Supplementary Geotechnical Investigation Report

Project

Proposed Geotechnical Investigation and Services
683 Pittwater Road, Brookvale NSW 2100

Prepared for

Monado Constructions Pty Ltd

Date

12 August 2022

Report No

15076-GR-1-1

alliance
geotechnical & environmental solutions

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Document Control

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APPENDICES

1 Introduction

This report presents the findings of a geotechnical investigation carried out by Alliance Geotechnical Pty Ltd (Alliance) for the proposed development at 638 Pittwater Road, Brookvale NSW 2100. The investigation was commissioned by Monado Constructions Pty Ltd (the client) and was undertaken in accordance with Alliance's Estimate No. 6634, dated 13 April 2022.

The objective of this geotechnical investigation was to assess the surface and subsurface conditions of the site and provide comments and recommendations for a geotechnical clarification on the ground conditions and input parameters for the shoring design.

The investigation comprised Cone Penetration tests (CPT) at six locations within the footprint of the project site. Additionally, the variation of the existing groundwater level at the above project site was monitored using the existing three groundwater monitoring wells that were installed at the project site by Morrow Geotechnics (2018) and Douglas Partners (2021). Details of the field results are presented in this report, together with comments and recommendations relating to the project objectives.

2 Site Description and Regional Geology

The site is located at 638 Pittwater Road, Brookvale NSW 2100. The proposed project location is bound by Orchard Road to the South, Charlton Lane to the east, Pittwater Road to the west, and an existing industrial building to the north. The site location relative to the surrounding features is shown in **Error! Reference source not found.** below. This site is located within the local government area of the Northern Beaches Council.

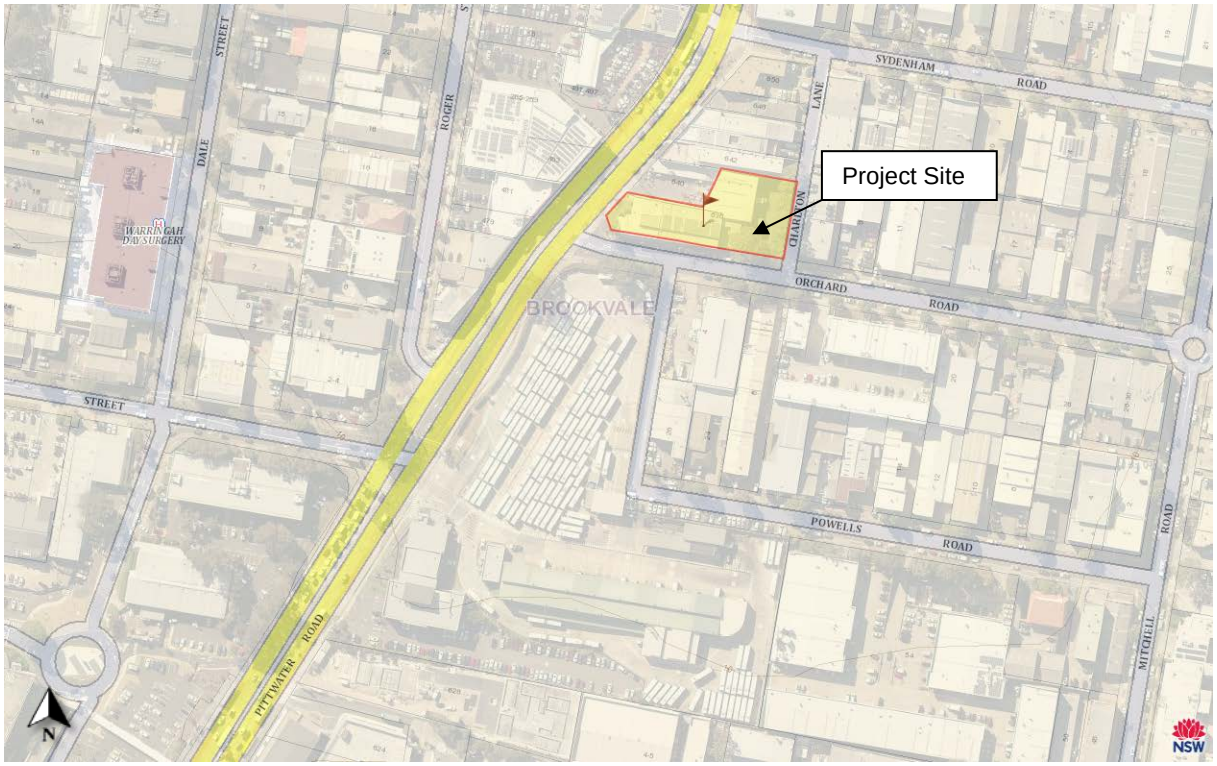

Figure 1 – Site Location, (Extracted from NSW Six Maps)

At the time of preparing this report, the site's detailed survey plan was not provided. However, based on the levels provided in the shoring drawings attached to the Douglas Partners numerical modelling report, the above site is estimated to be approximately at the RL of about 14.6m to 16.1m.

The New South Wales Seamless Geology dataset, version 2.1 [Digital Dataset] published by the Geological Survey of New South Wales, indicates that the site is underlain by Quaternary age Alluvial valley deposits of Qavf which may contain *fluvially-deposited quartz-lithic sand, silt, gravel, and clay.*

The site overlaying NSW Seamless Geology map are presented in Figure 2 below.

Figure 2 – Geological Map of the Site (Extracted from Minview)

3 Proposed Development

Based on the information provided, we understand that the development comprises the construction of a multi-storey building with three basement levels. According to the shoring plans attached to the Douglas Partners numerical modelling report for the above site, it is understood that the bulk excavation level will be at the reduced level (RL) of 4.5m Australian Height Datum (AHD). The maximum excavation depth is anticipated to be about 11.5m below the ground level (bgl).

4 Available Information

To assist with the geotechnical investigation, Alliance was supplied with the following documents:

- Geotechnical Investigation Report, prepared by: Morrow Geotechnics Pty Ltd, Reference No.: P1505_01, Dated: 17 August 2018
- Report on Numerical Modelling, prepared by: Douglas Partners, Project No.: 205246.00, Document No.: R.001.Rev0, Dated: 17 June 2021
- Geotechnical Monitoring Plan, prepared by: Douglas Partners, Project No.: 205246.00, Document No.: R.002.Rev0, Dated: 6 August 2021
- Preliminary Dewatering Drawdown Assessment, prepared by: Douglas Partners, Project No.: 205246.00, Document No.: R.003.Rev01, Dated: 29 September 2021
- WaterNSW, statement of approval, and notice of decision, Ref. No.: 10WA124633, Dated: 6th April 2022
- Detailed Site Investigation (DSI) report, prepared by: Foundation Earth Sciences, Job No.: E2316, Document No.: 1, Rev.:0, Dated: 10 October 2020.
- Detailed Site Investigation (DSI) report, prepared by: Foundation Earth Sciences, Job No.: E2316, Document No.:1, Rev.:1, Dated: October 2020.
- Dewatering Management Plan, prepared by: EI Australia, Report No.: E25406.E16_Rev0, Dated: 6 December 2021

The geotechnical investigation conducted by Morrow Geotechnics in 2018 which included the excavation of two boreholes (i.e., Morrow BH1, BH2) to the depths of 14.0 to 17.45m below ground level (bgl), with the locations shown in the Geotechnical Site Investigation Plan attached in Appendix B of current report. The results appear to show the existence of fill layers up to the depth of 0.5m, followed by loose sands up to the depth of 3m bgl, and medium dense sand up to the investigated depths. One groundwater monitoring well was also installed in Morrow's BH1 and is again monitored during current investigation. The earlier results of Morrow Geotechnics (2018) showed that the water level was at the depth of 3.4m bgl, or at the reduced level (RL) of 11.4m Australian Height Datum (AHD).

Douglas Partners conducted a further geotechnical investigation at the above site in 2021 that were consisted of two boreholes (i.e., DP B101 and DP B102) to the depths of 23.3m and 26.5m bgl, with the locations shown in the site plan in Appendix B of current report. The results of Douglas Partners (2018) investigation showed the exitance of fill layers up to the depth of 0.3m, followed by alluvial interbedded sand and clay deposits in altering sequence, generally ranging in thickness from 1.0m to 3.0m, and an inferred thin bedrock of very low-estimated sandstone at the depth of 23.3m to 26.5m. Two groundwater monitoring wells were also installed at the above excavated boreholes and were also monitored during the current investigation. The earlier results of Douglas Partners (2021) showed that the water level was at the depths of 3.2m to 3.7m bgl, or at the reduced level (RL) of 12.0 to 12.4m Australian Height Datum (AHD).

According to the site and ground conditions, a secant pile wall is considered for the proposed shoring system at the above site. The details of the proposed shoring wall are attached to the Douglas Partners (2021) numerical modelling report, which shows that the proposed shoring system consists of 450mm diameter piles supported by three rows of pre-stressed anchors with an out of plane spacing of about 2m. The 2D numerical modelling results presented by Douglas Partners (2021) show respectively maximum horizontal and vertical deflections of about 29mm and 18mm. The anchor working loads were assumed to be about 405 to 420 kN.

Detailed geotechnical investigations and modelling were conducted at the above site by Morrow Geotechnics Pty Ltd (2018), and later by Douglas Partners (2021). Thus, due to the nature of existing ground layers, the current geotechnical investigation aimed to provide more clarification on the ground conditions as well as the required design parameters for the proposed shoring system.

5 Fieldwork

5.1 Methods

The geotechnical site investigation at the above site consists of CPT tests at six locations and was carried out over three days, on 2 and 3 June 2022, and on 22 July 2022. Also included was the monitoring of the standing groundwater levels inside the existing three groundwater wells at the project site, with the details outlined in section 4.3.

Selected photographs taken during the fieldwork are presented in Appendix A and the approximate CPT locations, and groundwater monitoring wells are shown on the Geotechnical Investigation Plan (Drawing 15076-GR-1-A) presented in Appendix B. Prior doing the CPT tests, the test locations were cleared referring to DBYD referral maps.

Initially during the period between 2 to 3 June 2022, five (5) CPT tests were conducted, and are referred to as CPT02, CTP02A, CPT04, CPT05, and CPT05A with the locations shown in the geotechnical investigation plan attached in Appendix B. For the above tests, CPT02 and CPT05A tests were respectively adjacent to CPT02A, and CPT05 tests, and were conducted again to provide more data from deeper depths as CPT02A, and CPT05 tests were refused on shallower depths. The above CPT tests were taken up to the depths of 14.26m to 20.76m below ground level.

Later, on 22 July 2022, three additional CPT tests were conducted at the above site and are referred to as CPT01, CPT03, and CPT06 with the details shown in the geotechnical investigation plan attached in Appendix B. The later three CPT tests were taken up to depths of 27.20m to 30.14m below ground level.

The results of the above site investigation work, geotechnical interpretation, and assessments are outlined in the following.

5.2 Results

The subsoil conditions encountered during the CPT tests are summarised in The CPT logs attached in Appendix C.

The subsurface profile consisted of alluvial deposits of interbedded sandy and clayey alluvium with the details shown in the CPT logs. These trends appear to be consistent with the existing geological information at the above site as well as the observations in the earlier geotechnical investigation reports prepared by Morrow Geotechnics Pty Ltd (2018), and Douglas Partners (2021).

To prepare a better understanding of the site geology as well as to provide detailed design parameters for the proposed retaining system, the sublayer conditions together with consistency and design strength parameters are shown in the attached CPT logs. Two geotechnical cross-sections A-A and B-B are attached to this report in Appendix D.

5.3 Groundwater

Based on the CPT logs, it is estimated that the groundwater is at a depth of about 1.8m to 2.6m below ground level. To assist with a better understanding of the existing groundwater levels at the above site, the groundwater levels within the project site were monitored by the installation of three dataloggers inside the existing three groundwater monitoring wells. Two of the monitoring wells were already installed during the geotechnical investigation conducted by Douglas Partners (2021), and are referred to as MW3 (i.e. existing

DP BH101), and MW4 (i.e. existing DP BH102) in this report and one of the ground monitoring wells was earlier installed by Morrow Geotechnics earlier in 2018 and is referred to as MW5 (i.e., existing Morrow BH1) in this report. The approximate locations of the above monitoring wells are shown in the geotechnical investigation plan, attached in Appendix B. The groundwater monitoring at the above wells was continued for a period between 3rd June 2022 to 29th June 2022, with the detailed results attached in Appendix E. Accordingly, it is observed that the standing groundwater at the above project site during the monitoring periods between 3rd to 29th June 2022 was at the depths of 2.26m to 2.93m below ground level or at the reduced levels of RL 13.40m to RL 12.52m AHD, and is consistent with the earlier observation in CPT test results.
The above groundwater monitoring results show that the standing groundwater level at the project site has increased about 0.8m compared to the water levels measured in 2018 and 20221.

6 Discussion

Based on the proposed bulk excavation level at RL 4.5m, the maximum depth of excavation for the proposed development is expected to be about 11.5m below ground level and is expected to be throughout loose to medium dense sands with interbedded very stiff clay layers. According to the groundwater monitoring data summarised in Appendix E, the proposed bulk excavation level is to be about 8.9m below the groundwater level.

To provide more details for the design of the proposed retention system, CPT tests were conducted at different locations with the results summarised in Appendix C. Based on the results, it is observed that the ground condition consists of loose to medium dense sands with interbedded clay layers up to the bulk excavation level. In deeper depths, lenses of stiff to hard clay layers with a thickness of about 2m to 3m are observed. Two geotechnical cross sections are also provided to illustrate the variation of the existing sandy and clayey alluvial deposits within the project site.

A summary of the design parameters shown in the CPT logs is provided in Table 1 below, together with other relevant design parameters. Detailed design parameters are also provided in the CPT logs.

Table 1 – Generalised Parameters for Retaining Structure Design

Description	Su[(1)]	c' (kPa)	ϕ' [(1)] (deg)	γ (kN/m^3)	K_a	K_0	K_p	E_{50}[(1)] (MPa)	v
SAND Loose	-	-	32	18	0.39	0.56	2.6	9~10	0.3
SAND medium dense	-	-	32-34	19	0.31	0.47	3.25	25	0.3
SAND Dense	-	-	36	19-20	0.24	0.38	4.17	40	0.3
CLAY and/or Silty CLAY: Stiff	90	5	26	18	0.45	0.58	2.2	20	0.3
CLAY and/or Silty CLAY: Very Stiff	150	8	28	19	0.42	0.55	2.37	30	0.25

Legends:
Su: Undrained shear strength
c': Drained cohesion
ϕ': Drained friction angle
K_0: At rest earth pressure coefficient
K_a: Active earth pressure coefficient
K_p: Passive earth pressure coefficient
γ: Unit weight
E: Elasticity Modulus
v : Poisson's ratio

(1) Detailed design parameters for undrained shear strength, friction angle, and elasticity modulus are provided in CPT logs.
(2) Not applicable.

Due to the significant variations of the soil layers and consistency parameters at the above site, the geotechnical design parameters for the proposed shoring wall are provided separately at different CPT test locations and are shown in the CPT logs attached in Appendix C.

The detailed design of retaining shoring walls should include the recent geotechnical design parameters provided in this report in different sections, as well as for the most critical conditions. The retaining shoring walls designs are to be conducted by utilising commercial software packages such as WALLAP, RS2, or PLAXIS that can model the sequence of excavation to ensure deflections are within tolerable limits and the effect of excavation on adjacent buildings and/or road reserves and carriageways. The design of retaining structures should also consider horizontal pressures due to surcharge loads from any adjacent infrastructure.

A dilapidation survey may be required prior to excavation for the existing buildings within the adjoining properties and the section of road carriageway and the road reserve adjoining the site.

Detailed construction supervision, monitoring, and inspections should be carried out by an experienced geotechnical engineer during piling and subsequent bulk excavation, in addition to inspection of the structural elements by the project structural engineer. The inspections should constitute “Hold Points”.

7 Limitations

Alliance Geotechnical Pty Ltd (Alliance) has prepared this report for 683 Pittwater Road, Brookvale NSW 2100 (the Site), in accordance with Alliance’s fee proposal and Terms of Engagement. This geotechnical report has been prepared for Monado Constructions Pty Ltd (the Client) for this project and for the purposes outlined in this report. This report cannot be relied on for other projects, other parties on this site, or any other site.

The comments and recommendations provided in this report are provided based on the limited investigation. The borehole investigation and testing results provided in this report are indicative of the subsurface conditions at the site only at the specific sampling and testing locations, and to the depths drilled at the time of the investigation. Subsurface conditions can change significantly due to geological and human processes. Where variations in conditions are encountered further geotechnical advice should be sought from Alliance.

APPENDIX A – Selected Site Photographs

Figure 3 – Existing Warehouse at the Project Site

Figure 4 – Groundwater Monitoring at MW5

APPENDIX B – Geotechnical Investigation Plan

Geotechnical Investigation Plan

Client Name:	Monado Constructions Pty Ltd	Figure / Drawing Number:	15076-GR-1-A
Project Name:	Mixed-use multistorey development	Figure / Drawing Date:	26 July 2022
Project Location:	638 Pittwater Road, Brookvale NSW	Report Number:	15076-GR-1-1

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APPENDIX C – CPT logs

Alliance Geotechnical
10 Welder Road
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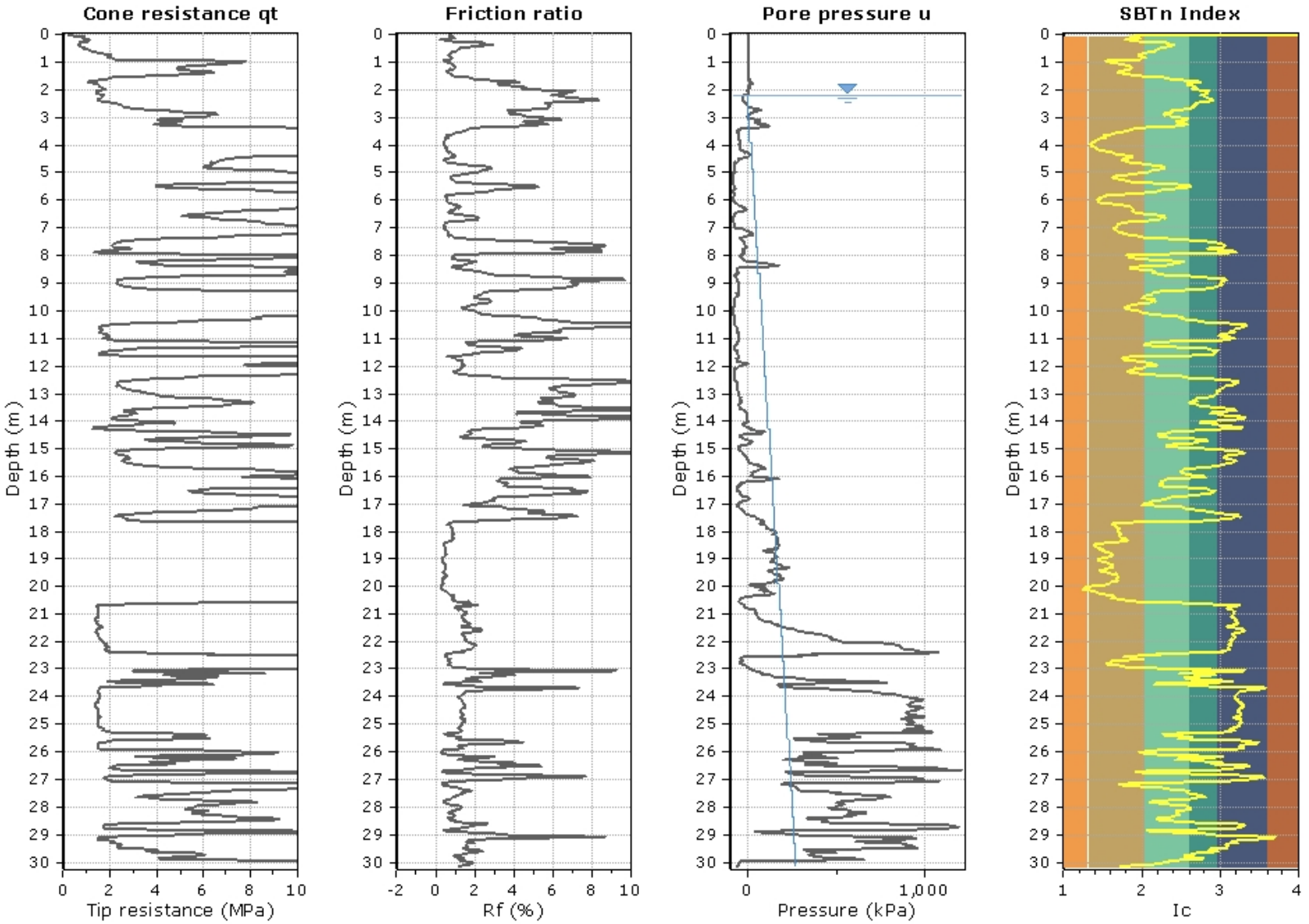
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookvale NSW 2100**

CPT: CPT01
Total depth: 30.14 m



Loose Sand
$\phi'=32^0$, E_{50}=9 MPa

up to 3.5m bgl

Medium Dense Sand

with Lenses of stiff clays

$\phi'=34^0$, E_{50}=18 MPa

Up to 12.5m

Very Stiff Clay

Su=180 kPa , E_{50}=36 MPa

Up to 17.5m

Dense Sand
$\phi'=36^0$, E_{50}=40 MPa
Up to 21.5m

Very Stiff Clay

Su=130 kPa , E_{50}=26 MPa

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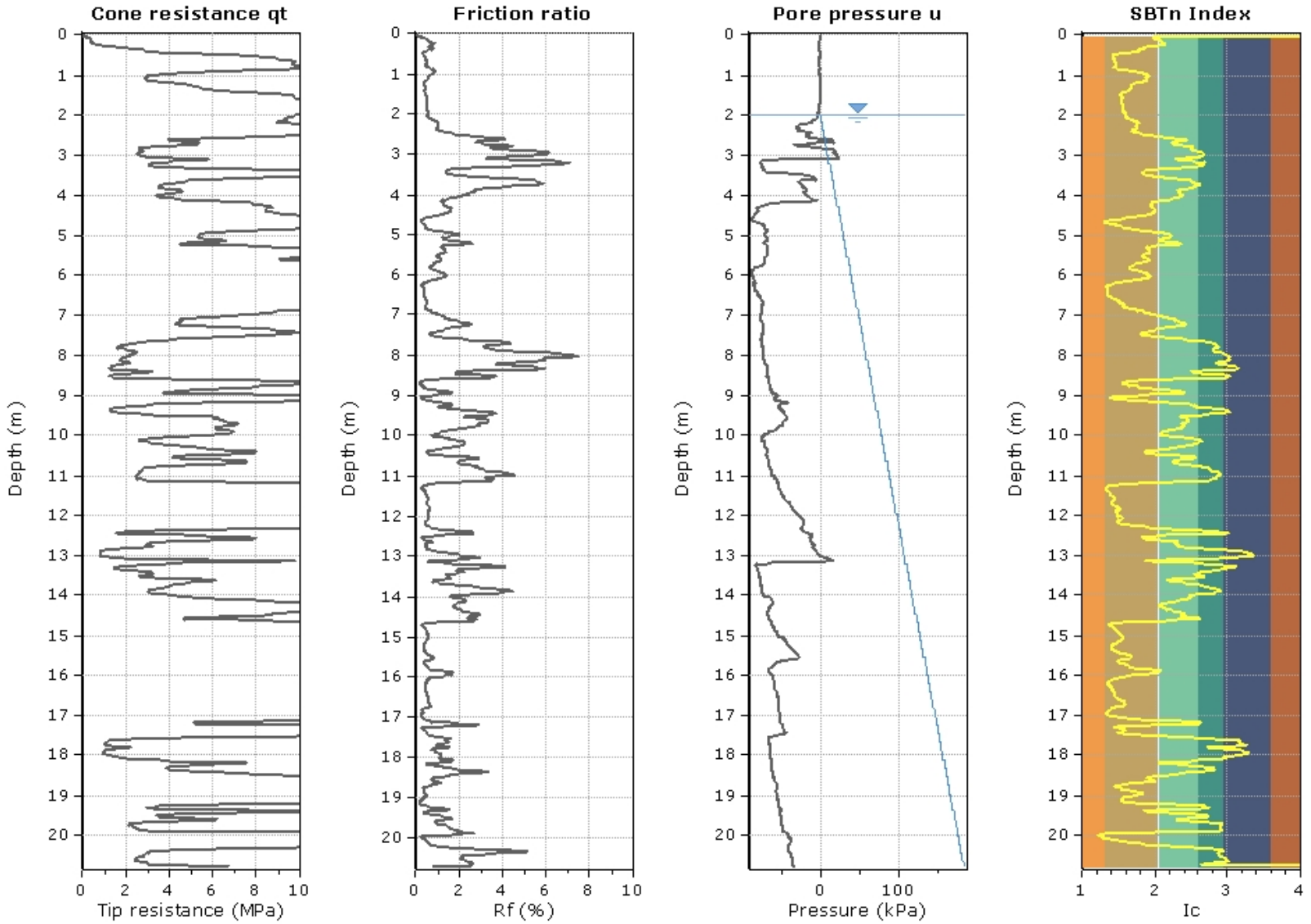
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookevale NSW**

CPT: CPT-02
Total depth: 20.76 m



Loose Sand
$\phi'=32^0$, E_{50}=10 MPa

up to 4.0m bgl

Medium Dense Sand
Locally with Lenses of very stiff to hard clays

$\phi'=34^0$, E_{50}=20 MPa

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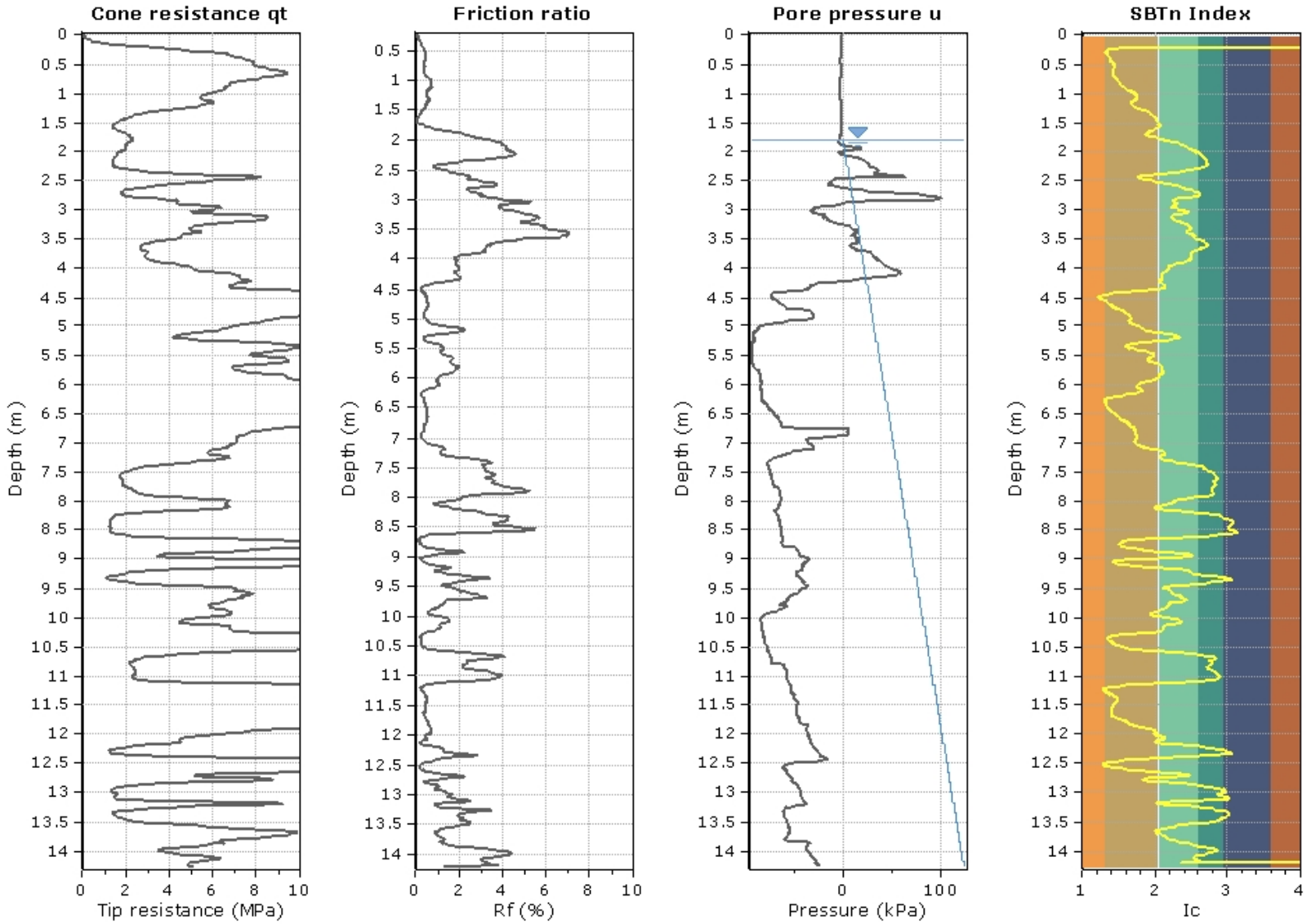
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookevale NSW**

CPT: CPT02.A
Total depth: 14.26 m



Loose Sand
$\phi'=32^0$, E_{50}=10 MPa

up to 3.8m bgl

Medium Dense Sand

Locally with lenses of very stiff to hard clays

$\phi'=34^0$, E_{50}=20 MPa

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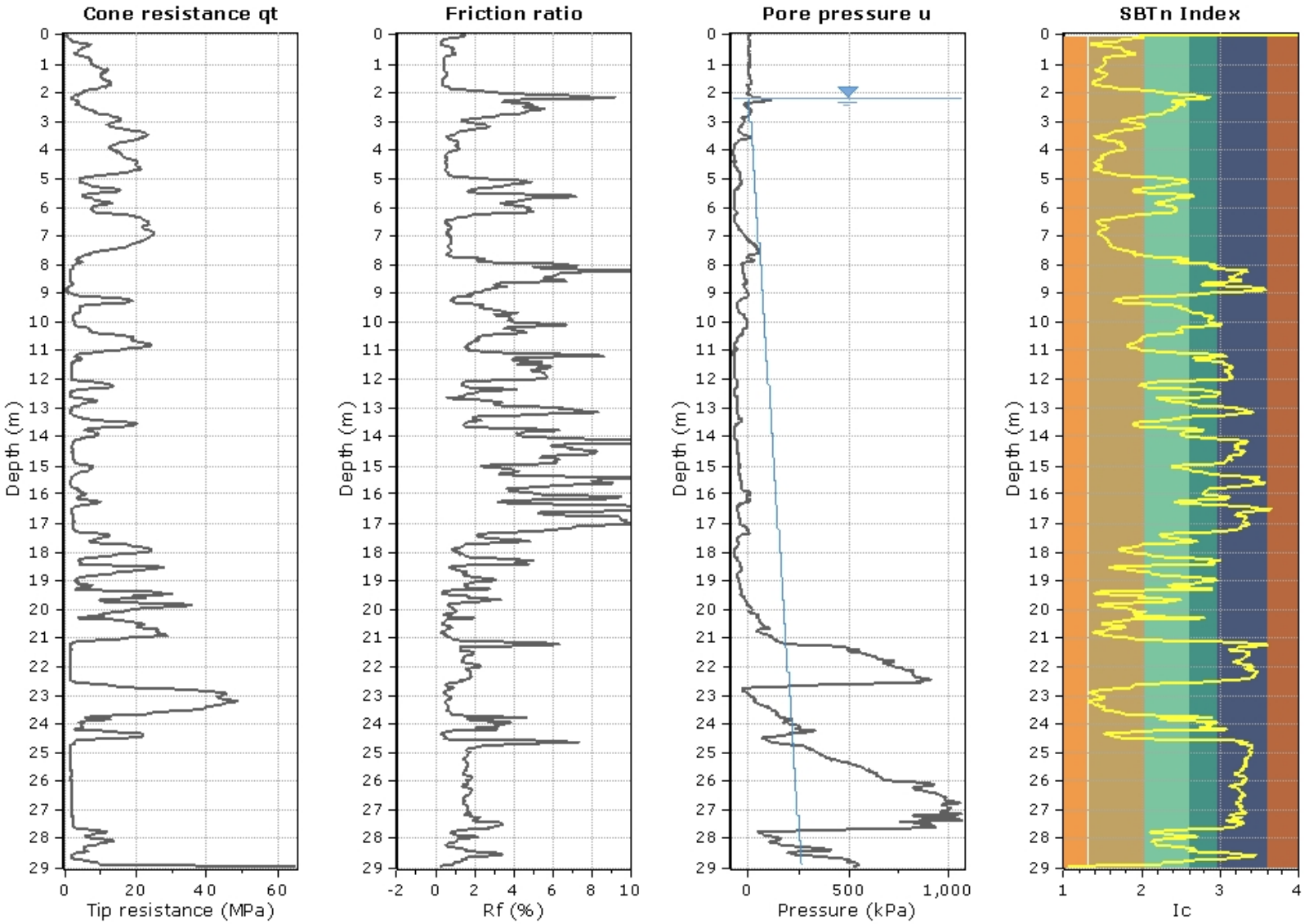
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookvale NSW 2100**

CPT: CPT03
Total depth: 28.94 m



Medium Dense Sand

locally with stiff to hard clay layers

$\phi'=34^0$, E_{50}=20 MPa

Up to 11m bgl

Very Stiff Clay

Su=220 kPa , E_{50}=36 MPa

Up to 17.0m

Medium Dense Sand

locally with stiff clay layers

$\phi'=34^0$, E_{50}=24 MPa

up to 25m

Stiff Clay

Su=90 kPa , E50=20 MPa

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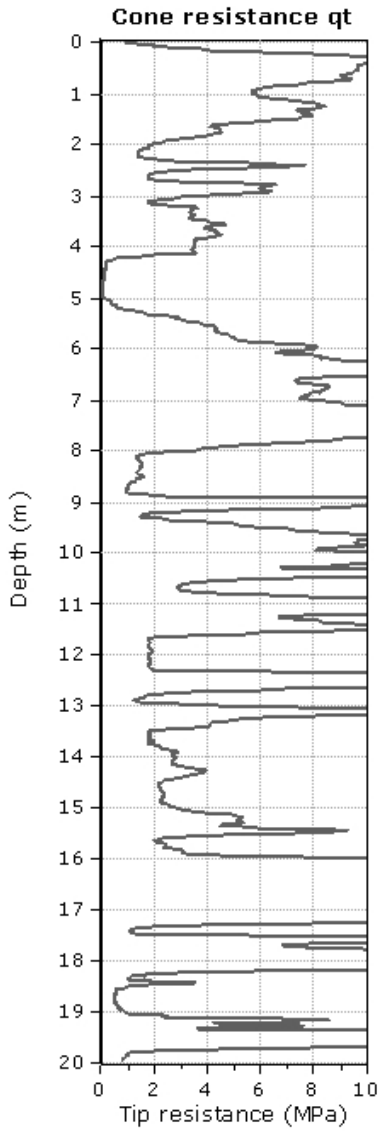
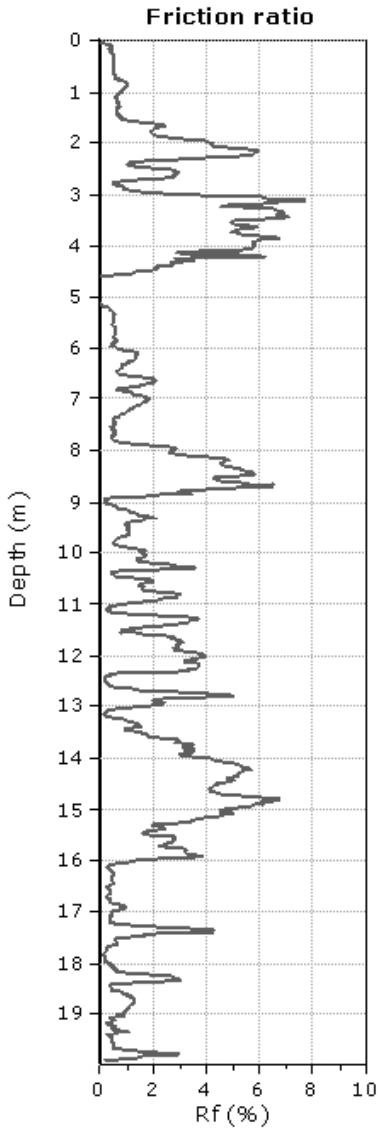
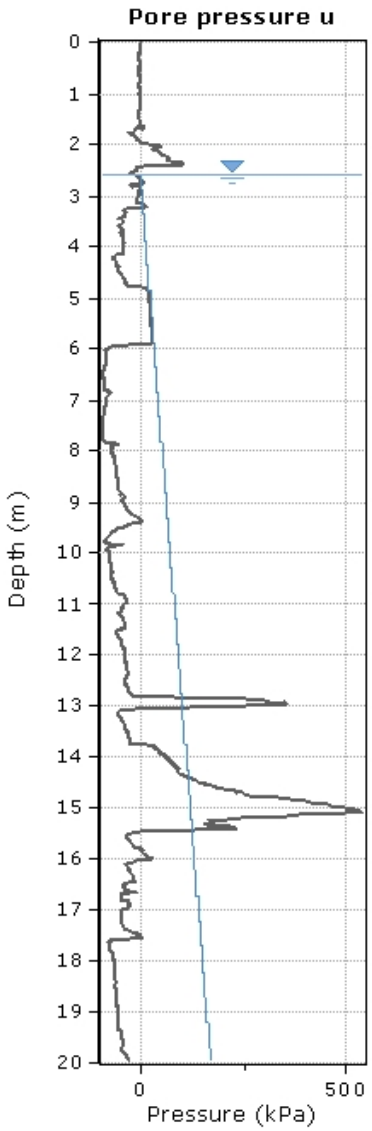
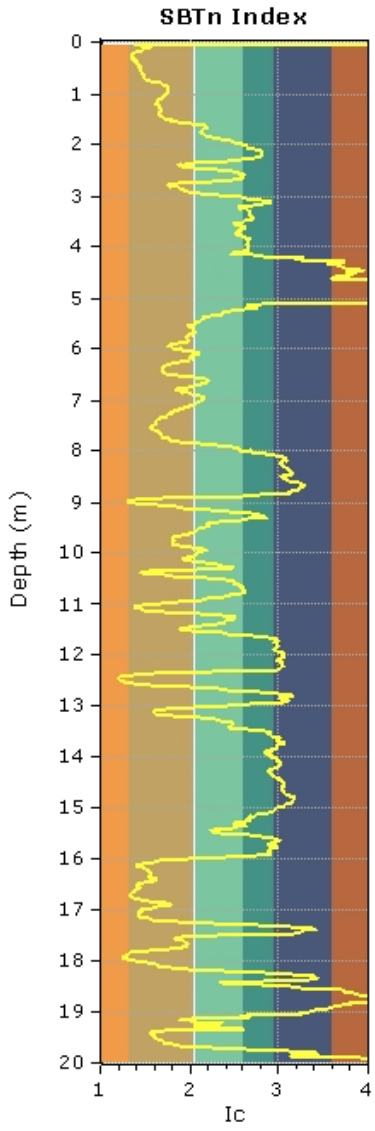
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookevale NSW**

CPT: CPT-04
Total depth: 19.95 m









Fill (Well-compacted, up to 1m)
$\phi'=34^0$, E_{50}=20 MPa

Medium Dense Sand
locally with very stiff clay layers

$\phi'=33^0$, E_{50}=15 MPa

Up to 5m

$\phi'=34^0$, E_{50}=20 MPa

Up to 14m

Very Stiff Clay
Su=180 kPa , E_{50}=36 MPa

Up to 16.0m

Medium Dense Sand
with very stiff clay layers

$\phi'=34^0$, E_{50}=25 MPa

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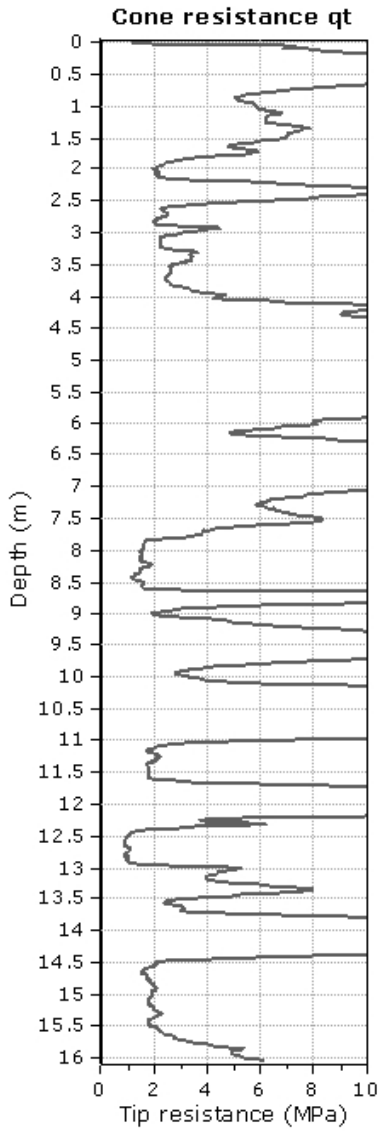
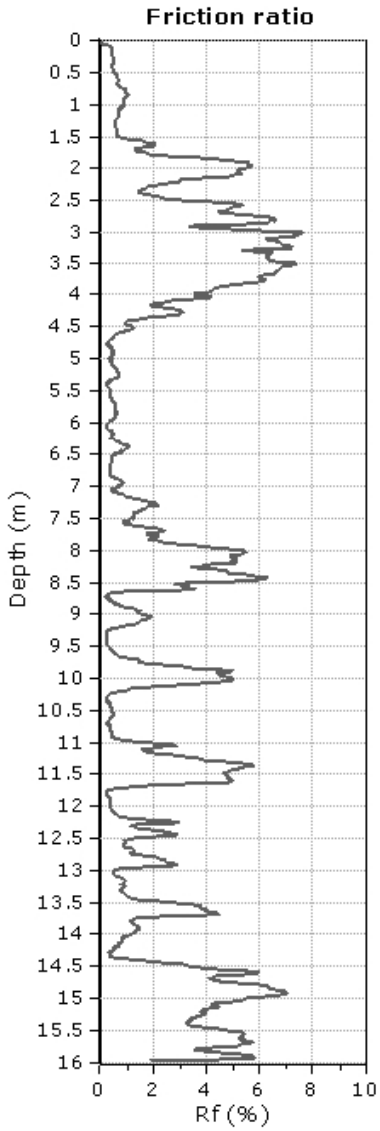
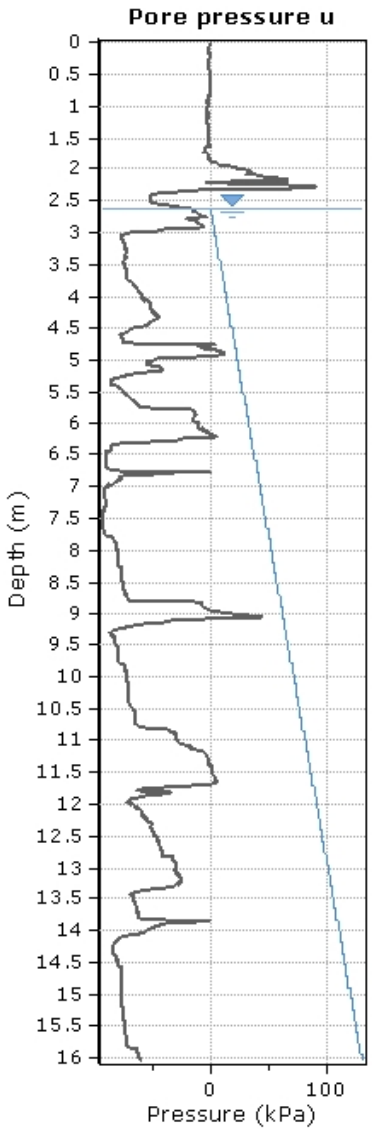
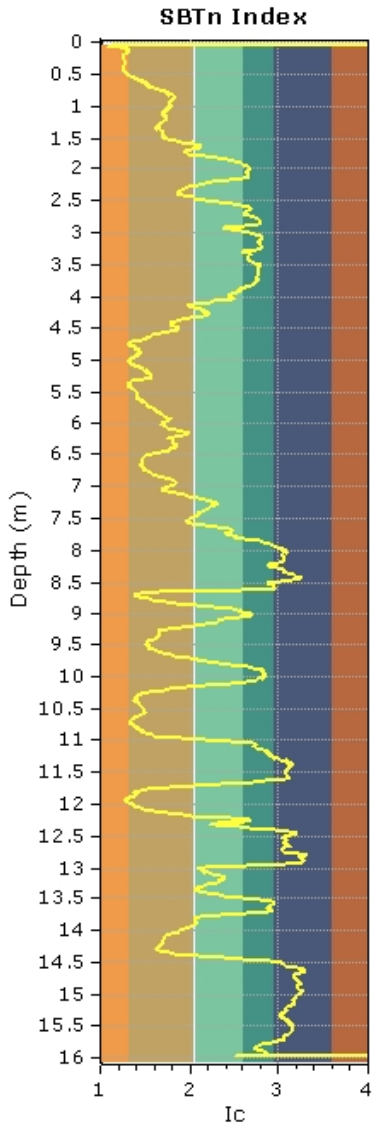
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookevale NSW**

CPT: CPT-05
Total depth: 16.04 m









Fill (Well-compacted, up to 1m)
$\phi'=34^0$, E_{50}=20 MPa

Medium Dense Sand
locally with very stiff clay layers

$\phi'=32^0$, E_{50}=12 MPa

Up to 4m

$\phi'=34^0$, E_{50}=25 MPa

Up to 12.5m

Very Stiff to Hard Clay

Su=180 kPa , E_{50}=36 MPa

Alliance Geotechnical
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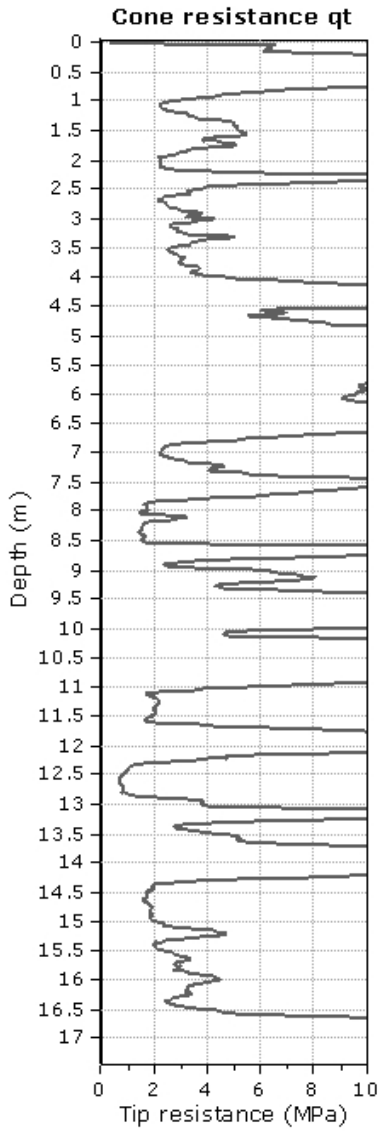
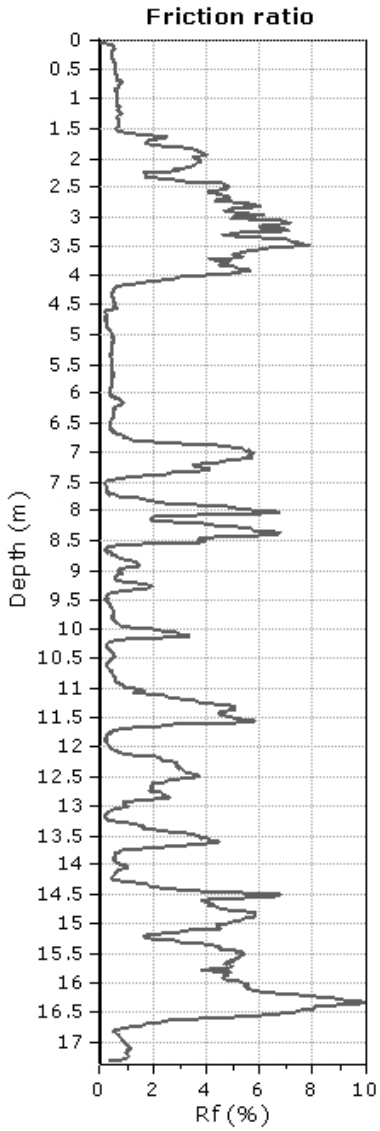
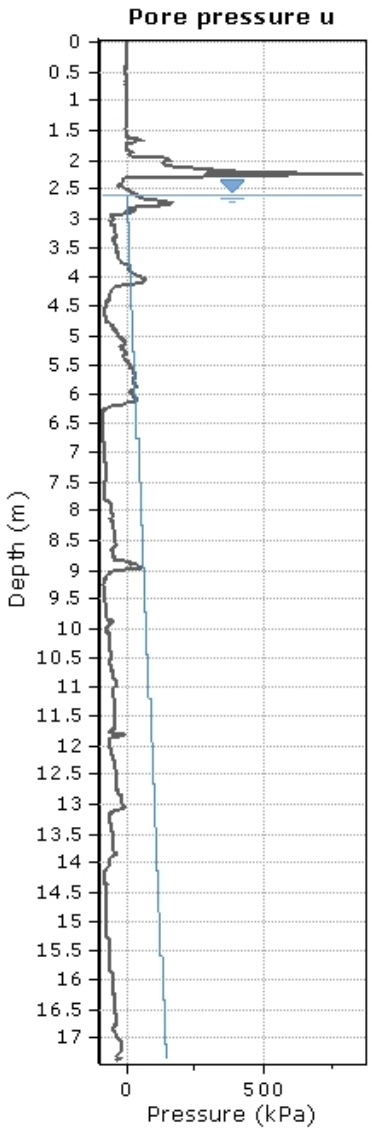
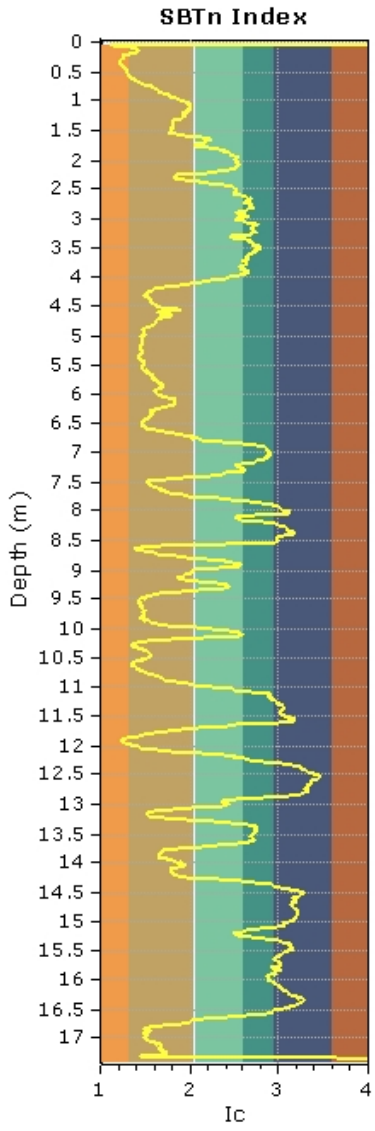
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookevale NSW**

CPT: CPT-05A
Total depth: 17.37 m









Fill (Well-compacted, up to 1m)
$\phi'=34^0$, E_{50}=20 MPa

Medium Dense Sand
locally with very stiff clay layers

$\phi'=33^0$, E_{50}=15 MPa

Up to 4m

$\phi'=34^0$, E_{50}=25 MPa

Up to 13.0m

Very Stiff to Hard Clay

Su=180 kPa , E_{50}=36 MPa

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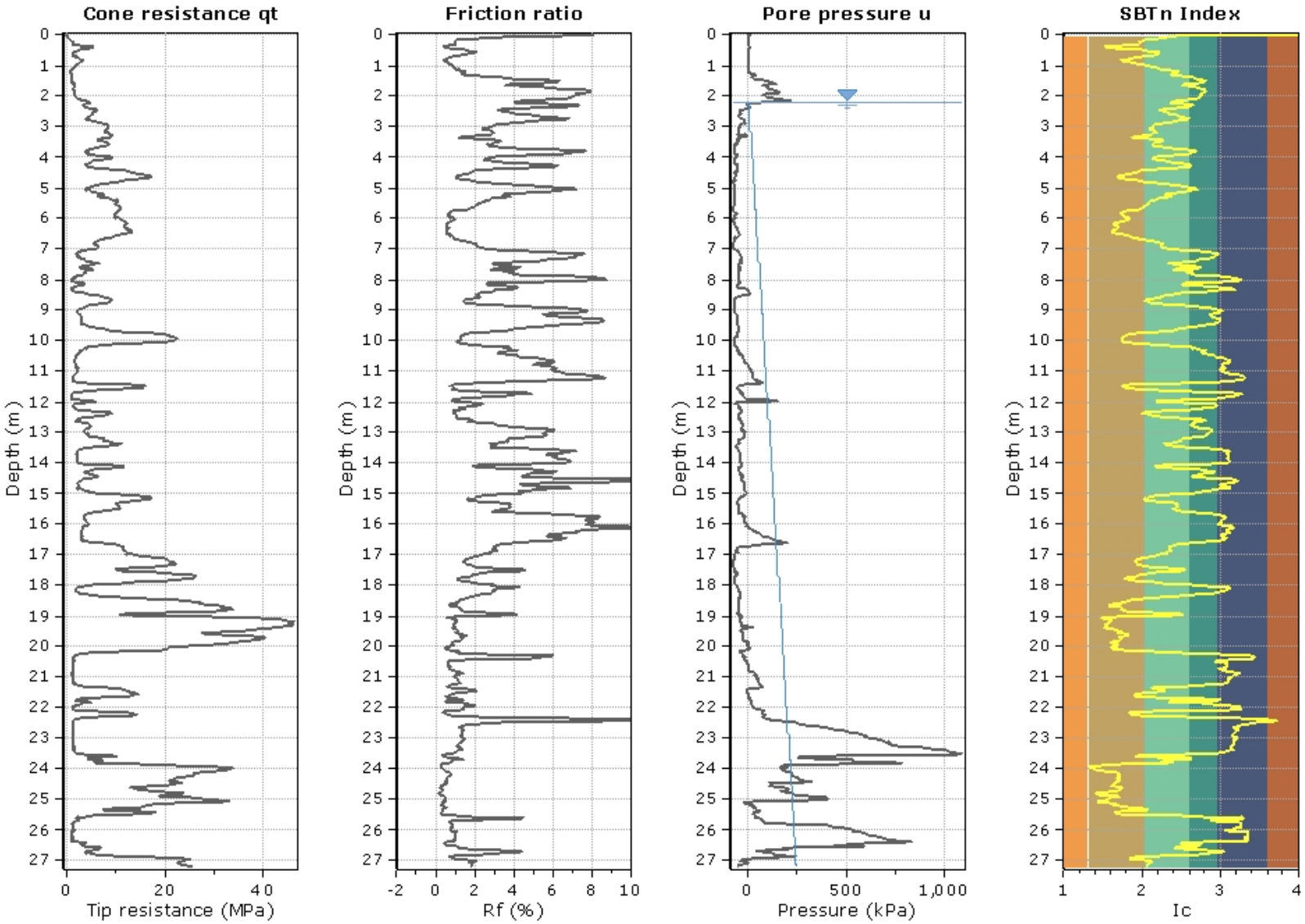
Project: **Proposed Geotechnical Investigation and Services**
Location: **638 Pittwater Road, Brookvale NSW 2100**

CPT: CPT06
Total depth: 27.20 m



Fill (Well-compacted, up to 1m)
$\phi'=34^0$, E_{50}=20 MPa

Medium Dense Sand
locally with very stiff clay layers

$\phi'=33^0$, E_{50}=12 MPa

Up to 7.5m

Very stiff to hard Clay
with silt and sands

Su=180 kPa , E_{50}=36 MPa

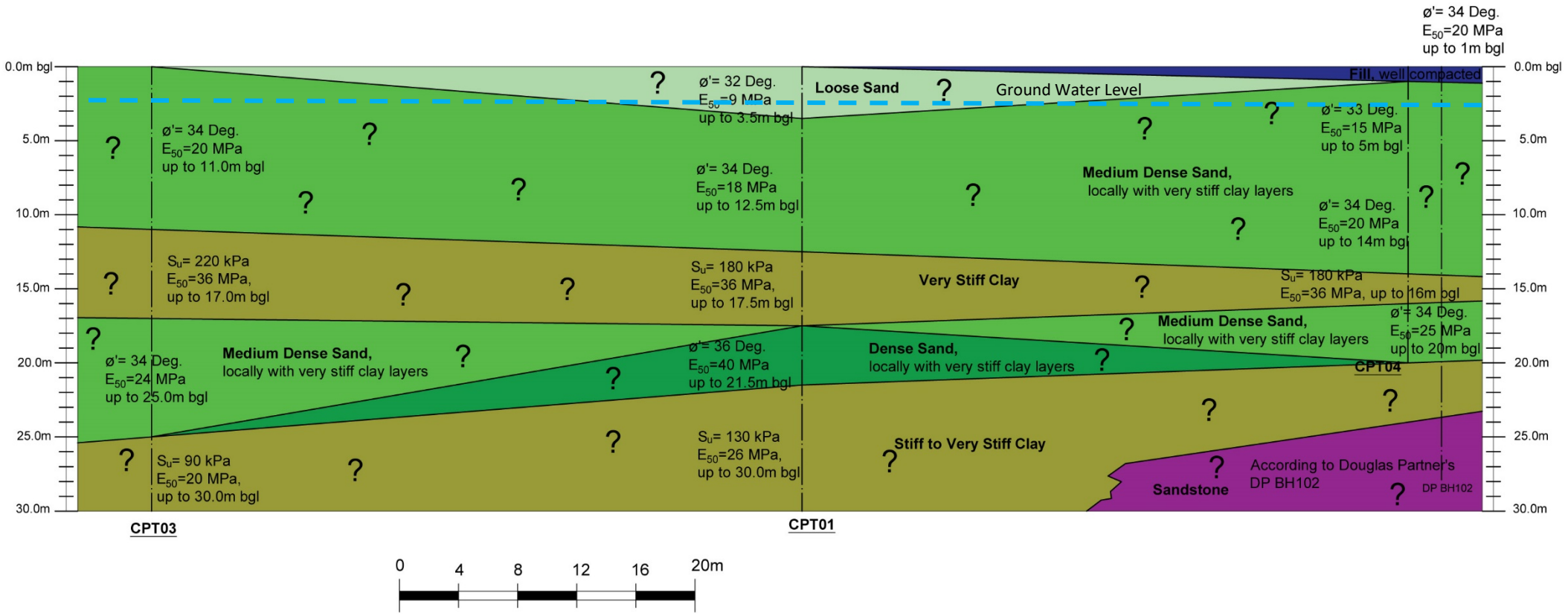
Up to 17.0m

Medium Dense Sand

with lenses of firm to stiff clay

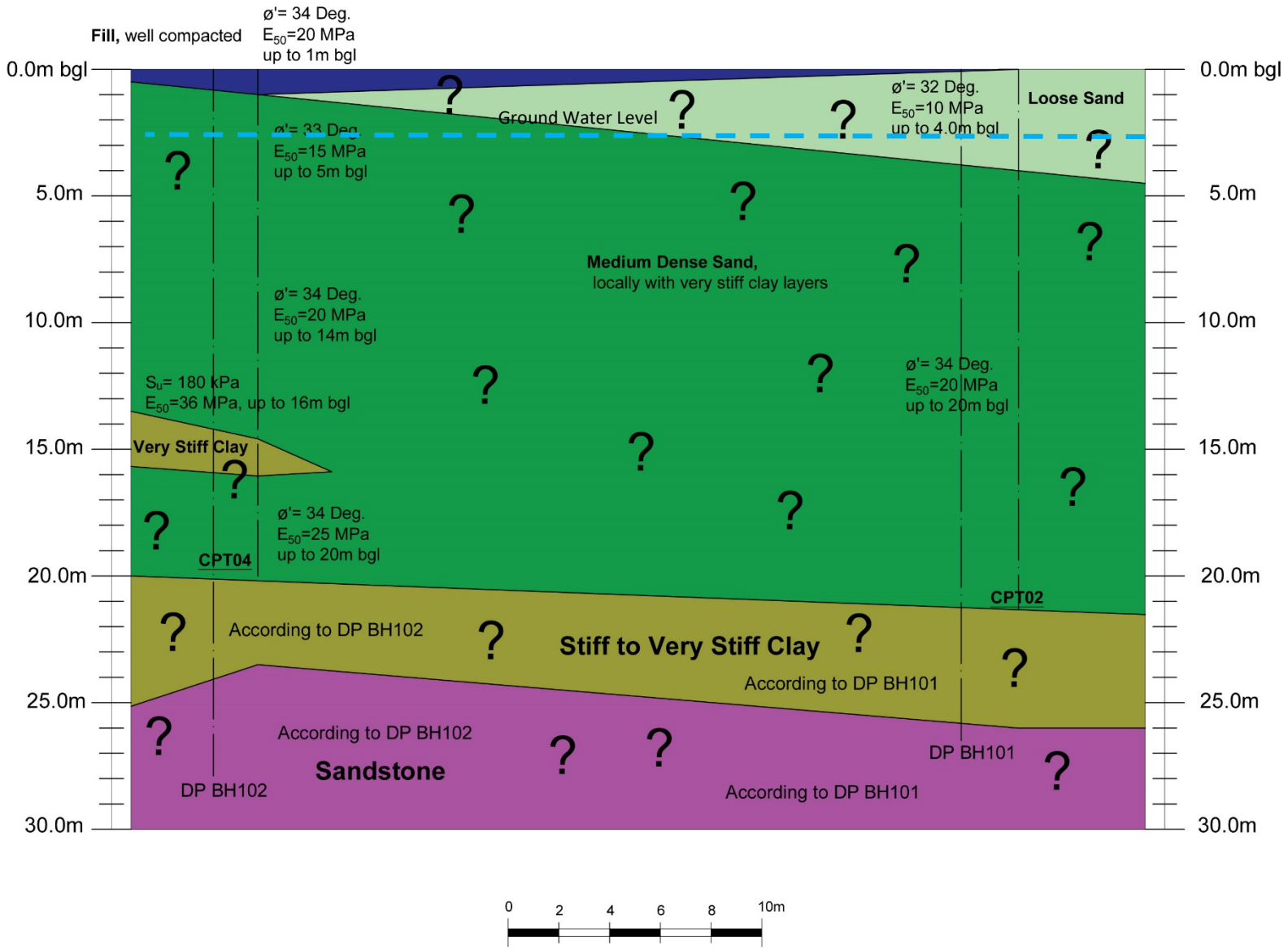
$\phi'=34^0$, E_{50}=24 MPa

APPENDIX D – Geotechnical Cross-Sections



Geotechnical Section A-A

alliance	Client Name:	Monado Constructions Pty Ltd	Report Number:	15076-GR-1-1
	Project Name:	Mixed-use multistorey development		
	Project Location:	638 Pittwater Road, Brookvale NSW		



Geotechnical Section B-B

alliance	Client Name:	Monado Constructions Pty Ltd	Report Number:	15076-GR-1-1
	Project Name:	Mixed-use multistorey development		
	Project Location:	638 Pittwater Road, Brookvale NSW		

APPENDIX E – Groundwater Levels Monitoring Results

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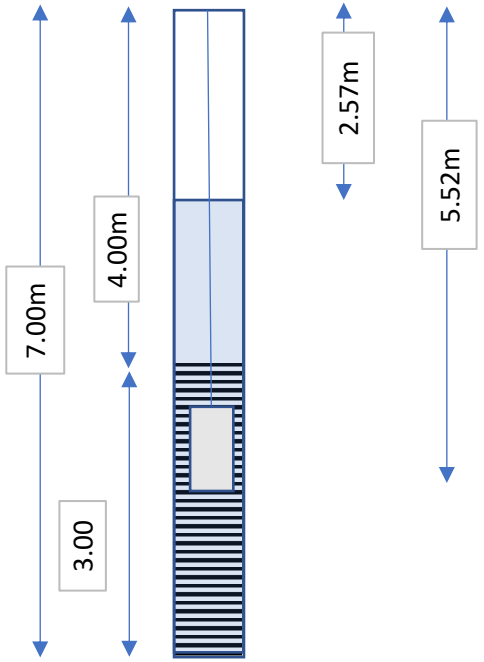
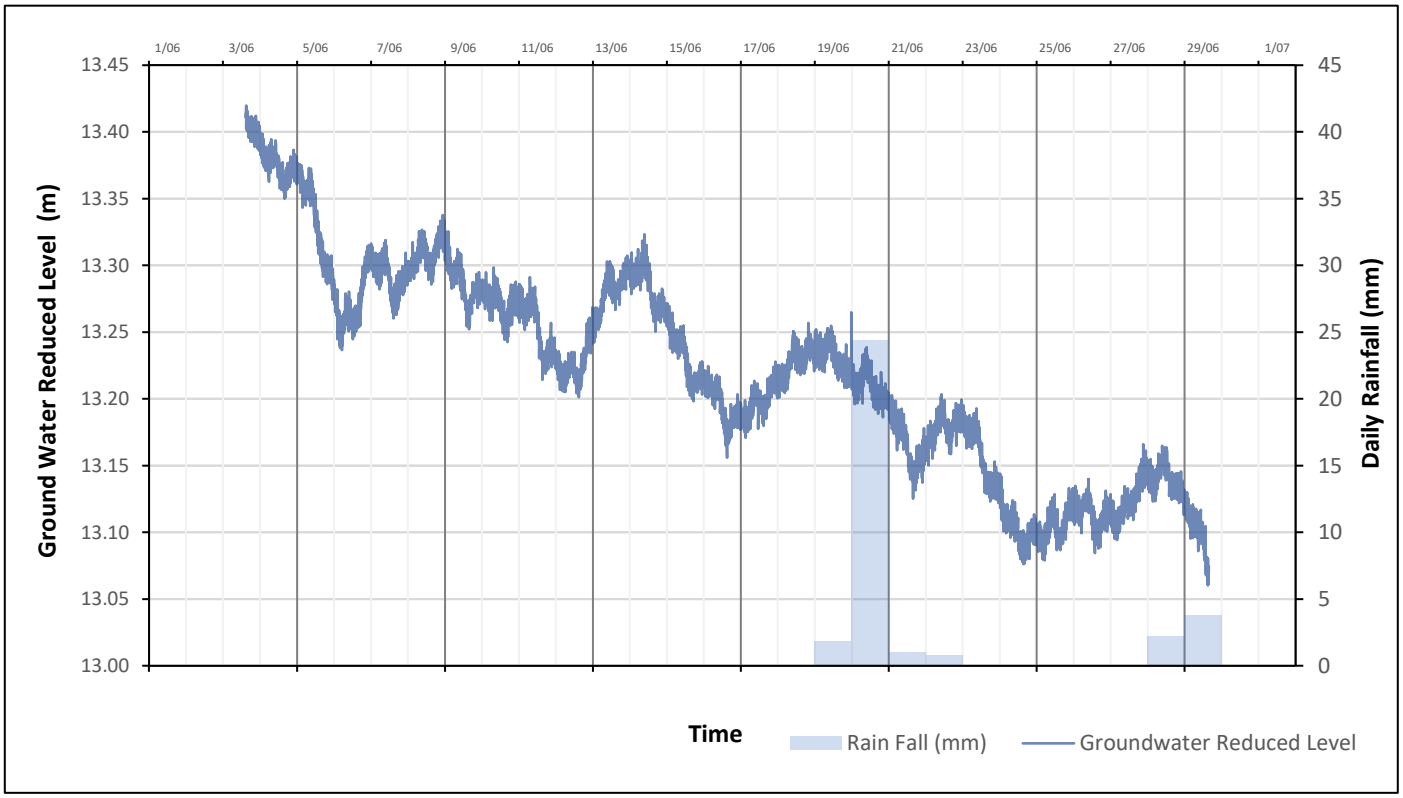
Groundwater Monitoring

Client :	PMC Constructions - John Mouawad	**Location:**	MW3
Project :	638 Pittwater Rd, Brookvale	**Job Number :**	15076
Test Location:	638 Pittwater Rd, Brookvale	**Test Date :**	3/06/2022 to 29/06/2022
Test Method :	-	**Tested By :**	ML

Test	MW3				
Borehole Data	**Unit**	**Value**	**Borehole Data**	**Unit**	**Value**
Initial Ground Water Depth (bgs)	m	2.57	**Solid Casing Length(L)**	m	4
Casing Radius (r_c)	m	0.025	**Screened Length (L_e)**	m	3
Borehole Radius (r_w)	m	0.05	**Existing Ground RL**	m	15.99

Well and Logger Details	
Start Time	3/06/2022 14:50





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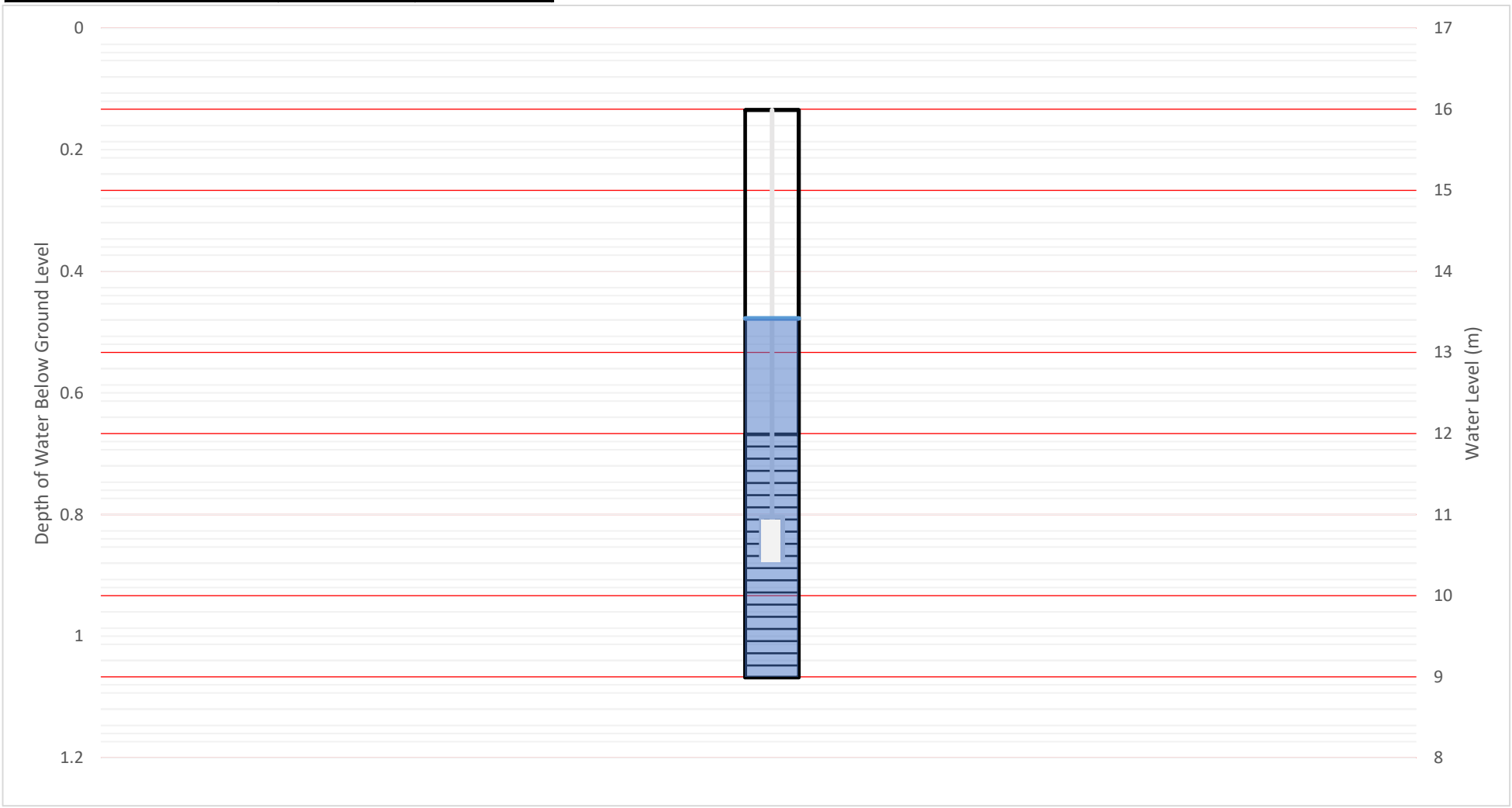
Scaled Well and Logger Details		
Ground RL	m	15.99
Solid Length	m	4
Slotted Length	m	3
Logger Install Depth	m	5.52
Initial Water Level	m	2.57



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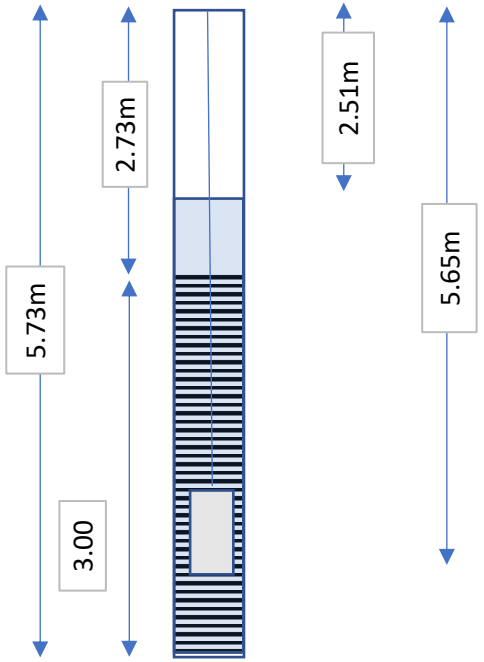
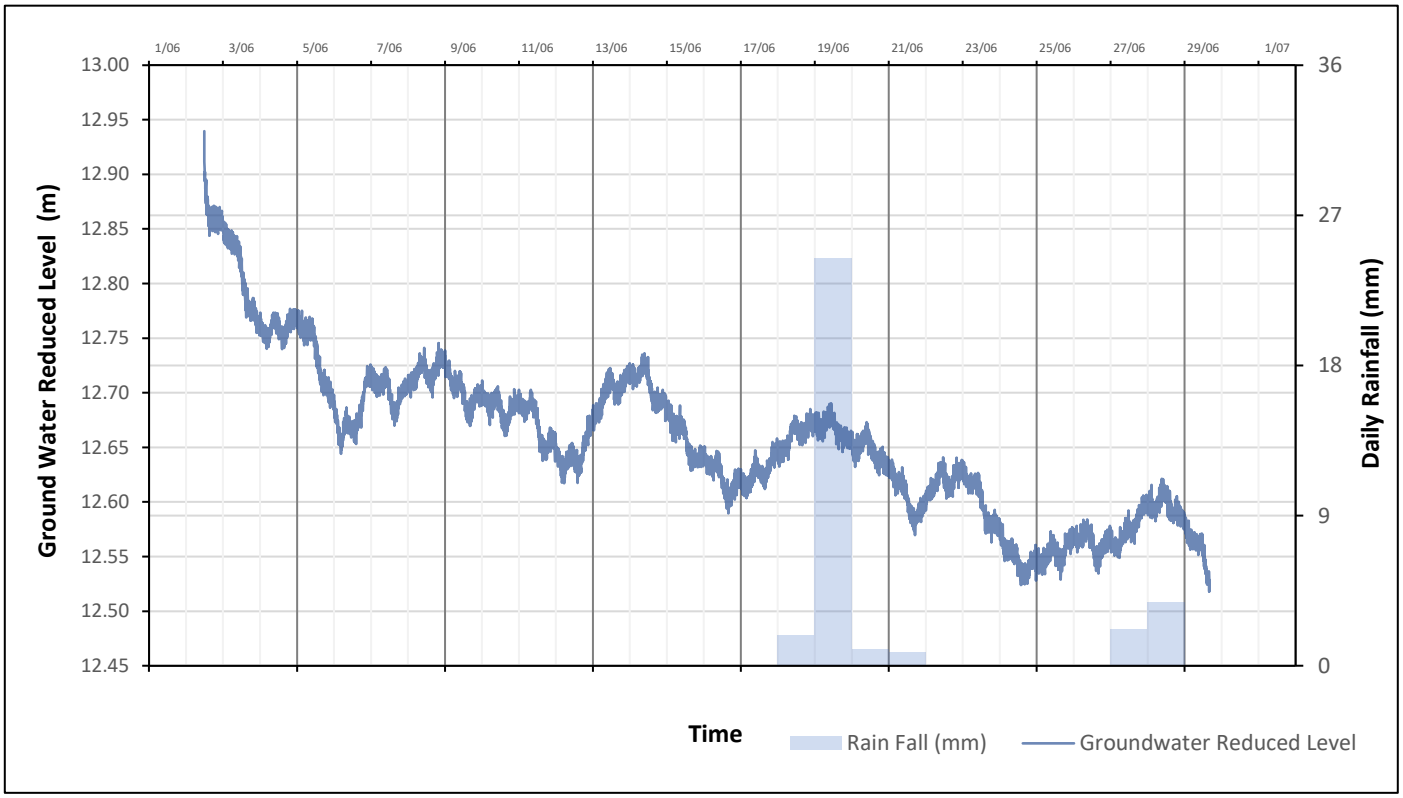
Groundwater Monitoring

Client :	PMC Constructions - John Mouawad	**Location:**	MW4
Project :	638 Pittwater Rd, Brookvale	**Job Number :**	15076
Test Location:	638 Pittwater Rd, Brookvale	**Test Date :**	2/06/2022 to 29/06/2022
Test Method :	-	**Tested By :**	ML

Test	MW4				
Borehole Data	**Unit**	**Value**	**Borehole Data**	**Unit**	**Value**
Initial Ground Water Depth (bgs)	m	2.51	**Solid Casing Length(L)**	m	2.73
Casing Radius (r_c)	m	0.025	**Screened Length (L_e)**	m	3
Borehole Radius (r_w)	m	0.05	**Existing Ground RL**	m	15.4

Well and Logger Details	
Start Time	2/06/2022 11:50





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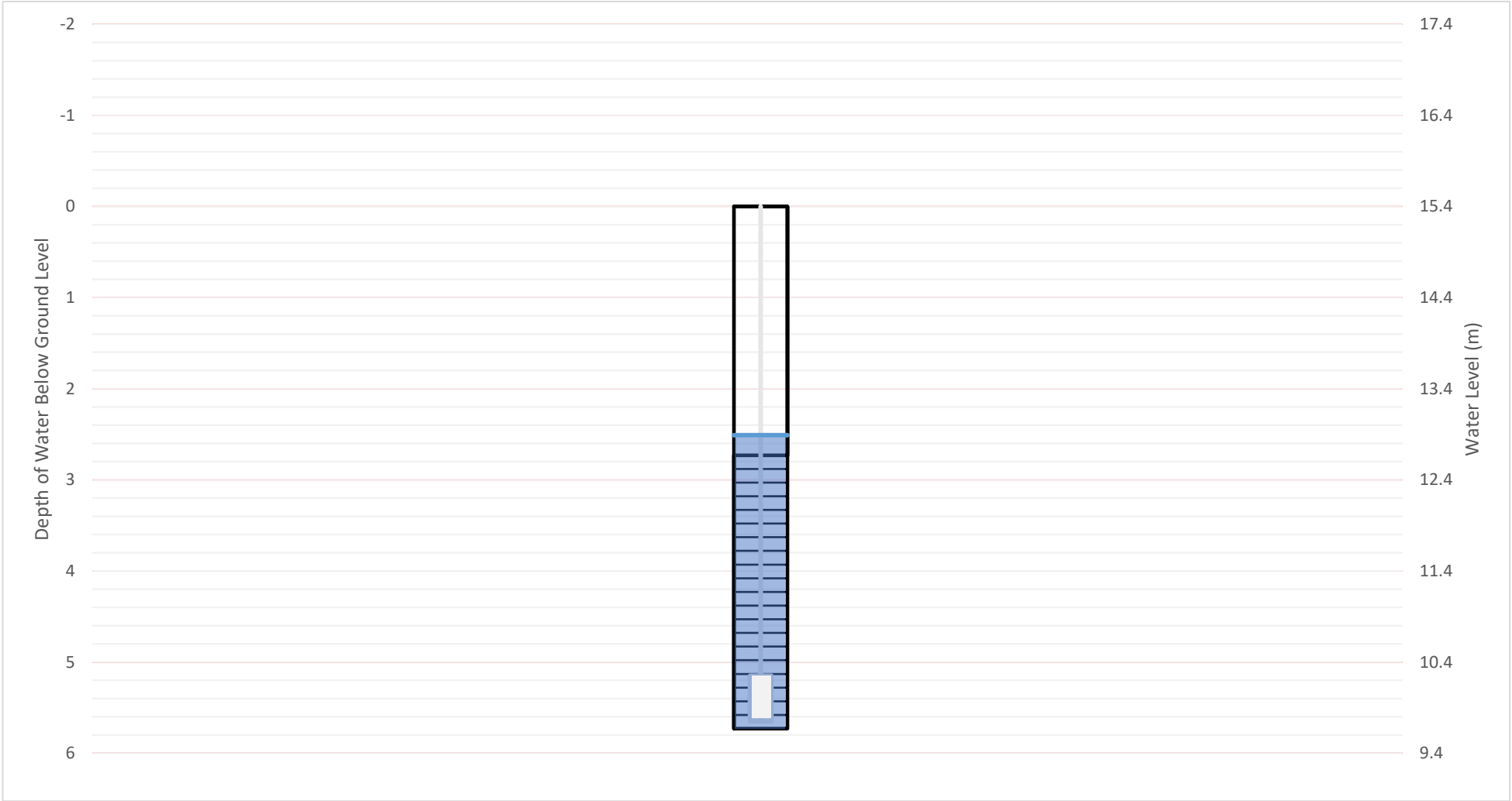
Scaled Well and Logger Details		
Ground RL	m	15.4
Solid Length	m	2.73
Slotted Length	m	3
Logger Install Depth	m	5.65
Initial Water Level	m	2.51



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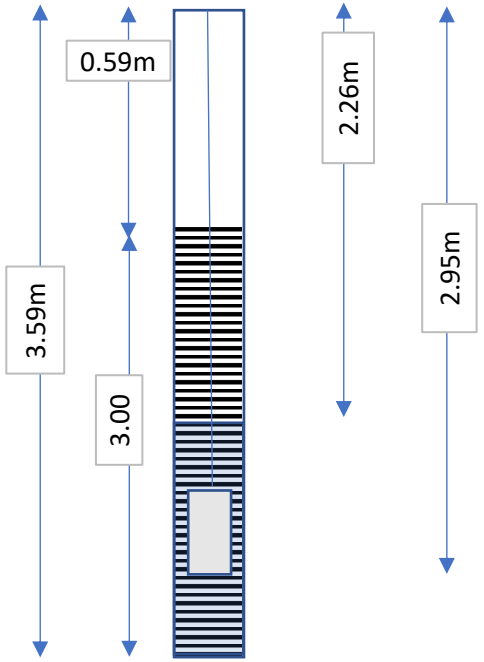
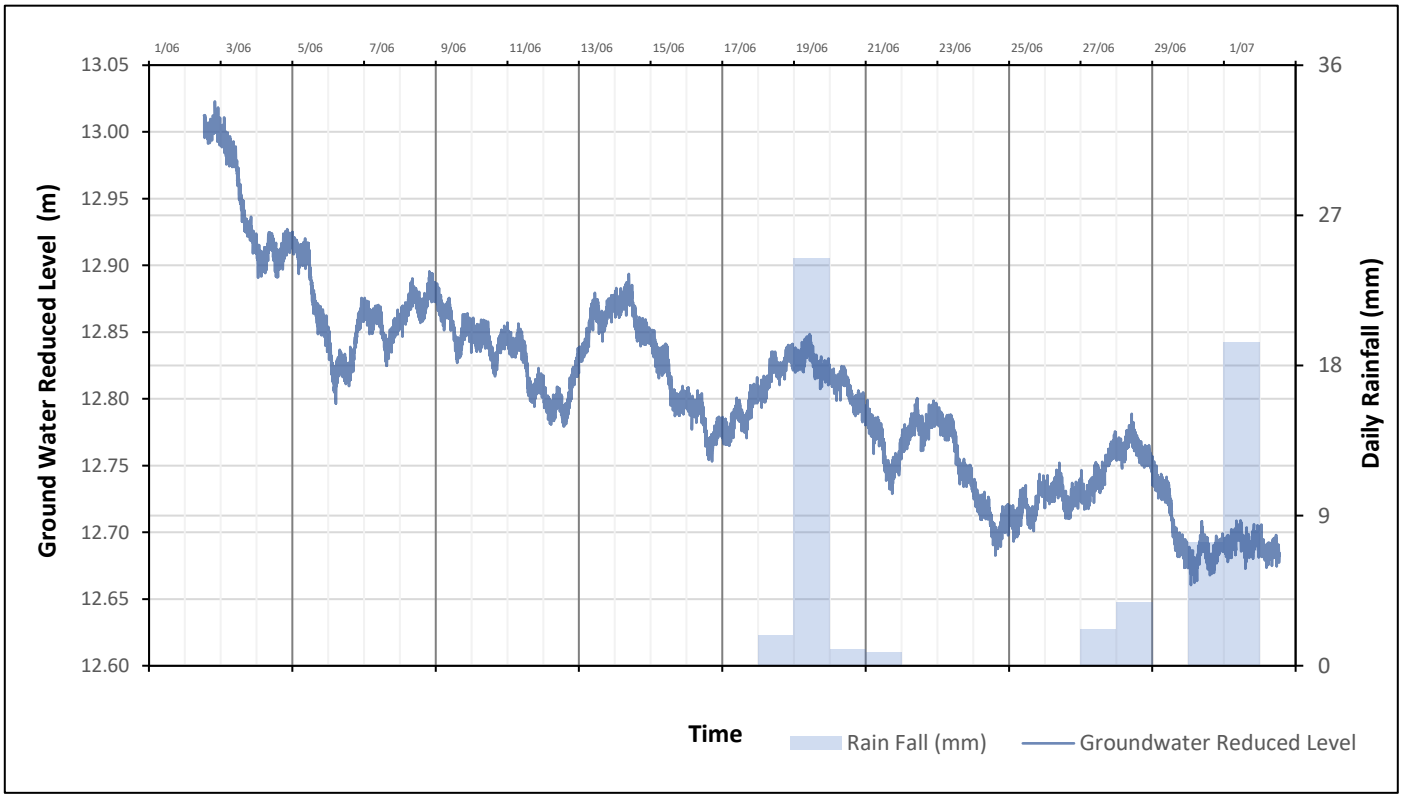
Groundwater Monitoring

Client :	PMC Constructions - John Mouawad	**Location:**	MW5
Project :	638 Pittwater Rd, Brookvale	**Job Number :**	15076
Test Location:	638 Pittwater Rd, Brookvale	**Test Date :**	2/06/2022 to 29/06/2022
Test Method :	-	**Tested By :**	ML

Test	MW5				
Borehole Data	**Unit**	**Value**	**Borehole Data**	**Unit**	**Value**
Initial Ground Water Depth (bgs)	m	2.26	**Solid Casing Length(L)**	m	0.59
Casing Radius (r_c)	m	0.025	**Screened Length (L_e)**	m	3
Borehole Radius (r_w)	m	0.05	**Existing Ground RL**	m	15.2

Well and Logger Details	
Start Time	2/06/2022 12:50





alliance

Scaled Well and Logger Details		
Ground RL	m	15.2
Solid Length	m	0.59
Slotted Length	m	3
Logger Install Depth	m	2.95
Initial Water Level	m	2.26