Douglas PARTNERS | GROUNDED EXPERTISE

Stockbridge Property Unit Trust
Level 6, 131 Macquarie Street
Sydney, NSW 2000

Attention: Chris Houghton
Email: choughton@mcdonald.com.au

Project 202337.03
15 May 2025
R.002.Rev0
DRC:sam

Addendum to Geotechnical Investigation
Proposed Mixed-Use Development
Cnr Mann St & Dwyer St, North Gosford NSW

1. Introduction

This addendum letter prepared by Douglas Partners Pty Ltd (Douglas) relates to a geotechnical report prepared by Douglas for a site located at the corner of Mann Street and Dwyer Street, North Gosford. The site is identified as Lots 4 and 5, Deposited Plan (DP) 15954, Lot 31, DP 553523 and Lot 2A, DP 407164.

This addendum and the earlier geotechnical report are to accompany an Environmental Impact Statement (EIS) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), in respect of a State Significant Development Application (SSDA). A summary of the relevant Secretary's Environmental Assessment Requirements (SEARs) is detailed in Table 1.

Table 1: Summary of relevant SEARs and response

SEAR	Requirement	Response	Report Section
13	Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity and acid sulfate soils. Provide a Surface and Groundwater Impact Assessment that assesses potential impacts on: • Surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourse. • Groundwater resources in accordance with the Groundwater Guidelines.	Geotechnical investigation carried out by Douglas	Douglas (2023) and this current addendum

2. Summary of geotechnical investigation

Field work as part of the geotechnical investigation was carried out in October and November 2022. It is understood that since the completion of the geotechnical report (Douglas, 2023), the proposed development has been revised.

Review of the latest plans indicates that the proposed development is to comprise the following:

- A mixed-use development, involving the construction of three buildings containing residential apartments, commercial / retail floor area and basement car parking;
- Building height ranging from seven storeys to 22 storeys; and
- Construction of a private road, landscaping and public domain improvements.

It is noted that communal open space areas are to be incorporated into the proposed design. The proposed development plans are attached. Figure 1 shows the site and various lots.

Figure 1: Aerial view of the site with perimeter boundary in red and internal lot boundaries in blue. Base image sourced from MetroMap dated 17 December 2024.

Based on review and comparison of recent MetroMap aerial imagery (between September 2022 and December 2024), and visual inspection from Dwyer and Mann Street, it is considered that the surface conditions at the site have not significantly changed since the time of the geotechnical investigation (Douglas, 2023). No development or disturbance appears to have taken place at the site and, with the possible exception of fluctuating groundwater levels, subsurface conditions relating to geotechnical aspects at the site are unlikely to have changed.

It is noted that the geotechnical report (Douglas, 2023) makes reference to 'Site B'. In the context of this project, Site B refers to the lots shown in Figure 1 of this addendum and is the subject site for the proposed development.

3. Groundwater

The geotechnical investigation included the installation of groundwater wells within the site, and these were monitored to check groundwater levels. Data was provided in the report regarding the levels at which groundwater was observed at the time of the investigation, and these were noted to be within the depth of the proposed basement excavation, which was expected to be about 6 m based on up to two levels of basement parking.

The current development proposal is for between three and five levels of basement parking, and selected plans showing the proposed development are attached for reference. Accordingly, the proposed basement would still be within the region where groundwater was previously observed.

Douglas understands that the basement will be designed as a 'tanked' rather than 'drained' basement. As such, removal and discharge of groundwater would not be required for the operation of the buildings.

In relation to groundwater, the following comments are made:

- The project site is located on a west to south-westerly sloping area, with a local high point at RL 40 m approximately 200 m to the east of the site;
- The subsurface profile generally comprises a residual clay or sandy clay profile overlying weathered sandstone and siltstone associated with the Terrigal Formation;
- Given the residual soil profile and surface gradients, it is expected that much of the rainfall landing on the site and the upslope catchment area would be shed off as runoff, with relatively minor infiltration into the ground;
- Groundwater seepage flows through the soil and rock profile would be relatively slow, as the permeability of the soils would be relatively low;
- The Main North Railway line runs between 20 m and 40 m from the western boundary of the site. The rail corridor is located within an area of cut, with the cutting on the side nearest to the site ranging from 2 m to 5 m high;
- Surface gradients through the site and surrounding area fall toward the railway cutting, and it is considered that this provides for favourable surface drainage; and
- The land located between the project site and the railway corridor has been developed for industrial purposes, and does not include any riparian zones or watercourses.

Provided that the development is designed and constructed with tanked basements, it is considered that there would be negligible impacts to surface and groundwater, and there would be no discharge considerations that need to be met for the operation of the buildings. Furthermore, there would be no ongoing extraction of groundwater from the local system, nor is the area a recognised groundwater aquifer. Accordingly, further assessment of seepage flows and water quality for extraction and discharge would not be necessary for the design of the tanked basement although short term seepage flows should be considered as part of the construction of the basement and this will be guided by additional investigations and seepage modelling as part of the pre-construction phase of the project.

4. Further geotechnical investigation

The geotechnical investigation (Douglas, 2023) comprised boreholes that were taken to depths ranging from 11.28 m to 19.42 m, and this was based on an expectation that the basement would be up to about 6 m deep.

For the current proposal, the lower basement level for Building 1 (the 22 storey tower) would be at RL 3.9, whereas for Building 2 (a seven-storey block) the lower basement level would be at RL 5.8. When considering the depth of the boreholes with regard to the levels for the proposed basement excavation, there is insufficient geotechnical information relating to founding conditions. Further geotechnical investigation would be required to inform the design of the building foundations (particularly piles), although this aspect is independent of the groundwater aspect discussed in Section 3 above.

5. References

Douglas. (2023). *Report on Geotechnical Investigation, Proposed Multi-Storey Residential Development, Mann Street & Dwyer Street, North Gosford (Site B)*. Ref: 202337.01.R.002.Rev0 dated 18 April 2023: Douglas Partners Pty Ltd.

6. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at Cnr Mann St & Dwyer St, North Gosford NSW in line with Douglas' email proposal dated 12 March 2025 and acceptance received from Mr Chris Houghton of Stockbridge Property Unit Trust dated 13 March 2025. The work was carried out under Douglas' Engagement Terms. This report is provided for the exclusive use of Stockbridge Property Unit Trust for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or another 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 subsurface 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, as reported in Douglas (2023). Subsurface 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 the Douglas (2023) 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.

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).

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

Darryl Carson
Principal / Geotechnical Engineer

Scott McFarlane
Principal / Geotechnical Engineer

Attachments: About this Report
Proposed Development Plans (selected)

About this Report

October 2024

Introduction

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

Douglas' 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.

Copyright

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, Douglas 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, Douglas 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, Douglas will be pleased to assist with investigations or advice to resolve the matter.

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, Douglas 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. Douglas 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.

intentionally blank

B9

B10

SITE F

NEW PRIVATE ROAD

B8
SITE G

RL 14.80

B3

RL 15.80

B2

UP

COMMUNAL OPEN SPACE

COMMUNAL OPEN SPACE

SITE B

SITE A

PARKING LANE

DWYER STREET

PEDESTRIAN THROUGH SITE LINK

B6
SITE E

B5
SITE D

B4
SITE C

RL 19.90

B1

RL 19.90

UP

UP

16000

EXISTING STREET PARKING

MANN STREET

EXISTING STREET PARKING

1 LOWER GROUND FLOOR PLAN
SCALE1 : 250

REVISION

A	FOR INFORMATION	22/05/24
B	FOR INFORMATION	04/06/24
C	FOR INFORMATION	04/09/24
D	FOR INFORMATION	23/09/24
E	FOR INFORMATION	2/10/24
F	ISSUE FOR DA	24/01/25

DRAWN	CHECKED	JOB NO.	SCALE
JJ	MC	23001	1 : 250 @A1

PROJECT

372-374 MANN ST & 35-37 DWYER ST
NORTH GOSFORD NSW 2250

DRAWING TITLE

LOWER GROUND FLOOR PLAN

CLIENT

CURZON + PARTNERS
L 13, 234 GEORGE STREET
SYDNEY NSW 2000
T: +61 87055475
CURZON AND PARTNERS PTY LTD ACN 649993377

ISSUE PURPOSE	REV	DRAWING NO.
SSDA	F	**DA 109**

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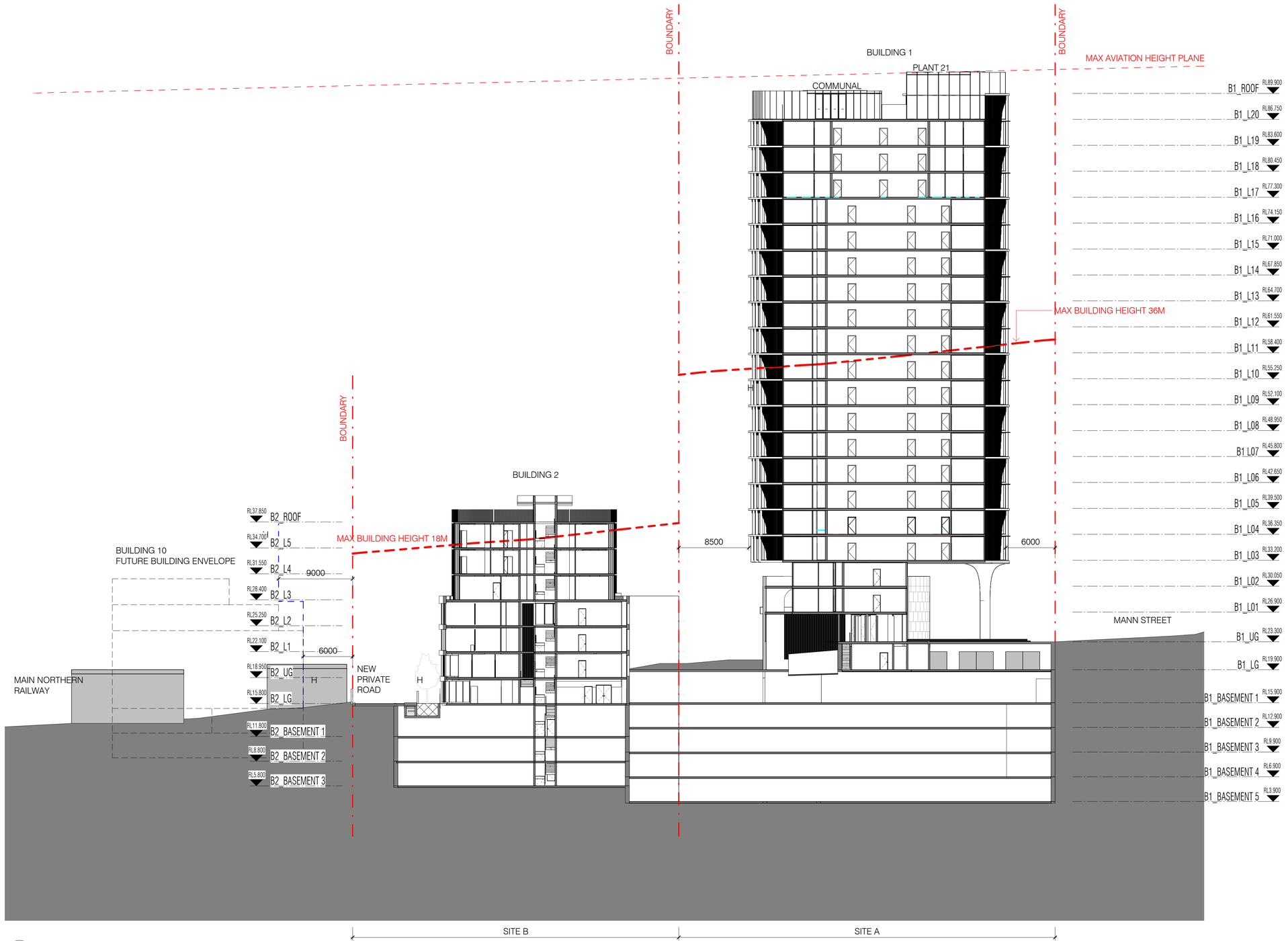

A SECTION AA
SCALE1 : 250

REVISION

A	ISSUE FOR DA	24/01/25

NOTES

DRAWN	CHECKED	JOB NO.	SCALE
JJ	MC	23001	As indicated @A1

PROJECT

372-374 MANN ST & 35-37 DWYER ST
NORTH GOSFORD NSW 2250

DRAWING TITLE

SECTION AA

CLIENT

CURZON + PARTNERS
L 13, 234 GEORGE STREET
SYDNEY NSW 2000
T: +61 87055475
CURZON AND PARTNERS PTY LTD ACN 649993377

ISSUE PURPOSE	REV	DRAWING NO.
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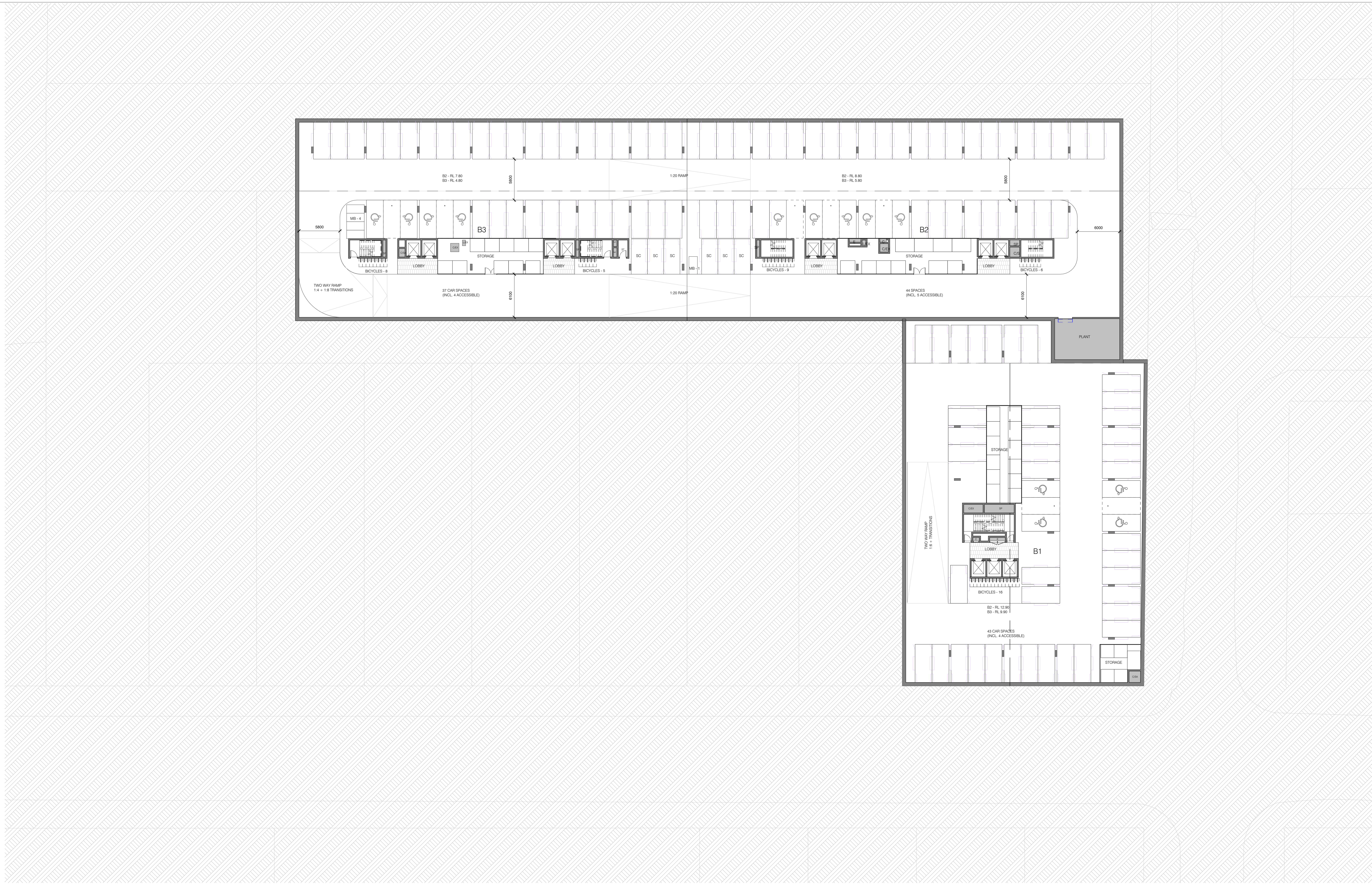

1 BASEMENT 3 PLAN
SCALE1 : 250

REVISION

C	FOR INFORMATION	04/09/24
D	FOR INFORMATION	23/09/24
E	FOR INFORMATION	2/10/24
F	FOR INFORMATION	11/12/24
G	FOR INFORMATION	20/01/25
H	ISSUE FOR DA	24/01/25

LEGEND
- RESIDENTIAL
- COMMERCIAL
- CARPARK
- COMMUNAL OPEN SPACE

NOTES

CHECK AND VERFIY ALL DIMENSIONS ON SITE PRIOR TO COMMENCING WORK. DRAWING TO BE READ IN CONJUCTION WITH ALL OTHER CONTRACT DOCUMENTS. DO NOT SCALE DRAWING. USE FIGURED DIMENSIONS ONLY. SEEK CLARIFICATION OF INCONSISTENCIES/CONFLICTS.

DRAWN	CHECKED	JOB NO.	SCALE
JJ	MC	23001	As indicated @A1

PROJECT
372-374 MANN ST & 35-37 DWYER ST
NORTH GOSFORD NSW 2250

DRAWING TITLE
BASEMENT 3 PLAN

CLIENT

CURZON + PARTNERS
L 13, 234 GEORGE STREET
SYDNEY NSW 2000
T: +61 87055475
CURZON AND PARTNERS PTY LTD ACN 649993377

ISSUE PURPOSE	REV	DRAWING NO.
SSDA	H	DA 106

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Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Multi-storey Residential Development
Mann Street & Dwyer Street, North Gosford (Site B)

Prepared for
Stockbridge Property Unit Trust

Project 202337.01
April 2023

Douglas Partners
Geotechnics / Environment / Groundwater

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Revision 0	1	0	Douglas Partners Archives

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 April 2023
Reviewer		18 April 2023

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Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
Unit 5, 3 Teamster Close
Tuggerah NSW 2259
Phone (02) 4351 1422

Douglas Partners
Geotechnics / Environment / Groundwater

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Report on Geotechnical Investigation
Proposed Multi-storey Residential Development
Mann Street & Dwyer Street, North Gosford

1. Introduction

This report presents the results of a geotechnical investigation undertaken for a proposed multi-storey residential development at Mann Street & Dwyer Street, North Gosford. The investigation was commissioned by Chris Houghton of Stockbridge Property Unit Trust and was undertaken with reference to Douglas Partners' proposal 202337.01.P.001.DftB dated 25 July 2022.

Stockbridge Property Unit Trust has two land parcels within North Gosford, and these are separated by Mann Street. The parcel on the western side of Mann Street has been identified as 'Site B', whereas the parcel on the eastern side is identified as 'Site A'. Both sites are proposed to be redeveloped, however, this report relates only to the proposed redevelopment of Site B, and specifically the geotechnical investigation carried out for that site. The project is anticipated to comprise the redevelopment of the site for multi-storey apartment buildings with basement carpark.

The geotechnical investigation was to carried out in order to provide:

- Subsurface conditions at test locations including observations on groundwater;
- Excavation conditions;
- Safe batter slopes for short term (temporary) stability;
- Geotechnical parameters for footings and retaining walls;
- Design parameters for anchors to support retaining walls;
- Exposure classification for durability design;
- Site subsoil class for earthquakes in accordance with AS 1170.4; and
- Site preparation measures.

The investigation included the drilling of six boreholes with coring into the underlying bedrock profile, together with testing of soil and rock samples. The details of the field work and laboratory testing are presented in this report, together with comments and recommendations on the items listed above.

It is noted that the geotechnical investigation was carried out concurrent with a Detailed Site Investigation (Contamination) which included additional shallow sampling locations that are not covered in this geotechnical report.

The proposed development includes multi-level residential buildings and as such are considered to be classified as NSW Class 2 Buildings as defined in the Design and Building Practitioners Act 2020. It is noted that this report provides geotechnical parameters to assist with development of a design and does not provide a specific design for the proposed development.

2. Proposed Development

At the time of preparing this report, the details of the proposed development had not been confirmed, and architectural plans for the overall site development were not available. Based on correspondence with the client, it is, however, understood that the development would comprise the following:

- Demolition of existing buildings;
- Construction of a 5 to 9 storey residential unit development over one or two levels of basement, with excavations up to 6 m deep.

DP has been advised that the project will aim to maximise the available area. Therefore, it is anticipated that the basement for the final multi-storey unit development would extend over the entire site area, with retaining walls likely to be along or close to the site boundaries.

3. Site Description

The site is bounded by Dwyer Street on the north side, with Manns Street forming part of the eastern boundary. The remaining boundaries are not formed by road frontages, but rather by other commercial or industrial developments. Further information is presented below.

Legal Description / Site Address	• Lot 4, D.P. 15954 – 374 Mann Street; • Lot 5, D.P. 15954 – 372 Mann Street; • Lot 31, D.P. 553523 – 37 Dwyer Street; and • Lot 2A, D.P. 407164 – 35 Dwyer Street.
Approximate Area	0.7 hectares
Zoning	B4 Mixed Use
Local Council Area	Central Coast Council
Current Use	• Lot 4 - residential land use with a dwelling and detached garage; • Lot 5 - used for commercial purposes (Gosford Sewing Machine Centre); • Lot 31 – residential land use with a single storey dwelling (northern portion) and vacant land (southern portion); and • Lot 2A – vacant land
Surrounding Uses	• North – Dwyer Street and residential land use beyond; • East – Mix of residential and commercial land use (including 'Site A' – reported separately and an automotive repair shop east of Lot 31 (south east corner)); • South – Commercial land use (including Tint Haus, a window tinting service, and John Anderson Automotive); and • West – Commercial land use (including Radio Five-O-Plus, and Gosford Windscreens) and rail line further west.

The site boundary and lot layout are shown in Figure 1.

Figure 1: Site B (the site) and Site A (reported separately) boundary (in red) and lot layout. Aerial image sourced from MetroMap (12 September 2022).

4. Published Data

4.1 Topography

Figure 2 shows an aerial image with the North Gosford development site (red outline) located in the centre and overlain by 2 m contour lines. This shows a local high point at RL 40 m approximately 200 m to the east, and slopes falling down to the west and south-west in the direction of the Main North Railway line and further beyond to Narara Creek which is visible in the top left of Figure 2. Figure 3 shows a closer view of the site.

Figure 2: Topography of the local area

Figure 3: Close view of the site with 2 m contour lines

Surface levels across the site fall from about RL 24 m AHD at the north-eastern corner down to about RL 14 m AHD in the south-western corner.

4.2 Geology

Reference to the NSW seamless geology mapping *Gosford-Lake Macquarie 1:100 000 Geology Sheet* (GSNSW, 2019) indicates that the site is underlain by the Terrigal Formation of the Triassic period of the Mesozoic era, characterised by interbedded laminite, shale and quartz to lithic-quartz sandstone, with some claystone.

Figure 4 shows the geological mapping for the project area. The green shaded area corresponds with the area mapped as Terrigal Formation, whereas the yellow shaded area is mapped as Quaternary Alluvium soil deposits.

Figure 4: Geological mapping for the site and surrounding area

The rock profile encountered in the boreholes was consistent with the geological mapping.

4.3 Soil Landscape

Reference to the *Gosford-Lake Macquarie 1:100 000 Soil Landscapes Sheet* indicates the site is underlain by the Erina erosional soil landscape (pink shading). The Erina landscape is associated with undulating to rolling rises and low hills on the Terrigal Formation. These soils typically include yellow podzolic soils and yellow earths, and typically have high soil erosion hazard, localised foundation hazard, seasonal waterlogging of footslopes and are strongly acid soils of low fertility. Figure 5 shows the local soil landscape mapping.

A region of 'disturbed terrain' (grey shading), which broadly matches the area of alluvial soils shown in Figure 4, is located to the west of the site. This suggests the likely presence of widespread fill materials or disturbed ground associated with the nearby Gosford Golf Course and low-lying areas adjacent to Narara Creek.

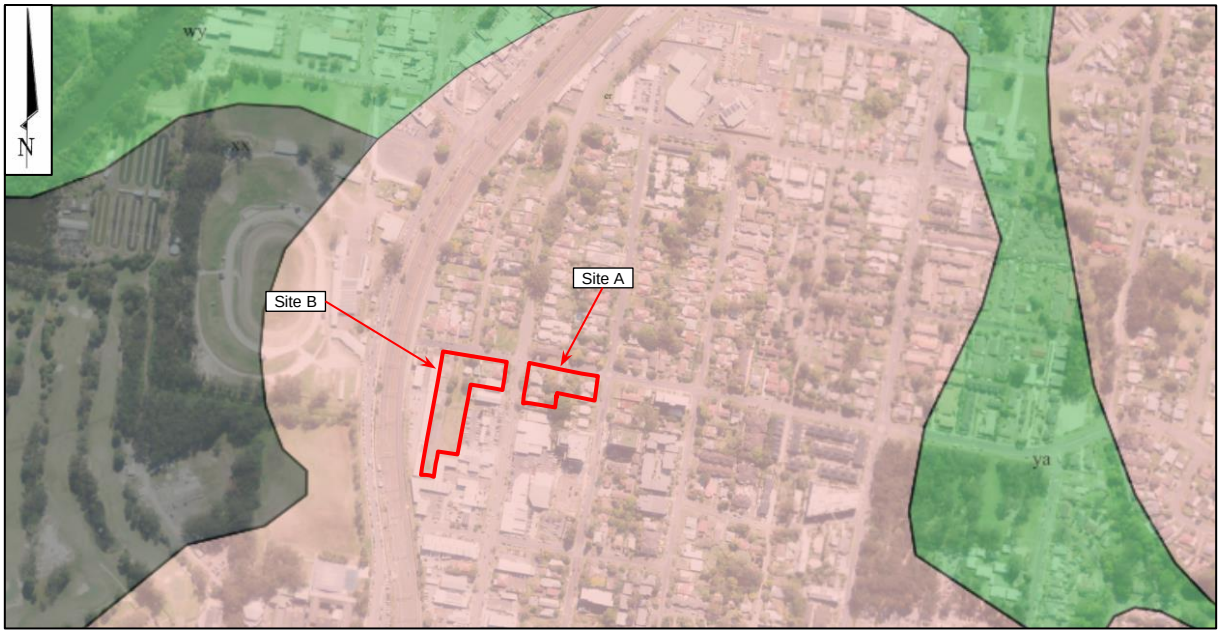

Figure 5: Soil landscape mapping for the site and surrounding area

5. Field Work

5.1 Field Work Methods

Field work for the investigation was undertaken between 10 October 2022 and 24 November 2022 and included the drilling of six boreholes (Bores B1 to B6) to depths ranging from 11.28 m to 19.42 m.

Drilling was carried out using a track mounted drilling rig with 125 mm diameter solid flight augers and a tungsten carbide (TC) drill bit within soils until rock was encountered. Drilling was then advanced using NMLC diamond rock coring equipment until the target depths were reached. Standard penetration tests (SPTs) were carried out at nominal 1.5 m depth intervals in the soil profile and starting from 1 m depth.

Point load strength tests were also undertaken at nominal 1 m intervals within the rock core, with the results presented on the borehole logs.

The introduction of water for rock coring purposes precluded observation of groundwater levels during drilling. As such, standpipe piezometers (or groundwater monitoring wells) were installed in Bores B1, B3 and B5 to allow monitoring of groundwater levels. The piezometers were installed through the residual soil layer and into the underlying weathered rock profile (with the exception of Bore B5 where it did not penetrate into the rock profile), with the bottom of each piezometer extending to 8 m below the ground surface, which corresponded to 2 m below the proposed maximum depth of basement excavation of 6 m. A slotted pipe (screen) was used over the lower 6 m of the piezometer, and the annulus was backfilled with 5 mm washed gravel. Bentonite pellets were placed above the screened section to prevent surface runoff infiltrating into the well. All the wells (where water was present) were then developed by the removal of at least three well volumes, or until practically dry.

The site was revisited on 24 November 2022 approximately two weeks following the completion of drilling, and each of the wells were dipped to check standing groundwater levels. Where groundwater was present within the wells, samples of the groundwater were collected at that time.

Borehole locations were set out with reference to the site plan and at accessible areas to give broad coverage of the overall site. The locations of the boreholes are shown on Drawing 1, included in Appendix B. The coordinates and surface elevations of the boreholes were recorded using a differential GPS. Levels given on the logs are to 10 mm increments, however, the dGPS unit can be affected by trees and buildings, and it is generally considered to have an accuracy of ± 100 mm for this project.

Engineering logs of the subsurface conditions encountered in the boreholes were prepared by a geotechnical engineer who also collected representative samples for identification purposes and photographed the rock core in the core boxes. Details of the conditions encountered in the boreholes are given in the log sheets which are presented in Appendix C. These logs should be read in conjunction with the explanatory notes, which define the descriptive terms and classification methods. Photographic plates of the rock core recovered in each of the boreholes accompany the logs.

As mentioned earlier, the geotechnical investigation was carried out in conjunction with a detailed site investigation for contamination which included other shallow boreholes and sampling locations. Those, however, have not been included in this geotechnical investigation report.

5.2 Field Work Results

The subsurface conditions encountered during the investigation are typically summarised as fill to about 0.3 m depth, overlying residual soils and extremely weathered material to depths ranging from about 3 m (northern end) to about 13 m (southern end), then sandstone and siltstone bedrock.

The typical subsurface materials encountered during the investigation have been divided into geotechnical units as summarised in Table 1, with a distribution of the materials interpreted at each test location presented in Table 2.

Table 1: Summary of Geotechnical Units

Unit	Soil Type	Description
1	Fill	Silty SAND, Sandy SILT, or SILT: dark brown or grey; considered to be disturbed topsoil.
2	Topsoil / Colluvium	Silty SAND or SAND: dark brown or brown
3	Residual Soil	CLAY or Sandy CLAY: generally stiff or very stiff; plasticity ranging from low to high; typically yellow brown over upper portion then grey and red brown.
4	Extremely Weathered Material	Sandy CLAY or Clayey SAND: very stiff or hard or dense; grey mottled red brown; low or medium plasticity; extremely weathered sandstone.
5	Weathered Rock	SANDSTONE and SILTSTONE: Generally moderately or slightly weathered; generally very low, low or medium strength but with some high strength bands; typically light grey, grey, orange brown and red brown.

Table 2: Distribution of Geotechnical Units Encountered at Borehole Locations

Borehole	Surface Level (AHD)	Borehole Depth (m)	Base Depth of Each Layer (m)				
			Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Bore B1	17.19	15.30	0.3	-	1.3	2.8	>15.30
Bore B2	23.14	15.11	-	0.4	1.7	4.5	>15.11
Bore B3	22.77	11.28	0.8	-	1.8	6.8	>11.28
Bore B4	15.27	15.00	0.3	-	4.4	-	>15.00
Bore B5	15.31	14.57	-	0.6	10.2	-	>14.57
Bore B6	14.33	19.42	1.5	-	10.4	12.8	>19.42

Note to Table 2:

- denotes material not encountered.

Free groundwater was observed in two of the three monitoring wells. Table 3 presents the groundwater observations made during the visit on 24 November 2022.

Table 3: Groundwater Observations

Well Location	Ground Surface Level * (AHD)	Depth to Groundwater (m BGL)	Elevation of Groundwater Table (AHD)
Bore B1	17.19	5.51	11.68
Bore B3	22.77	dry	dry
Bore B5	15.31	3.36	11.95

Note to Table 3:

* Surveyed by dGPS

AHD – Australian Height Datum

BGL – Below Ground Level

dry – No groundwater observed within the monitoring well

Groundwater was not observed within the wells installed at Bore B3 at the time of the monitoring event. As such, at this location and at the time of monitoring, groundwater levels would have been at depths greater than 8 m.

It should be noted that groundwater levels are variable and can be affected by factors such as soil permeability and recent climatic conditions and can vary with time.

6. Laboratory Testing

6.1 Point Load Tests

Point load strength tests were carried out in the laboratory on the rock core obtained from the cored boreholes.

A total of 52 axial and diametral point load tests were scattered throughout the length of the core. Individual test results are shown on the borehole logs which are included in Appendix C.

6.2 Aggressivity Testing

Testing for pH, chloride, sulfates and resistivity was carried out to provide information on the aggressiveness of the soil and groundwater. A total of three soil samples and two groundwater samples were submitted to Envirolab Services Pty Ltd, a NATA accredited laboratory, for testing. Samples from Site A were also tested.

A summary of the results of this testing is given in Table 6, with laboratory test reports included in Appendix D. The results of testing for both Site A and Site B are presented as these provide greater context to the chemical conditions of the local area.

Table 4: Results of Aggressivity Testing

Bore	Depth (m)	Description	Soil Condition	pH (concrete)	pH (steel)	Resistivity(1) (Ω.cm) (steel)	SO_4 (ppm) (concrete)	Cl (ppm) (steel)
A3		Groundwater	B	5.5	5.5	7400	21	13
B1		Groundwater	B	5.6	5.6	6100	21	16
B5		Groundwater	B	5.6	5.6	5900	5	15
A1	1.0-1.45	CLAY	B	4.7	4.7	20000	58	10
A3	1.0-1.45	CLAY	B	4.8	4.8	27000	34	10
B1	1.0-1.45	CLAY	B	5.2	5.2	44000	28	<10
B3	1.0-1.45	CLAY	B	4.6	4.6	18000	21	10
B6	2.5-2.95	Sandy CLAY	B	4.9	4.9	28000	44	<10

Notes to Table 4:

Non-aggressive
Mildly aggressive
Moderately aggressive
Severely Aggressive
Very Severe

NT

1 Resistivity calculated based on inverse of conductivity in aqueous solution results

Scale of aggressivity based on threshold values given in AS 2159 – 2009: Piling – Design and Installation.

Comparison of the test results to AS 2159 (2009) indicates that soils and groundwater are generally non-aggressive or mildly aggressive to concrete and steel elements. Further comment on the results is given in Section 7.7 of this report.

7. Comments

7.1 Excavation Conditions

Excavations for the proposed unit development (second phase of development) are understood to be to depths of up to 6 m below the existing ground surface to allow for up to two levels of basement car parking.

It is expected that excavation of the fill (Unit 1), topsoil and colluvium (Unit 2), residual soils (Unit 3), and extremely weathered material (Unit 4) could be undertaken using conventional earthmoving equipment such as a 12 tonne excavator (or larger) with a slower rate of production in the deeper Unit 4 soils. The summarised conditions presented in Table 2 indicates that the bedrock (Unit 5) was encountered at depths within the potential basement excavation at the northern end (Bores B1, B2 and B4), but well below basement level at the southern end (Bores B5 and B6). As such, most of the excavation would be within residual soils and extremely weathered material, with the lower 1.5 m to 3 m at the northern end being within mainly sandstone. The depth to rock at Bore B3 was slightly greater than at the other nearby bores, and this was considered to be due to the presence of siltstone rather than sandstone as the upper rock layer at this location.

The very low and low strength rock are generally expected to be able to be removed using a 20 tonne excavator fitted, with assistance from a rock tyne. Medium strength rock is also expected to be encountered for 6 m deep excavations, particularly as indicate by Bores B2 and B4. Detailed excavation within low or medium strength rock would likely require the use of hydraulic hammers.

It is important to note that excavatability of rock is dependent not only on rock strength, but also on the presence, orientation and extent of discontinuities such as jointing, bedding and fracturing, the presence of favourable versus adverse bedding planes, presence of groundwater and other factors. For example, low strength rock with few discontinuities may be more difficult to excavate than highly fractured, high strength rock.

Prospective excavation contractors should take into consideration the information presented in the borehole logs together with their experience and capability of their equipment when making their own assessment of excavatability of the rock and production rates.

Due to the scale of the proposed development, it is recommended that dilapidation surveys of structures on adjoining sites be carried out before commencing site works. Furthermore, depending on the types of structures that may be present at the time of the future second stage of development (the multi-storey unit buildings), consideration should be given to undertaking vibration monitoring, particularly during bulk excavation activities.

NSW EPA Guidelines require that all material removed from site should be subjected to a Waste Classification Assessment.

7.2 Groundwater

Monitoring of the groundwater wells installed within Site B was carried out on 24 November 2022 and observations are presented in Table 3. One of the wells (Bore B3) was dry at the time of monitoring, indicating that the groundwater table at this location was at depths of more than 8 m at the time of the

monitoring event. At Bores B1 and B5, groundwater was observed at 5.51 m and 3.36 m depth, respectively.

During wet weather conditions there is likely to be temporary seepage zones at shallower depths, therefore the presence of groundwater seepage within the basement excavation will depend on preceding rainfall. Given the proximity of the site to a local high point about 200 m to the east (refer to comments in Section 4.1), groundwater is generally likely to be relatively deep with limited upslope catchment area available for infiltration that would impact on the site.

Seepage rates are not known, however, based on experience with other site in the local area and considering the local topography as described above, it is expected that inflows could be managed by sump and pump methods, depending on the depth and extent of the excavations. It is noted also that there is several metres of fall across the site and advantage could be taken to set basement levels such that fall is provided to the reticulated drainage network outside of the site, thereby allowing for the basement to be designed as a 'drained basement'. Alternatively, a drained basement with pumping from a collection sump located below basement level could also be considered.

It is noted that there has been greater emphasis from state government (NSW Department of Planning, Industry and Environment) regarding management of groundwater including discharges from basement excavations. Approval for a drained basement may need to be obtained from NSW DPIE, and it is our experience that they prefer tanked rather than drained basements. It is also noted that this project constitutes a 'Class 2 Building' under the Design and Building Practitioners Act (2020), and that the design of Class 2 buildings includes stringent controls relating to seepage and leaks within buildings, including basements. As such, there may be other considerations that govern the design of the basement aside from the potential to manage seepage flows.

Further investigation and analysis would be required to estimate seepage flows for possible basements and to check against discharge criteria.

7.3 Batter Slopes

Excavations for the proposed basement are expected to be adjacent to site boundaries, therefore, there are likely to be few instances where battering of excavations would be appropriate for this project. Notwithstanding this, where excavations are sufficiently distant from adjacent structures, in-ground services or site boundaries, temporary excavations may be able to be battered or benched. Table 5 provides recommended temporary (short term) and permanent (long term) batter slopes for excavations or fill batters less than 3 m deep.

Table 5: Recommended Safe Batter Slopes

Material	Temporary Batter Slope(1)	Permanent Batter Slope(1)
Fill (Unit 1) / Topsoil Colluvium (Unit 2)	1.5H:1V	2.5H:1V
Residual Soil (Unit 3) / Extremely Weathered Material (Unit 4)	1.5H:1V	2H:1V
Weathered Rock (Unit 5)	0.75H:1V	1H:1V

Notes to Table 5:

The above recommendations require that:

- excavations are above the groundwater table.
- surcharge loads are set back an appropriate distance from the crest of batter slopes.
- all batter slopes are protected from erosion.
- excavations in rock are inspected by a geotechnical engineer during excavation.

Similarly to the comments given in Section 7.1 regarding excavations within rock, batter slopes within bedrock can also be affected by bedding and jointing and would be subject to further inspection by a geotechnical engineer.

Excavations deeper than 3 m are mainly expected to be for basements and, due to anticipated space constraints, these would require support from retaining walls rather than relying on batters for stability.

7.4 Retaining Walls

Additional allowances should be made for the lateral loads from any future additional surcharge loads above the zone of influence of the retaining wall, which may be preliminarily taken as being within a plane drawn at 2H:1V from the base of the wall.

Furthermore, it is important that the excavation support methods maintain appropriate foundation support of the adjacent structures. While no excavation method or procedure can absolutely guarantee that no damage will occur to adjacent structures, services or pavements, the risks can be minimised by using an appropriate support system.

For temporary support, sheet pile walls may not be suitable because penetration into the weathered rock would be difficult to achieve and such walls tend to be too flexible around their support anchors.

Retaining walls should be designed for appropriate factors of safety or material reduction factors and include checks for global stability, bearing capacity, overturning and sliding.

The recommended preliminary geotechnical parameters for design of retaining walls are presented in Table 6.

Table 6: Retaining Wall Design Parameters - Unfactored

Material	γ_b (kN/m^3)	$\gamma_{b.sat}$ (kN/m^3)	ϕ'	c' (kPa)	C_u (kPa)	E (MPa)	υ	K_o
FILL (Unit 1) and COLLUVIUM (Unit 2)	18	8	25°	0	-	5	0.3	0.6
RESIDUAL SOIL (Unit 3)	20	10	28°	3	50	15	0.3	0.6
EXTREMELY WEATHERED MATERIAL (Unit 4)	21	11	28°	5-10	150	30-50	0.3	0.53
SANDSTONE and SILTSTONE (Unit 5)	22	12	33°	20-50	-	75-150	0.25	0.46

Notes to Table 6:

γ_b – bulk density

$\gamma_{b.sat}$ – saturated bulk density

ϕ' – Effective friction angle

c' – Effective cohesion

C_u – Undrained shear strength

E – Young's Modulus of Elasticity

υ – Poisson's Ratio

K_a – coefficient of active earth pressure

K_o – coefficient of 'at-rest' earth pressure

K_p – coefficient of passive earth pressure

1. – The earth pressure design parameters given above are based on the assumption that the ground behind the wall is level and that full drainage will be provided behind the retaining wall.

2.- A range of drained cohesion and modulus parameters has been provided and a sensitivity analysis is recommended for analysis.

Wall friction coefficients of 0.5 and 0.65 are suggested for the passive and active sides of the wall, respectively.

An ultimate passive pressure of 800 kPa is suggested for the Unit 5 rock. An adequate strength reduction factor should be applied to all parameters for limit state design.

Where retaining walls are not able to tolerate deflections (e.g. wall along property boundaries, supporting sensitive in-ground services, or supporting other structures), then they should be designed based on 'at rest' conditions rather than 'active' conditions.

The earth pressure design parameters given in Table 6 do not account for hydrostatic pressures. For a drained basement option, it is recommended that full drainage behind the retaining walls is provided. All retaining walls, regardless of height, should be provided with geotextile encapsulated free draining backfill (such as 10 mm or 20 mm single size aggregate) with a slotted drainage pipe at the base of the wall for the relief of hydrostatic pressures. For cast in-situ type walls, strip drains should be installed behind the shotcrete with a drainage pipe and spigot at the base. Water intercepted by the drainage system should be discharged to the formal stormwater drainage system outside of the site. If drainage is not provided behind retaining walls, then the walls should be designed to withstand hydrostatic pressures over the full height of the respective walls (i.e. groundwater at the surface), and this aspect should be evaluated by the structural designers considering the development scheme will be for Class 2 buildings. Gravity type retaining walls greater than 2 m high should have an additional subsoil pipe within the backfill at mid-height of the wall.

It is noted that some degree of dampness is inevitable in subsurface construction.

7.4.1 Cantilever Walls

Cantilever type walls (unanchored or not propped) should not be used in areas where excavation will be undertaken close to the site boundaries or existing services, buildings or road reserves, unless they can be constructed rigid enough to resist the imposed earth pressures and minimise lateral displacements.

As a guide, earth pressures acting on cantilevered or gravity type retaining walls can be estimated on the basis of a triangular pressure distribution where no movement-sensitive structures are located within a horizontal distance of 2H (where H is the vertical height of the retained zone) of the rear of the wall.

If displacements from full height cantilevered walls are not acceptable, then anchors could be used to reduce the length of the cantilevered section. In these situations, because the wall is only permitted to undergo relatively minor displacements, earth pressures should be based on an 'at rest', or K_o, state. It is common for walls greater than about 3 m to be supported by anchors or internal propping rather than acting as fully cantilevered walls.

7.4.2 Braced Retaining Walls

For braced walls (e.g. top down construction) or where more than one row of bracing is required for piled walls, retaining walls should not be designed as cantilevered walls. Whilst the earth pressure distribution used for the design of cantilevered retaining walls suggests that the lateral pressure linearly increases with depth, as a result of lateral bracing being used to restrict lateral movements, the pressure should be redistributed when assessing restraint requirements so that relatively uniform resistance is provided.

As a guide, preliminary design of braced retaining walls should be based on a trapezoidal earth pressure distribution. The maximum earth pressure in the trapezium distribution is determined using the earth pressure coefficient multiplied both by the retained height (H) and the unit weight of the retained material. This pressure is applied to the central half of the wall. The pressure increases linearly from zero to full pressure over the upper 0.25H, then decreases linearly to zero pressure over the lowest 0.25H.

Braced retaining walls should be designed for 'at rest' conditions, with preliminary design based on the recommended lateral earth pressure design parameters presented in Table 6.

7.4.3 Anchors

Inclined tie back anchors would be suitable for the support of a piled retaining wall. The working bond stresses for design of anchors will depend largely on the construction method adopted and is probably best assessed by the contractor at the time of construction. Given that residual clay and extremely weathered material was encountered to depths of 3 m to 4 m at the northern end, and increasing to about 13 m depth at the southern end, and that the upper sequences of the weathered rock profile

include significant very low strength zones, anchors would need to be designed based on relatively weak materials.

Provisionally an ultimate bond stress of 30 kPa is suggested for preliminary sizing of grouted anchors within very stiff residual soils, and 80 kPa within at least extremely weathered material or very low strength rock. Selection of final design bond stress is best made after proof testing of trial anchors installed by the successful anchoring contractor using the same equipment, procedures and crew.

Anchors could be of temporary construction given that the floor slabs would provide long term support to the retaining walls.

The anchors should have a free length of at least 3 m or equal to their height above the base of the excavation, and after installation should be check stressed to 125% of the nominal working load. As a guide, where they are designed for 'active' conditions they should be locked off at 60% of the working load, whilst anchors providing support to walls that in turn support any adjoining buried services or structures (i.e. 'at rest' conditions), should be locked off at 100% of the working load. Checks should also be made at regular intervals during the construction phase to ensure that load is maintained in anchors and not lost due to creep effects.

It is noted that if temporary or permanent anchors are proposed to extend under adjoining properties or into the Council road reserve, then permission from the respective property owners would be required. Temporary anchors should be severed once bracing from the structure (e.g. floor slabs and internal beams) is in place.

7.5 Footings

7.5.1 Shallow Footings

Based on the conditions encountered in the boreholes, and dependent on bulk excavation (assumed to be to 6 m depth), it is expected that Unit 5 weathered rock would be exposed at, or close to, design basement levels for the northern section of the proposed multi-storey unit development. Bores B5 and B6 encountered a significantly deeper weathered zone, with increased depth to the underlying rock some 5 m to 6 m below the anticipated bulk excavation level.

Footings should be founded in similar materials to limit the potential for differential settlements. All footings should be taken to below the zone of influence of adjacent service trenches and retaining walls (unless those walls are specifically designed to withstand the applied loads). For this site and based on the presence of mainly cohesive materials, the zone of influence would be defined as a plane extending upwards at 2H:1V above horizontal from the base of the trench or retaining wall.

Shallow strip or pad footings could be designed for the maximum allowable bearing pressures provided in Table 7.

Table 7: Design Parameters for Shallow Foundations

Founding Stratum	Typical Range of Depths* to Top of Founding Stratum (m)	Allowable Bearing Pressure (kPa)
RESIDUAL SOIL (Unit 3) Stiff	0.5	100
RESIDUAL SOIL (Unit 3) Very Stiff	2 - 5	150
WEATHERED ROCK (Unit 5) Typically Very Low Strength	3 - 7 (Bores B1, B2, B3 and B4)	1,000

Notes to Table 7:

* depth below existing ground surface level.

It is noted that the boreholes indicate that medium strength sandstone will likely be present over parts of the site, albeit not sufficiently consistent to be relied upon for footing design purposes. As such, some of the detailed excavation for footings may be within material that could be of greater strength than that which might be inferred from Table 7, however, it is recommended that the design pressures given in the table should still be adopted despite this apparent discrepancy. High level footings on rock would not be appropriate for the southern end of the site due weathered rock being several metres below basement level.

Pad footings of up to 1.5 m square or strip footings 0.6 m wide proportioned as above could expect settlements of up to about 10 mm to 20 mm when founded on stiff or stronger residual soil (Unit 3). High level pad footings up to about 1.5 m square founded on very low strength weathered bedrock (Unit 5) would also expected to have settlements up to about 10 mm to 15 mm.

During construction, shallow footing excavations should be inspected by a suitably qualified geotechnical engineer prior to construction of the footing to assess the suitability of the founding stratum for the design bearing pressures adopted and to assess cleanliness.

7.5.2 Piled Footings

7.5.2.1 Geotechnical Strength Reduction Factor

The design geotechnical strength of a pile ($R_{d,g}$) is the ultimate geotechnical strength ($R_{d,ug}$) multiplied by the geotechnical strength reduction factor (ϕ_g), such that:

$$R_{d,g} = \phi_g \, . \, R_{d,ug}$$

The calculated design geotechnical strength ($R_{d,g}$) must equal or exceed the structural design action effect (E_d). Further reference can be made to AS 2159 (2009) regarding these terms and the design procedure.

Selection of the basic geotechnical strength reduction factor (ϕ_g) is based on a series of individual risk ratings (IRR) which are weighted and lead to an average risk rating (ARR). The individual risk ratings and final value of ϕ_g depend on the following factors:

- Site: the type, quantity and quality of testing;
- Design: design methods and parameter selection;
- Installation: construction control and monitoring;
- Pile testing regime; testing benefit factor based on percentage of piles tested and type of testing; and
- Redundancy: whether other piles can take up load if a given pile settles of fails.

DP is able to assess and comment on factors associated with site characteristics and investigation but does not control the design procedures or construction and testing methods for a project. DP has provided preliminary guidance based on assumptions about the design and construction process but this will change if any of the assumptions are incorrect. Consequently the ARR will need to be checked by the pile designer when all the input factors are known or the assumptions have been confirmed.

Using the methodology outlined in the piling code and making assumptions about design, installation and testing, an average risk rating of 3.14 has been estimated, which relates to a 'moderate' overall risk category. A basic geotechnical strength reduction factor, ϕ_{gb}, of 0.48 is applicable for low redundancy (i.e. single piles) whereas this would increase to 0.56 for a high redundancy pile arrangement (e.g. pile groups). For indicative design purposes, the basic geotechnical strength reduction factor has been adopted as the geotechnical strength reduction factor (i.e. $\phi_g = \phi_{gb}$).

7.5.2.2 Pile Design Parameters

Given the conditions encountered in the boreholes, bored piles are considered to be a suitable piling method.

Table 8 provides the recommended ultimate and serviceability limit state end bearing pressures and shaft adhesion values for pile design.

Table 8: Design Parameters for Bored Piles

Founding Stratum	Approx. Depth Range* of Stratum (m)	Characteristic Rock Classification[1]	Ultimate End Bearing (kPa)[2,3]	Serviceability End Bearing (kPa)[3,4]	Ultimate Shaft Adhesion (kPa)[5,6,7]
FILL (Unit 1) and Colluvium (Unit 2)	0 – 1	-	-	-	-
RESIDUAL SOIL (Unit 3) and EXTREMELY WEATHERED MATERIAL (Unit 4)	0.5 – 13	-	-		30
WEATHERED ROCK (Unit 5) – Very Low Strength Sandstone and Siltstone	>3 m (north end) to >13 m (south end)	Class V Sandstone	4,000	1,500	150

Notes to Table 8:

* depth below existing ground surface level.

1. Rock classification based on (Pells, Mostyn, & Walker, 1998)
2. Ultimate Values occur at large settlements (> 5% of minimum pile diameter/width)
3. Minimum founding depth, end bearing parameters are based on a minimum embedment of one pile diameter into the relevant bearing stratum. Piles should be confirmed for structural adequacy
4. Serviceability end bearing pressure to cause settlement of < 1% of minimum pile diameter/width
5. Shaft adhesion values based on a shaft roughness of R2 or better
6. AS 2159 (2009) requires that the contribution of the shaft from ground surface to 1.5 times pile diameter or 1 m (whichever is greater) shall be ignored
7. Adopt 50% of shaft adhesion values for resistance to uplift
8. Design geotechnical strength ($R_{d,g}$) should be based on a strength reduction factor of ϕ_g = 0.48, subject to pile testing scope

For design purposes, the ultimate bearing capacity of the piles is equal to the sum of the contribution from both shaft adhesion and end bearing resistance. The design of piles should include assessment of both strength and serviceability limit states. In accordance with AS 2159 (2009), a geotechnical reduction factor should be applied to the ultimate values indicated in Table 8 when considering the strength limit state.

The above parameters are given such that the pile holes have appropriately clean, dry bases and rough shafts (R2 or better) prior to pouring concrete. Specialised cleaning buckets should be used in order to achieve sufficiently clean bases, although some piling contractors are suitability equipped with good rock augers and have skilled operators that can also produce clean pile sockets and bases.

A tremie pipe or similar should be used to deliver concrete to the base of the hole for conventional bored piles, as concrete may separate in which case the integrity of the finished pile would be compromised if it is poured into the pile hole from the ground surface.

Piled footing excavations should be inspected by a geotechnical engineer to confirm that the design bearing stratum and socket has been achieved and that the pile holes have been sufficiently cleaned prior to placing reinforcing steel and pouring concrete.

7.5.2.3 Pile Settlements

Individual piles designed for the serviceability values are expected to settle by less than about 1% of the diameter of the pile. Settlements of loads approaching the ultimate capacity would be in the order of 5% of the pile diameter but could be greater. Specific settlement analysis should be undertaken for single piles when design loads and pile details have been determined, and also if pile groups are proposed.

7.5.2.4 Pile Testing

AS 2159 (2009) states that where the basic geotechnical strength reduction factor is greater than 0.4 and the average risk rating is 2.5 or greater, testing of a selection of the piles shall be undertaken. Table 8.2.4(a) of AS 2159 (2009) indicates that, for the 'moderate' overall risk category, at least 2% of the piles installed at the site are to be tested for serviceability. Testing is also required to verify the integrity of the pile shafts, and this could comprise either high-strain dynamic pile testing or other methods of integrity testing. The ratio of piles that require shaft integrity testing would depend on the type of pile to be installed amongst other factors. Reference should be made to Section 8 of AS 2159 (2009) for guidance on testing requirements.

7.6 Durability Design

The results of the laboratory testing, as detailed in Table 4, indicate that site soils in the location of the proposed development are generally 'non aggressive' to 'mildly aggressive' to buried concrete and steel structures.

Consideration could therefore be given to designing concrete elements based on the presence of 'mildly aggressive' soils, whereas 'non aggressive' soils could be adopted for the design of steel elements.

The aggressiveness categories provided above are based on threshold values given in AS 2159 (2009). Reference should also be made to AS 2159 (2009) for the required concrete strength and reinforcement cover for concrete structures (Table 6.4.3) and corrosion allowances for steel structures (Table 6.5.3) where no corrosion protection is provided.

7.7 Earthquake Parameters

Sections 3 and 4 of AS 1170.4 (2007) provides details regarding hazard factors and site sub-soil classes.

Reference to Table 3.2 of AS 1170.4 (2007) indicates that a hazard factor, Z, of 0.09 would be applicable for earthquake design at this site, as the site would fall under the location of "Gosford".

Conditions encountered during the investigation are summarised as fill up to about 1.5 m depth, overlying residual soils and extremely weathered material to depths of up to 13 m, then weathered sandstone and siltstone bedrock. Based on these conditions, Section 4 of AS 1170.4 (2007) indicates that the site would be classed as a "shallow soil site", for which a sub-soil 'Class C_e' would apply.

8. References

AS 1170.4. (2007). *Structural Design Actions, Part 4: Earthquake Actions in Australia.* Reconfirmed 2018. Incorporating Amendments 1 & 2: Standards Australia.

AS 2159. (2009). *Piling - Design and Installation.* Standards Australia.

AS 3798. (2007). *Guidelines on Earthworks for Commercial and Residential Developments.* Standards Australia.

DP. (2023). *Report on Detailed Site Investigation (Contamination), Proposed Residential Development, Corner of Mann Street & Dwyer Street, North Gosford (Site B).* Ref. 202337.02.R.002.Rev0: Douglas Partners Pty Ltd.

GSNSW. (2019). *NSW Seamless Geology.* Geological Survey NSW Web Map Service.

Pells, P. J., Mostyn, G., & Walker, B. F. (1998). Foundations on Sandstone and Shale in the Sydney Region. *Australian Geomechanics, No 33 Part 3*, 17-29.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 'Site B' in North Gosford in accordance with DP's proposal dated 25 July 2022 and acceptance received from Chris Houghton of Stockbridge Property Unit Trust dated 8 September 2022. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Stockbridge Property Unit Trust for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or another 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 DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the subsurface 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. Subsurface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP 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 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. DP 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 DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope of work for this investigation/report did not include the assessment of surface or subsurface 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. Reference should also be made to the Detailed Site Investigation (Contamination) report (DP, 2023) issued in conjunction with this geotechnical report.

Douglas Partners Pty Ltd

Appendix A

About This Report

Terminology, Symbols and Abbreviations

Soil Descriptions

Rock Descriptions

Sampling, Testing and Excavation Methodology

About this Report

November 2020

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.

Copyright

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

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.

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Terminology, Symbols and Abbreviations

November 2020

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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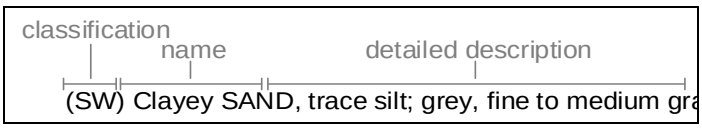
Introduction

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 it's behaviour. The detailed description presents more information about the soil's composition, condition, structure, and origin.

Classification, naming and description of soils requires 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 Fraction	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 soils 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 it's 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 symbol identifies the primary component. The second symbol 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 characterize 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	19 - 63
	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 particle size with the range

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

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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	<PL
	Near plastic limit	Can be moulded	≈PL
	Wet of plastic limit	Water residue remains on hands when handling	>PL
	Near liquid limit	"oozes" when agitated	≈LL
	Wet of liquid limit	"oozes"	>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 Rock

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 rock 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	MCE
Weakly cemented	WKCE
Cemented	CE
Strongly bound	SB
Weakly bound	WB
Unbound	UB

Extremely Weathered Rock

AS1726-2017 considers weathered rock material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. very low strength rock). These materials may be identified as “extremely weathered rock” in reports and by the abbreviation code XWR 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	RES
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	LCS
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
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 sea shore	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”.

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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] Assumes a ratio of 20:1 for UCS to $I_{s(50)}$. It should be noted that the UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site.

On investigation logs only, the following data contiguity codes may be in rock strength tables for 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[1,2]	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[1,2]	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] AS1726-2017 6.1.9 provides similar definitions for "residual soil" and "extremely weathered material" as soil origins. Generally, the soil origin terms would be used above the depth at which very low strength or stronger rock material is first encountered, while both soil origin and weathering should may be stated for soil encountered below the first contact with rock material, where appropriate.

[2] 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:

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

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

Defect Descriptions

Defect Type

Term	Abbreviation Code
Bedding plane	B
Clay seam	CS
Cleavage	CV
Crushed zone	CZ
Decomposed seam	DS
Fault	F
Joint	J
Lamination	LAM
Parting	PT
Sheared zone	SZ
Vein	VN
Drilling/handling break	DB , HB
Fracture	FCT

Rock Defect Orientation

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

Rock Defect Coating

Term	Abbreviation Code
Clean	CLN
Coating	CO
Healed	HE
Infilled	INF
Stained	STN
Tight	TI
Veneer	VEN

Rock Defect Infill

Term	Abbreviation Code
Calcite	CA
Carbonaceous	CBS
Clay	CLY
Iron oxide	FE
Manganese	MN
Silty	SLT

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Rock Defect Shape/Planarity

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

Rock Defect Roughness

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

Other Rock Defect Attributes

Term	Abbreviation Code
Fragmented	FG
Band	BND
Quartz	QTZ

Defect Orientation

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

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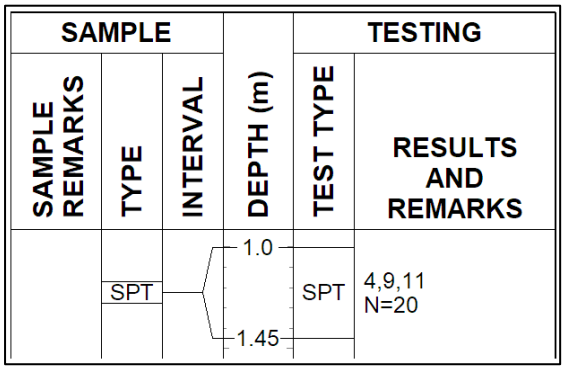
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

November 2020

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:



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
Acid sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Sample from SPT test	SPT
Environmental sample	E
Gas sample	G
Jar sample	J
Undisturbed tube sample	U[1]
Water sample	W
Piston sample	P
Core sample for unconfined compressive strength testing	UCS

[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	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(_)
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
Excavator/backhoe bucket	B[1]
Toothed bucket	TB[1]
Mud/blade bucket	MB[1]
Ripping tyne/ripper	RT
Rock breaker/hydraulic hammer	RB
Hand auger	HA[1]
NMLC series coring	NMLC
HMLC series coring	HMLC
NQ coring	NQ
HQ coring	HQ
PQ coring	PQ
Push tube	PT [1]
Rock roller	RR[1]
Solid flight auger. Suffixes: (TC) = tungsten carbide tip, (V) = v-shaped tip	SFA[1]
Sonic drilling	SON[1]
Vibrocore	VC[1]
Wash bore (unspecified bit type)	WB[1]
Existing exposure	X
Hand tools (unspecified)	HT
Predrilled	PD
Specialised bit (refer report)	SPEC[1]
Diatube	DT[1]
Hollow flight auger	HFA[1]
Vacuum excavation	VE

[1] – numeric suffixes indicate tool diameter/width in mm

Appendix B

Drawing 1 – Test Location Plan

Drawing adapted from Metromap Image, dated 12 September 2022

CLIENT: Stockbridge Property Unit Trust	OFFICE: Central Coast	DRAWN BY: DRC	SCALE: 1:500 @ A3	N	PROJECT No: 202337.01
Douglas Partners Geotechnics / Environment / Groundwater	TITLE: **Test Location Plan** **Proposed Residential Development** **Corner of Mann St and Dwyer St, North Gosford (Site B)**				DATE: 17.04.2023 DRAWING No: 1 REVISION: 0

Appendix C

Borehole Logs – Bores B1 to B6

Core Photographs

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 17.19 AHD
COORDINATE E:345960.4 **N:** 6301467.8
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B1
PROJECT No: 202337.01
DATE: 04/11/22
SHEET: 1 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
5.51 m depth, 24/11/22	17	0.0	FILL/ Gravelly Sandy SILT; grey brown; silt fraction low plasticity; gravel fraction fine to medium; sand fraction fine to coarse; gravel is crushed basalt		FILL		M								PID<1	E		0.1				
		0.3			RES possibly FILL																	
		0.6	FILL(?)/ Sandy CLAY; yellow brown; high plasticity												PID<1	E		0.5				
			(CL) CLAY, with sand; yellow brown; low plasticity		RES	ST	=PL															
	16	1.0													PID<1	E		1.0				
		1.3	(SC) Clayey SAND, with clay; yellow brown and light grey; fine to medium, low plasticity																SPT	6,10,13 N=23	Bentonite	50mm diameter Class 18 PVC
					XWM	D	M								PID<1	E		1.5				
	15	2.0																2				
		2.5													PID<1	D		2.5	SPT	21/50		
		2.8	SANDSTONE; pale grey and dark red brown; fine to medium						2.8	L				2.85-2.88m: CZ IR, RO, CLN					PLT	PL(D)=0.25 PL(A)=0.18		
		3.0							3.2	M	100	82		3.2-3.79m: PT x3 5° PL, RO, CLN				3				
	14							SW	3.8					3.93m: J 70° IR, RO, CLN					PLT	PL(D)=0.30 PL(A)=0.43		
														4.09-4.14m: F 5°-90° IR, RO, CLY CO								
	13	4.0												4.23-4.27m: CS				4				
									4.6					4.39-4.48m: PT x2 5° PL, RO, CLN								
														4.73-4.82m: J x3 10°-10° IR, RO, CLN								
		5.0								VL-L				4.82m: CS				5	PLT	PL(D)=0.05 PL(A)=0.05		
	12										100	79		5.16m: PT 5° PL, RO, CLN								
		5.38	SILTSTONE; grey											5.16-5.26m: J x3 5°-80° IR, RO, CLN								
														5.23-5.38m: PT x3 5° PL, RO, CLN								
		6.0																6	PLT	PL(D)=0.08 PL(A)=0.12		
	11	6.16	SANDSTONE; yellow brown red brown and grey; fine to coarse						6.16					6.23-6.25m: J 40° IR, RO, FE STN								
								MW						6.29m: PT 10° PL, RO, CLN								
														6.34-6.47m: F x5 5°-90° IR, RO, FE STN								
														6.47m: PT 5° IR, RO, FE STN								
														6.51-6.76m: J 80° IR, RO, CLY INF, 10mm								
		7.0									100	16		6.51-6.89m: PT x3 5° PL, RO, CLN				7	PLT	PL(D)=0.15 PL(A)=0.03	5mm Gravel	50mm diameter Class 18 PVC Machine Slotted
	10													6.8-6.89m: J 80° IR, RO, FE/CLY STN/VN								
														7.0-7.23m: J 70° IR, RO, CLY INF, 10mm								
									7.7	H				7.16-7.52m: PT x3 5° PL, RO, CLY VN								
														7.49-7.55m: J x2 60° IR, RO, CLY CO					PLT	PL(D)=1.6	Bentonite	

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: MD-300
METHOD: 125mm diameter Spiral Flight Auger to 2.8m then NMLC to 15.3m
REMARKS: NFGWO whilst augering. Piezometer installed to 8m depth

OPERATOR: Traccess
CASING:

LOGGED: MLG

EXPORTED 18/04/23 14:26. TEMPLATE ID: DP_103.02.00_COMBINED

Refer to explanatory notes for symbol and abbreviation definitions

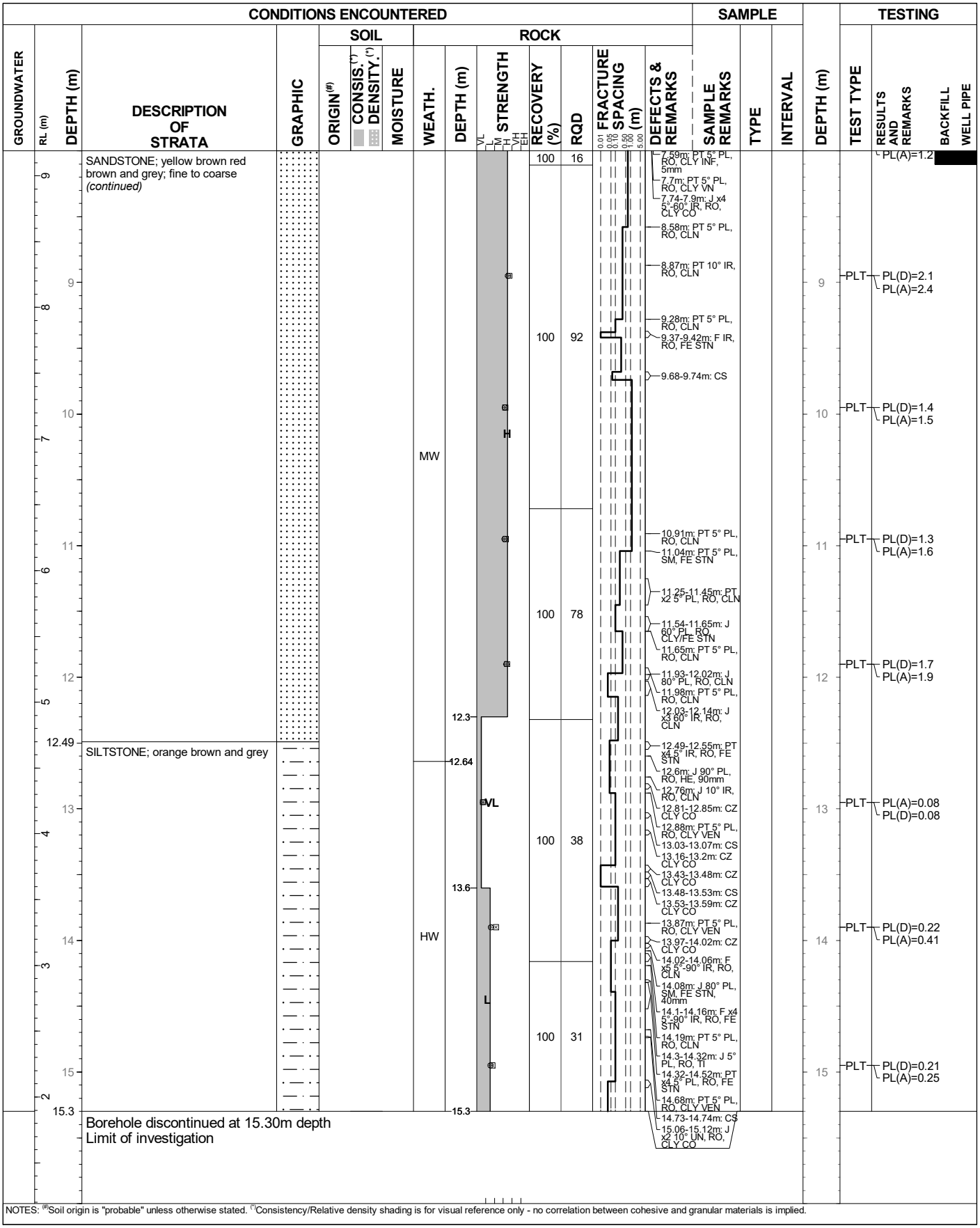
Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 17.19 AHD
COORDINATE E:345960.4 **N:** 6301467.8
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B1
PROJECT No: 202337.01
DATE: 04/11/22
SHEET: 2 of 2



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: MD-300
METHOD: 125mm diameter Spiral Flight Auger to 2.8m then NMLC to 15.3m
REMARKS: NFGWO whilst augering. Piezometer installed to 8m depth

OPERATOR: Traccess
CASING:

LOGGED: MLG

CLIENT:	Stockbridge Property Unit Trust	TITLE:	**Core Photographs** **Proposed Residential Development** **Site B – North Gosford**				
PROJECT No:	202337.01						
OFFICE:	Central Coast						
Douglas Partners Geotechnics / Environment / Groundwater		DATE:	17/04/2023	DRAWN BY:	DRC	BORE No:	**B1**
		SCALE:	As shown	PLATE No:	1	REVISION:	0

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 23.14 AHD
COORDINATE E:346006.2 **N:** 6301460.8
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B2
PROJECT No: 202337.01
DATE: 09/11/22
SHEET: 1 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING TEST TYPE	TESTING RESULTS AND REMARKS
09/11/22, No free groundwater observed whilst augering	23	0.0	TOPSOIL/ Sandy SILT; dark brown; silt fraction low plasticity; sand fraction fine to medium; with organics		TOP		=PL								PID<1	E		0.1		
		0.4	(CH) CLAY, with sand; yellow brown; high plasticity																	
	22	1			RES	ST TO VST	=PL								PID<1	E		1.0	PP	>400
																			SPT	5,8,9 N=17
							<PL to =PL								PID<1	E		1.5		
		1.7	(CL) Sandy CLAY; pale red brown and pale grey; low plasticity																	
	21	2													PID<1	E		2.0		
																			PP	300
																			SPT	8,23,21 N=44
	20	3			XWM	VST TO H	<PL											3		
	19	4																4	PP	>400
																			SPT	8,9/100 (HB)
		4.5	SANDSTONE; red brown and pale grey; fine to medium						4.5	VL-L	100	0		4.5-4.54m: F IR, RO, CLY CO						
	18	5	4.76-4.98m: very thinly bedded silstone					HW	5.2					4.58-4.61m: PT x2 5° PL, RO, CLY/FE VN/STN				5		
														4.65m: J 80° PL, RO, CLY CO						
														4.69m: PT 10° PL, RO, CLY CO						
														4.69-4.76m: J x3 20°-80° PL, RO, CLY CO						
														5.25m: J 80° PL, RO, CLN					PLT	PL(D)=0.32 PL(A)=0.57
		5.53	SANDSTONE; orange brown and grey; fine to medium							L-M				5.09-5.52m: PT x5 5° PL, RO, CLN						
									5.8					5.67m: PT 5° PL, RO, CLY/FE CO/STN						
	17	6							6.0					5.72-5.75m: CS 25mm				6		
														5.92m: PT 5° PL, RO, CLY INF, 5mm						
														6.08m: PT 5° PL, RO, CLN						
											100	80		6.13m: J 20° PL, RO, FE STN					PLT	PL(D)=0.62 PL(A)=0.70
														6.52m: PT 15° PL, RO, CLY VN						
														6.62m: J x3 10°-80° IR, RO, CLN						
								MW		M				6.81m: PT 5° PL, RO, CLN						
	16	7												7.08m: J x2 50° PL, RO, CLN, 40mm				7		
														7.2m: J 10° PL, RO, CLN					PLT	PL(D)=1.5 PL(A)=1.7
														7.63m: J 60° PL, RO, FE STN						
											100	41		7.91m: J x2 40° PL, RO, FE STN						

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: MD-300
METHOD: 125mm diameter Spiral Flight Auger to 4.5m then NMLC to 15.11m
REMARKS: NFGWO whilst augering.

OPERATOR: Traccess
CASING:

LOGGED: MLG

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Refer to explanatory notes for symbol and abbreviation definitions

Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 23.14 AHD
COORDINATE E:346006.2 **N:** 6301460.8
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B2
PROJECT No: 202337.01
DATE: 09/11/22
SHEET: 2 of 2

CONDITIONS ENCOUNTERED																		SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	15		SANDSTONE; orange brown and grey; fine to medium *(continued)*											8.05-8.17m: PT x2 5° PL, RO, CLN					PLT	PL(D)=0.70 PL(A)=0.65
		8.69												8.35m: J 70° PL, RO, CLY/FE CO/STN						
			SILTSTONE; grey and red brown						8.65	M L	100	41		8.37-8.41m: F x5 IR, RO, CLY/FE VN/STN						
		8.95							8.95					8.41-8.58m: J x4 70° PL, RO, CLY CO						
	14		SANDSTONE; orange brown; medium to coarse								100	48		8.62m: J 70° PL, RO, FE STN				9	PLT	PL(D)=0.97 PL(A)=1.2
														8.63m: F IR, RO, CLY CO						
														8.75m: CS 5mm						
														8.96-9.03m: J x3 20°-80° ST, RO, CLN						
														9.03m: PT 5° PL, RO, CLY CO						
										M				9.1-9.15m: J x3 5°-45° PL, RO, FE STN						
														9.16m: PT 5° PL, RO, FE/CLY STN/VN						
	13													9.24-9.3m: J x2 20°-45° IR, RO, FE/CLY STN/CO						
														9.3-9.32m: PT x2 5° PL, RO, CLY CO						
									10.4					9.32-9.36m: CS 40mm				10	PLT	PL(D)=1.1 PL(A)=0.66
								MW			100	91								
														10.18-11.84m: PT x5 5° PL, RO, CLN						
	12									H								11	PLT	PL(D)=1.4 PL(A)=1.6
														11.91m: PT 5° PL, RO, CLY CO						
														12.0-12.1m: F x5 IR, RO, CLY CO						
											100	70						12	PLT	PL(D)=2.2 PL(A)=1.9
		12.78							12.78					12.58m: J 60° PL, RO, CLY/FE VN/STN						
			SILTSTONE; grey and orange brown							L				12.77m: PT x2 5° PL, RO, FE STN						
	11	13.08												12.87m: PT 5° PL, RO, CLY VN						
			SANDSTONE; orange brown and grey						13.1					13.08m: PT 10° PL, RO, CLN				13	PLT	PL(D)=2.7 PL(A)=2.2
									13.4					13.34m: J 70° PL, RO, CLY/FE CO/STN						
														13.47m: PT 5° PL, RO, CLN						
														13.65m: PT 10° PL, RO, CLY INF, 5mm						
	9									H	100	82						14	PLT	PL(D)=1.1 PL(A)=1.0
								SW						14.29m: PT 10° PL, RO, CLN						
																		15	PLT	PL(D)=1.6
		15.11	Borehole discontinued at 15.11m depth Limit of investigation						15.11											

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: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 4.5m then NMLC to 15.11m
CASING:

REMARKS: NFGWO whilst augering.

EXPORTED 18/04/23 14:26. TEMPLATE ID: DP_103.02.00_COMBINED

CLIENT:	Stockbridge Property Unit Trust	TITLE:	**Core Photographs** **Proposed Residential Development** **Site B – North Gosford**				
PROJECT No:	202337.01						
OFFICE:	Central Coast						
Douglas Partners Geotechnics / Environment / Groundwater		DATE:	17/04/2023	DRAWN BY:	DRC	BORE No:	**B2**
		SCALE:	As shown	PLATE No:	2	REVISION:	0

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 22.77 AHD
COORDINATE E:346029.7 **N:** 6301428.9
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B3
PROJECT No: 202337.01
DATE: 09/11/22
SHEET: 1 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
24/11/22, No free groundwater observed in monitoring well (8m)	22	0.0	FILL/ Sandy GRAVEL; grey; gravel fraction medium, angular to sub-angular; sand fraction fine to coarse		FILL		D								PID<1	E		0.1				
		0.2	FILL(?)/ Sandy Silty CLAY; dark brown; clay fraction high plasticity; sand fraction fine to medium		possibly FILL possibly RES										PID<1	E		0.3				
		0.8	(CH) CLAY, with sand; orange brown and grey; clay fraction high plasticity; sand fraction fine		RES	VST	=PL								PID<1	E		1.0	PP SPT	>400 3,5,6 N=11	Soil Backfill	
	21	1.8	(CH) Sandy CLAY; red brown and grey; clay fraction high plasticity; sand fraction fine												PID<1	E		1.5			Bentonite	50mm diameter Class 18 PVC
		2													PID<1	E		2.0				
	20	3																3	PP SPT	>400 14,13,10/50 (HB)		
	19	4			XWM	H	<PL											4	PP SPT	>400 12,22/120 (HB)	5mm Gravel	50mm diameter Class 18 PVC Machine Slotted
	18	5																5	SPT	22/150 (HB)		
	17	6																6				
	16	6.8	SILTSTONE; red brown and grey					MW-HW	6.8	VL	100	67		6.81-6.83m: PT x2 5° PL, RO, CLY CO 6.85m: J 80° PL, RO, CLY INF, 5mm 6.87m: PT 5° PL, RO, CLY INF, 5mm 6.96m: J x2 70°-80° UN, RO, CLY/FE CO/STN 7.02m: PT x2 5° PL, RO, FE STN 7.23m: PT 10° PL, RO, CLY/FE CO/STN 7.34m: J 60° IR,			7	PLT	PL(D)=0.09 PL(A)=0.04		
	15	7																				

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.

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PLANT: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 6.8m then NMLC to 11.28m
CASING:

REMARKS: NFGWO whilst augering. Piezometer installed to 8m depth. Bore drilled in area without wearing course.

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 22.77 AHD
COORDINATE E:346029.7 **N:** 6301428.9
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B3
PROJECT No: 202337.01
DATE: 09/11/22
SHEET: 2 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL: ORIGIN(#)	SOIL: CONSIS.(*) DENSITY.(*)	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH	ROCK: RECOVERY (%)	ROCK: RQD	ROCK: FRACTURE SPACING (m)	ROCK: DEFECTS & REMARKS	SAMPLE: SAMPLE REMARKS	SAMPLE: TYPE	SAMPLE: INTERVAL	DEPTH (m)	TESTING: TEST TYPE	TESTING: RESULTS AND REMARKS	BACKFILL	WELL PIPE
	14.41	8.41	SILTSTONE; red brown and grey *(continued)*					MW-HW	8.4	VL	100	67		RO, CLY/FE VN/STN 7.33-7.36m: F x5 IR, RO, CLY/FE VN/STN 7.97-8.0m: CS 30mm 8.28-8.32m: J IR, RO, FE STN 8.45m: J 70° UN, CLY VN				9	PLT	PL(D)=0.09 PL(A)=0.06		
			SANDSTONE; red brown grey and orange brown; fine to medium							L-M				8.75-9.04m: PT x10 5°-10° PL, RO, FE/CLY STN/VN								
	13.67	9.33						MW	9.33	VL	100	57		9.31m: J 30° PL, RO, CLN 9.33m: PT 5° PL, RO, CLN 9.44m: PT 5° PL, RO, FE/CLY STN/VN 9.69m: PT 5° PL, RO, FE STN				10	PLT	PL(D)=0.18 PL(A)=0.33		
									9.6	M												
									9.9	M-H				10.08m: J 60° IR, RO, FE/CLY STN/CO 10.1m: PT 5° PL, RO, FE/CLY STN/VN 10.19-10.28m: J x5.5° IR, RO, FE STN 10.32m: J 45° PL, RO, FE STN					PLT	PL(D)=0.76 PL(A)=1.1		
	12.67	10.7						SW-FR	10.7	H	100	46		10.62-10.67m: PT x3.5° PL, RO, FE STN 10.77m: J 60° PL, RO, CLN 10.96m: PT 5° PL, RO, CLN 11.15m: J 70° RO, CLN 11.19m: PT 5° UN, RO, CLN 11.24m: J 80° UN, RO, CLN				11	PLT	PL(D)=2.1 PL(A)=1.7		
	11.49	11.28	Borehole discontinued at 11.28m depth Limit of investigation						11.28													

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: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 6.8m then NMLC to 11.28m
CASING:

REMARKS: NFGWO whilst augering. Piezometer installed to 8m depth. Bore drilled in area without wearing course.

EXPORTED 18/04/23 14:26. TEMPLATE ID: DP_103.02.00_COMBINED

CLIENT:	Stockbridge Property Unit Trust	TITLE:	**Core Photographs** **Proposed Residential Development** **Site B– North Gosford**
PROJECT No:	202337.01		
OFFICE:	Central Coast		

Douglas Partners
Geotechnics / Environment / Groundwater

DATE:	17/04/2023	DRAWN BY:	DRC	BORE No:	**B3**
SCALE:	As shown	PLATE No:	3	REVISION:	0

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 15.27 AHD
COORDINATE E:345961.7 **N:** 6301397.5
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B4
PROJECT No: 202337.01
DATE: 07/11/22
SHEET: 1 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING TEST TYPE	TESTING RESULTS AND REMARKS
07/11/22, No free groundwater observed whilst augering	15	0.0	FILL/ Sandy SILT; brown; low plasticity; trace rootlets/organics		FILL		<PL								PID<1	E		0.1		
		0.3	(CL) Sandy CLAY; yellow brown; clay fraction low plasticity; sand fraction fine to medium grained																	
	14	1	1.0m: red brown		RES	ST	<PL								PID<1	E		0.5		
															PID<1	E		1.0	S	2,3,5 N=8 pp=150
	13	2													PID<1	E		2.0		
						VST TO H													S	15,10,14 N=24 pp=400
	12	3.0	(CH) CLAY, with sand; red brown and grey; clay fraction high plasticity; sand fraction fine to medium grained		RES	VST	=PL											3		
	11	4																4	S	20/70
		4.4	SANDSTONE; orange brown grey and red brown; fine to coarse						4.4					4.42-4.44m: CS 20mm						
														4.6-4.66m: PT x2 5° PL, RO					PLT	PL(D)=0.79 PL(A)=0.77
	10	5									100	79		4.95-5.04m: PT x2 5° PL, RO				5		
								MW						5.22m: PT 5° PL, RO						
														5.67m: PT 5° PL, RO, CLY CO					PLT	PL(D)=0.94 PL(A)=0.82
	9	6								M				5.81-5.89m: CS				6		
														6.04m: PT 5° PL, RO, CLY INF, 5mm						
														6.07-6.17m: PT x2 5° PL, RO, CLN						
									6.4					6.22m: PT 5° PL, RO, HE						
														6.25m: J 50° IR, RO, CLY CLN						
											100	82		6.33m: PT 5° PL, RO, CLN					PLT	PL(D)=0.80 PL(A)=0.94
	8	7						SW						6.35m: J 50° IR, RO, CLY INF, 5mm				7		
														6.38m: PT 5° PL, RO, CLY INF, 5mm						
														6.6m: PT 10° PL, RO, FE STN						
									7.5					6.78m: PT 5° PL, RO, CLN						
										L				7.58-7.67m: CS 90mm						
											100	55		7.8-7.88m: PT x2 5° PL, RO, CLN					PLT	PL(D)=0.24

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: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 4.4m then NMLC to 15.0m
CASING:

REMARKS: NFGWO whilst augering.

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 15.27 AHD
COORDINATE E:345961.7 **N:** 6301397.5
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B4
PROJECT No: 202337.01
DATE: 07/11/22
SHEET: 2 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING TEST TYPE	TESTING RESULTS AND REMARKS
	7		SANDSTONE; orange brown grey and red brown; fine to coarse *(continued)*						8.0	L										
	6								8.8		100	55		8.21m: J 50° PL, RO, CLY CO 8.36m: PT 5° PL, RO, FE STN 8.32-8.7m: J 80° UN, RO, CLY CO 8.63m: PT 5° PL, RO, CLN 8.77-8.8m: J x3 5°-80° PL, RO, CLY CO				9	PLT	PL(D)=1.1 PL(A)=0.69
	9							MW		M				9.46m: CS 40mm					PLT	PL(D)=0.37 PL(A)=0.27
	5	9.96	SILTSTONE; very thinly bedded sandstone						9.95	L	100	45		9.88m: J 45° PL, RO, CLY VN 9.96-10.03m: CS 10mm 10.08m: PT 5° PL, CLY CO 10.38m: PT 5° PL, RO, CLY CO 10.42-10.5m: CZ 10.58m: PT 5° PL, RO, FE STN 10.69m: PT 10° PL, RO, FE STN				10	PLT	PL(D)=0.24 PL(A)=0.15
	4								11.0					10.95m: PT 5° PL, RO, CLN 11.07m: PT 5° PL, RO, FE STN				11	PLT	PL(D)=0.47 PL(A)=0.42
	3								11.3	M				11.34-11.9m: PT x6 5° PL, RO, FE STN						
	2	12.23	SANDSTONE; pale grey and light brown					SW	12.3		100	49		11.94m: J 25° PL, RO, FE STN 11.95m: PT 5° PL, RO, FE STN 12.03-12.13m: PT x2 5° PL, RO, CLN 12.16m: PT 5° PL, RO, CLY INF, 10mm 12.29-12.71m: PT x5 5° PL, RO, FE STN 12.83-13.09m: PT x3 5° PL, RO, CLN				12	PLT	PL(D)=0.38 PL(A)=0.40
	1		14.1m: brown and orange brown						14.1	L	100	9		13.22-13.25m: CS 30mm 13.34-13.49m: PT x3 10° PL, RO, FE STN 13.52m: PT 10° PL, RO, CLY CO 13.52-13.78m: J x15 10°-80° IR, RO, FE STN/TI 13.79-13.8m: CZ CLY CO 13.93m: PT 5° PL, RO, CLN 14.1-14.15m: F x6 IR, RO, FE STN 14.18m: PT 5° PL, RO, FE STN 14.15-14.25m: J x4 80° IR, RO, FE STN 14.38-14.67m: F x10 14.6m: J 80° IR, RO, FE STN, 400mm 14.7-14.88m: F x8 80mm 14.84m: J 80° IR, RO, FE STN 14.88-14.95m: F x15				13	PLT	PL(D)=0.15 PL(A)=0.16
	0	15.0	Borehole discontinued at 15.00m depth Limit of investigation					MW-MW	15.0									14	PLT	PL(D)=0.07 PL(A)=0.24
																		15		

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: MD-300
METHOD: 125mm diameter Spiral Flight Auger to 4.4m then NMLC to 15.0m
REMARKS: NFGWO whilst augering.

OPERATOR: Traccess
CASING:

LOGGED: MLG

CLIENT:	Stockbridge Property Unit Trust	TITLE:	**Core Photographs** **Proposed Residential Development** **Site B – North Gosford**				
PROJECT No:	202337.01						
OFFICE:	Central Coast						
Douglas Partners Geotechnics / Environment / Groundwater		DATE:	17/04/2023	DRAWN BY:	DRC	BORE No:	**B4**
		SCALE:	As shown	PLATE No:	4	REVISION:	0

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 15.31 AHD
COORDINATE E:345971.3 **N:** 6301350.3
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B5
PROJECT No: 202337.01
DATE: 07/11/22
SHEET: 1 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	ROCK FRACTURE SPACING (m)	ROCK DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TEST TYPE	TESTING RESULTS AND REMARKS	BACKFILL	WELL PIPE
3.36 m depth, 24/11/22	15	0.0	TOPSOIL/ Sandy SILT; brown; silt fraction low plasticity; sand fraction fine to medium grained; trace rootlets/organics		TOP		<PL								PID<1	E		0.1				
		0.3	(SP) SAND, with clay; brown; fine to medium		COL	MD	D								PID<1	E		0.5				
		0.6	(CH) Sandy CLAY; yellow brown; clay fraction high plasticity; sand fraction fine to medium grained																			
	14	1	0.9m: red brown and grey, with ironstone gravels			ST	=PL								PID<1	E		1.0	S	2,2,5 N=7 pp=100	Soil Backfill	50mm diameter Class 18 PVC
	13	2	2.0m: red brown												PID<1	E		2.0			Bentonite	
	12	3																3	S	4,6,8 N=14 pp=300		
	11	4			RES													4	S	7,6,11 N=17 pp=300	5mm Gravel	
	10	5				VST	<PL											5	S	9,11,14 N=25 pp=>400		50mm diameter Class 18 PVC Machine Slotted
	9	6																6				
	8	7																7	S	8,10,12 N=22 pp=300		

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: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 10m then NMLC to 14.57m
CASING:

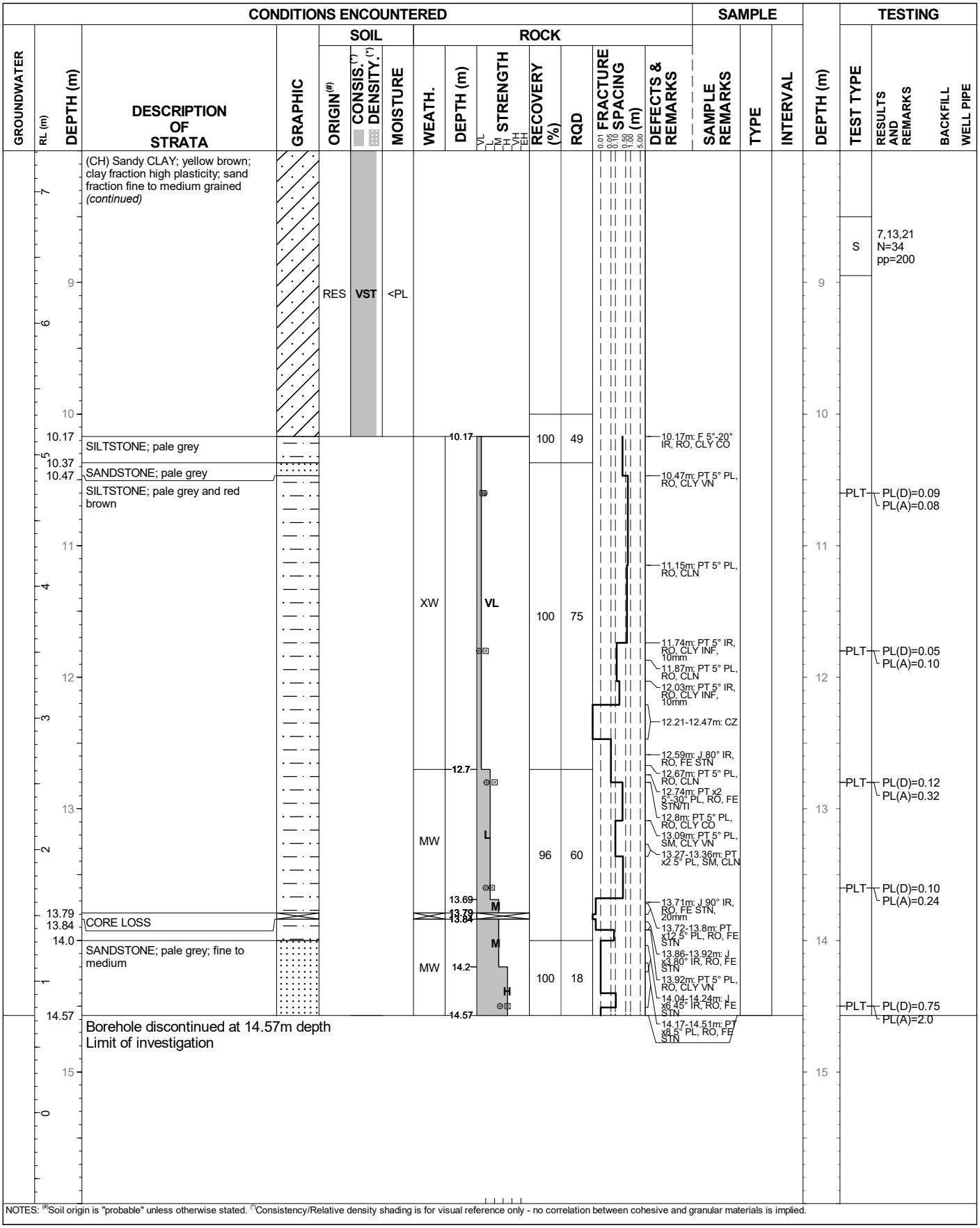
REMARKS: FGWO at 5.6m whilst augering. Piezometer installed to 8m depth

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 15.31 AHD
COORDINATE E:345971.3 **N:** 6301350.3
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B5
PROJECT No: 202337.01
DATE: 07/11/22
SHEET: 2 of 2



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: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 10m then NMLC to 14.57m
CASING:

REMARKS: FGWO at 5.6m whilst augering. Piezometer installed to 8m depth

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Refer to explanatory notes for symbol and abbreviation definitions

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT:	Stockbridge Property Unit Trust	TITLE:	**Core Photographs** **Proposed Residential Development** **Site B – North Gosford**				
PROJECT No:	202337.01						
OFFICE:	Central Coast						
Douglas Partners Geotechnics / Environment / Groundwater		DATE:	17/04/2023	DRAWN BY:	DRC	BORE No:	**B5**
		SCALE:	As shown	PLATE No:	5	REVISION:	0

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 14.33 AHD
COORDINATE E:345936.1 **N:** 6301325.7
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B6
PROJECT No: 202337.01
DATE: 08/11/22
SHEET: 1 of 3

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	ROCK FRACTURE SPACING (m)	ROCK DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING TEST TYPE	TESTING RESULTS AND REMARKS
4.2 m depth, 08/11/22, Free groundwater observed whilst augering	14	0.0	FILL/ Sandy GRAVEL; grey; sand fraction fine to coarse		FILL		D								PID<1	E		0.05		
		0.07													PID<1	E		0.1		
		0.2	FILL/ Silty Sandy GRAVEL; dark brown and grey; sand fraction fine to coarse		FILL										PID<1	E		0.3		
		0.4	FILL/ Gravelly Silty SAND; dark brown; fine to coarse												PID<1	E		0.5		
	13	1	FILL/ Silty SAND; dark grey; fine to coarse		FILL		M											1	SPT	1,2,2 N=4
		1.5	(CH) Sandy CLAY; brown; clay fraction high plasticity; sand fraction fine to medium												PID<1	E		1.6		
	12	2	2.0m: red brown and grey												PID<1	E		2.1		
	11	3			RES	ST	=PL											3	SPT	1,4,6 N=10
	10	4													PID<1	E		3.1	SPT	4,5,5 N=10
	9	5.0	(CH) CLAY, with silt; red brown and grey; high plasticity															4		
	8	6			RES	VST	=PL											5	SPT	5,12,16 N=28
	7	7																6		
	7																	7	SPT	7,13,15 N=28

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: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 10.4m then NMLC to 19.42m
CASING:

REMARKS: NFGWO whilst augering.

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 14.33 AHD
COORDINATE E:345936.1 **N:** 6301325.7
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B6
PROJECT No: 202337.01
DATE: 08/11/22
SHEET: 2 of 3

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH	ROCK RECOVERY (%)	ROCK RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING TEST TYPE	TESTING RESULTS AND REMARKS
			(CH) CLAY, with silt; red brown and grey; high plasticity *(continued)*			VST													SPT	9,16,27 N=43
					RES		=PL													
	10.4		(CH) CLAY; red brown and grey; high plasticity; with medium strength ferruginous sandstone bands throughout			H			10.4		100	0								
					XWM		<PL	XW			100	0								
	12.83		SANDSTONE; red brown and pale grey						12.83		95	8		12.86m: J 80° PL, RO, FE STN 12.94m: PT 10° PL, RO, CLY INF, 20mm 13.01-13.03m: CS 13.07m: PT 5° PL, RO, FE STN 13.09m: J 80° IR, RO, FE/CLY STN 13.1-13.12m: PT x2 5° PL, RO, FE STN 13.32m: CS 20mm 13.4m: PT 5° IR, RO, CLN 13.44m: J x2 5°-60° IR, RO, 20mm 13.4-13.49m: PT x2 5° IR, RO, CLN 13.49m: PT 5° IR, RO, CLN 13.54m: CS 30mm 13.92-13.93m: PT x2 5° PL, RO, CLY VN 13.97m: J 90° IR, RO, CLN, 50mm 14.03m: PT 5° PL, RO, FE STN 14.06m: CS 10mm 14.17m: PT 5° PL, RO, FE STN 14.22-14.24m: CZ 5°-90° IR, RO, FE STN 14.3m: PT 5° PL, RO, CLN 14.36m: J 90° PL, RO, FE STN, 40mm 14.43m: PT 5° PL, RO, CLN 14.55m: CS 50mm					PLT	PL(D)=0.06 PL(A)=0.17
	13.59		CORE LOSS						13.59											
	13.66		SANDSTONE; light grey and orange brown					MW	13.66		100	15							PLT	PL(D)=0.28 PL(A)=0.26
	15.49		SANDSTONE; grey and red brown					MW	15.1	H									PLT	PL(D)=0.86 PL(A)=3.4
									15.45	L	100	21								

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.

EXPORTED 18/04/23 14:27. TEMPLATE ID: DP_103.02.00_COMBINED

PLANT: MD-300
METHOD: 125mm diameter Spiral Flight Auger to 10.4m then NMLC to 19.42m
REMARKS: NFGWO whilst augering.

OPERATOR: Traccess
CASING:

LOGGED: MLG

BOREHOLE LOG

CLIENT: Stockbridge Property Unit Trust
PROJECT: Proposed Multi-Storey Residential Development
LOCATION: Cnr Mann & Dwyer Streets, North Gosford

SURFACE LEVEL: 14.33 AHD
COORDINATE E:345936.1 **N:** 6301325.7
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: B6
PROJECT No: 202337.01
DATE: 08/11/22
SHEET: 3 of 3

CONDITIONS ENCOUNTERED																				SAMPLE				TESTING	
				SOIL				ROCK																	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	-2		SANDSTONE; grey and red brown *(continued)*											14.69m: PT 5° PL, RO, FE STN 14.72m: J 90° PL, RO, FE STN, 40mm 14.74m: PT 5° PL, RO, FE STN 14.77-14.93m: PT x3.5° PL, RO, FE STN						
		16.7									100	21								
			SILTSTONE; grey											14.96-15.06m: CZ IR, RO, CLY INF, 20mm 15.14-15.32m: PT x4.5° PL, RO, FE STN 15.38m: CS 10mm 15.41m: J 80° UN, RO, FE STN, 70mm						
	-3	17						MW		L				15.7-15.72m: J 80° PL, RO, FE STN 15.7-16.06m: PT x4.5° PL, RO, FE STN 16.17m: J 70° IR, RO, CLN				17	PLT	PL(D)=0.06 PL(A)=0.13
														16.24-16.44m: PT x4.5° PL, RO, FE STN						
		18	18.0m: grey and red brown											16.54-16.58m: CZ 5°,20° IR, RO, FE STN 16.58-16.59m: CS 16.66-16.69m: CS 16.66-16.75m: J 80° IR, RO, FE STN				18		
	-4								18.5		100	44								
		18.63	SANDSTONE; grey						18.63					16.79m: J 30° PL, RO, FE STN 16.86m: J x2 30° PL, RO, CLN, 40mm 16.88m: PT 5° PL, RO, CLY CO					PLT	PL(D)=0.30 PL(A)=0.26
		19						FS		M				16.91-17.0m: CZ 17.0-17.13m: J x3 80° UN, RO, FE STN				19	PLT	PL(D)=0.32 PL(A)=0.98
	-5	19.42							19.42					17.04-17.12m: PT x3.5° PL, RO, FE STN						
			Borehole discontinued at 19.42m depth Limit of investigation											17.34-17.37m: F x5 RO, CLN 17.55m: PT 5° IR, RO, FE STN 17.6m: PT 5° IR, RO, CLY CO 17.8m: F 5° IR, RO, CLN, 10mm 17.86-17.92m: PT x2.5° PL, RO, CLY VN 18.08-18.11m: CS 18.13-18.34m: PT x3.5° PL, RO, FE STN 18.35m: J 60° IR, RO, FE/CLY STN/CO 18.38-18.44m: PT x3.5° PL, RO, FE STN 18.49m: J 30° IR, RO, FE STN 18.58m: J 80° IR, RO, FE/CLY STN, 90mm 18.63m: PT 5° PL, RO, CLY/FE CO 18.78-18.81m: F CLN 18.88-19.23m: PT x3.5° -30° PL, RO, CLN						
	-6	20																20		
	-7	21																21		
	-8	22																22		
	-9	23																23		

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: MD-300
OPERATOR: Traccess
LOGGED: MLG

METHOD: 125mm diameter Spiral Flight Auger to 10.4m then NMLC to 19.42m
CASING:

REMARKS: NFGWO whilst augering.

EXPORTED 18/04/23 14:27. TEMPLATE ID: DP_103.02.00_COMBINED

CLIENT:	Stockbridge Property Unit Trust	TITLE:	**Core Photographs** **Proposed Residential Development** **Site B – North Gosford**				
PROJECT No:	202337.01						
OFFICE:	Central Coast						
Douglas Partners Geotechnics / Environment / Groundwater		DATE:	17/04/2023	DRAWN BY:	DRC	BORE No:	**B6**
		SCALE:	As shown	PLATE No:	6	REVISION:	0

Appendix D

Laboratory Test Certificates

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 311637-A

Client Details

Client	Douglas Partners Tuggerah
Attention	Darryl Carson
Address	Unit 5, 3 Teamster Close, Tuggerah, NSW, 2259

Sample Details

Your Reference	**202337.01, North Gosford**
Number of Samples	3 Water
Date samples received	25/11/2022
Date completed instructions received	14/12/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

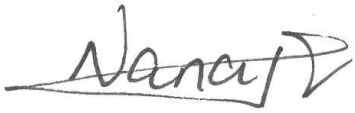
Date results requested by	21/12/2022
Date of Issue	21/12/2022

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Nick Sarlamis, Assistant Operation Manager

Authorised By



Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics		
Our Reference		311637-A-1
Your Reference	UNITS	Well A3
Date Sampled		24/11/2022
Type of sample		Water
Date prepared	-	20/12/2022
Date analysed	-	20/12/2022
pH	pH Units	5.5
Sulphate, SO4	mg/L	21
Chloride, Cl	mg/L	13
Electrical Conductivity	µS/cm	140
Resistivity by calculation	ohm m	74

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			20/12/2022	[NT]	[NT]	[NT]	[NT]	20/12/2022	[NT]
Date analysed	-			20/12/2022	[NT]	[NT]	[NT]	[NT]	20/12/2022	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	91	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	93	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Resistivity by calculation	ohm m	0.1	Inorg-002	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

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Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

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Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 311639-A

Client Details

Client	Douglas Partners Tuggerah
Attention	Darryl Carson
Address	Unit 5, 3 Teamster Close, Tuggerah, NSW, 2259

Sample Details

Your Reference	**202337.01, North Gosford**
Number of Samples	3 Water
Date samples received	25/11/2022
Date completed instructions received	14/12/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	21/12/2022
Date of Issue	21/12/2022

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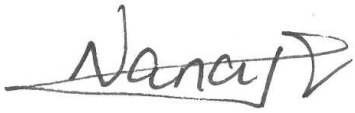
Results Approved By
Diego Bigolin, Inorganics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics			
Our Reference		311639-A-1	311639-A-2
Your Reference	UNITS	Well B5	Well B1
Date Sampled		24/11/2022	24/11/2022
Type of sample		Water	Water
Date prepared	-	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022
pH	pH Units	5.6	5.6
Sulphate, SO4	mg/L	5	21
Chloride, Cl	mg/L	15	16
Resistivity by calculation	ohm m	61	59

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			20/12/2022	[NT]	[NT]	[NT]	[NT]	20/12/2022	[NT]
Date analysed	-			20/12/2022	[NT]	[NT]	[NT]	[NT]	20/12/2022	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	91	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	93	[NT]
Resistivity by calculation	ohm m	0.1	Inorg-002	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

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LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
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The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

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CERTIFICATE OF ANALYSIS 313096

Client Details

Client	Douglas Partners Tuggerah
Attention	Darryl Carson
Address	Unit 5, 3 Teamster Close, Tuggerah, NSW, 2259

Sample Details

Your Reference	**202337.01, North Gosford**
Number of Samples	5 Soil
Date samples received	14/12/2022
Date completed instructions received	14/12/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	21/12/2022
Date of Issue	21/12/2022

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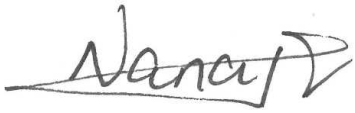
Results Approved By
Nick Sarlamis, Assistant Operation Manager

Authorised By



Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		313096-1	313096-2	313096-3	313096-4	313096-5
Your Reference	UNITS	A1/1.0-1.45	A3/1.0-1.45	B1/1.0-1.45	B3/1.0-1.45	B6/2.5-2.95
Date Sampled		04/11/2022	14/10/2022	04/11/2022	09/11/2022	08/11/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/12/2023	20/12/2023	20/12/2023	20/12/2023	20/12/2023
Date analysed	-	20/12/2023	20/12/2023	20/12/2023	20/12/2023	20/12/2023
pH 1:5 soil:water	pH Units	4.7	4.8	5.2	4.6	4.9
Chloride, Cl 1:5 soil:water	mg/kg	10	10	<10	10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	58	34	28	21	44
Resistivity in soil*	ohm m	200	270	440	180	280

Method ID	Methodology Summary
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QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			20/12/2022	1	20/12/2023	20/12/2023		20/12/2022	[NT]
Date analysed	-			20/12/2022	1	20/12/2023	20/12/2023		20/12/2022	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	4.7	4.6	2	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	10	20	67	103	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	58	57	2	108	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	1	200	190	5	[NT]	[NT]

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Report Comments

pH analysed outside holding time.