs.
 3. Horizontal and vertical scales are not equal.

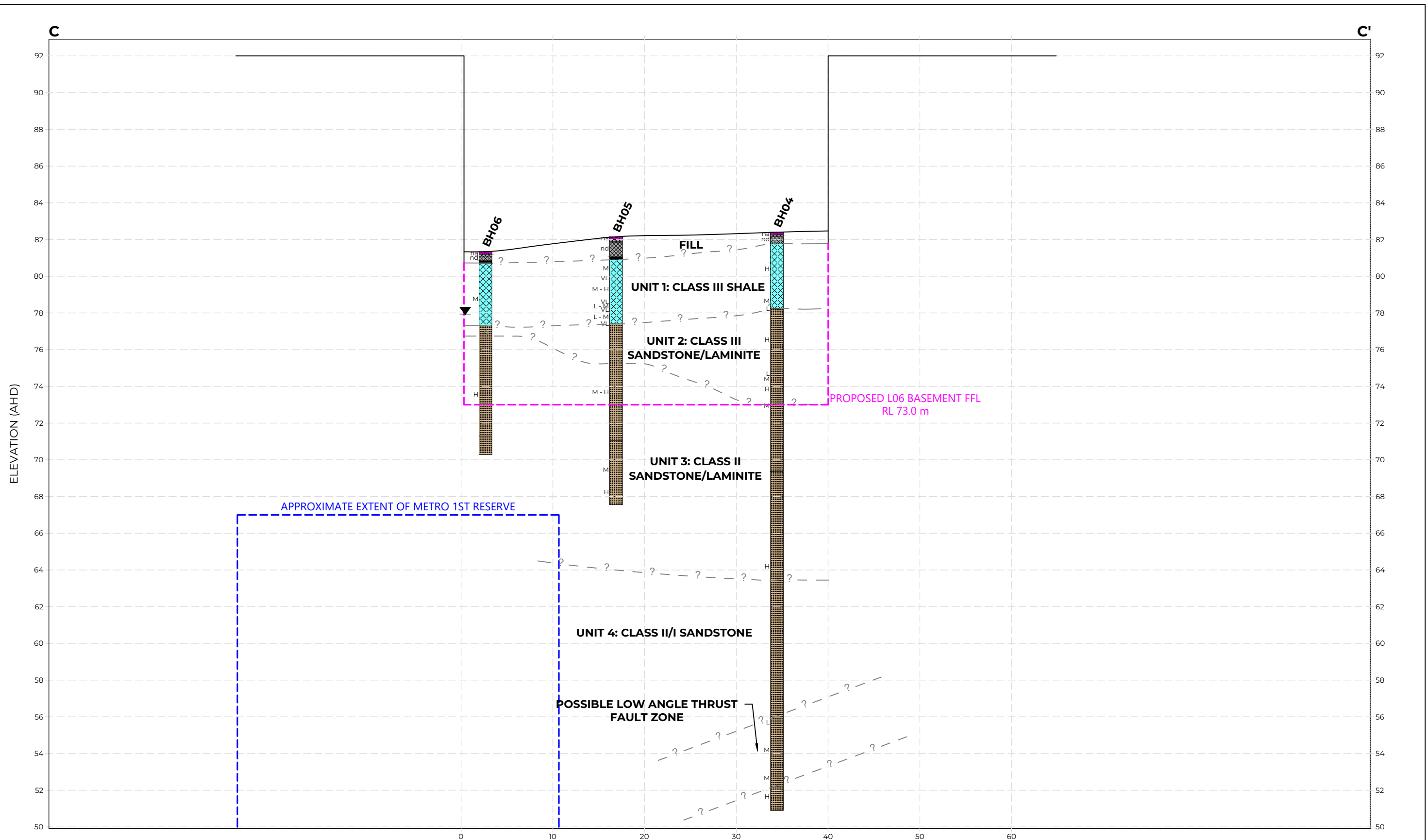
PROJECT NAME:
Proposed Commercial Building
 PROJECT ADDRESS:
601 Pacific Highway, St Leonards

DRAWING TITLE:
Geological Cross Section B-B'

PROJECT No:	86230.01
DRAWING No:	4
REVISION:	0

\\dps\pna22\Projects\86230.01 - ST LEONARDS\601 Pacific Highway\geo\7.0 Drawings\7.2 Out\86230.01.D.002-004_Rev0_Cross Sections A-C.dwg

\\dfsyrnas2\Projects\86230_01 - ST LEONARDS_601 Pacific Highway_geo\7.0 Drawings\7.2 Out\86230_01.D_002-004_Rev0_Cross Sections A-C.dwg



LEGEND

CONCRETE	SANDSTONE
NO CORE	SILTSTONE
FILL	Groundwater Level

TESTS / OTHER
 - ? - - - Interpreted geotechnical boundary

ROCK STRENGTH	COMPACTION (anthropogenically modified soil)
VL- Very Low	na - Not applicable
L - Low	nd - No data
M - Medium	pc - Poorly compacted
H - High	mc - Mostly compacted
	wc - Well compacted
	vc - Variably compacted

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0	INITIAL ISSUE	24.10.2025	EC

SCALE: 0 2 4 6 8 10 15 20
 1:400 @ A3
 Vertical Exaggeration = 2.0

OFFICE: SYDNEY
 96-98 Hermitage Rd, West Ryde NSW 2114
 (02) 9809 0666

CLIENT:
Stockland Commercial Property

NOTES
 1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
 2. Summary logs only and should be read in conjunction with detailed logs.
 3. Horizontal and vertical scales are not equal.

PROJECT NAME:
Proposed Commercial Building
 PROJECT ADDRESS:
601 Pacific Highway, St Leonards

DRAWING TITLE:
Geological Cross Section C-C'

PROJECT No:	86230.01
DRAWING No:	5
REVISION:	0

Appendix C

Borehole Logs

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333081.1, N:6255981.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH01
PROJECT No: 86230.01
DATE: 25/03/25
SHEET: 1 of 3

GROUNDWATER		CONDITIONS ENCOUNTERED				SAMPLE			TESTING AND REMARKS								
		RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (%)	DENSITY (%)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
	82.4	0.25	CONCRETE; reinforcement 8mm, 2 slabs 130mm thick and 90mm thick (low), second slab has no reinforcement observable, 10mm blinding sand separating slabs. FILL / GRAVEL: dark grey; fine to medium, angular, igneous. FILL / CLAY trace sand: dark grey; low to medium plasticity; fine sand. 2.00m: poor compaction Continued as rock log	FILL		NA	NA										
	82.4	0.35								D	0.40						
	82.4	0.50								D	0.50						
	81.0	1.00								D	0.90						
	81.0	1.50				FILL	PC	w<PL		D	1.40						
	81.0	2.00								D	1.90						
	80.0	2.60															
	79.0	3.00															
	78.0	4.00															
	78.0	5.00															
	77.0	6.00															
	77.0	7.00															
	76.0	8.00															
	75.0	9.00															
	74.0																
	73.0																

NOTES: #Soil origin is "probable" unless otherwise stated. %Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: DTS 700

OPERATOR: Terratest

LOGGED: JDS

METHOD: DT to 0.25m, AD/T to 2.6m, NMLC to 14.80m

CASING: HWT to 2m

REMARKS: Unable to perform SPTs due to height restriction

Generated with CORE-GS by Geoc - Split Soil-Rock Log

Refer to explanatory notes for symbol and abbreviation definitions



BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333081.1, N:6255981.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH01
PROJECT No: 86230.01
DATE: 25/03/25
SHEET: 2 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING						
GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE	
RL (m)	82																		
	81																		
	80																		
	79	Continued from soil log SILTSTONE: dark grey, indistinct bedding; (horizontal). Ashfield Shale.			2.60		100	100								PLT	PL(A)=0.62MPa		
	78						100	100		2.87m: JT, 70°, PR, CN, SM 3.23m: JT, 70°, PR, CN, SM						PLT	PL(A)=0.78MPa		
	77	SANDSTONE: grey, fine to medium grained, indistinct bedding; siltstone ~5 - 10%. Mittagong Formation.	FR		5.00		100	100		3.00m: Very minimal water loss						PLT	PL(A)=0.65MPa		
	76				5.60		95	100		3.72m JT, 70°, PR, CN, SM						PLT	PL(A)=0.62MPa		
	6.65				6.70		100	90		4.09m: JT, 30°, PR, CN, SM						PLT	PL(A)=0.98MPa		
	75				7.65		100	93		4.70m: Water loss ~20%						PLT	PL(A)=0.28MPa		
	74				8.65		100	100		5.70m: Water loss ~30-40%						PLT	PL(A)=1.1MPa		
	73						100	100		7.30m: Water loss 80-100% recovering to ~40%						PLT	PL(A)=1.1MPa		
										7.55-7.65m: B, 5°, PR, CN, RF, x3									
										8.03m: B, 10°, PR, CN, RF									
										8.25m: B, 10°, PR, CN, RF									
										8.40m: B, 10°, PR, CN, RF						PLT	PL(A)=1.6MPa		
										8.62-8.70m: B, 0°, PR, RF, x4									
										8.90m: Water loss 60-90%									
										9.10m: Water loss ~10-20%						PLT	PL(A)=0.73MPa		

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT to 0.25m, AD/T to 2.6m, NMLC to 14.80m
REMARKS: Unable to perform SPTs due to height restriction

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 2m

Refer to explanatory notes for symbol and abbreviation definitions



BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333081.1, N:6255981.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH01
PROJECT No: 86230.01
DATE: 25/03/25
SHEET: 3 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING							
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS		BACKFILL	WELL PIPE	
																PLT	PL(A)			
72		SANDSTONE: grey, medium to coarse grained, indistinct bedding. Hawkesbury Sandstone.		FR																
71	11											10.80m: Water loss ~20-30%					PLT	PL(A)=0.76MPa		
70	12.00							11.50				11.90m: JT, 90°, PR, SN Fe, RF					PLT	PL(A)=0.74MPa		
69	13											12.05m: JT, 90°, PR, CN, RF					PLT	PL(A)=1.1MPa		
68	14											12.23m: JT, 50°, PR, CN, RF					PLT	PL(A)=1.1MPa		
68	14.80	Borehole discontinued at 14.80m depth. Target depth reached.																		
67	15									12.60m: B, 5°, PR, INF M, RF										
66	16									14.26m: CS 50mm										
65	17									14.71m: B, 10°, PR, SN Fe, RF										
64	18																			
63	19																			

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT to 0.25m, AD/T to 2.6m, NMLC to 14.80m
REMARKS: Unable to perform SPTs due to height restriction

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 2m

Refer to explanatory notes for symbol and abbreviation definitions



CORE PHOTO LOG

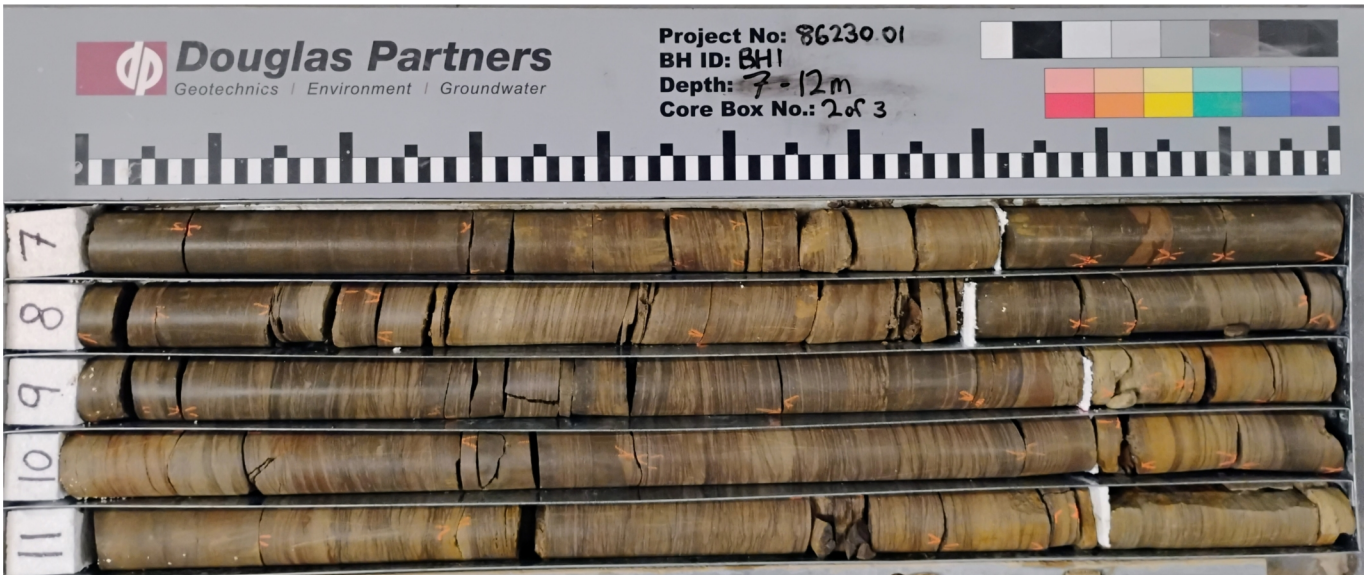
CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333081.1, N:6255981.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH01
PROJECT No: 86230.01
DATE: 25/03/25
SHEET: 1 of 2



2.60-7.00 m depth



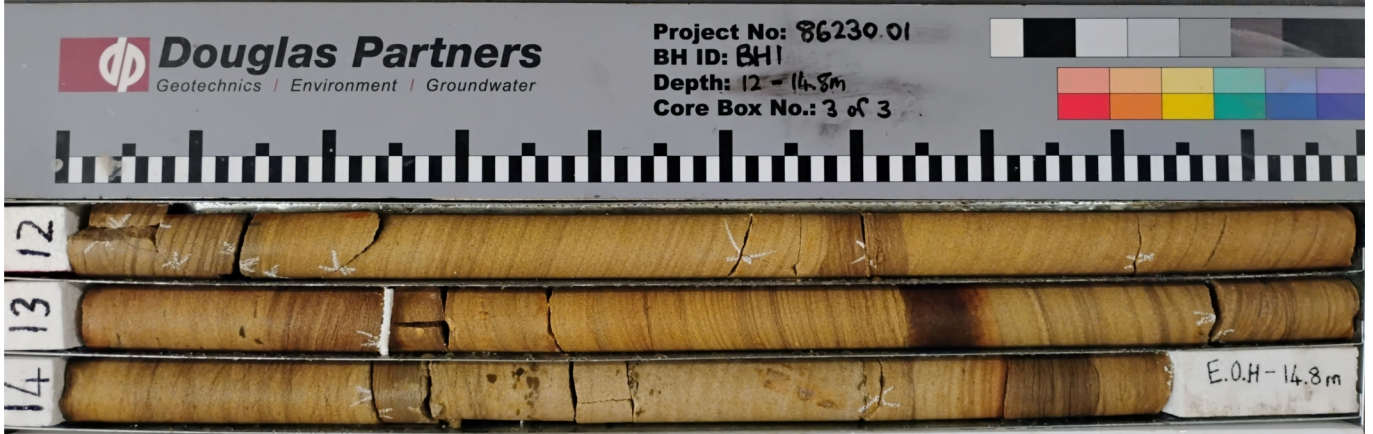
7.00-12.00 m depth

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333081.1, N:6255981.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH01
PROJECT No: 86230.01
DATE: 25/03/25
SHEET: 2 of 2



12.00-14.80 m depth

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333075.4, N:6255998.3
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH02
PROJECT No: 86230.01
DATE: 28/03/25
SHEET: 1 of 3

CONDITIONS ENCOUNTERED						SAMPLE			TESTING AND REMARKS			
GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (°)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
RL (m)	0.18	CONCRETE; 2 layers reinforcement 8mm and 4mm.			NA	NA						
	0.40	FILL / Gravelly SAND with clay: brownish-grey; fine to medium; medium, sub-angular, igneous gravel.		FILL		M						
	0.90	FILL / Clayey SAND trace gravel: dark grey; fine to medium; low to medium plasticity clay; fine to medium, angular, igneous gravel.		FILL	ND	D						
	1.10	FILL / CLAY trace sand trace gravel: dark grey; low to medium plasticity.		FILL		w<PL				1		
	2	Continued as rock log								2		
	3									3		
	4									4		
	5									5		
	6									6		
	7									7		
	8									8		
	9									9		

NOTES: #Soil origin is "probable" unless otherwise stated. °Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: DTS 700
METHOD: DT to 0.13m, AD/T to 1.10m, NMLC to 14.10m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 1m

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333075.4, N:6255998.3
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH02
PROJECT No: 86230.01
DATE: 28/03/25
SHEET: 2 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING					
GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
RL (m)																		
82	0	Continued from soil log			1.10	L	100	100						1	PLT	PL(A)=0.12MPa		
81	1	SILTSTONE: dark grey, indistinct bedding, 0 to 10°. Ashfield Shale.		FR	2.00	L	100	100		1.33m JT, 40°, PR, CN, SM				2	PLT	PL(A)=0.14MPa		
80	2				2.63					2.50m - 3.60m: Water loss ~10% 2.80m JT, 50°, PR, CN, SM				2	PLT	PL(A)=0.32MPa		
79	2.50				4.72		88	100		3.27m JT, 45°, PR, CN, SM				3	PLT	PL(A)=0.60MPa		
78	2.63				5.30	M				3.90m: CZ, 0°, PR, Clay, SM, ~5mm				3	PLT	PL(A)=0.66MPa		
77	3	SANDSTONE: grey, fine and medium grained; with siltstone laminations and bedding. Mittagong Formation.		SW	5.30	M	100	100		4.25m: CZ, 0°, PR, Clay, SM, ~5mm				4	PLT	PL(A)=0.87MPa		
76	4	5.50m-5.80m: rip up clasts			7.60	M				4.62-4.67m CZ, 5°, PR, Clay				4	PLT	PL(A)=0.54MPa		
75	4.72				8.05	H								5	PLT	PL(A)=0.48MPa		
74	5				7.60	M								5	PLT	PL(A)=0.37MPa		
73	6				8.05	H								6	PLT	PL(A)=1.2MPa		
	7													7	PLT	PL(A)=1.3MPa		
	8									8.56m CZ, 20mm				8	PLT	PL(A)=1.4MPa		
	9													9	PLT	PL(A)=1.1MPa		

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT to 0.13m, AD/T to 1.10m, NMLC to 14.10m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 1m

Refer to explanatory notes for symbol and abbreviation definitions



BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333075.4, N:6255998.3
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH02
PROJECT No: 86230.01
DATE: 28/03/25
SHEET: 3 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING						
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS		BACKFILL	WELL PIPE
																PLT	PL(A)		
72	11	[CONT] SANDSTONE: grey, fine and medium grained; with siltstone laminations and bedding. Mittagong Formation.			10.00 - 10.40	M	100	100		10.60m CZ, 20mm				11	PLT	PL(A)=0.49MPa			
71	12					H	100	100		11.10m - 14.10m: Water loss <10%				12	PLT	PL(A)=1.4MPa			
70	13													13	PLT	PL(A)=1.8MPa			
69	13.37	SANDSTONE: pale grey, medium to coarse grained; cross-bedded 0-10 degrees. Hawkesbury Sandstone.					87	87		13.38m B, 0°, PR, INF Clay 10mm, RF				14	PLT	PL(A)=1.1MPa			
68	14	Borehole discontinued at 14.10m depth. Target depth reached.																	
67	15																		
66	16																		
65	17																		
64	18																		
63	19																		

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT to 0.13m, AD/T to 1.10m, NMLC to 14.10m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 1m

Refer to explanatory notes for symbol and abbreviation definitions



CORE PHOTO LOG

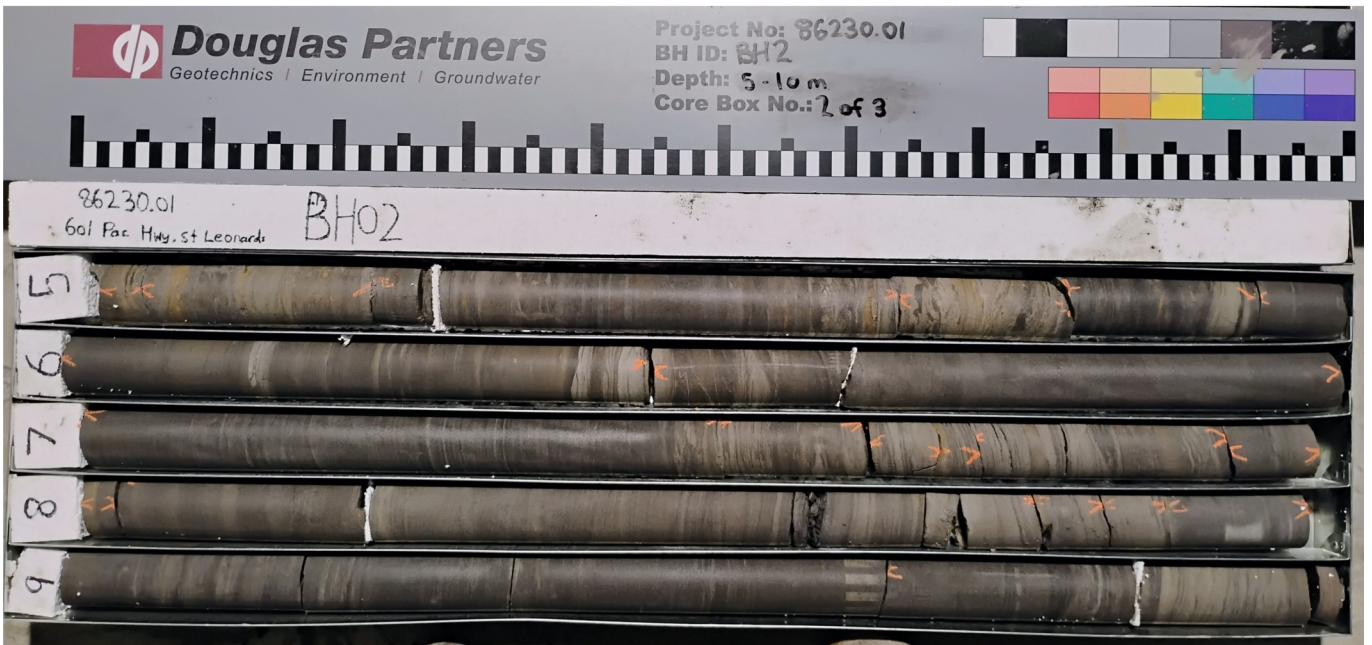
CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333075.4, N:6255998.3
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH02
PROJECT No: 86230.01
DATE: 28/03/25
SHEET: 1 of 2



1.10-5.00 m depth



5.00-10.00 m depth

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333075.4, N:6255998.3
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH02
PROJECT No: 86230.01
DATE: 28/03/25
SHEET: 2 of 2



10.00-14.10 m depth

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333109.1, N:6256004.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH03
PROJECT No: 86230.01
DATE: 01/04/25
SHEET: 1 of 3

GROUNDWATER		CONDITIONS ENCOUNTERED				SAMPLE			TESTING AND REMARKS						
		RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (%) DENSITY (%)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL
01/04/25 No free groundwater observed whilst augering	0.15	0.15	CONCRETE; 150mm thick.	[Concrete Symbol]		NA					0.15			[Concrete Symbol]	
	0.25	0.25	FILL / Gravelly SAND: yellow and grey; medium; fine to coarse, igneous, concrete gravel.	[Fill Symbol]	FILL					D	0.20			[Fill Symbol]	
	0.70	0.70	FILL / Sandy CLAY trace gravel: dark grey; low to medium plasticity; fine to coarse sand; fine gravel; shale. Continued as rock log	[Fill Symbol]	FILL	ND	w<PL			D	0.40 0.50			[Fill Symbol]	
	1	1									1				
	2	2									2				
	3	3									3				
	4	4									4				
	5	5									5				
	6	6									6				
	7	7									7				
	8	8									8				
	9	9									9				

NOTES: #Soil origin is "probable" unless otherwise stated. %Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: DTS 700
METHOD: DT to 0.15m, AD/T to 0.70m, NMLC to 12.10m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 0.5m

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333109.1, N:6256004.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH03
PROJECT No: 86230.01
DATE: 01/04/25
SHEET: 2 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING						
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH. LRS DWS HWS LWS EWS FR	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS		BACKFILL	WELL PIPE
																PL(A)	PL(B)		
82	0.70	Continued from soil log																	
	1.00	SILTSTONE: dark grey, indistinct bedding, 0 to 10°. Ashfield Shale.		SW			100	100		0.75m: JT, 35°, PR, SN Fe 0.92m: JT, 85°, PR, SN Fe				1	PLT	PL(A)=1.3MPa			
	2.00						100	100		0.70m - 1.80m: Water loss <10% 1.39m: JT, 70°, PR, CN, SM				2	PLT	PL(A)=0.80MPa			
	3.00						100	100		2.80m JT, 40°, PR, CN, SM				3	PLT	PL(A)=0.61MPa			
	4.00						100	100		3.30m - 4.00m: Water loss ~10%				4	PLT	PL(A)=0.91MPa			
	4.80						100	100		4.13-4.15m: CZ, 0°, PR, SN Clay 4.25m: JT, 80°, PR, CN, SM				5	PLT	PL(A)=0.70MPa			
	5.00	SANDSTONE: grey and pale grey, fine to medium grained, distinct laminations and bedding 0 to 10 degrees. Mittagong Formation.		FR			100	100						5	PLT	PL(A)=0.67MPa			
	6.00						100	100						6	PLT	PL(A)=0.86MPa			
	7.00						100	90		6.08m: B, -5°, PR, CN, RF 6.49m JT, 15°, PR, CN, RF				7	PLT	PL(A)=1.1MPa			
	8.00						100	100		7.28m B, 10°, PR, RF 7.30m B, 5°, PR, HE 7.35m: B, 50°, PR Clay 6 mm 7.41m: B, -20°, UN, RF 7.50m: JT, 70°, PR, HE 7.62m: JT, 85°, UN, HE 7.75m: JT, 20°, UN, Clay, ~5 mm				8	PLT	PL(A)=0.77MPa			
	9.00						100	100		8.46m: B, 5°, ST, Clay, ~2 mm 8.79m: JT, 70°, PR, CN, RF				9	PLT	PL(A)=2.4MPa			
	9.40						100	84		9.45m: JT, 80-90°, CU, Clay, 1-3mm 9.60m B, ~50°, PR, Clay, PO, 1-2mm					PLT	PL(A)=1.5MPa			

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT to 0.15m, AD/T to 0.70m, NMLC to 12.10m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 0.5m

Refer to explanatory notes for symbol and abbreviation definitions



BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333109.1, N:6256004.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH03
PROJECT No: 86230.01
DATE: 01/04/25
SHEET: 3 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING														
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.			DEPTH (m)	STRENGTH			RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE					
				LS	XW	HW		VL	ML	HL													EH				
72		[CONT] SANDSTONE: grey and pale grey, fine to medium grained, distinct, laminated; siltstone laminations and bedding 0 to 10 degrees. Mittagong Formation.		FR			11	•		100	84		11.55m JT, 40°, PR, VNR Clay, RF 11.63m: CS, 30mm 12.06m: JT, 80°, PR, CN, SM						PLT	PL(A)=0.92MPa							
71							11																				
12							12																				PLT
70		Borehole discontinued at 12.10m depth. Target depth reached.																									
69																											
68																											
67																											
66																											
65																											
64																											
63																											

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT to 0.15m, AD/T to 0.70m, NMLC to 12.10m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 0.5m

CORE PHOTO LOG

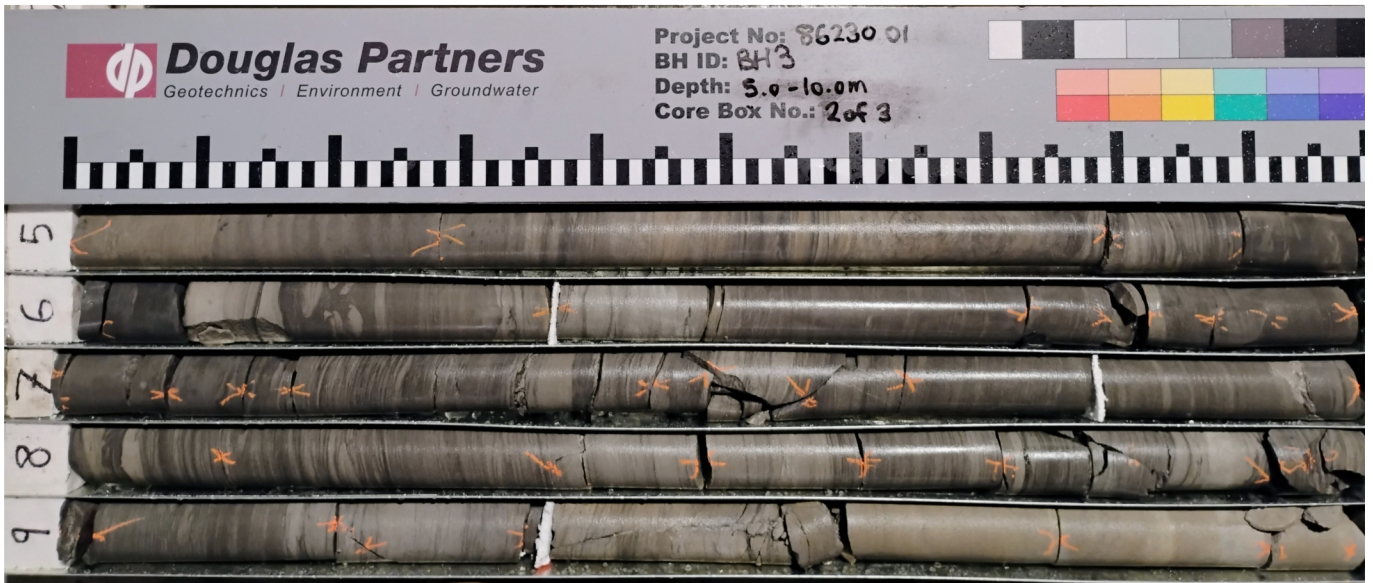
CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333109.1, N:6256004.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH03
PROJECT No: 86230.01
DATE: 01/04/25
SHEET: 1 of 2



0.70-5.00 m depth



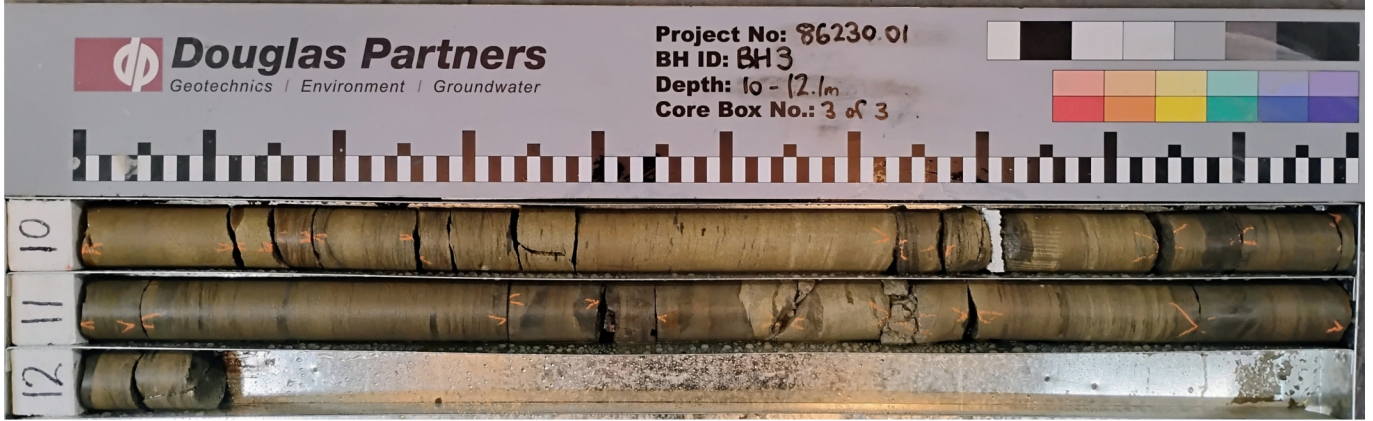
5.00-10.00 m depth

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333109.1, N:6256004.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH03
PROJECT No: 86230.01
DATE: 01/04/25
SHEET: 2 of 2



10.00-12.10 m depth

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333129.9, N:6256002.4
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH04
PROJECT No: 86230.01
DATE: 03/04/25 - 07/04/25
SHEET: 1 of 5

CONDITIONS ENCOUNTERED					SAMPLE			TESTING AND REMARKS					
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (°)	DENSITY (°)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
82.4	0.15	CONCRETE; 150mm thick; one layer bidirectional reinforcement (SL82).	[Concrete Symbol]		NA		NA				0.15		
	0.23	FILL / SAND: grey; medium.	[Fill Symbol]	FILL			M				0.20		
	0.60	FILL / Sandy GRAVEL: dark grey; fine to medium, sub-angular, igneous; fine to coarse sand.	[Fill Symbol]	FILL	ND		M / W				0.40		
	1.00	Continued as rock log									0.50		
	2.00												
	3.00												
	4.00												
	5.00												
	6.00												
	7.00												
	8.00												
	9.00												

NOTES: #Soil origin is "probable" unless otherwise stated. °Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: DTS 700

OPERATOR: Terratest

LOGGED: JDS

METHOD: DT (200mm) to 0.15m, AD/T to 0.60m, NMLC to 31.50m

CASING: HW to 0.5m

REMARKS:

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333129.9, N:6256002.4
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH04
PROJECT No: 86230.01
DATE: 03/04/25 - 07/04/25
SHEET: 3 of 5

CONDITIONS ENCOUNTERED										SAMPLE			TESTING																									
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.			DEPTH (m)	STRENGTH		RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE																	
				RS	XW	HW		SW	FR													VL	LM	VH	EH													
72	10.00	SANDSTONE: grey, pale grey, and pale brown, fine to medium grained, distinct bedding, 0 to 10%; siltstone laminae ~5-15%. Mittagong Formation.	[Pattern]	FR	FR	FR	10.00	M	H	100	100	[Fracture Spacing]				72	PLT	PL(A)=1.1MPa																				
71	11																				SANDSTONE: pale grey and pale brown, medium to coarse grained; cross-bedded. Hawkesbury Sandstone.	[Pattern]	FR	FR	11.00	M	H	100	100	[Fracture Spacing]				71	PLT	PL(A)=0.99MPa		
70	12																																					
69	13	15.00m-15.65m: 50% carbonaceous laminations	[Pattern]	FR	FR	13.05	M	H	100	100	[Fracture Spacing]	13.81m: B, 5-10°, PR, VNR Clay, RF			13	PLT	PL(A)=0.89MPa																					
68	14																			15.00m-15.65m: 50% carbonaceous laminations	[Pattern]	FR	FR	14.00	M	H	100	92	[Fracture Spacing]	15.54m: B, 0°, PR, VNR Clay, RF	15.67m: B, 10°, PR, VNR, RF			14	PLT	PL(A)=0.80MPa		
67	15	15.00m-15.65m: 50% carbonaceous laminations	[Pattern]	FR	FR	15.00	M	H	100	100	[Fracture Spacing]					15	PLT	PL(A)=0.73MPa																				
66	16																			15.00m-15.65m: 50% carbonaceous laminations	[Pattern]	FR	FR	16.00	M	H	100	100	[Fracture Spacing]					16	PLT	PL(A)=1.1MPa		
65	17	15.00m-15.65m: 50% carbonaceous laminations	[Pattern]	FR	FR	17.00	M	H	100	100	[Fracture Spacing]					17	PLT	PL(A)=1.3MPa																				
64	18																			15.00m-15.65m: 50% carbonaceous laminations	[Pattern]	FR	FR	18.00	M	H	100	100	[Fracture Spacing]					18	PLT	PL(A)=1.0MPa		
63	19	15.00m-15.65m: 50% carbonaceous laminations	[Pattern]	FR	FR	19.00	M	H	100	100	[Fracture Spacing]	19.57m: B, 10°, PR, RF, iron clay	19.80m: Water loss ~20%			19	PLT	PL(A)=1.1MPa																				

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT (200mm) to 0.15m, AD/T to 0.60m, NMLC to 31.50m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HW to 0.5m

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333129.9, N:6256002.4
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH04
PROJECT No: 86230.01
DATE: 03/04/25 - 07/04/25
SHEET: 4 of 5

CONDITIONS ENCOUNTERED										SAMPLE			TESTING								
GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE			
	62	[CONT] SANDSTONE: pale grey and pale brown, medium to coarse grained; cross-bedded. Hawkesbury Sandstone.		FR																	
	21									100	100		20.77m: CS, 10mm				PLT	PL(A)=1.0MPa			
	61												21.20m: B, -5°, PR, Clay 2mm, RF								
	22									100	100		21.40m: Water loss ~10%				PLT	PL(A)=1.3MPa			
	60																				
	23																PLT	PL(A)=1.1MPa			
	59																				
	23								H								PLT	PL(A)=1.6MPa			
	24									100	100										
	58																				
	25						100	100													
	57																				
	26																				
	56									26.12m: JT, 90°, U, CN, RF											
	27					L	100	92		26.20m: B, 5-10°, PR, Clay, RF, 3-4mm				PLT	PL(A)=0.34MPa						
	55									26.26m: B, 0°, PR, Clay, RF, 1-2mm											
	27									26.57m: B, 15°, PR, Clay 1mm, RF											
	55									26.70m: B, 0°, PR, Clay 5mm, RF											
	28									26.75m: B, 0°, PR, Clay, RF, 1-2mm				PLT	PL(A)=0.59MPa						
	54									26.00m - 27.40m: Water loss 25%											
	28					M	100	90		27.75m: CS, 10°, PR, Clay 40mm, RF											
	54									28.08m: CS, Clay 15mm											
	29									28.20m: JT, 20°, PR, Clay 4mm, RF											
	53									28.25m: B, 0°, PR, Clay, RF, 2-4mm				PLT	PL(A)=0.32MPa						
	29									28.70m: JT, 15°, PR, Clay 4mm, RF											
	53									28.94m: JT, 20°, PR, VNR Clay, RF											
	29									29.04-29.30m: B 5°, PR, VNR, RF				PLT	PL(A)=0.43MPa						
	53									29.36m: JT, 70°, PR, CN, RF											
	29					M				29.40m: JT, 15°, PR, VNR, RF											
	53									29.57-29.67m: CZ, 10°, PR											
	29									29.82m: JT, 5°, UN, VNR				PLT	PL(A)=0.29MPa						

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT (200mm) to 0.15m, AD/T to 0.60m, NMLC to 31.50m
REMARKS:

OPERATOR: Terratest

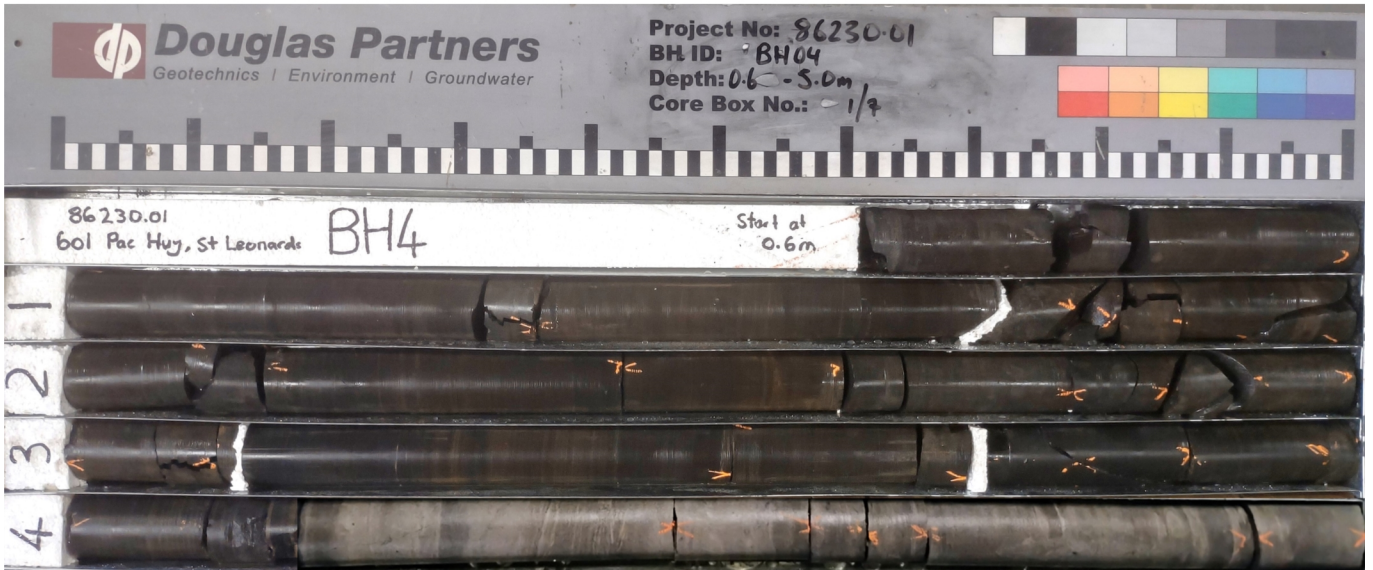
LOGGED: JDS
CASING: HW to 0.5m

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333129.9, N:6256002.4
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH04
PROJECT No: 86230.01
DATE: 03/04/25 - 07/04/25
SHEET: 1 of 4



0.60-5.00 m depth



5.00-10.00 m depth

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333129.9, N:6256002.4
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH04
PROJECT No: 86230.01
DATE: 03/04/25 - 07/04/25
SHEET: 2 of 4



10.00-15.00 m depth



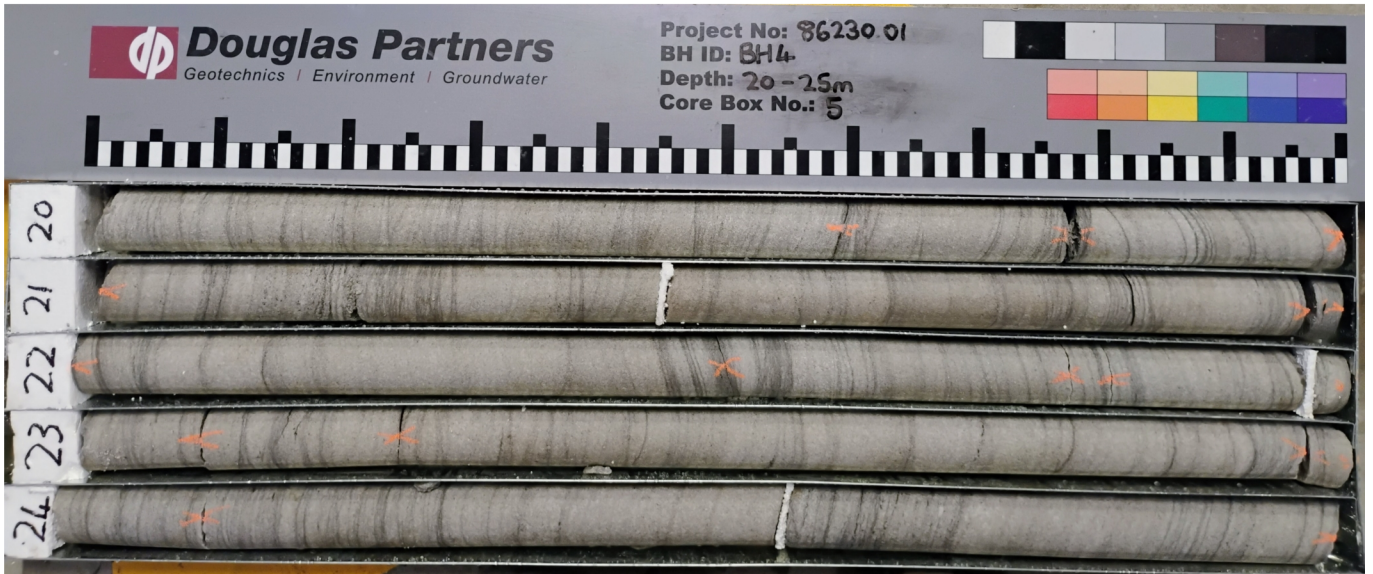
15.00-20.00 m depth

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333129.9, N:6256002.4
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH04
PROJECT No: 86230.01
DATE: 03/04/25 - 07/04/25
SHEET: 3 of 4



20.00-25.00 m depth



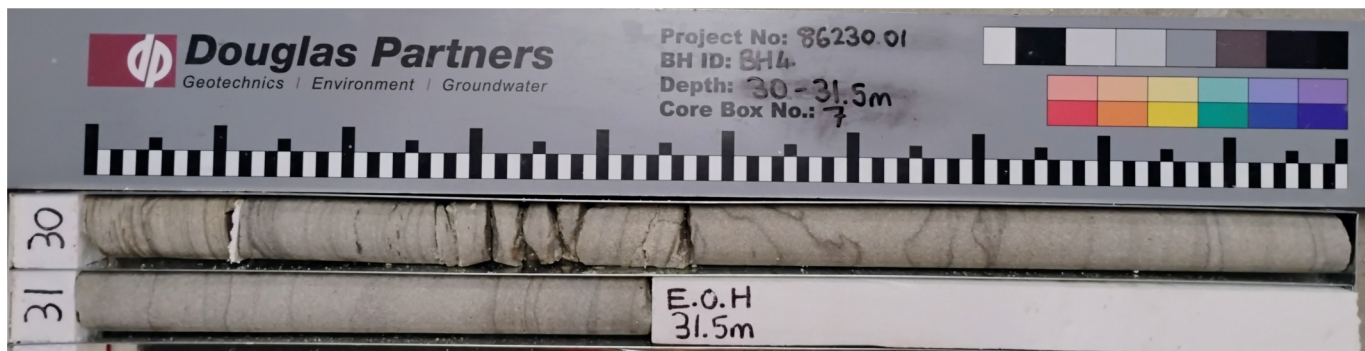
25.00-30.00 m depth

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.4 AHD
COORDINATE: E:333129.9, N:6256002.4
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH04
PROJECT No: 86230.01
DATE: 03/04/25 - 07/04/25
SHEET: 4 of 4







30.00-31.50 m depth

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.2 AHD
COORDINATE: E:333135.6, N:6255984.9
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH05
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 1 of 3

GROUNDWATER		CONDITIONS ENCOUNTERED				SAMPLE			TESTING AND REMARKS					
		RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (%)	DENSITY (%)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE
	82	0.15	CONCRETE; 150mm thick; one layer reinforcement 8mm (SL82). FILL / SAND: yellow-grey; medium. FILL / GRAVEL: grey; fine to medium, sub-angular, igneous. FILL / Sandy CLAY trace gravel: grey; low to medium plasticity; fine sand; fine, angular, siltstone gravel; trace PVC fragments. Continued as rock log				NA	NA			D	0.20		
	0.25				FILL						D	0.40		
	0.30				FILL		ND		M		D	0.50		
	1										D	0.90		
	1.10											1.00		
		2										2		
		3										3		
		4										4		
		5										5		
		6										6		
		7										7		
		8										8		
		9										9		

NOTES: #Soil origin is "probable" unless otherwise stated. %Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: DTS 700

OPERATOR: Terratest

LOGGED: JDS

METHOD: DT (200mm) to 0.15m, AD/T to 1.10m, NMLC to 14.60m

CASING: HWT to 1m

REMARKS:

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.2 AHD
COORDINATE: E:333135.6, N:6255984.9
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH05
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 3 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING						
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS		BACKFILL	WELL PIPE
72		[CONT] SANDSTONE: grey and pale grey, fine to medium grained, distinct, bedded; with siltstone laminations and bedding ~5%. Mittagong Formation.		FR	12.20	M	100	100	10.30m: No drilling muds, water loss ~20% 10.55-10.59m CZ, INF Clay 6mm, 10.66m: B 15°, PR, Clay 10mm, SM 11.57m: B, 10°, PR, M, SM					11	PLT	PL(A)=1.9MPa			
71							100	92						11	PLT	PL(A)=0.95MPa			
70							100	100						12	PLT	PL(A)=0.40MPa			
69							100	95						13	PLT	PL(A)=1.0MPa			
68							100	95						14	PLT	PL(A)=1.1MPa			
	15	Borehole discontinued at 14.60m depth. Target depth reached.																	
	16																		
	17																		
	18																		
	19																		

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700
METHOD: DT (200mm) to 0.15m, AD/T to 1.10m, NMLC to 14.60m
REMARKS:

OPERATOR: Terratest

LOGGED: JDS
CASING: HWT to 1m

Refer to explanatory notes for symbol and abbreviation definitions



CORE PHOTO LOG

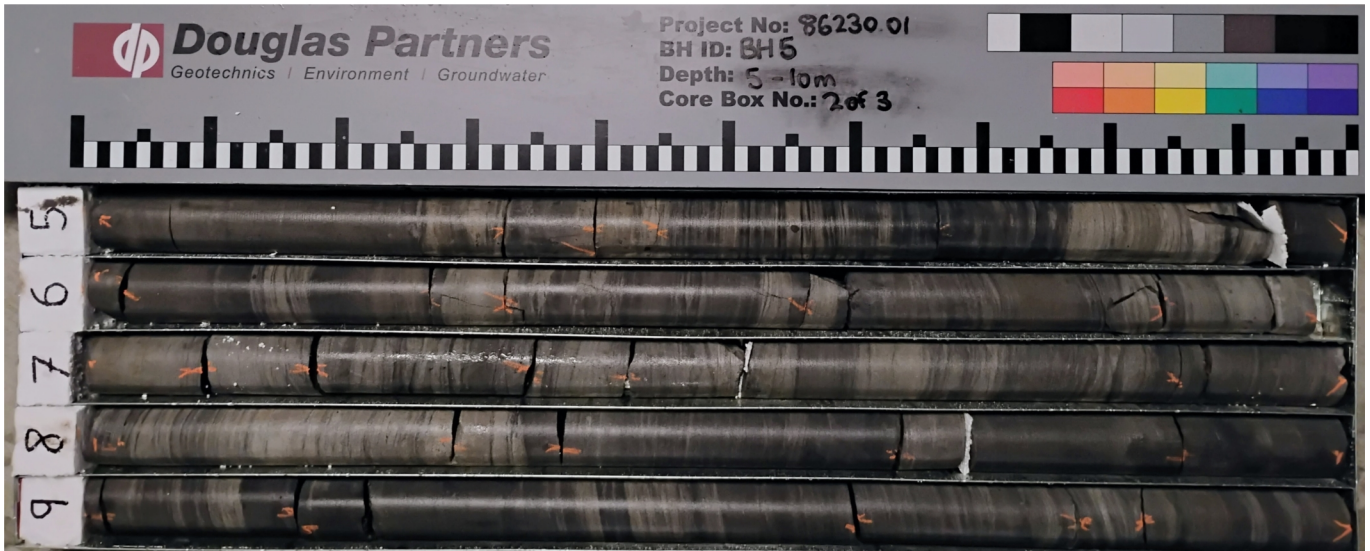
CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.2 AHD
COORDINATE: E:333135.6, N:6255984.9
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH05
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 1 of 2



1.10-5.00 m depth



5.00-10.00 m depth

CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 82.2 AHD
COORDINATE: E:333135.6, N:6255984.9
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH05
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 2 of 2



10.00-14.60 m depth

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 81.3 AHD
COORDINATE: E:333122.5, N:6255970.7
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH06
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 1 of 3

CONDITIONS ENCOUNTERED						SAMPLE			TESTING AND REMARKS					
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (%) DENSITY (g)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
81.15	0.15	CONCRETE; 150m thick; one layer reinforcement (SL82).			NA	NA		D	0.15					
81.25	0.25	FILL / SAND: grey-brown; medium.		FILL	ND	M		D	0.25					
81.50	0.50	FILL / SANDY CLAY with gravel: dark grey; low to medium plasticity; fine to coarse sand; fine, siltstone gravel.		FILL	ND	w=PL		D	0.40					
81.65	0.65	SILTSTONE: dark grey. Ashfield Shale.												
	1.00	Continued as rock log												
	2.00													
	3.00													
	4.00													
	5.00													
	6.00													
	7.00													
	8.00													
	9.00													

NOTES: #Soil origin is "probable" unless otherwise stated. #Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: DTS 700

OPERATOR: Terratest

LOGGED: JDS

METHOD: DT (200mm) to 0.15m, AD/T to 0.50m, WB to 0.65m, NMLC to 11.05m

CASING: HWT to 0.5m

REMARKS:

Generated with CORE-GS by Geoc - Split Soil-Rock Log

Refer to explanatory notes for symbol and abbreviation definitions



BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 81.3 AHD
COORDINATE: E:333122.5, N:6255970.7
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH06
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 2 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING					
GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
08/04/25 No free groundwater observed whilst augering	81	Continued from soil log SILTSTONE: dark grey, indistinct bedding, 0 to 10°. Ashfield Shale.		FR	0.65	●	100	76	0.85m B, 0°, PR, 1mm, SM, fines	1.15m JT, 30°, PR, VNR, SM, fines 1.33m: JT, 30°, PR, VNR, SM, fines 1.35m: JT, 70°, PR, CN, SM 1.42m CZ, 40mm				1	PLT	PL(A)=0.94MPa		
	80													1	PLT	PL(A)=1.8MPa		
	79													2	PLT	PL(A)=0.72MPa		
	78													2	PLT	PL(A)=0.95MPa		
	77	SANDSTONE: grey and pale grey, fine to medium grained, indistinct bedding, 0 to 10°; siltstone laminations and bedding. Mittagong Formation.		FR	4.50	●	100	100	3.00m CZ, 40mm	1.70m: Water loss <10%. no drilling mud added.				3	PLT	PL(A)=0.80MPa		
	76													3	PLT	PL(A)=0.75MPa		
	75													4	PLT	PL(A)=0.88MPa		
	74													4	PLT	PL(A)=0.70MPa		
	73													5	PLT	PL(A)=0.93MPa		
	72													5	PLT	PL(A)=1.0MPa		
71	SANDSTONE: grey and pale grey, fine to medium grained, indistinct bedding, 0 to 10°; siltstone laminations and bedding. Mittagong Formation.		FR	4.50	●	100	100	6.2m: CZ, 20mm 6.3m: CZ, 20mm					6	PLT	PL(A)=2.0MPa			
70													6	PLT	PL(A)=1.0MPa			
69													7	PLT	PL(A)=2.3MPa			
68													7	PLT	PL(A)=1.4MPa			
67	SANDSTONE: grey and pale grey, fine to medium grained, indistinct bedding, 0 to 10°; siltstone laminations and bedding. Mittagong Formation.		FR	4.50	●	100	100						8	PLT	PL(A)=2.3MPa			
66													8	PLT	PL(A)=1.4MPa			
65	SANDSTONE: grey and pale grey, fine to medium grained, indistinct bedding, 0 to 10°; siltstone laminations and bedding. Mittagong Formation.		FR	4.50	●	100	100						9	PLT	PL(A)=1.5MPa			
64													9	PLT	PL(A)=1.5MPa			

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700

OPERATOR: Terratest

LOGGED: JDS

METHOD: DT (200mm) to 0.15m, AD/T to 0.50m, WB to 0.65m, NMLC to 11.05m

CASING: HWT to 0.5m

REMARKS:

BOREHOLE LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 81.3 AHD
COORDINATE: E:333122.5, N:6255970.7
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH06
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 3 of 3

CONDITIONS ENCOUNTERED										SAMPLE			TESTING							
GROUNDWATER RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS		BACKFILL	WELL PIPE	
																PL	PL(A)			
71	11	[CONT] SANDSTONE: grey and pale grey, fine to medium grained, indistinct bedding, 0 to 10°; siltstone laminations and bedding. Mittagong Formation.		FR			100	91		9.97m: CZ, 80mm 10.10m: B, 10° PR, Clay 10mm, RF					PLT	PL(A)=1.3MPa				
70	11.05	Borehole discontinued at 11.05m depth. Target depth reached.																		

NOTES: #Soil origin is "probable" unless otherwise stated.

PLANT: DTS 700

OPERATOR: Terratest

LOGGED: JDS

METHOD: DT (200mm) to 0.15m, AD/T to 0.50m, WB to 0.65m, NMLC to 11.05m

CASING: HWT to 0.5m

REMARKS:

Refer to explanatory notes for symbol and abbreviation definitions



CORE PHOTO LOG

CLIENT: Stockland Commercial Property
PROJECT: Proposed Commercial Building
LOCATION: 601 Pacific Highway, St Leonards, NSW 2065

SURFACE LEVEL: 81.3 AHD
COORDINATE: E:333122.5, N:6255970.7
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH06
PROJECT No: 86230.01
DATE: 08/04/25
SHEET: 1 of 1



0.50-5.00 m depth



5.00-11.05 m depth

Appendix D

Permeability Test Results

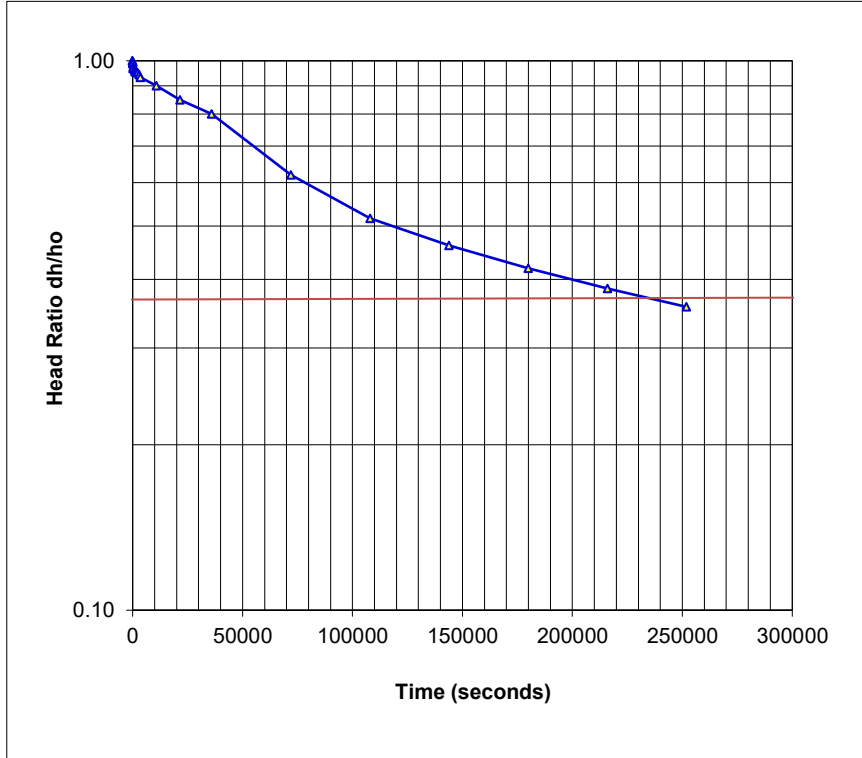
Permeability Testing - Falling Head Test Report

Client:	Stockland Developments Pty Ltd	Project No:	86230.01
Project:	Proposed Residential Development	Test date:	10-Apr-25
Location:	601 Pacific Highway, St Leonards	Tested by:	JDS

Test Location	Test No.	BH3
Description:	Falling Head Test (Case 2)	Easting: 333109.1 m
Material type:	Siltstone & Sandstone	Northing: 6256004.1 m
		Surface Level: 82.4 m AHD

Details of Well Installation			
Effective diameter (2re)	76 mm	Depth to water before test	9 m
borehole diameter (2R)	76 mm	Depth to water at start of test	0.5 m
Effective Length of well screen (Le)	3.1 m	Depth of top of PVC standpipe	0.5 m
		Depth of base of PVC standpipe	12.1 m

Test Results			
Time (sec)	Depth (m)	Change in Head δH (m)	$\delta H/H_0$
0.00	0.50	8.50	1.000
60.00	0.53	8.47	0.996
120.00	0.54	8.46	0.995
180.00	0.61	8.39	0.987
240.00	0.72	8.28	0.974
300.00	0.77	8.23	0.968
900.00	0.82	8.18	0.962
1200.00	0.88	8.12	0.955
1800.00	0.89	8.11	0.954
2400.00	0.92	8.08	0.951
3000.00	0.98	8.02	0.944
3600.00	1.07	7.93	0.933
10800.00	1.35	7.65	0.900
21600.00	1.79	7.21	0.848
36000.00	2.20	6.80	0.800
72000.00	3.73	5.27	0.620
108000.00	4.61	4.39	0.516
144000.00	5.08	3.92	0.461
180000.00	5.44	3.56	0.419
216000.00	5.73	3.27	0.385
252000.00	5.97	3.03	0.356

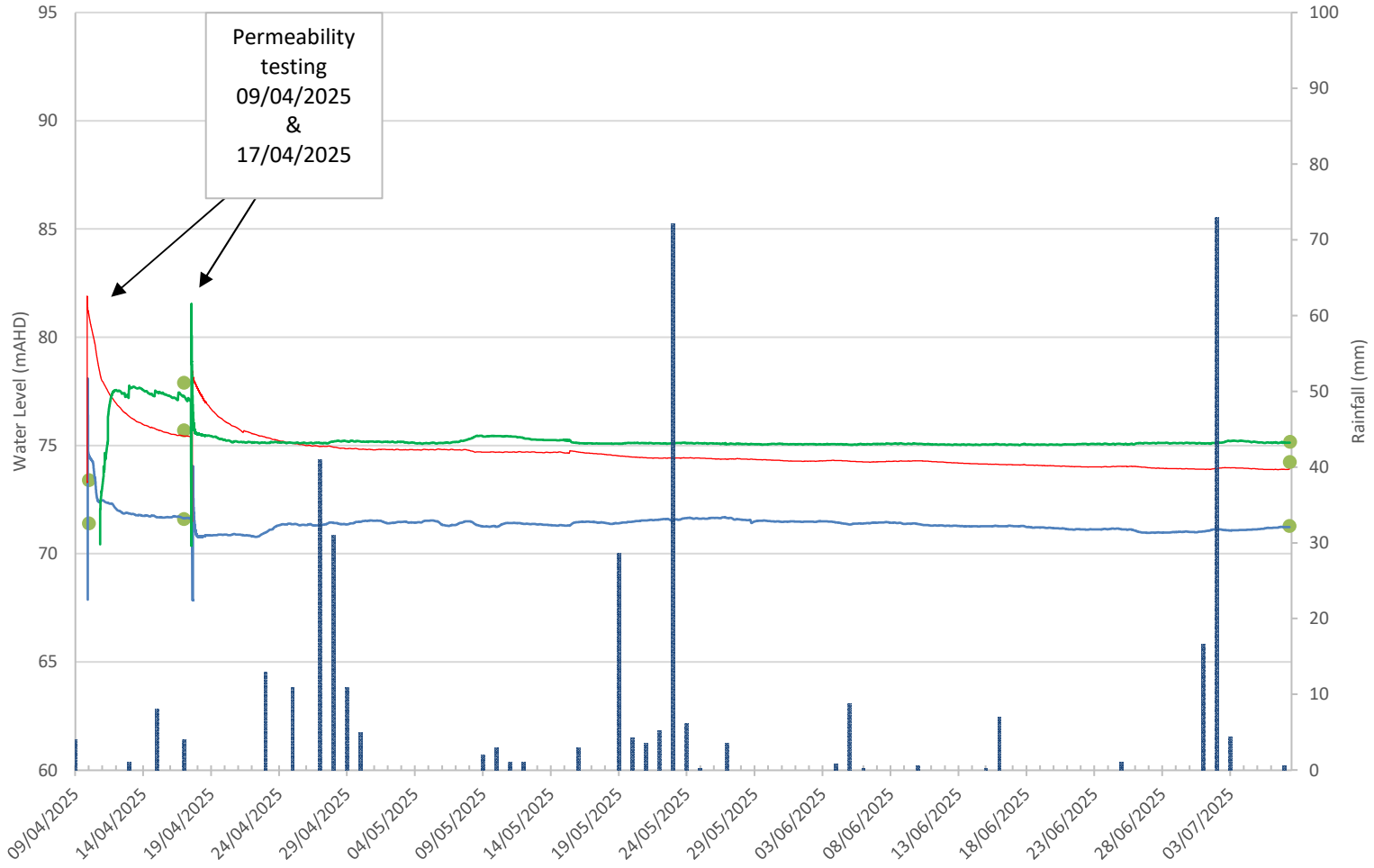


To = 4000 mins
240000 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev
 $k = [r^2 \ln(Le/R)] / 2Le To$ where r = radius of casing
 R = radius of well screen
 Le = length of well screen
 To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	k =	4.3E-09	m/sec
	=	0.0004	m/day

Groundwater Level Monitoring Summary



Permeability testing
09/04/2025
&
17/04/2025

Note: Reading Interval = 1 hour



GROUND
EXPERTISE

- Manual Levels
- Water Level BH01
- Water Level BH03
- Water Level BH06
- Rainfall data (ST: 066011)

Date:
08/07/2025

From
09/04/2025
To
07/07/2025

Drawn:
AG
Checked:
STE

Appendix E

Laboratory Results

RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORES YOUNG'S MODULUS AND POISSON'S RATIO

Client: Stockland Commercial Property
Project: Proposed Commercial Building
Location: 601 Pacific Hwy, St Leonards NSW



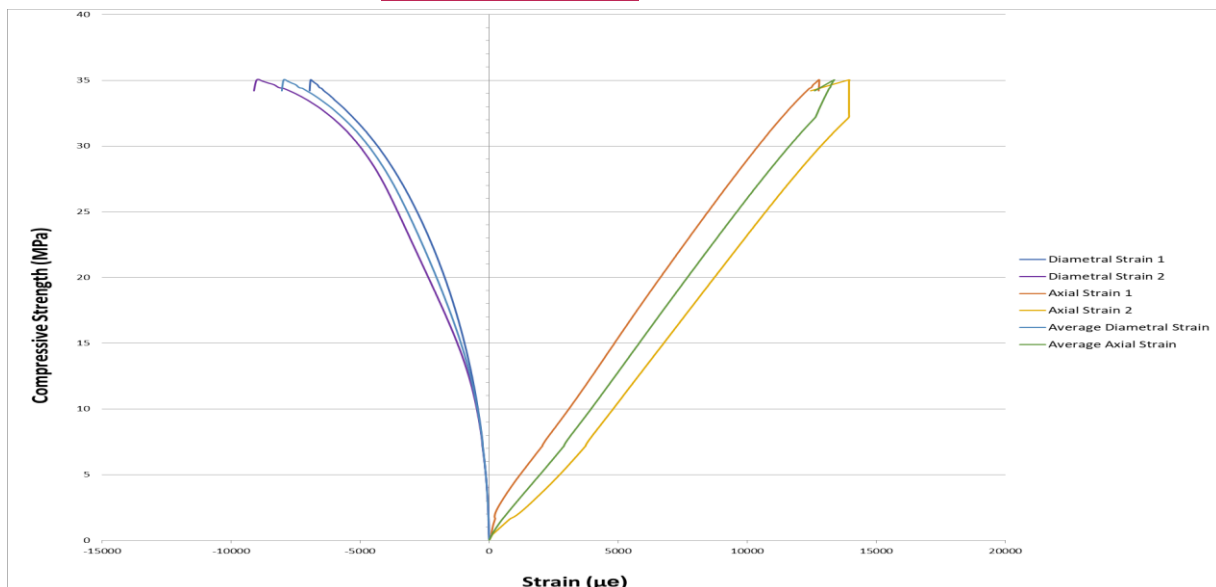

Project No: 86230.01
Report No: 86230.01_12937
Report Date: 02.05.2025
Date of Testing: 29.04.2025
Date Sampled: 14.04.2025

Approved Signatory: Peter Gorseski
peter.gorseski@douglaspartners.com.au

Accredited for Compliance with ISOIEC 17025 - Testing
 NATA Accredited Laboratory Number: 828

Young's Modulus + Poisson Ratio and UCS (< 50 MPa) AS 4133.4.3.2

Lab Sample Number	NC-12937A	
Sample Location	BH01	
Depth (m)	7.07 - 7.29	
Rock Description	Interlaminated Siltstone & Sandstone	
Storage History	Wrapped in Plastic	
Conditioning	Tested as Received	
Compression Machine	Automax Multitest	
Measurement	Electric Strain Gauges	
Specimen Diameter / Height (mm)	51.7	145
Height to Diameter Ratio	2.8 : 1	
Moisture Content (%)	2.3	
Wet Mass / Unit Volume (t/m ³)	2.59	
Dry Mass / Unit Volume (t/m ³)	2.53	
Test Duration (sec)	438	
Rate of Displacement (kN/sec)	0.17	
Failure Mode	Tensile	
Uniaxial Compressive Strength (MPa)	35.0	
SECANT MODULUS (50% load)		
Young's modulus (GPa)	2.6	
Poisson's ratio	0.23	
TANGENT MODULUS (25 - 55% load)		
Young's modulus (GPa)	2.7	
Poisson's ratio	0.39	



**RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORES
YOUNG'S MODULUS AND POISSON'S RATIO**

Client: Stockland Commercial Property
Project: Proposed Commercial Building
Location: 601 Pacific Hwy, St Leonards NSW



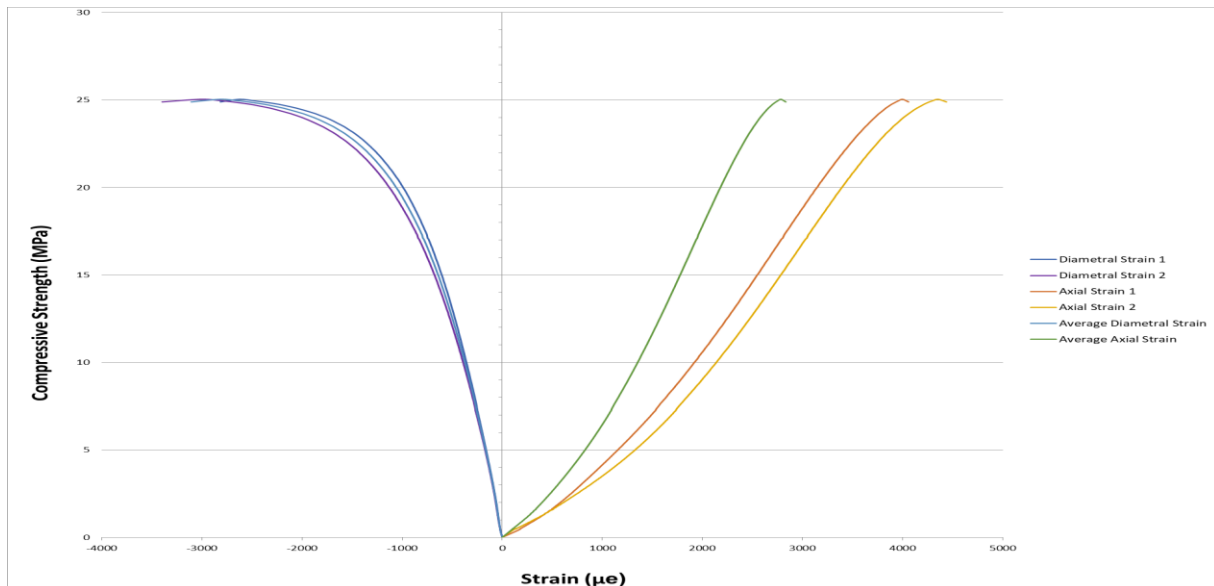
Project No: 86230.01
Report No: 86230.01_12937
Report Date: 02.05.2025
Date of Testing: 29.04.2025
Date Sampled: 14.04.2025

Approved Signatory: Peter Gorseski
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NATA Accredited Laboratory Number: 828

Young's Modulus + Poisson Ratio and UCS (< 50 MPa) AS 4133.4.3.2

Lab Sample Number	NC-12937B	
Sample Location	BH02	
Depth (m)	13.43 - 13.67	
Rock Description	Sandstone	
Storage History	Wrapped in Plastic	
Conditioning	Tested as Received	
Compression Machine	Automax Multitest	
Measurement	Electric Strain Gauges	
Specimen Diameter / Height (mm)	51.4	143
Height to Diameter Ratio	2.8 : 1	
Moisture Content (%)	6.0	
Wet Mass / Unit Volume (t/m ³)	2.40	
Dry Mass / Unit Volume (t/m ³)	2.27	
Test Duration (sec)	469	
Rate of Displacement (kN/sec)	0.11	
Failure Mode	Shear	
Uniaxial Compressive Strength (MPa)	25.0	
SECANT MODULUS (50% load)		
Young's modulus (GPa)	5.3	
Poisson's ratio	0.21	
TANGENT MODULUS (35 - 65% load)		
Young's modulus (GPa)	7.8	
Poisson's ratio	0.42	



RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORES YOUNG'S MODULUS AND POISSON'S RATIO

Client: Stockland Commercial Property
Project: Proposed Commercial Building
Location: 601 Pacific Hwy, St Leonards NSW



Project No: 86230.01
Report No: 86230.01_12937
Report Date: 02.05.2025
Date of Testing: 29.04.2025
Date Sampled: 14.04.2025

Approved Signatory: Peter Gorseski
peter.gorseski@douglaspartners.com.au

Accredited for Compliance with ISOIEC 17025 - Testing
 NATA Accredited Laboratory Number: 828

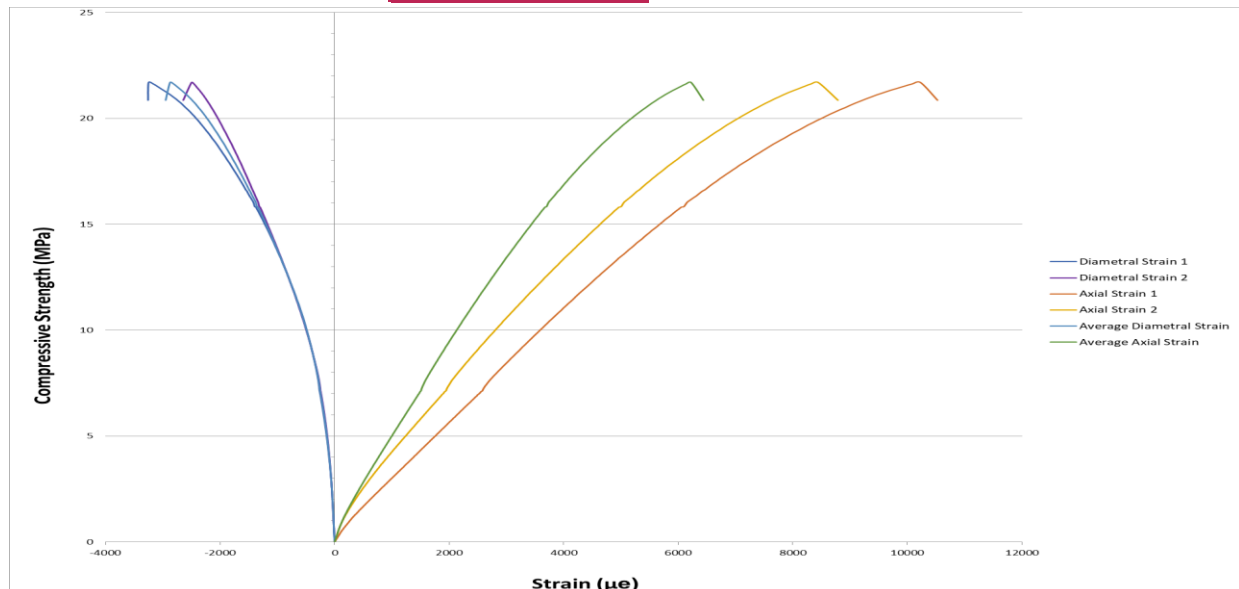
Young's Modulus + Poisson Ratio and UCS (< 50 MPa) AS 4133.4.3.2

Lab Sample Number	NC-12937C
Sample Location	BH03
Depth (m)	8.12 - 8.36
Rock Description	Interlaminated Siltstone & Sandstone
Storage History	Wrapped in Plastic
Conditioning	Tested as Received
Compression Machine	Automax Multitest
Measurement	Electric Strain Gauges
Specimen Diameter / Height (mm)	51.7 145
Height to Diameter Ratio	2.8 : 1
Moisture Content (%)	2.6
Wet Mass / Unit Volume (t/m ³)	2.58
Dry Mass / Unit Volume (t/m ³)	2.52
Test Duration (sec)	437
Rate of Displacement (kN/sec)	0.10
Failure Mode	Shear
Uniaxial Compressive Strength (MPa)	21.7
SECANT MODULUS (50% load)	
Young's modulus (GPa)	3.1
Poisson's ratio	0.17
TANGENT MODULUS (35 - 65% load)	
Young's modulus (GPa)	2.7
Poisson's ratio	0.32

Before



After



RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORES YOUNG'S MODULUS AND POISSON'S RATIO

Client: Stockland Commercial Property
Project: Proposed Commercial Building
Location: 601 Pacific Hwy, St Leonards NSW



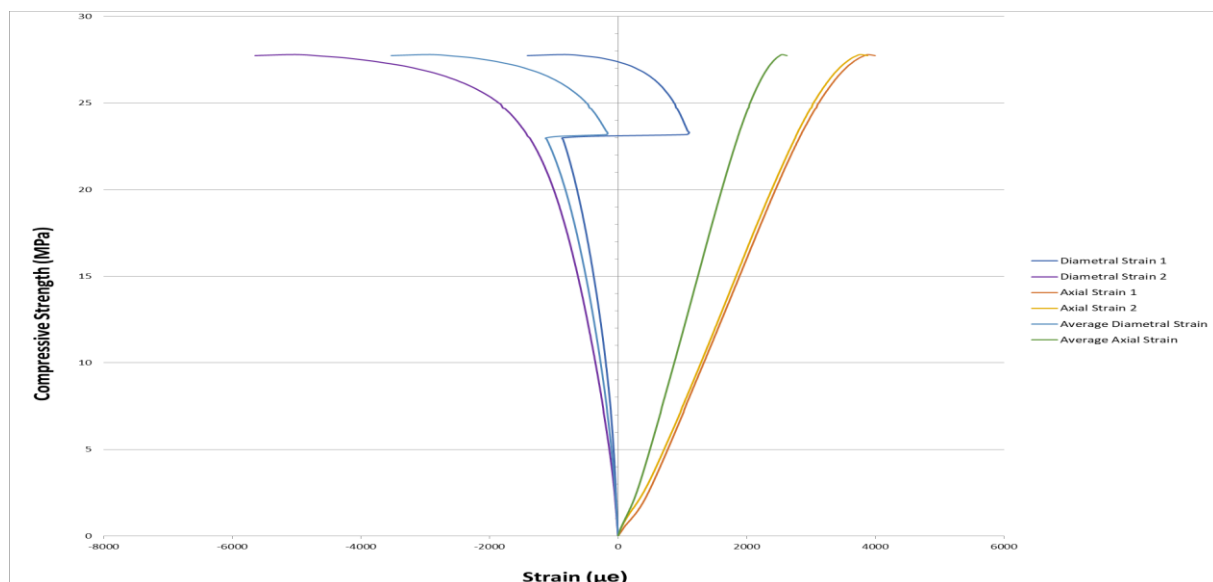
Project No: 86230.01
Report No: 86230.01_12937
Report Date: 02.05.2025
Date of Testing: 29.04.2025
Date Sampled: 14.04.2025

Approved Signatory: Peter Gorseski
peter.gorseski@douglaspartners.com.au

Accredited for Compliance with ISOIEC 17025 - Testing
 NATA Accredited Laboratory Number: 828

Young's Modulus + Poisson Ratio and UCS (< 50 MPa) AS 4133.4.3.2

Lab Sample Number	NC-12937D	
Sample Location	BH04	
Depth (m)	25.03 - 25.36	
Rock Description	Sandstone	
Storage History	Wrapped in Plastic	
Conditioning	Tested as Received	
Compression Machine	Automax Multitest	
Measurement	Electric Strain Gauges	
Specimen Diameter / Height (mm)	51.8	145
Height to Diameter Ratio	2.8 : 1	
Moisture Content (%)	5.0	
Wet Mass / Unit Volume (t/m ³)	2.44	
Dry Mass / Unit Volume (t/m ³)	2.32	
Test Duration (sec)	501	
Rate of Displacement (kN/sec)	0.12	
Failure Mode	Tensile	
Uniaxial Compressive Strength (MPa)	27.8	
SECANT MODULUS (50% load)		
Young's modulus (GPa)	8.0	
Poisson's ratio	0.26	
TANGENT MODULUS (25 - 55% load)		
Young's modulus (GPa)	9.0	
Poisson's ratio	0.39	



**RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORES
 YOUNG'S MODULUS AND POISSON'S RATIO**

Client: Stockland Commercial Property
Project: Proposed Commercial Building
Location: 601 Pacific Hwy, St Leonards NSW



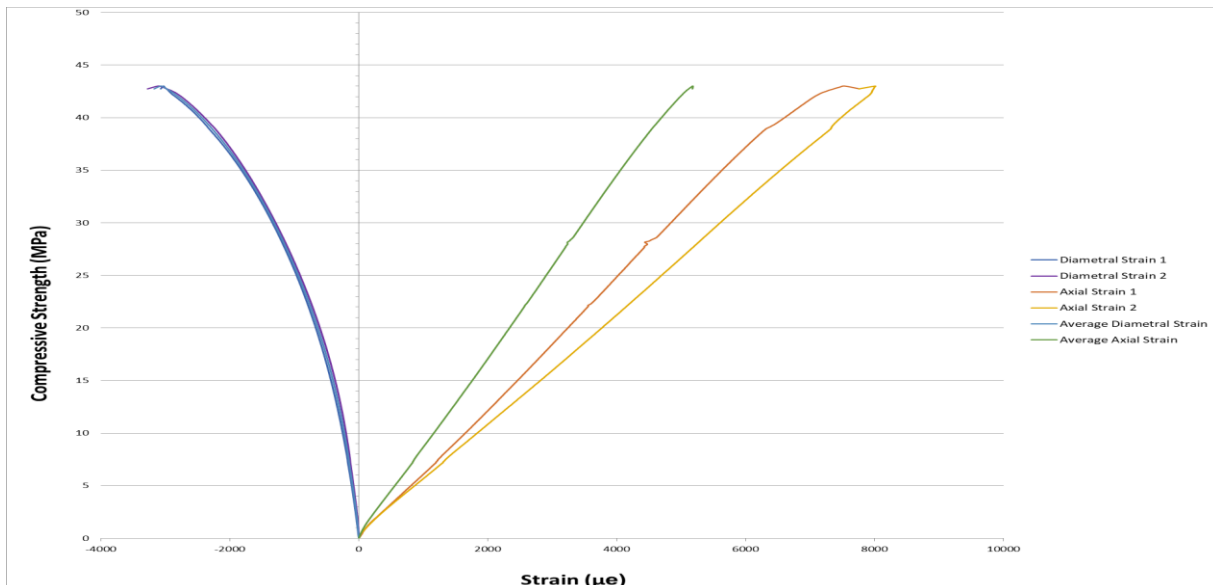
Project No: 86230.01
Report No: 86230.01_12937
Report Date: 02.05.2025
Date of Testing: 29.04.2025
Date Sampled: 14.04.2025

Approved Signatory: Peter Gorseski
peter.gorseski@douglaspartners.com.au

Accredited for Compliance with ISOIEC 17025 - Testing
 NATA Accredited Laboratory Number: 828

Young's Modulus + Poisson Ratio and UCS (< 50 MPa) AS 4133.4.3.2

Lab Sample Number	NC-12937E
Sample Location	BH05
Depth (m)	7.61 - 7.87
Rock Description	Interlaminated Siltstone & Sandstone
Storage History	Wrapped in Plastic
Conditioning	Tested as Received
Compression Machine	Automax Multitest
Measurement	Electric Strain Gauges
Specimen Diameter / Height (mm)	51.6 144
Height to Diameter Ratio	2.8 : 1
Moisture Content (%)	1.7
Wet Mass / Unit Volume (t/m ³)	2.55
Dry Mass / Unit Volume (t/m ³)	2.51
Test Duration (sec)	658
Rate of Displacement (kN/sec)	0.14
Failure Mode	Mixed
Uniaxial Compressive Strength (MPa)	43.0
SECANT MODULUS (50% load)	
Young's modulus (GPa)	5.7
Poisson's ratio	0.19
TANGENT MODULUS (35 - 65% load)	
Young's modulus (GPa)	5.9
Poisson's ratio	0.34



**RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORES
YOUNG'S MODULUS AND POISSON'S RATIO**

Client: Stockland Commercial Property
Project: Proposed Commercial Building
Location: 601 Pacific Hwy, St Leonards NSW



Project No: 86230.01
Report No: 86230.01_12937
Report Date: 02.05.2025
Date of Testing: 29.04.2025
Date Sampled: 14.04.2025

Approved Signatory: Peter Gorseski
peter.gorseski@douglaspartners.com.au

Accredited for Compliance with ISOIEC 17025 - Testing
NATA Accredited Laboratory Number: 828

Young's Modulus + Poisson Ratio and UCS (< 50 MPa) AS 4133.4.3.2

Lab Sample Number	NC-12937F	
Sample Location	BH06	
Depth (m)	6.41 6.64	
Rock Description	Interlaminated Siltstone & Sandstone	
Storage History	Wrapped in Plastic	
Conditioning	Tested as Received	
Compression Machine	Automax Multitest	
Measurement	Electric Strain Gauges	
Specimen Diameter / Height (mm)	51.8	144
Height to Diameter Ratio	2.8 : 1	
Moisture Content (%)	4.8	
Wet Mass / Unit Volume (t/m ³)	2.47	
Dry Mass / Unit Volume (t/m ³)	2.35	
Test Duration (sec)	396	
Rate of Displacement (kN/sec)	0.09	
Failure Mode	Shear	
Uniaxial Compressive Strength (MPa)	17.7	
SECANT MODULUS (50% load)		
Young's modulus (GPa)	3.0	
Poisson's ratio	0.10	
TANGENT MODULUS (35 - 65% load)		
Young's modulus (GPa)	2.9	
Poisson's ratio	0.15	

