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REPORT ON GEOTECHNICAL SITE INVESTIGATION

for

PROPOSED NEW RESIDENTIAL DEVELOPMENT

at

No.75-No.77 FOAMCREST AVENUE, NEWPORT,
NSW

Prepared For

Provent Property Group

Project No.: 2020-202
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0	12th November 2020	Original issue
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GEOTECHNICAL REPORT FOR PROPOSED NEW RESIDENTIAL DEVELOPMENT
No.75- No.77 FOAMCREST AVENUE, NEWPORT, NSW

1. INTRODUCTION:

This report details the results of a preliminary and subsequent geotechnical investigation carried out for a proposed residential development at No.75 - No.77 Foamcrest Avenue, Newport, NSW. The investigation was undertaken by Crozier Geotechnical Consultants (CGC) at the request of Provent Property Group.

Following initial investigation for the Development Application (DA) and it's subsequent approval, further geotechnical testing was required to obtain better detail on sub-surface ground conditions, assist with the structural design of the new development, assist with the Special Engineering Assessment (SEA) on an existing Sydney Water (SW) sewer and for Council Submission purposes.

This report includes the results of the initial investigation and the subsequent more detailed geotechnical investigation, geological sections, and provides further recommendations for construction to ensure stability is maintained for a design life of 100 years.

The subsequent investigation and reporting were undertaken as per the Proposal No.: P21-660, Dated: 22nd December 2021.

The subsequent investigation comprised:

a) DBYD plan request and onsite review.
b) Drilling of four boreholes (BH101 to BH104) to 6.45m depth and 9.45m depth, with SPT testing at varying intervals between 1.0m and 1.5m down to 6.0m depth and identification of ground water conditions.
c) Lab analysis of collected samples
d) Full time supervision and logging of drilling by a Geotechnical Engineer

The following plans and drawings were supplied for the work:

- Architectural Drawings – by Richard Cole Architecture Pty Ltd, Project Number: 1612, Date: September 2020 and Drawings: A01 to A20.
- Survey Drawings – by Bee & Lethbridge Quality Surveying & Development Solutions, Ref. No.: 21796, Sheet No.: 1 of 1, Rev. No.: 00 and Date: 03/09/2020

2. PROPOSED DEVELOPMENT:

It is understood that the proposed works involve demolition of two existing dwellings and the construction of a new two storey unit development with a basement carpark. The proposed basement will require an excavation to 4.00m depth to achieve a proposed Basement Level (BL) of R.L.= 5.20m and will gradually reduce to ≤0.50m depth within the south-west corner of the site for a proposed new driveway ramp.

The excavation will extend to the south boundary and within approximately 4.50m of the north boundary, 6.50m of the west boundary and 6.50m of the east boundary.

Based on the available DBYD plans, a sewer main intersects the rear of the site, striking north-south approximately 4.50m from the rear east boundary. The proposed basement excavation is designed to be approximately 1.50m west from the sewer main.

3. SITE FEATURES:

3.1. Description:

The site is a rectangular shaped block located on the low east side of Foamcrest Avenue. The site contained two properties with two separate single storey clad houses, which were located within the centre of each block with front and rear lawns. It has west front and east rear boundaries of 30.48m and north and south side boundaries of 45.72m as referenced from the provided survey plan.

Ground surface levels within the site reduce from a high of approximately RL 8.96m adjacent to the north-west corner of the site to a low of approximately RL 8.10m in the south-east corner of the site.

An aerial photograph of the site and its surrounds is provided below, as sourced from NSW Government Six Map spatial data system, as Photograph-1. A general view of the site at the time of investigation are provided in Photograph-2 to Photograph-6 below.

Photograph-1: Aerial photo of site and surrounds.

Photograph-2: Front of No.77 Foamcrest Avenue. View looking east.

Photograph-3: Rear of No.77 Foamcrest Avenue. View looking west.

Photograph-4: Front of No.75 Foamcrest Avenue. View looking east.

Photograph-5: Rear of No.75 Foamcrest Avenue. View looking west.

Photograph-6: Rear of No.75 Foamcrest Avenue. View looking north.

3.2. Geology:

Reference to the Sydney 1: 100,000 Geological Series sheet (9130) indicates that the site is underlain by Quaternary sands (Qha) which comprise of silty to peaty quartz sand, silt, clay with common shell layers, ferruginous and humic cementation. The Quaternary sands are underlain by weathered bedrock at the boundary of the Newport Formation (Upper Narrabeen Group) rock (Rnn) of middle Triassic Age and the Bald Hill Claystone (Rnbh) of early Triassic Age. The Newport Formation typically comprises inter-bedded laminite, shale and quartz to lithic quartz sandstones and pink clay pellet sandstones and has a tendency to weather to significant depth, whilst the Bald Hill Claystone comprises dominantly red shale and fine to medium sandstone.

4. FIELD WORK:

4.1. Methods:

The initial field investigation comprised a walk over inspection and mapping of the site and adjacent properties on the 15th October 2020 by a Geotechnical Engineer. It included a photographic record of site conditions as well as geological/geomorphological mapping of the site and adjacent land with examination of existing structures. It also included the drilling of two auger boreholes (BH1 and BH2) using a restricted access drill rig employing solid stem, spiral flight augers and a tungsten carbide bit and two auger boreholes (BH3 and BH4) using hand tools at the rear of the properties, due to limited access, to investigate sub-surface geology.

Dynamic Cone Penetrometer (DCP) testing was carried out from ground surface adjacent to the boreholes and through the base of the boreholes when they had progressed in accordance with AS1289.6.3.2 – 1997, "Determination of the penetration resistance of a soil – 9kg Dynamic Cone Penetrometer test" to estimate near surface soil conditions.

Strata identification was undertaken on material recovered from the boreholes with samples collected as per "AS1726: 2017 Geotechnical Site Investigation" for logging purposes.

The subsequent investigation included the drilling of four boreholes (BH101 to BH104) at similar locations as the previous four boreholes on the 17th January 2022 by a geotechnical engineer. The boreholes were undertaken using a CE180 restricted access geotechnical drilling rig utilising a solid stem, spiral flight auger drilling techniques following demolition of the previous residential structures.

SPT testing as per AS 1289, Methods of Testing Soils for Engineering Purposes – Test 6.3.1.

Lab samples sent for analysis at NATA accredited Geotechnical laboratory and the results are attached to this report.

Explanatory notes are included in Appendix: 1. Mapping information and test locations are shown on Figure: 1, along with detailed bore log and DCP sheets in Appendix: 2. A geological model/section is provided as Figure: 2 and Figure: 3, Appendix 2.

4.2. Field Observations (prior to demolition):

The site is located on the low east side of Foamcrest Avenue within gently east dipping topography. Foamcrest Avenue is formed with a gently south dipping bitumen pavement where it passess the site, with low concrete gutter and kerbs, a concrete pathway, grass lawn and two trees (up to ≤ 10.0m height). The road pavement and road reserve appeared in good condition, there were no signs of significant undulations, deformations or underlying geotechnical issues.

Photograph-7: Foamcrest Avenue road reserve. View looking south.

No. 77 Foamcrest Avenue, contains a concrete driveway at the south-west corner of the block with a grass lawn to the north, subdivided by an east-west striking concrete entry pathway. The block contains a single storey clad cottage with a timber verandah at the north-east corner of the dwelling, founded on brick footings above Ground Surface Level (GSL) with an attached garage to the south. Access to the rear of the block is achieved through the dwelling and via a narrow pathway along the north boundary. The rear of the block contains a grass lawn that extends approximately 8.0m east from the dwelling and is bounded by a timber paling fence along the eastern, northern and southern sides. The dwelling, driveway, front and rear lawns appeared in good condition, signs of excessive cracking, deformation or underlying geotechnical issues were not observed within the structures.

No. 75 Foamcrest Avenue, contains a single clad house that broadly occupies the centre of the block and contains a timber deck within the north-east corner of the dwelling. Access to the rear of the block is achieved through the dwelling and via narrow pathways to the north and south of the dwelling. The rear of the block contains a grass lawn that extends approximately 14.0m east and extends north to the rear of No. 77 Foamcrest Avenue. The rear lawn is bounded by paling fences along the eastern, northern and southern sides and contains small to large trees within the eastern end of the block (up to 16.0m height). The dwelling, front driveway, front and rear lawns appeared in good condition, deformation or underlying geotechnical issues were not observed within the structures.

The neighbouring property to the north (No.79-83 Foamcrest Avenue) contains two separated two storey rendered unit buildings (within the west and east side of the property) that extend south to within approximately 4.50m to 7.00m from the common boundary at similar GSL to the site. The south-west corner of the property contains a concrete driveway ramp (Photograph-8), that leads down east to a basement carpark at a level approximately 3.0m below the site's GSL. The neighbouring dwellings, driveway and observed structures appeared in good condition, significant deformation or cracking or underlying geotechnical issues were not observed within the neighbouring property.

Photograph-8: No.79-No.83 Foamcrest's front driveway, directly to the north of the site. View looking east.

The neighbouring property to the south (No.73 Foamcrest Avenue) contains a single storey clad house with a detached fibro shed to the north east, front and rear grass lawns with a front strip driveway (Photograph-9) at the north-west corner of the property. The fibro shed is adjacent to the common boundary, whilst the dwelling extends north to approximately 2.50m from the common boundary. The front driveway and fibro shed, and rear grass lawn contain a similar GSL to the site. The property dwelling appeared in a relatively old condition, however significant deformation, cracking or underlying geotechnical issues were not observed within the neighbouring property.

Photograph-9: No.73 front driveway, directly to the south of the site. View looking east.

The neighbouring property to the east (No.405 Barrenjoey Rd.) contains a four storey brick residential unit building that broadly occupies the centre of the block and extends west to approximately 6.50m to 16.0m from the common boundary within the site. The neighbouring block contains a grass lawn at the front east with two concrete driveways (accessible from Barrenjoey Road) that continue west along the northern and southern boundaries of the property and then along the rear of the building. The rear of the building also contains a grass lawn with a clothes drying area directly adjacent to the site. The building and concrete driveways appeared in good condition, significant deformation, cracking or underlying geotechnical issues were not observed within this property.

The neighbouring buildings and properties were only inspected from within the site or from the road reserve however the visible aspects did not show any significant signs of instability or other major geotechnical concerns which would impact the site or the proposed development.

4.3. Field Testing:

The initial boreholes (BH1 to BH4) were drilled approximately at the corners of the proposed basement. BH1 and BH2 were discontinued on a hard ironstone band/ extremely weathered sandstone/ siltstone bedrock (BH1) and sandy clay (BH2) at 3.40m depth and 5.00m depth, respectively. Hand auger refusal was encountered within BH4 and BH3 in silty/ sandy clay at varying depths between 0.90m and 1.20m, respectively. Dynamic Cone Penetrometer (DCP) tests were carried out from ground surface and through the boreholes to refusal.

The subsequent investigation boreholes (BH101 to BH104) were drilled in the same locations to the previously drilled boreholes but deeper to varying depths between 9.0m (BH102) and 6.45m (BH101 and BH103) with SPT testing at approximately 1.50m depth intervals. The new boreholes test results were combined with the results obtained from the boreholes drilled in the initial investigation and a summary of the subsurface ground conditions is given below.

Based on the field borehole logs and DCP test results the subsurface conditions at the project site can be classified as follows:

- **TOPSOIL/FILL –** this layer was encountered in all boreholes to a maximum depth of 0.50m below the existing ground surface. It comprised loose dark grey fine to medium grained moist silty sand with some roots.
- **SILTY SAND** – this layer was encountered below the topsoil within all test locations to varying depths between 0.70m (RL 7.90m) and 1.40m (RL 6.95m). This was classified as medium dense, grey, fine to medium grained, moist and moist/wet within BH103 at 1.40m depth.
- **SANDY CLAY** – this layer was encountered below the silty sand unit to greater depths within the north-eastern (BH101, 6.45m depth, RL 2.15m) and north-western side (BH104, 6.00m

depth, RL 2.85m) of the site. This unit was present to shallower depths within the south-eastern (BH102, 4.40m depth, RL 3.95m) and south-western (BH103, 2.10m, RL 6.25m depth). This unit was classified as firm to very stiff, orange brown mottled grey/ grey mottled orange brown, low to medium plasticity, moist and sandy clay.

- **CLAYEY SAND** – this unit was encountered within BH102 to BH104. It was encountered below a shallow depth within the south-eastern (3.15m, RL 5.20m, BH102) and south-western (2.10m, RL 6.25m, BH103) of the site and also present at deeper depths below 6.00m (RL 2.85m, BH104) and 6.50m (RL 1.85m, BH102) to the maximum drilled depth of 9.0m. It was classified as grey/yellow orange, loose to medium dense, fine to medium grained, moist and moist/wet below 4.40m (RL 3.95m, BH102) and 6.60m (RL 2.85m, BH104), clayey sand.

Seepage was encountered within the clayey sand unit below varying depths between 4.40m (RL 3.95m, BH102) and 6.0m (RL 2.85m, BH104).

5. COMMENTS:

5.1. Geotechnical Assessment:

The initial investigation identified potential bedrock in the north western corner of the block. However, the subsequent investigation determined that previous auger refusal was likely upon ironstone band with bedrock not encountered. The geotechnical investigations identified topsoil/fill identified to a maximum depth of 0.50m (RL 7.85m) underlaid by a silty sand layer down to a maximum depth of 1.40m (RL 7.45m). The silty sand layer is underlaid by sandy clay which is present to greater depths within the north-eastern (6.45m depth, RL 2.15m) and north-western (6.00m depth, RL 2.85m) corners of the site and becomes thinner (less clay dominant) to a higher level towards the south. Below the sandy clay unit, a clayey sand/low plasticity sandy clay unit is present from 2.10m depth RL 6.25m (BH103) within the southern portion of the site and extends (is more dominant) from 6.0m depth to at least 9.0m depth (RL -0.65m). The presence of bedrock was not encountered within the site. Noticeable seepage was encountered below a depth of 4.40m depth (RL 3.95m) in parts of the site, however a free standing groundwater table does not appear to exist within the depth of investigation.

The proposed basement level will require an excavation down to a maximum of 4.00m depth to achieve a FFL of R.L. 5.20m and will extend to the separation distances of adjacent boundaries and structures as summarised in Section 5.3.2. It is anticipated that the majority of the bulk excavation at the site will extend through silty sand/sandy clay/clayey sand and should be achievable using standard hydraulic plant and no bedrock excavation will be required. As a result, ground vibrations due to the site excavation are expected to be low, hence full-time ground vibration monitoring will not be required.

Basement Excavation

The eastern portion of the basement excavation will likely expose stiff sandy clay within the north-east corner and clayey sand within the south-east corner. The western portion of the basement excavation will likely expose stiff sandy clay within the north-west corner and clayey sand within the south-west corner. Due to the percentage of sand in these soils, they are considered slightly reactive, with little to no ground movement from moisture changes expected. The excavation might intersect through minor seepage particularly within the clayey sand layer; however, the basement excavation is not expected to intersect the free-standing groundwater table, therefore significant dewatering is not anticipated pending prevention of stormwater inflow. The ponding groundwater may impact the stability of the overlying material, therefore it must be removed and prevented from ponding adjacent to excavation support systems or batter slopes.

The soil exposed at the Basement Excavation Level (BEL) was classified as stiff and medium dense and therefore offer an allowable bearing capacity of 200kPa for shallow footings, provided it is not disturbed and is maintained dry during excavation.

Below the BEL, a summary of the ground conditions is summarized below (For detail description, please refer to the borehole log sheets).

Eastern Portion

BH102	**Density/ Consistency**	**From Depth (m)/ RL (m)**	**To Depth (m)/ RL (m)**
Clayey SAND	Medium Dense	3.15m depth/ RL 5.20m	5.00m depth/ RL 3.350m
Constant seepage at 4.40m depth / RL 3.95m			
Clayey SAND	Loose	5.00m depth/ RL 3.350m	6.00m depth/ RL 2.35m
Clayey SAND	Medium Dense	6.00m depth/ RL 2.35m	9.00m depth/ RL -0.65m
BH101	**Density/ Consistency**	**From Depth (m)/ RL (m)**	**To Depth (m)/ RL (m)**
Sandy CLAY	Very Stiff	3.00m depth/ RL 5.60m	4.50m depth/ RL 4.10m
Sandy CLAY	Stiff	4.50m depth/ RL 4.10m	6.00m depth/ RL 2.60m
Sandy CLAY	Very Stiff	6.00m depth/ RL 2.60m	6.45m depth/ RL 2.15m
No seepage identified			

Western Portion

BH103	**Density/ Consistency**	**From Depth (m)/ RL (m)**	**To Depth (m)/ RL (m)**
Clayey SAND	Medium Dense	2.10m depth/ RL 6.25m	6.45m depth/ RL 1.90m
Constant seepage at 5.00m depth / RL 3.35m			
BH104	**Density/ Consistency**	**From Depth (m)/ RL (m)**	**To Depth (m)/ RL (m)**
Sandy CLAY	Stiff	2.40m depth/ RL 6.45m	5.00m depth/ RL 3.85m
Sandy CLAY	Very Stiff	5.00m depth/ RL 3.85m	6.00m depth/ RL 2.85m
Constant seepage at 6.00m depth / RL 2.85m			
Clayey SAND	Loose	6.00m depth/ RL 2.85m	8.50m depth/ RL 0.35m
Clayey SAND	SPT Testing skipped until below 8.5m depth (RL 0.35m)		
Clayey SAND	Medium dense	8.50m depth/ RL 0.35m	8.95m depth/ RL -0.10m

The SPT test results indicate a loose band of sand was encountered from around 5.0m depth (RL 3.35m) to 6.0m depth (RL 2.35m), becoming medium dense below 6.0m depth (RL 2.35m). It is recommended that where piles are proposed, these be extended to below 6.0m depth (which is approximately 3.0m below the proposed basement level).

Based on the proposed basement excavation and the safe temporary batter slopes as per Section 5.3.2, the excavation of safe batters appears achievable in most parts of the excavation with respect to property boundaries except along the southern and eastern sides of the excavation. However, where high batters (≥3.0m) are proposed, seepage inflow or ponding must not occur adjacent in any situation whilst surcharge loads must be considered. Therefore, they at not recommended. Therefore, the construction of support prior to excavation will be required along the southern and eastern sides of the excavation and is recommended along the northern side of the excavation. Where chosen, geotechnical inspection of temporary batters is required and the potential need to install support systems to battering where adverse conditions are encountered should be allowed for in project planning and costing.

Based on SW Building Over Adjacent (BOA) the excavation influence zone of 1.0V:1.0H includes the existing sewer pipe. Therefore, it is anticipated that a Specialist Engineering Assessment (SEA) will be required by SW as part of approvals.

Where support prior to bulk excavation is required, driven piles, sheet piles or methodologies likely to generate significant vibrations to the adjacent structures are not recommended. Due to sandy soils encountered, the construction of a contiguous pile wall would be a viable option. The proposed pile wall

should be designed to limit any lateral deflection as a result of the lateral pressures to protect the underlying SW sewer pipe, however separation distances to other boundaries reduces the deflection stringency. The pile wall will require lateral support by internal bracing or propping to limit deflection due to the proximation of the sewer and its construction style unless it can be replaced or supported independently. All retaining structures must be constructed as per *Earth-retaining structures AS 4678-2002* and as per Section 5.3.3 of this report.

The clayey sandy layer expected to be exposed across the excavation base may not remain stable during construction due to seepage and during wet weathered. This should be considered with respect to maintain open shallow footing excavations. Also, where the pile footings are required to extend to depths below the interpreted seepage (which will impact the ability to maintain open bored piles or clean base) methodologies such as CFA will be required due to the sandy soils and seepage encountered.

The soils exposed within the base of the excavation are likely to comprise predominantly sandy soils. The soils will be difficult to traffic for site machinery in wet conditions and a free draining coarse granular layer (recycled concrete for example) is recommended to assist site movements. The required layer thickness will depend on the type of plant proposed to traffic the site and should be determined on a case-by-case basis. However, a layer thickness of not less than 0.2m to 0.3m is anticipated for 'light' equipment.

The trafficability layer thickness required for 'heavy' construction plant such as piling rigs, large excavators and mobile cranes must be confirmed on a plant-by-plant basis.

The site is also classified as being within an Acid Sulphate Soils (ASS) Class 4 Zone, however, due to the ground conditions encountered in the site investigations, indicators of ASS were not encountered in the investigation, whilst water table won't be encountered or lowered. Therefore, an ASS Management Plan (ASSMP) is not considered necessary.

The proposed works are considered suitable for the site and may be completed with negligible impact to existing, nearby structures within the site or neighbouring properties provided the recommendations of this report are implemented in the design and construction phases.

The recommendations and conclusions in this report are based on an investigation utilising only surface observations and isolated boreholes from hand tools and a restricted access drill rig. This test equipment provides limited data from small isolated test points across the entire site, therefore some minor variation to the interpreted sub-surface conditions is possible, especially between test locations. However, the results of the investigation provide a reasonable basis for the Development Application analysis and subsequent design of the proposed works.

5.2. Site Specific Risk Assessment:

Based on our site investigation we have identified the following geological/geotechnical landslip hazard which needs to be considered in relation to the existing site and the proposed works. The hazard is:

A. Landslip of soils from basement excavation (<10m³).

A qualitative assessment of risk to life and property related to these hazards is presented in Tables A and B, Appendix: 3, and is based on methods outlined in Appendix: C of the Australian Geomechanics Society (AGS) Guidelines for Landslide Risk Management 2007. AGS terms and their descriptions are provided in Appendix: 4.

The **Risk to Life** from **Hazard A** was estimated to be up to **1.25×10^{-6}** for a single person, whilst the **Risk to Property** was considered to be **'Moderate'** in all situations.

Although the 'Moderate' Risk to Property for Hazard A is considered to be 'Unacceptable', the assessments were based on excavations with no support or planning. Provided the recommendations of this report are implemented including installation of retaining wall prior to bulk excavation the likelihood of any failure becomes 'Rare' and as such the consequences reduce and risk becomes within 'Acceptable' levels when assessed against the criteria of the AGS. As such the project is considered suitable for the site provided the recommendations of this report are implemented.

5.3. Design & Construction Recommendations:

Design and the construction recommendations are tabulated below:

5.3.1. New Footings:	
Site Classification as per AS2870 – 2011 for new footing design	Class 'S' due to the slightly reactive clay site
Type of Footing	Strip/Pad or Slab at base of excavation or piers/piles
Sub-grade material and Maximum Allowable Bearing Capacity for shallow footings	- Stiff Silty CLAY: 100kPa - Very Stiff Silty CLAY: 200kPa - Loose Clayey SAND: 100kPa - Medium dense Clayey SAND: 200kPa - Dense Clayey SAND: 250kPa - Bedrock (Very Low Strength): 800kPa *
Site sub-soil classification as per *Structural design actions AS1170.4 – 2007, Part 4: Earthquake actions in Australia*	C_e – Shallow soil site

Sub-grade material and Maximum Ultimate End Bearing Capacity for a deep footings:

Using Decourt, L (1995) correlation between SPT values and pile ultimate base capacity an Allowable and Ultimate bearing capacity are provided:

R.L. (m)	Soil Depth below BEL	Density	Allowable Bearing Capacity (kPa)	Ultimate Bearing Capacity (kPa)
2.0	3.0m depth	MD	600	1800

Remarks:

*Requires confirmation via core drilling investigation below 9.0m depth

All footings should be founded off material of similar strength unless the structure can accommodate potentially high differential settlements.

All new footings must be inspected by an experienced geotechnical professional before concrete or steel are placed to verify their bearing capacity and the in-situ nature of the founding strata. This is mandatory to allow them to be 'certified' at the end of the project.

5.3.2. Excavation:

Property Separation

The tables below show the properties potentially affected by the proposed excavation and the separation distances to the shared property boundary and structure.

Carpark Excavation

Table 1: Property Separation Distances

Boundary	Adjacent Property	Structure	Bulk Excavation Depth (m bgl)	Separation Distances (m)	
				Boundary (m)	Structure
North	No.79 to No.83 Foamcrest Ave.	Driveway, terrace & pathway, and dwellings	3.60 to 4.0	4.50	-Adjacent to the boundary are the driveway, terrace, and patio. -Building a further 4.50m.
South	No.73 Foamcrest Ave	Strip driveway, shed & grass lawn and dwelling	0.0 to 3.50	0	-Adjacent to the driveway, shed and rear grass lawn. -House, a further 2.50m.
East	No.405 Barrenjoey Rd.	Grass lawn and clothes and drying area	3.30 to 3.60	6.50	-Adjacent to the building are the grass lawn and clothes and drying area. -Building, a further 6.50m.
	Sewer Main approximately 1.50m east from the basement excavation				
West	Foamcrest Ave. (Road Reserve)	Pathway and road pavement	3.60 to 4.00	6.50	- Pathway and road pavement a further >4.0m

<table>
<tr><td>Type of Material to be Excavated</td><td>Fill ≤ 0.85m depth (BH1).
Silty Sand, Low Plasticity Sand Clay/Clayey Sand down to the base of the basement excavation.</td></tr>
<tr><td colspan="2">Guidelines for unsurcharged batter slopes for this site are tabulated below:
<table>
<tr><th rowspan="2">Material</th><th colspan="2">Safe Batter Slope (H:V)</th></tr>
<tr><th>Short Term/ Temporary</th><th>Long Term/ Permanent</th></tr>
<tr><td>Fill/ Sand</td><td>1.5:1</td><td>2:1</td></tr>
<tr><td>Very stiff sandy clay/ clayey sand</td><td>1:1*</td><td>1.5:1*</td></tr>
</table>
*Dependent on seepage and assessment by engineering geologist
Ponding of groundwater/stormwater must not be allowed to occur at crest or base of batter slopes.</td></tr>
<tr><td colspan="2">Remarks:
Seepage along defects in the soil can also reduce the stability of batter slopes and invoke the need to implement additional support measures. Where safe batter slopes are not implemented the stability of the excavation cannot be guaranteed until the installation of permanent support measures. This should also be considered with respect to safe working conditions.</td></tr>
<tr><td>Equipment for Excavation</td><td>Topsoil/Sandy Clay/Clayey Sand</td><td>Excavator with bucket</td></tr>
<tr><td>Recommended Vibration Limits (Maximum Peak Particle Velocity (PPV))</td><td colspan="2">-Not considered critical
- Residential structures 5mm/s on nearby properties.
- Maximum PPV for intermittent vibrations 10mm/s; Maximum PPV for continuous vibrations 5mm/s.</td></tr>
<tr><td>Full time vibration Monitoring Required</td><td colspan="2">Pending proposed equipment or works proposed onsite.
and vibration calibration testing results</td></tr>
<tr><td>Geotechnical Inspection Requirement during construction</td><td colspan="2">Yes, recommended that these inspections be undertaken as per below mentioned sequence:
During construction of the retaining/support structures, prior to bulk excavation.
For assessment of batter slopes.
At 2.0m depth interval
At completion of excavation
Where unexpected ground conditions are encountered
Prior to the construction of footings for assessment of bearing.</td></tr>
<tr><td>Dilapidation Surveys Requirement</td><td colspan="2">Survey of structures with 10.0m of proposed excavation will reduce the potential for spurious claims of damage.
<u>Note:</u> CGC have the experience in performing Dilapidation Surveys</td></tr>
</table>

5.3.3. Retaining Structures:

Required	All sides of the basement excavation will require support.
Types	- The southern and eastern sides of the basement excavation will require contiguous pile/support wall prior to and/or during bulk excavation. - The northern side of the basement excavation is recommended to construct a soldier pile wall with 0.5m spacing between the external sides of each pile or that support is implemented incrementally (i.e. 1.50m depth intervals) during excavation. This spacing is recommended where some failure/settlement of soils to ≤1.0m distance from rear of the wall can be accepted. Even though safe batters are achievable, it is still recommended to construct a soldier pile due to the depth of excavation being ≥3.0m depth. - Construction of steel reinforced concrete/concrete block wall where safe temporary batters can be formed. Designed in accordance with Australian Standard AS 4678-2002 Earth Retaining Structures

Parameters for calculating pressures acting on retaining walls for the materials likely to be retained:

Table 2: Material Strength Properties

Material	Strength	Undrained Analysis		Drained Analysis*	
		Cohesion (c_u) (kPa)	Friction (φ_u) Degrees	Cohesion (c') (kPa)	Friction (φ') Degrees
Sandy Clay	stiff	50	0	5	26
	very stiff	100			
	hard	200			
Clayey Sand	Loose	-	25	0	28
	Medium Dense	-	27	0	32
	Dense	-	32	0	34

Table 3: Material Strength Properties-Trapezoidal Pressure Distribution

Material	Strength	Unit Weight (kN/m^3)	Earth Pressure Coefficients		Passive Earth Coefficients /Lateral Pressures
			Active (Ka)	At rest (Ko)	
Sandy Clay	Stiff	20	0.42	0.59	3.25
	Very Stiff	20			
	Hard	20			
Clayey Sand	Loose	19	0.35	0.52	
	Medium Dense	20			
	Dense	20			

Table 4: Material Stiffness Properties

Material	Strength	Young's Modulus E – Mpa[1]
Sandy Clay	Stiff	30
	Very Stiff	
	Hard	40
Clayey Sand	Loose	18
	Medium Dense	25
	Dense	30

Any (building/construction etc.) surcharge loads/pressures must be added to the above distribution

Remarks:

In suggesting these parameters, it is assumed that the retaining walls will be fully drained with suitable subsoil drains provided at the rear of the wall footings. If this is not done, then the walls should be designed to support full hydrostatic pressure in addition to pressures due to the soil backfill. It is suggested that the retaining walls should be back filled with free-draining granular material (preferably not recycled concrete) which is only lightly compacted in order to minimize horizontal stresses.

Retaining structures near site boundaries or existing structures should be designed with the use of at rest (K_0) earth pressure coefficients to reduce the risk of movement in the excavation support and resulting surface movement in adjoining areas. Backfilled/ retaining walls within the site, away from site boundaries or existing structures, that may deflect can utilize active earth pressure coefficients (Ka).

5.3.4. Drainage and Hydrogeology		
Groundwater Table or Seepage identified in Investigation		Seepage encountered at varying depths between 4.40m (RL 3.95m, BH102) and 6.0m (RL 2.85m, BH104).
Excavation likely to intersect	Water Table	No
	Seepage	Significant (<5L/min) below the levels as specified in the borehole logs
Site Location and Topography		Low east side of road, within gently east dipping topography
Impact of development on local hydrogeology		Negligible
Onsite Stormwater Disposal		Subject to Hydraulic Engineer's design, clay soils have very low permeability, therefore only possible via dispersion.
Depth to rock		Not encountered to a maximum depth of 9.0m.
Minimum distance of stormwater system from down slope boundaries		≥ 5.00m to allow maximum transpiration within property boundaries

Remarks:
As the excavation faces are expected to encounter some seepage, an excavation trench should be installed at the base of excavation cuts to below floor slab levels to reduce the risk of resulting dampness issues. Trenches, as well as all new building gutters, down pipes and stormwater intercept trenches should be connected to a stormwater system designed by a Hydraulic Engineer which preferably discharges to the Council's stormwater system off site.

5.4. Conditions Relating to Design and Construction Monitoring:

To comply with Councils conditions and to enable us to complete Forms: 2b and 3 required as part of construction, building and post-construction certificate requirements of the Councils Geotechnical Risk Management Policy 2009, it will be necessary for Crozier Geotechnical Consultants to:

1. Review the structural design drawings for compliance with the recommendations of this report prior to construction,
2. Inspection of site and works as per Section 5.3 of this report
3. Inspect all new footings and earthworks to confirm compliance to design assumptions with respect to allowable bearing pressure, basal cleanness and the stability prior to the placement of steel or concrete,
4. Inspect completed works to ensure construction activity has not created any new hazards and that all retention and stormwater control systems are completed.

The client and builder should make themselves familiar with the Councils Geotechnical Policy and the requirements spelled out in this report for inspections during the construction phase. Crozier Geotechnical Consultants cannot sign Form: 3 of the Policy if it has not been called to site to undertake the required inspections.

5.5. Design Life of Structure:

We have interpreted the design life requirements specified within Council's Risk Management Policy to refer to structural elements designed to support the existing structures, control stormwater and maintain the risk of instability within acceptable limits. Specific structures and features that may affect the maintenance and stability of the site in relation to the proposed and existing development are considered to comprise:

- stormwater and subsoil drainage systems,
- retaining walls and instability,
- maintenance of trees/vegetation on this and adjacent properties.

Man-made features should be designed and maintained for a design life consistent with surrounding structures (as per AS2870 – 2011 (100 years)). It will be necessary for the structural and geotechnical engineers to incorporate appropriate design and inspection procedures during the construction period. Additionally, the property owner should adopt and implement a maintenance and inspection program.

If this maintenance and inspection schedule are not maintained the design life of the property cannot be attained. A recommended program is given in Table: C in Appendix: 3 and should also include the following guidelines.

- The conditions on the block don't change from those present at the time this report was prepared, except for the changes due to this development.
- There is no change to the property due to an extraordinary event external to this site
- The property is maintained in good order and in accordance with the guidelines set out in;
  a) CSIRO sheet BTF 18
  b) Australian Geomechanics "Landslide Risk Management" Volume 42, March 2007.
  c) AS 2870 – 2011, Australian Standard for Residential Slabs and Footings

Where changes to site conditions are identified during the maintenance and inspection program, reference should be made to relevant professionals (e.g. structural engineer, geotechnical engineer or Council). Where the property owner has any lack of understanding or concerns about the implementation of any component of the maintenance and inspection program the relevant engineer should be contacted for advice or to complete the component. It is assumed that Council will control development on neighbouring properties, carry out regular inspections and maintenance of the road verge, stormwater systems and large trees on public land adjacent to the site so as to ensure that stability conditions do not deteriorate with potential increase in risk level to the site. Also, individual Government Departments will maintain public utilities in the form of power lines, water and sewer mains to ensure they don't leak and increase either the local groundwater level or landslide potential.

6. MONITORING PROGRAM:

6.1 Settlement and Deflection:

Provided an adequately engineer designed retention system is constructed prior to bulk excavation of the soils underlying the site it is considered that movements outside the excavation perimeter are likely to be negligible. The wall design should be undertaken by an experienced structural engineering practitioner to ensure assessment and minimization of the likely support wall deflections as a result of the proposed excavation.

To ensure actual wall movements are within anticipated design tolerances, an accurate survey monitoring program of the excavation boundary should be put in place for the duration of the excavation and construction works. This system should include survey points installed at the following locations and time frames:

- on surface structures within 7m of the excavation perimeter prior to any works on site. This should include surface points above or at the sewer assets.
- on several points of the excavation support walls capping beam, including mid-points prior to any bulk excavation/earthworks
- at mid-depth of excavation support wall directly following excavation to mid-level

These measurements should be completed/undertaken by a registered surveyor to ≤2mm accuracy and will be used in comparison with the anticipated wall deflection to allow early detection of movement should latent, unforeseen ground conditions be encountered. Deflection measurements may be analyzed via FEA methods to allow accurate assessment of wall and soil deformation levels for more accurate comparison against survey results. However, as the sewer asset is only intersected by the excavation influence zone in a small section of the site this detailed analysis is not considered critical.

Measurements of all previously installed points should be undertaken prior to bulk excavation, when excavation has achieved mid-depth, at completion of excavation, and at two week intervals until 1 month after permanent support of the excavation support wall by the new development has occurred.

As part of the pile support wall construction, geotechnical supervision should be undertaken during drilling of the piles to allow assessment of contractor's methodologies and quality control with respect to suitable equipment and procedures to reduce potential for over-excavation of soils or vertical deflection of piles.

It should be noted however that inspection of CFA pile drilling is 'blind' in that conditions at the base of the pile can not be confirmed during drilling, therefore where the foundation conditions for bearing pressure need confirmation then this must occur through further geotechnical investigation drilling prior to construction.

6.2 Ground Vibrations:

Driven excavation support methods are not suitable for this site due to the potential for high vibration levels from these types of support which is likely to result in compaction of very loose sandy soils and subsequent settlement of shallow footings or services in adjacent areas. Bulk excavation for the development is not anticipated to intersect bedrock therefore vibration generating equipment is not anticipated on this site.

6.3 Ground Water:

Groundwater lowering does not appear to be a hazard from the development, based on identified groundwater measurements. Provided a contiguous support wall and limited dewatering is required then impacts to the sewer assets due to the development (with respect to groundwater) are not anticipated.

7. CONTINGENCY PLAN:

7.1 Settlement and Deflection

Survey measurements of settlement and deflection should be assessed immediately by the site foreman and referred to the geotechnical engineer and structural engineer for assessment against the original measured values and the engineers expected wall deflection values.

Where variation to these expected values is encountered then excavation should immediately cease adjacent to the western end of the site. Additional support systems will then be devised/designed and will need to be implemented prior to restart or further excavation.

8. CONCLUSION:

The site investigation identified the presence of sandy topsoil to a maximum depth of 0.80m, underlaid by silty sand and then sandy clay down to a shallower level towards the south of the site. Below the sandy clay clayey sand (and low plasticity sandy clay) is encountered down to the maximum drilled depth of 9.0m depth. Bedrock was not encountered in the investigation. Interpreted consistent seepage/groundwater table was encountered below varying depths between 4.40m (RL 3.95m) and 6.0m (RL 2.85m).

The proposed basement excavation is expected to primarily extend through silty/sand, sandy clay/clayey sand through to the BEL. As such, conventional earth moving excavation machinery will be suitable and rock excavation equipment will not be required.

We recommend that all the footings be founded onto/ within similar founding material and bearing characteristics to prevent differential settlement. Where CGC is required to provide sign off on completion, all piles/ footings will need supervision/ inspection.

The construction of support prior to excavation structures will be required along the southern and eastern sides of the basement carpark. Due to the sandy soils encountered it is recommended that a contiguous pile wall be constructed, to prevent the soils to cave into the excavation. The pile wall will require lateral support by internal bracing or propping to limit deflection due to the proximation of the sewer.

The subsequent investigation did not identify any indicators of Acid Sulfate Soils (ASS). Therefore, further investigation into ASS will not be required.

Provided the recommendations of this report are implemented in the design and construction phases of the development, it is considered that the works can be carried out with negligible impact to the site and neighbouring properties and as such are considered suitable for the site.

The potential risks associated with the proposed development will be within 'Unacceptable' levels where insufficient/unsuitable support systems are implemented. However, where suitable engineer designed systems are implemented the risks will be reduced and can be maintained within 'Acceptable' risk criteria for the design life of the development, taken as 100 years.

Prepared By:

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Geotechnical Engineer

Reviewed By:

Troy Crozier
Principal
MIE Aust. MAIG,
RPGeo – Geotechnical and Engineering
Registration No.: 10197

9. REFERENCES:

1. Australian Geomechanics Society 2007, "Landslide Risk Assessment and Management", Australian Geomechanics Journal Vol. 42, No 1, March 2007.
2. Pittwater Council Local Environmental Plan 2014, Acid Sulphate Soils Map – Sheet ASS_017 and Geotechnical Hazard Map – Sheet GTH_017.
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4. E. Hoek & J.W. Bray 1981, "Rock Slope Engineering" By The Institution of Mining and Metallurgy, London.
5. C. W. Fetter 1995, "Applied Hydrology" by Prentice Hall.
6. V. Gardiner & R. Dackombe 1983, "Geomorphological Field Manual" by George Allen & Unwin

CROZIER
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Appendix 1

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring 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.

Description and classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. Sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very soft	Less than 12
Soft	12 - 25
Firm	25 – 50
Stiff	50 – 100
Very stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300mm)	CPT Cone Value (Qc – MPa)
Very loose	less than 5	less than 2
Loose	5 – 10	2 – 5
Medium dense	10 – 30	5 -15
Dense	30 – 50	15 – 25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling to allow information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the company and some comments on their use and application.

Test Pits – these are excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descent into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) – the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling – the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers – the hole is advanced using 90 – 115mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling – similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. From SPT).

Continuous Core Drilling – a continuous core sample is obtained using a diamond-tipped core barrel, usually 50mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedures is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken

as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150mm of say 4, 6 and 7 as 4, 6, 7 then N = 13
- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm then as 15, 30/40mm.

The results of the test can be related empirically to the engineering properties of the soil. Occasionally, the test method is used to obtain samples in 50mm diameter thin wall sample tubes in clay. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone – abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australia Standard 1289, Test 6.4.1.

In tests, a 35mm diameter rod with a cone-tipped end is pushed continually into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separte 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected buy electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) their information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: -

- Cone resistance – the actual end bearing force divided by the cross-sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0 – 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0 – 50 MPa) is less sensitive and is shown as a full line. The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios 1% - 2% are commonly encountered in sands and very soft clays rising to 4% - 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range: -

Qc (MPa) = (0.4 to 0.6) N blows (blows per 300mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range: -

Qc = (12 to 18) Cu

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculations of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Dynamic Penetrometers

Dynamic penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer – a 16mm diameter flattened rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test 6.3.3). The test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2). The test was developed initially for pavement sub-grade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is generally carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Borehole Logs

The bore logs presented herein 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. 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 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, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Details of the type and method of sampling are given in the report and the following sample codes are on the borehole logs where applicable:

D	Disturbed Sample	E	Environmental sample	DT	Diatube
B	Bulk Sample	PP	Pocket Penetrometer Test		
U50	50mm Undisturbed Tube Sample	SPT	Standard Penetration Test		
U63	63mm " " " " "	C	Core		

Ground Water

Where ground water levels are measured in boreholes there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it 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.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations 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 interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. A three-storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty-storey building). If this happens, the Company 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 condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction**.** However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions – the potential for this will depend partly on bore spacing and sampling frequency,
- changes in policy or interpretation of policy by statutory authorities,
- the actions of contractors responding to commercial pressures,

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

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, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information in Tender Documents”, published by the Institution of Engineers Australia. Where information obtained from this investigation 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 special ally edited document. The Company 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 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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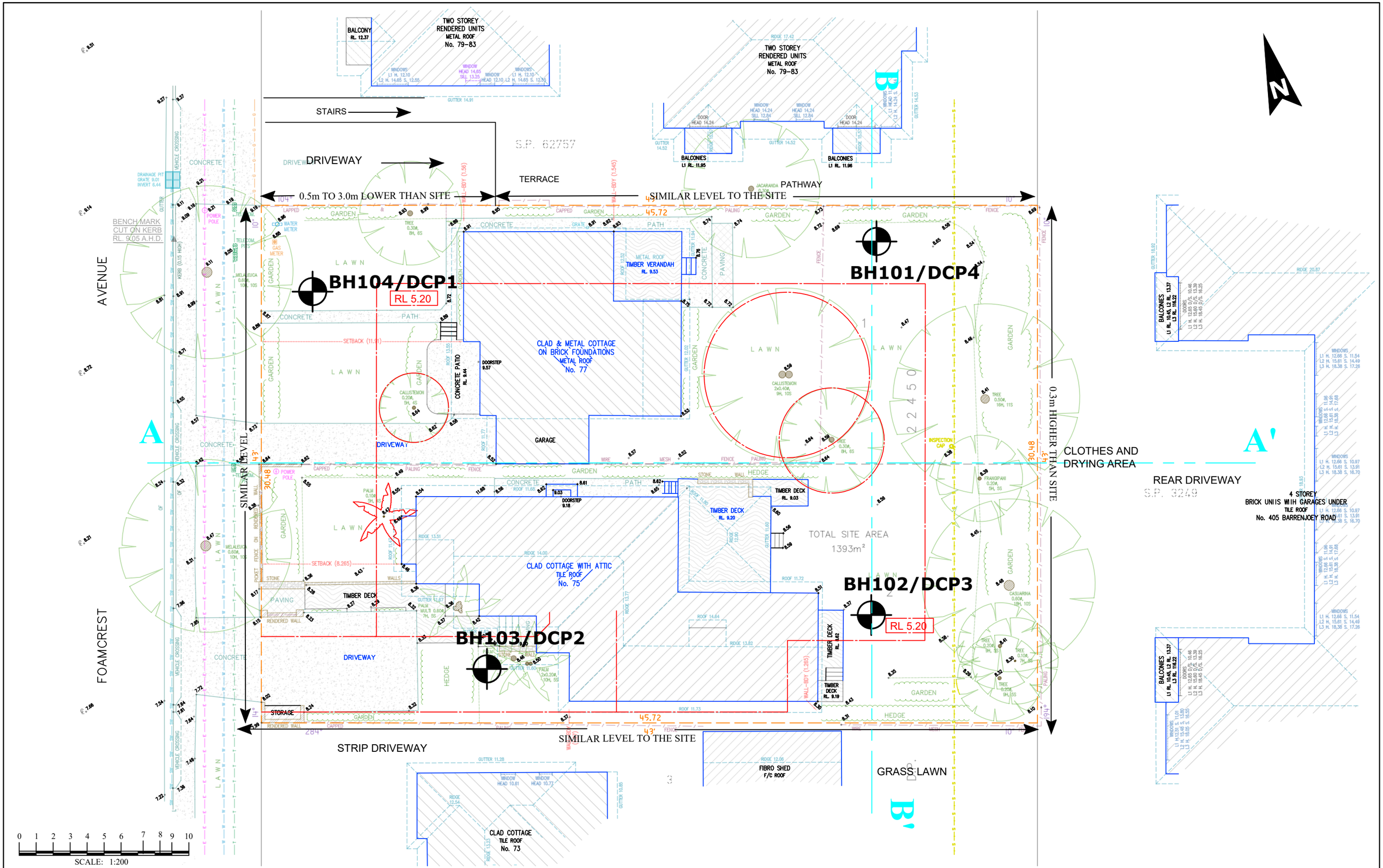
Appendix 2



0 1 2 3 4 5 6 7 8 9 10

SCALE: 1:200

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LEGEND

- BH DCP — AUGER / DYNAMIC CONE PENETROMETER LOCATION
- A — A' — CROSS-SECTION REFERENCE LINE
- EXISTING STRUCTURE
- PROPOSED EXCAVATION
- PROPERTY BOUNDARY
- PROPOSED STRUCTURE

SCALE:	1:200 @ A3
DRAWING:	FIGURE 1
DATE:	21/01/2022
APPROVED BY:	TMC
DRAWN BY:	ML
PROJECT:	2020-202

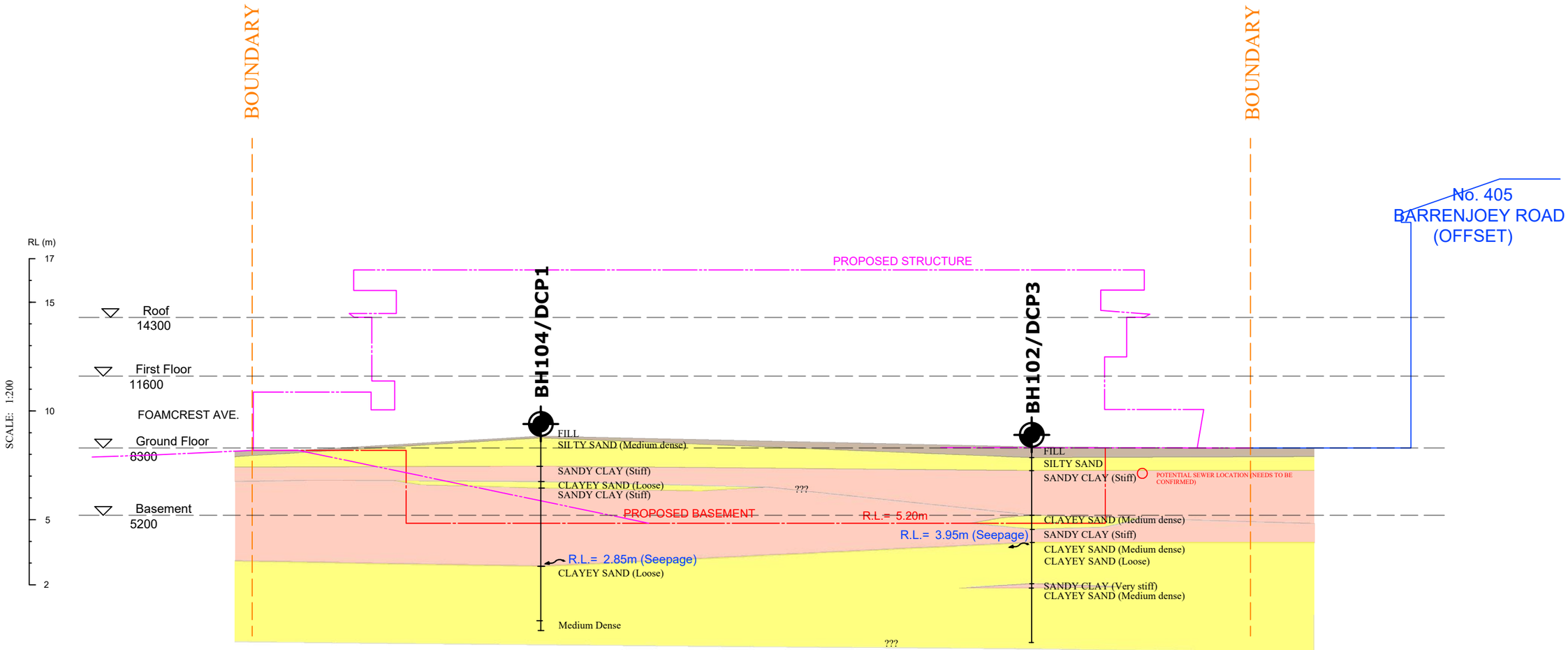
PREPARED FOR:
PROVENT PROPERTY

ADDRESS:
75-77 FOAMCREST AVENUE, NEWPORT

A — A'

WEST

EAST



0 1 2 3 4 5 6 7 8 9 10

SCALE: 1:200

VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

NB. FOR LOCATION OF SECTION A-A', PLEASE REFER TO FIGURE 1. SITE PLAN AND TEST LOCATIONS

GEOLOGICAL MODEL FIGURE 2.

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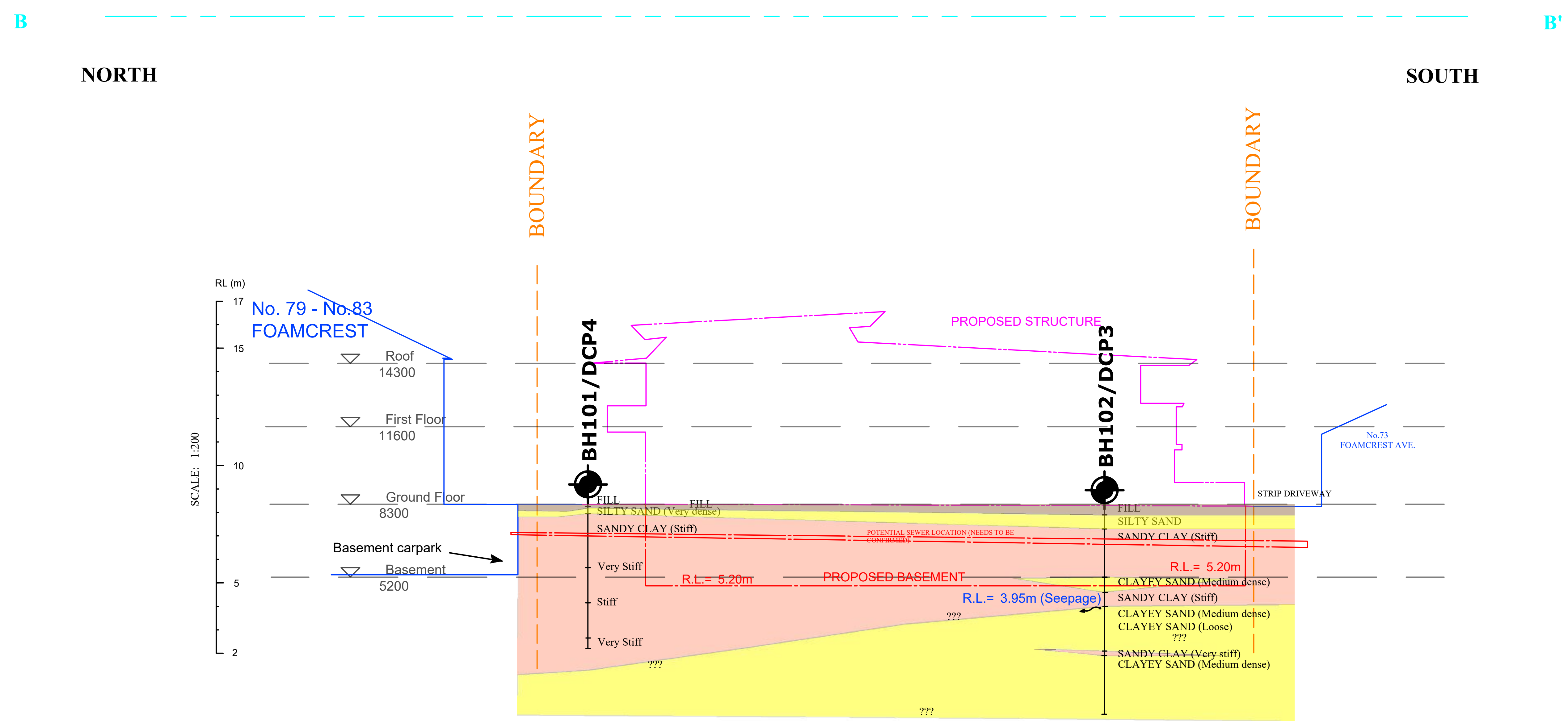
LEGEND

- A — A' CROSS-SECTION REFERENCE LINE
- PROPOSED EXCAVATION
- PROPOSED ADDITION
- SAND/ SILTY CLAYEY SAND
- BH DCP AUGER / DYNAMIC CONE PENETROMETER LOCATION
- PROPERTY BOUNDARY
- CLAY
- FILL

SCALE:	1:200 @ A3
DRAWING:	FIGURE 2
DATE:	21/01/2022
APPROVED BY:	TMC
DRAWN BY:	ML
PROJECT:	2020-202

PREPARED FOR:
PROVENT PROPERTY

ADDRESS:
75-77 FOAMCREST AVENUE,
NEWPORT



0 1 2 3 4 5 6 7 8 9 10

SCALE: 1:200

VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

NB. FOR LOCATION OF SECTION B-B', PLEASE REFER TO FIGURE 1. SITE PLAN AND TEST LOCATIONS

GEOLOGICAL MODEL FIGURE 3.

CROZIER GEOTECHNICAL CONSULTANTS

Crozier Geotechnical
Unit 12, 42-46 Wattle Road
Brookvale NSW 2100
ABN: 96 113 453 624
Phone: (02) 9939 1882
Fax: (02) 9939 1883
Crozier Geotechnical is a division of PJC Geo-Engineering Pty Ltd

LEGEND

- A — A' CROSS-SECTION REFERENCE LINE
- PROPOSED EXCAVATION
- PROPOSED ADDITION
- POTENTIAL BEDROCK
- CLAY
- SAND/ SILTY CLAYEY SAND
- BH DCP AUGER / DYNAMIC CONE PENETROMETER LOCATION
- PROPERTY BOUNDARY
- EXISTING STRUCTURE
- FILL
- SEEPAGE

SCALE:	1:200 @ A3
DRAWING:	FIGURE 3
DATE:	21/01/2022
APPROVED BY:	TMC
DRAWN BY:	ML
PROJECT:	2020-202

PREPARED FOR:
PROVENT PROPERTY

ADDRESS:
75-77 FOAMCREST AVENUE, NEWPORT

BOREHOLE LOG

CLIENT: Provent Property **DATE:** 17/01/2022 **BORE No.:** 101

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202.1 **SHEET:** 1 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.6

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
0.00			TOPSOIL/FILL: Dark grey fine to medium grained moist silty sand with roots				
0.40	8.20	SM	SILTY SAND: Very dense, grey, fine to medium grained, moist, sand with trace of silt clay				
0.70	7.90	CL	SANDY CLAY: Stiff, dark brown, low plasticity, fine to medium grained				
1.50		CI	… becoming pale grey, medium plasticity		1.50		
1.70			… becoming orange	SPT			SPT 3,4,4 N = 8
1.90		CL/CI	… becoming pale grey, low to medium plasticity		1.95		
2.00					2.00		
				D	2.10		
					2.80		
3.00	5.60	CI	... very stiff, pale grey mottled orange red, medium plasticty	D	3.00		
				SPT			SPT 6,7,10 N = 17
3.50			… becoming orange mottled pale grey		3.45		
4.00							
					4.30		
4.50	4.10		… stiff, orange red mottled pale grey	D	4.50		
				SPT			SPT 4,4,5 N = 9
5.00					4.95		

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 6.0m depth with SPT down to 6.45m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: None

REMARKS:

BOREHOLE LOG

CLIENT: Provent Property **DATE:** 17/01/2022 **BORE No.:** 101

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202.1 **SHEET:** 2 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.6

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
6.00	2.60		… becoming very stiff	SPT			SPT 6,11,10 N = 21
6.45	2.15		END OF BOREHOLE at 6.45m depth within sandy clay		6.45		
7.00							
8.00							

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 6.0m depth with SPT down to 6.45m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: None

REMARKS:

BOREHOLE LOG

CLIENT: Provent Property **DATE:** 17/01/2022 **BORE No.:** 102

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202.1 **SHEET:** 1 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.35

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
0.00			TOPSOIL/FILL: Dark grey fine to medium grained moist silty sand with roots				
					0.40		
0.50	7.85			D	0.50		
		SM	SILTY SAND: Very dense, grey, fine to medium grained, moist, silty sand				
0.70			… becoming pale grey				
1.00			… becoming dark brown with bands of clayey sand				
1.05			… becoming brown				SPT
1.10	7.25						Not taken due to many blows and no penetration
		CL	SANDY CLAY: Hard, orange mottled brown, low plasticity, moist, sandy clay		1.30		
				D			
1.70		CI	… orange mottled grey, medium plasticity		1.50		
				D	1.60		
2.00					2.00		
2.10	6.25		… stiff	SPT			SPT 4,5,6 N = 11
					2.45		
3.00					3.00		
3.15	5.20			SPT			SPT 7,8,8 N = 16
		SM	CLAYEY SAND: Medium dense, grey/pale grey, fine to medium grained, moist, silty sand		3.45		
3.80	4.55						
		CI	SANDY CLAY: Stiff, pale grey, moist, medium plasticity, sandy clay				
4.00					4.00		
				SPT			SPT 3,3,9 N = 12
4.40	3.95				4.50		
		SC	CLAYEY SAND: Medium dense, brown/orange, moist/wet, fine to medium grained, clayey sand	D	4.60		
5.00	**3.35**		… loose		5.00		
				SPT			SPT 4,3,4 N = 7
					5.45		
5.50	2.85		… wet				

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 9.0m depth with SPT down to 6.45m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: Seepage was encountered at 4.40m depth

REMARKS:

BOREHOLE LOG

CLIENT: Provent Property **DATE:** 17/01/2022 **BORE No.:** 102

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202 **SHEET:** 2 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.35

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
6.00			As above'	SPT			SPT 5,8,10 N = 18
6.30	2.05				6.45		
		CI	SANDY CLAY: Very stiff, grey, low plasticity, moist/wet, sandy clay				
6.50	1.85						
		SC	CLAYEY SAND: Medium dense, grey/brown, moist.wet, fine to medium grained, clayey sand				
7.00							
8.00							
					8.90		
9.00	-0.65			D	9.00		
			END OF BOREHOLE at 9.00m depth within clayey sand				

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 9.0m depth with SPT down to 6.45m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: Seepage was encountered at 4.40m depth

REMARKS:

BOREHOLE LOG

CLIENT: Provent Property **DATE:** 17/01/2022 **BORE No.:** 103

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202 **SHEET:** 1 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.35

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
0.00			TOPSOIL/FILL: Loose, dark brown, fine to medium grained, moist, silty sand with plant roots				
0.30	8.05	SC	SILTY SAND: Medium dense, grey, fine to medium grained, moist, silty clayey sand				
0.75	7.60		… dense				
0.90	7.45		… very dense		0.90		
				D	1.00		
1.40	6.95		… moist/ wet				
		CI	SANDY CLAY: Firm, orange red mottled dark brown, medium plasticity, moist, silty sandy clay		1.50		SPT 3,3,4 N = 7
				SPT			
2.00			… orange red mottled pale grey, low plasticity		1.95		
2.10	6.25	SC	CLAYEY SAND: Medium dense, grey/ yellow orange, fine to medium grained, moist/wet, clayey silty sand				
2.60			... moist, bands of sandy clay				
3.00			… pale grey, moist/wet		3.00		
3.20			… grey/ yellow brown				SPT 3,5,6 N = 11
				SPT			
3.50			… orange brown/ dark grey		3.45		
4.00			… grey/ orange brown				
4.40	3.95		… orange brown/grey, moist		4.50		
				SPT			SPT 4,6,6 N = 12
					4.95		
5.00	**3.35**		… moist/wet				

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 6.0m depth with SPT down to 6.45m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: Seepage was encountered at 5.0m depth. However the seepage was remeasured after 1hr and it was at 5.70m depth

REMARKS: DCP rod was wet from 3.0m depth

BOREHOLE LOG

CLIENT: Provent Property **DATE:** 17/01/2022 **BORE No.:** 103

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202 **SHEET:** 2 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.35

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
6.00			… becoming grey	SPT	6.45		SPT 6,10,12 N = 22
6.45	1.90		END OF BOREHOLE at 6.45m depth within sandy clay				
7.00							
8.00							

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 6.0m depth with SPT down to 6.45m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: Seepage was encountered at 5.0m depth. However the seepage was remeasured after 1hr and it was at 5.70m depth

REMARKS:

BOREHOLE LOG

CLIENT: Provent Property **DATE:** 17/01/2022 **BORE No.:** 104

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202 **SHEET:** 1 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.85

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
0.00			TOPSOIL/FILL: Loose, dark grey, fine to medium grained, moist, silty sand with some plant roots				
0.10	8.75	SM	SILTY SAND: Medium dense, orange red, fine to medium grained, moist, silty sand				
					0.80		
				D	0.85		
1.00			… becoming dark brown	D	1.00		
				SPT			SPT 11,7,5 N = 12
1.40	7.45				1.40		
		CI	SANDY CLAY: Stiff, orange red, medium plasticity, moist, sandy clay	D	1.50		
2.00					2.00		
2.10	6.75			SPT			SPT 8,5,4 N = 9
		SC	CLAYEY SAND: Loose, grey, fine to medium graind, moist/wet, clayey sand				
2.40	6.45				2.45		
		CI	SANDY CLAY: Stiff, grey mottled pale orange, medium plasticity, moist, sandy clay				
2.50	6.35	CL	… pale orange mottled grey, low plasticity, moist/wet				
3.00		CI	… orange red mottled pale grey, medium plasticity		3.00		
				SPT			SPT 3,4,6 N = 10
3.40			… layer of hard ironstone band		3.45		
4.00			… grey		4.00		
				SPT			SPT 5,5,5 N = 10
					4.45		
5.00	**3.85**		… very stiff		5.00		
5.15			… moist	SPT			SPT 5,8,11 N = 19
					5.45		
5.50			… pale grey mottled orange brown				

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 8.5m depth with SPT down to 8.95m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: Seepage was encountered at 2.5m depth. However constant moist/wet below 6.0m depth

REMARKS:

BOREHOLE LOG

CLIENT: Martin Cork **DATE:** 17/01/2022 **BORE No.:** 104

PROJECT: Demolition of 2 dwellings and construction of 2 storey unit block **PROJECT No.:** 2020-202 **SHEET:** 2 of 2

LOCATION: 75-77 Foamcrest Avenue, Newport 2106 **SURFACE LEVEL RL (m):** 8.85

Depth (m)	RL (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
				Type	Tests	Type	Results
	2.85	SC	CLAYEY SAND: Loose, pink, fine to medium grained, moist/wet, clayey sand	SPT	6.45		SPT 2,2,3 N = 5
6.00							
7.00							
8.00							
8.50	0.35		… grey, medium dense	SPT	8.50		SPT 7,9,11 N = 20
8.95	-0.10		END OF BOREHOLE at 8.95m depth within sandy clay		8.95		

RIG: CE Restricted access drilling rig DRILLER: BG Drilling LOGGED: ML

METHOD: Auger to 8.5m depth with SPT down to 8.95m depth CHECKED: TMC

GROUND WATER OBSERVATIONS: Seepage was encountered at 2.5m depth. However constant moist/wet below 6.0m depth

REMARKS:

DYNAMIC PENETROMETER TEST SHEET

CLIENT: Provent Property **DATE:** 15/10/2020

PROJECT: Demolition of 2 dwellings and construction of 2 storey dwelling **PROJECT No.:** 2020-202

LOCATION: 75-77 Foamcrest Ave, Newport 2106 **SHEET:** 1 of 1

	Test Location							
Depth (m)	DCP1	DCP1a	DCP1b	DCP2	DCP2a	DCP3	DCP4	DCP4a
0.00 - 0.15	1	--	--	4	--	2	2	--
0.15 - 0.30	3	--	--	3	--	3	2	--
0.30 - 0.45	3	--	--	4	--	3	5	--
0.45 - 0.60	5	--	--	5	--	7	9	--
0.60 - 0.75	30	--	--	6	--	13	8	--
0.75 - 0.90	23	--	--	10	--	34	6	--
0.90 - 1.05	40	--	--	17	--	26	37	--
1.05 - 1.20	14 (D) @1.20m depth	--	--	15	--	27 (R) @1.18m depth	12	17
1.20 - 1.35		5	--	45	--		9	3
1.35 - 1.50		6	--	44 (R) @1.35m	--		10	5
1.50 - 1.65		9	--		--		10	4
1.65 - 1.80		13	--		--		12	9
1.80 - 1.95		18	--		--		16	11
1.95 - 2.10		21	--		--		14	12
2.10 - 2.25		22	--		--		11	11
2.25 - 2.40		24 (D) @2.40m depth	--		--		12	10
2.40 - 2.55			--		--		10	10
2.55 - 2.70			10		5		13	11
2.70 - 2.85			9		7		19	12
2.85 - 3.00			14		7		26 (D) @3.00m depth	23
3.00 - 3.15			22		19			31
3.15 - 3.30			28		25			29
3.30 - 3.45			25		26			28 (R) @3.45m depth
3.45 - 3.60			30 (R) @ 3.60m depth		20			
3.60 - 3.75					22 (R) @ 3.75m depth			
3.75 - 3.90								
3.90 - 4.05								

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS:

(B) Test hammer bouncing upon refusal on solid object

(D) Test discontinnued

-- No test undertaken at this level due to prior excavation of soils

CROZIER
GEOTECHNICAL CONSULTANTS

Appendix 3

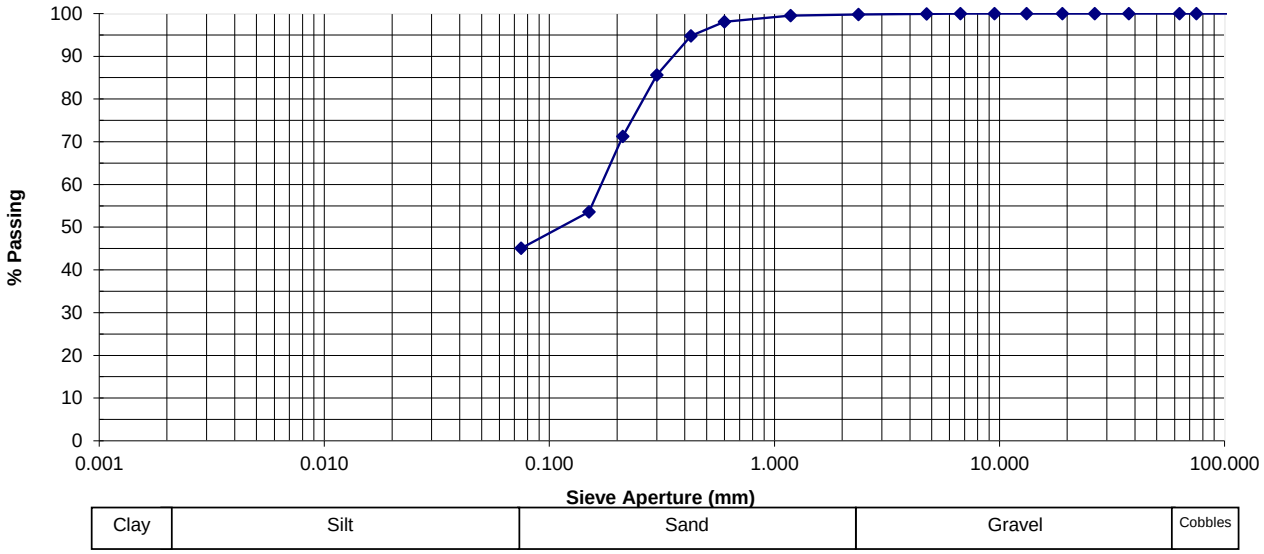
Particle Size Distribution Report

Client	Crozier Geotech	**Source**	BH103 3.0-3.45m
Address	Unit 12/ 42-46 Wattle Street Brookvale NSW 2100	**Sample Description**	Silty Sandy CLAY
Project	75-77 Foamcrest Newport (2020-202)	**Report No**	S74282-PSD
Job No	S21493-1	**Lab No**	S74282

Test Procedure AS 1289.3.6.1 Determination of the particle size distribution of a soil - Standard method of analysis by sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 17/01/2022

Preparation Prepared in accordance with the test method **Date Tested** 3/02/2022



Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	100		4.75	100	
75	100		2.36	100	
63	100		1.18	100	
37.5	100		0.600	98	
26.5	100		0.425	95	
19	100		0.300	86	
13.2	100		0.212	71	
9.5	100		0.150	54	
6.7	100		0.075	45	

Notes

NATA

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The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
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Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

Authorised Signatory: Date:

3/02/2022

Chris Lloyd

MACQUARIE GEOTECH

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

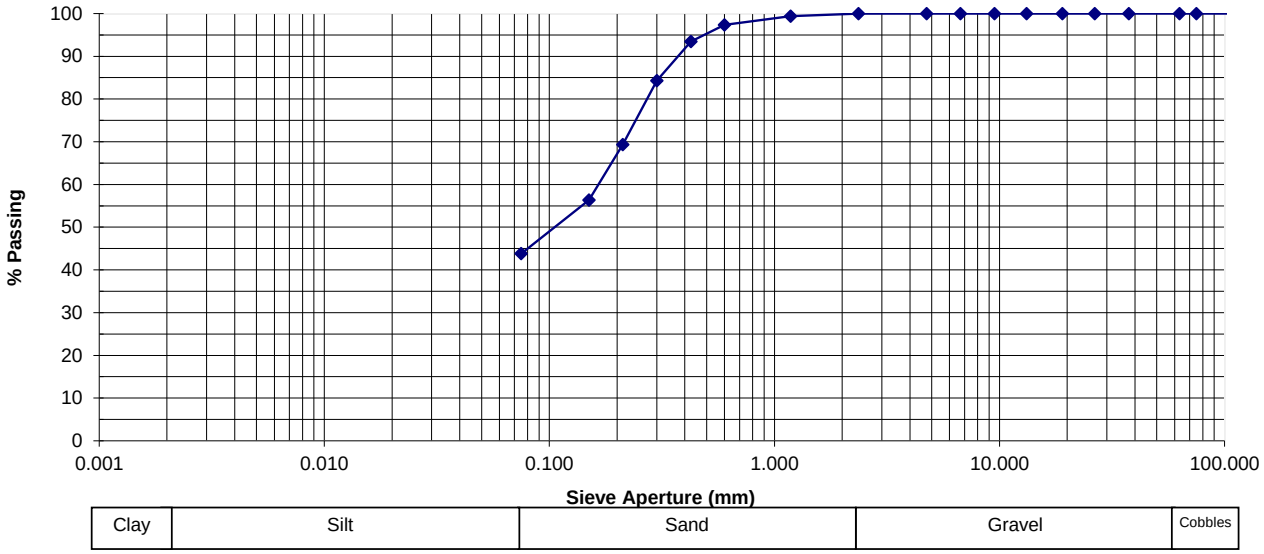
Particle Size Distribution Report

Client	Crozier Geotech	**Source**	BH103 6.0-6.45m
Address	Unit 12/ 42-46 Wattle Street Brookvale NSW 2100	**Sample Description**	Silty Sandy CLAY
Project	75-77 Foamcrest Newport (2020-202)	**Report No**	S74283-PSD
Job No	S21493-1	**Lab No**	S74283

Test Procedure AS 1289.3.6.1 Determination of the particle size distribution of a soil - Standard method of analysis by sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 17/01/2022

Preparation Prepared in accordance with the test method **Date Tested** 4/02/2022



Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	100		4.75	100	
75	100		2.36	100	
63	100		1.18	99	
37.5	100		0.600	97	
26.5	100		0.425	93	
19	100		0.300	84	
13.2	100		0.212	69	
9.5	100		0.150	56	
6.7	100		0.075	44	

Notes

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4/02/2022

Chris Lloyd

MACQUARIE GEOTECH

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

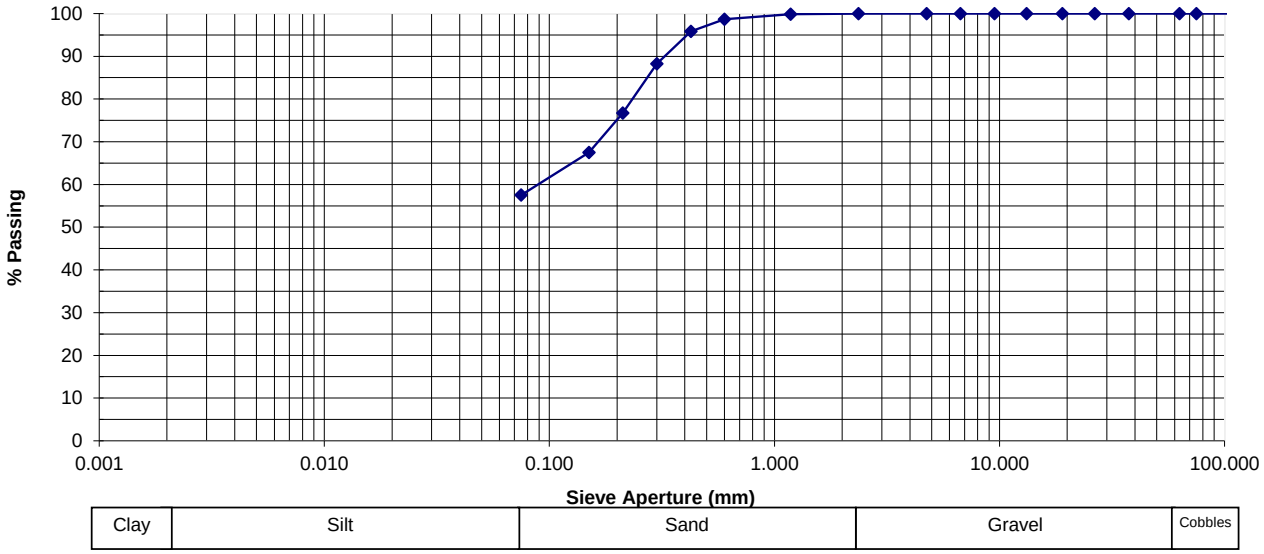
Particle Size Distribution Report

Client	Crozier Geotech	**Source**	BH104 3.0-3.45m
Address	Unit 12/ 42-46 Wattle Street Brookvale NSW 2100	**Sample Description**	Silty Sandy CLAY
Project	75-77 Foamcrest Newport (2020-202)	**Report No**	S74284-PSD
Job No	S21493-1	**Lab No**	S74284

Test Procedure AS 1289.3.6.1 Determination of the particle size distribution of a soil - Standard method of analysis by sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 17/01/2022

Preparation Prepared in accordance with the test method **Date Tested** 4/02/2022



Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	100		4.75	100	
75	100		2.36	100	
63	100		1.18	100	
37.5	100		0.600	99	
26.5	100		0.425	96	
19	100		0.300	88	
13.2	100		0.212	77	
9.5	100		0.150	67	
6.7	100		0.075	58	

Notes

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4/02/2022

Chris Lloyd

MACQUARIE GEOTECH

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

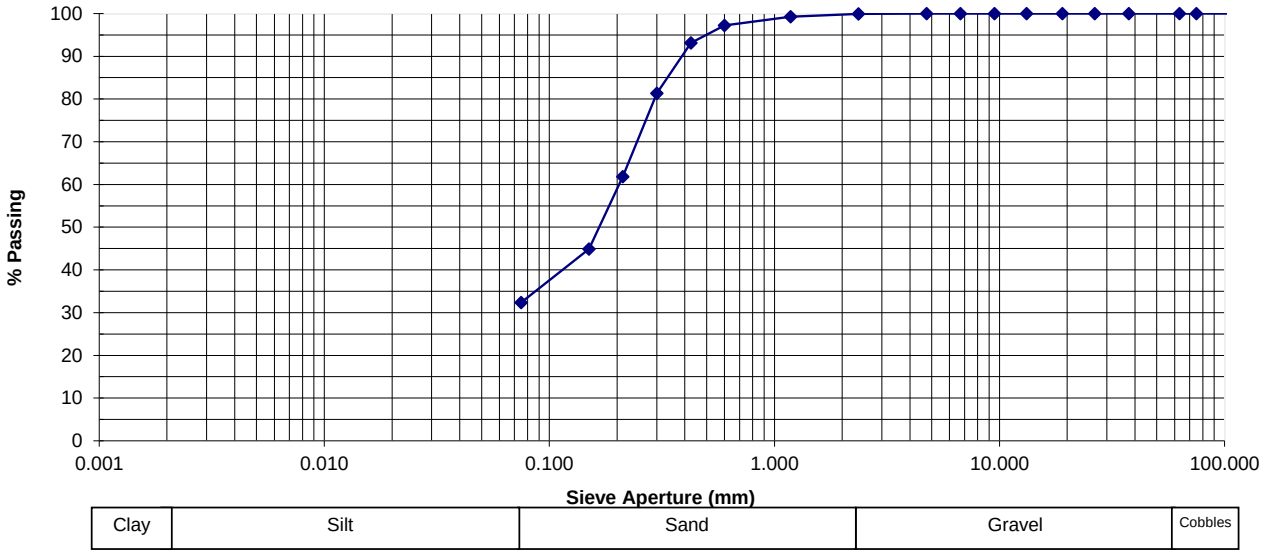
Particle Size Distribution Report

Client	Crozier Geotech	**Source**	BH104 8.50-8.95m
Address	Unit 12/ 42-46 Wattle Street Brookvale NSW 2100	**Sample Description**	Silty Clayey SAND
Project	75-77 Foamcrest Newport (2020-202)	**Report No**	S74285-PSD
Job No	S21493-1	**Lab No**	S74285

Test Procedure AS 1289.3.6.1 Determination of the particle size distribution of a soil - Standard method of analysis by sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 17/01/2022

Preparation Prepared in accordance with the test method **Date Tested** 4/02/2022



Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	100		4.75	100	
75	100		2.36	100	
63	100		1.18	99	
37.5	100		0.600	97	
26.5	100		0.425	93	
19	100		0.300	81	
13.2	100		0.212	62	
9.5	100		0.150	45	
6.7	100		0.075	32	

Notes

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Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

CROZIER
GEOTECHNICAL CONSULTANTS

Appendix 4

Appendix A. Evidence of Competency Form – Example

Individual Designer Qualifications and Relevant Experience

Name:	*Troy Crozier*
Position Title:	*Principal*
Organisation:	*Crozier Geotechnical Consultants*
Role at Organisation:	*Technical review, design, and reporting*
Role on Project:	*Geotechnical analysis and reporting for inputs to SEA*
Qualifications:	*Dip. Civ. Eng.; BSc (Geol), MEngSc.* *MIE Aust, MAIG, RPGeo – Geotechnical and Engineering (No. 10197)*

Engineering Discipline	Proposed Category and Sub-Category of Design Work (as per Table 3)	Required Competency Level
Geotechnical - Verifier	*Geotechnical investigation scoping, interpretation and Design Input for Medium structures in Simple Geology – Geotechnical Inputs for earth retaining structures, excavation fill embankments and cut slopes with effective retained height >3m and <6m in simple geology* *Geotechnical assessment and modelling of Impact on Assets – Geotechnical Inputs, modelling and assessment of movements for minor structures or pipelines*	*G4*

Comparable jobs

Project Name	Project Description	Client	Details of Design Tasks Carried out	Referee and Contact Details
39 The Serpentine, Bilgola	New development and excavation to 4.0m depth adjacent 150mm sewer main	G. Mortlock (property owner)	Review investigation data and reporting, assist and review FEM analysis of impacts to sewer from bulk excavation	Tobin Bald (MGP)
304 Bronte Rd, Bronte	New building adjacent 225mm diameter sewer	(property owner)	Investigation and reporting for new building footings adjacent sewer	Peter Standen (Partridge Engineers)
36 Coles St, Concord	New dwelling over 700mm diameter sewer main	T. Nguyen (property owner)	Review investigation data and reporting	Andrew (Cam Consulting)
296 Condamine Street, Manly Vale	New Development, 6.0m deep excavation adjacent to main road and service infrastructure, piled support wall with anchoring	CITE Group (Developers)	Supervision of investigation and reporting, analysis and assessment of support wall (anchored soldier pile wall) with construction supervision	Damien Ienco (Istruct Engineers)
1 Whistler St, Manly	New building adjacent NSOOS	Beach Property Group (owner)	Investigation and reporting, provision of monitoring programs and construction monitoring	Nix Management
32-34 Perouse Rd, Randwick	New Development, excavation to 8.0m depth, piled support wall including anchoring near 225 VC sewer pipe and road reserve	JSRT Developer	Determine and supervise geotechnical investigation to provide engineering design parameters, review and advise engineering support design, construction inspection	Zlatko Gashi (M+G Consulting Engineers)

2–4 Foamcrest Ave, Newport	New Development with excavation to 4.0m depth adjacent to road reserve including services	Provent Property Group	Design geotechnical investigation, review reporting, assessment of engineering support design against investigation results, construction inspection and advice	Martin Cork (Provent Property)
327 Barrenjoey Road, Newport	Commercial and residential development, excavation to >5.0m depth with pile support walls	Wallhouse Group	Design geotechnical investigation, review reporting and analysis, review support assessment and construction inspections	Joseph Ormaechea (Wallhouse Group)
562 Miller Street, Cammeray	Residential development with excavation to >8m depth adjacent to main road reserve and service lines	Moore Development Group	Design geotechnical investigation, review reporting, assessment of engineering support design against investigation results, construction inspection and advice	Zlatko Gashi (M+G Consulting Engineers)
30 Queens Parade, Newport	Commercial development with excavation to >3.50m depth	Billy Kids Learning Centres	Design geotechnical investigation, review reporting, assessment of engineering support design against investigation results, construction inspection and advice	Sean Gartner (Gartner Trovato Architects)

Competence Statement *Outline years of relevant experience and describe relevance of listed experience to the competencies requested)* *Attach detailed CV, with relevant details*	*I have over 20 years of experience in various senior engineering roles across significantly more than 10 projects directly related to investigation and reporting, analysis and construction monitoring of residential and commercial developments including over and adjacent to Sydney Water assets of various sizes up to 700mm and the NSOOS.*

CROZIER
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Curriculum Vitae

Troy Mathew Crozier

Principal

(Engineering Geologist)

Qualifications:

Mar 05 – Dec 08	University of New South Wales
	Master of Engineering Science (Engineering Geology) 2009
Mar 96 – Feb 99	Macquarie University, NSW
	Bachelor of Science (Geology) 1999
Jan 94 – Dec 95	Sydney Institute of Technology (TAFE)
	Diploma (Civil Engineering) 1995

Memberships:

Engineers Australia (EA) Member.

Australian Institute of Geoscientists (AIG) Member,

RPGeo – Geotechnical and Engineering (Registration No.: 10197)

Australian Geomechanics Society (AGS)

Biography:

Troy is the Principal of Crozier Geotechnical Consultants and has been operating in this role since 2015. He graduated with a Diploma in Civil Engineering in 1995 and then completed a Bachelor in Science (Geology) to further his understanding of earth processes with respect to engineering methods and assessments.

Following work as an Engineering Geologist for GHD – Longmac in 1999 he undertook several positions within the mining industry working as both a geologist and engineering geologist before returning to Sydney to undertake more detailed study into the field of engineering geology and geotechnical engineering whilst also taking up a full time position within Crozier Geotechnical Consultants (CGC). At the completion of his Masters degree he took further seniority within CGC until taking control of the business and furthering its technical capabilities from 2015.

Experience:

Site Investigations

- Detailed geological/geotechnical mapping of rock excavations and natural cliff outcrops including design and supervision installation of temporary and permanent support systems
- Site investigations for footing and excavation stability design for residential and commercial developments (>250 sites, NSW)
- Site investigations for Shell Service Station fuel tank replacement program - Sydney Metropolitan, NSW Central Coast, Moree, Goulburn, Bowral, Wagga Wagga
- Interpretation of CPT results and design of pile footings for residential to medium commercial developments in Mona Vale, Newport, Dee Why, Narrabeen- Collaroy-Fishermans Beach foreshore erosion zone.
- Investigation and supervision of earthworks for engineered fill and pavement construction

Risk Analysis

- Detailed geotechnical mapping and risk analysis in line with AGS 2007 Landslip Risk Management for numerous residential developments throughout Pittwater, Gosford, Wollongong, Manly, Woollahra and Warringah LGA's
- Slope stability assessment and provision of remedial design program for large illegal filled embankment Duffy's Forest.
- Site investigation for design of residential structure in actively eroding coastal zone Thirroul and Clifton, NSW.

Excavation

- Preparation of excavation methodology and design of rock slope support systems for commercial and residential developments in Pittwater, Warringah, Manly, Woollahra, Sydney, Waverley, Randwick LGA's in both rock and sediments.
- Excavation and outcrop mapping with provision of stabilising design and advice (numerous, Sydney, NSW)
- Analysis of soil/rock deflection as a result of excavation destressing
- Vibration assessment and monitoring of rock excavation equipment (numerous Sydney, NSW)

Solar

- Site investigations and Pile Load Testing for Solar Power Projects at Leeton, Gunnedah, Newcastle (NSW); Cultana, Narracoorte, Murray Bridge (SA), Aitutaki (Cook Islands)

Mining

- Geotechnical and lithological logging of 2000m deep boreholes including structural measurements for mine feasibility assessment, Leonora-Gwalia, WA.
- Geological mapping of outcrop and mine wall stability, Southern Cross, WA.
- 3D modeling and interpretation of geological formations

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Appendix 5

Appendix A. Evidence of Competency Form

Individual Designer Qualifications and Relevant Experience

Name:	*Marvin Lujan Liza*
Position Title:	*Geotechnical Engineer*
Organisation:	*Crozier Geotechnical Consultants*
Role at Organisation:	*Geotechnical Engineer*
Role on Project:	*Investigation, interpretation and reporting*
Qualifications:	*BEng, Hons (Civil)*

Engineering Discipline	Proposed Category and Sub-Category of Design Work (as per Table 3)	Required Competency Level
Geotechnical Engineering - Designer	*Geotechnical investigation scoping, interpretation and Design Input for Medium structures in Simple Geology – Geotechnical Inputs for earth retaining structures, excavation fill embankments and cut slopes with effective retained height >3m and <6m in simple geology*	*G2*

Comparable jobs				
Project Name	**Project Description**	**Client**	**Details of Design Tasks Carried out**	**Referee and Contact Details**
29 Birriga Road, Bellevue Hill, NSW	*Proposed subdivision and new development excavation to 4.50m depth near existing unit buildings and minor pool excavation adjacent to a sewer main*	*Renata Biller*	*Investigation and reporting for the new development including providing construction recommendations to protect the nearby sewer and structures*	*MHN Design Union Pty Ltd*
2A Battle Boulevard, Seaforth, NSW	*Proposed new development excavation to 4.50m depth directly adjacent to a sewer main*	*Brendan Minkus*	*Investigation and reporting for the new development including providing recommendations on construction methodology (e.g. excavation ground vibration limits) to protect the adjacent sewer main and structures.*	*Watershed Design Pty Ltd*
65 Villa High Road, Vaucluse, NSW	Proposed new childcare centre with a basement carpark, excavation to 3.50m depth directly adjacent to a sewer main	Vaucluse Early Learning Pty Ltd	*Investigation and reporting for new structure including providing recommendations on construction methodology (e.g. excavation ground vibration limits) to protect the adjacent sewer main and structures.*	Neoscape Pty Ltd
1-3 Spencer Street, Rose Bay	Proposed new development with a basement carpark,	Papi Developments Pty Ltd	*Sub-surface investigation (regular SPT), reporting report, ground vibration*	MHN Design Union Pty Ltd

	excavation to 4.80m depth within sand near a concrete encased sewer main.		*monitoring during construction and provide recommendation shoring design to protect the adjacent structures.*	
12 Bulkara Road, Bellevue Hill	Alterations and additions and construction of a new pool above an existing sewer main where excavation down to 4.0m depth will be required for sewer encasement works.	Catherine Chung and Stanley Yu	*Investigation and reporting for the proposed alterations and additions including recommendations on excavation and construction methodology to conduct the sewer encasement works appropriately.*	ARC Architects Pty Ltd
Competence Statement *Outline years of relevant experience and describe relevance of listed experience to the competencies requested)* *Attach detailed CV, with relevant details*	*I have extensive experience as a geotechnical engineer in the Northern Beaches area. I have conducted geotechnical investigation, reporting and recommendations for design, construction and for Council submission. I have experience in over 10 projects directly related to shoring and excavation adjacent to a sewer main and well familiarised with the Geology in the Northern Beaches area.* *I possess the necessary skills and experience to provide the appropriate recommendations (in line with the Sydney Water Guidelines) to successfully assist in design process.*			

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Marvin Lujan

BACHELOR OF CIVIL ENGINEERING (HONOURS)

2/10 Dee Why Parade, Dee Why 2099, NSW

marvin_lujan1219@hotmail.com

0431413145

ABOUT ME

Age: 26

Nationality: Australian Citizen

Driver's license: Full driver's license

Languages: English, Spanish.

SKILLS

Microsoft Excel (Advance)

★★★★★

AutoCAD (Intermediate)

★★★★

AS 1726 – Geotechnical Site investigations (Experienced)

★★★★★

AS 1289 – Method of testing soil (Advance)

★★★★★

AS 3600 – Concrete Structures (Intermediate)

★★★★

AS 4100 – Steel Structures (Intermediate)

★★★★

AS 1720.1 – Timber Structures (Intermediate)

★★★★

WORK EXPERIENCE

MANLY AUTOMOTIVE **Nov 2012 – Dec 2012**

Role: Mechanical Technician. **Job Description:** Basic car service and I have learned the use of tools e.g.: wrenches, screwdriver set, spanners, pliers, screwdrivers, etc.

COLES TEAM MEMBER: **Dec 2013 – Jan 2017**

Role: Nightshift team member and team leader from 2014- 2016.
Job Description: Decision making; Time management, Communication Skills and building a good relationship with my team members.

FAMILY OWN FRANCHISE CLEANING BUSINESS: **Nov 2015 – Jan 2018**

Job Description: Managing the paperwork related to a business i.e. bookkeeping, Invoicing, BAS lodgement, problem solving, job organisation and team leader.

DEMOSTRATOR AT UNSW **2018 Semester 1**

Job Description: I've worked as a demonstrator at UNSW for a 3rd year engineering course CVEN3202 – Soil Mechanics. I have taught the course content theory and the laboratory part of the course according to Australian's Standards. I've gained confidence in public speaking and improved my communication skills.

GEOTECHNIQUE PTY LTD **Nov 2018 – July 2019**

Role: Geotech Laboratory Technician in accordance with AS1289.
Job Description: Undertook soil tests e.g. Soil classification test, CBR, Hilf Density Ratio Test, Shrink – Swell test, Point Load test, Atterberg w/linear shrinkage.
Role: Junior Geotechnical Engineer.
Job Description: This includes site investigation as per AS 1726:2017.
Role: Environmental Engineer Assistant
Job Description: Conducted Excavated Natural Material (ENM) soil contamination tests; Acid Sulfate Soils (ASS). Also have experience in data analysis, data separation and data management. Well experienced using Microsoft Excel with a basic knowledge using VBA/Macro Excel programming.

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Strand 7 (Basic)

★★★

Strong work ethic (Advance)

★★★★★

Problem Solving (Advance)

★★★★★

Flexible (Advance)

★★★★★

Detail oriented (Advance)

★★★★★

InfraWorks 360 (Basic)

★★★

Matlab (Basic)

★★★

Python (Basic)

★★★★

R (Basic)

★★★★

CROZIER GEOTECHNICAL CONSULTANTS PTY LTD
July 2019 - Current Role

Role: Geotechnical Engineer.
Job Description:
- Geotechnical investigation (AS 1726:2017 and AS 2870) and report preparation for Local Council, Sydney Water and Structural Design/Construction purposes. Including preparation of Landslip Risk Assessment as per AGS 2007 for sites in zones of Landslip Risk. Where I have learned skills i.e.: Rock core logging, Soil borehole logging and Test Pit logging.
- Project Manager of Geotechnical Investigations.
- Hydrogeological Investigation: Ground absorption/infiltration rates.
- Ground Vibration Monitoring.
- Acid Sulfate Soils (ASS) Investigation and report preparation for Council Submission.
- Conducted Construction inspection for shallow and deep (e.g. pile inspection) footings; Excavation monitoring; batter slope stability assessment and Dilapidation Survey.
- Site mapping using geological and geomorphological Mapping Symbols.

EDUCATION

BACHELOR'S IN CIVIL ENGINEERING (HONOURS)
University of New South Wales, Australia
2014-2019

HIGH SCHOOL
Cromer High School- Northern Beaches Sydney
Year of Completion: 2013
Awards: Rank 1st in Physics HSC Rank 2nd in Mathematics and Extension Math HSC
Rank 1st in ESL HSC Rank 2nd in Spanish Extension HSC
Rank 1st in Chess Competition
Rank 3rd in the whole year HSC

CERTIFICATES

- FIRST AID COURSE (HLTAID003 First Aid) in CBD College
- WHITE CARD in eot.edu.au (Express Online Training)
- FULL DRIVERS LICENCE (Clean Record) (Manual/Automatic)
- WORKING WITH CHILDREN CHECK (WWCC)

HOBBIES

I play music, I'm a member of 2 music bands and constantly play in dancing events in Venues like Sugar Lounge Manly and dance studios.
I'm also a dancer, I have composed and performed number of dancing choreographies in UNSW open days.
I have a passion in Mathematics and Economics and programming. My next goal is to learn to write in Python and R for Data Analysis
I fluently speak Spanish and English

This form relates to obligations under the Design and Building Practitioners Act 2020 and supporting Regulation

Instructions for completing this form
You must complete all Parts of this form.

Use this form in designs that consist of independent schedules, specifications or reports.

Attach the completed form to the front of the schedule, specification or report as a separate page before uploading to the NSW Planning Portal. Do not insert this form as an image or resize the form.

Regulated Design Record				
Project Address: 75-77 Foamcrest Avenue, Newport				
Project Title: Beach House Newport				
Consent No: N/A			Body Corporate Reg No: N/A	
Drawing Title: Not Applicable			Drawing No: Not Applicable	
Rev	Date (dd.mm.yy)	Description	DP Full Name	Reg No
1	04.02.22	GEOTECHNICAL REPORT FOR PROPOSED NEW RESIDENTIAL DEVELOPMENT	Troy Crozier	DEP0002517
		No.75- No.77 FOAMCREST AVENUE, NEWPORT, NSW		
		Project No.: 2020-202		