GREYWACKE GEOTECHNICS

GEOTECHNICAL INVESTIGATION REPORT

TO

Cornerstone Construction & Development

ON

Geotechnical Investigation

FOR

Proposed New Childcare Centre

LOCATION

110-112 Mount Vernon Rd, Mount Vernon 2178 NSW

Job Number: COCD0206 - GEO AA Rev_01

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Table of contents

Table index

Figures

Appendices

Appendix A – General Notes

Appendix B – Figures

Appendix C – Borehole Logs and DCP Records

Appendix D – Laboratory Test Certificates

1. Introduction

1.1 General

This report presents the results of a geotechnical investigation carried out by Greywacke Geotechnics (Greywacke) for a proposed new childcare centre development at 110-112 Mount Vernon Road, Mount Vernon, 2178 NSW. The investigation was carried out in general accordance with Greywacke's proposal to Cornerstone Construction and Development and was commissioned by Mr. Moussa Alam.

Under this engagement, a geotechnical site investigation was completed for the purpose of informing the designers and contractors managing/planning the works of ground conditions and ground related issues at the site.

The proposed works will generally involve demolition of the existing residence and other notable structures at the site and shallow to moderately deep excavations (i.e. cut earthworks), most notably, cut earthworks for the construction of footings.

This report provides the factual results of the geotechnical investigation, including details of the fieldwork, the inferred subsurface conditions encountered during the investigations and general site observations made during the investigations.

It is understood that this geotechnical report may be submitted to Council to accompany a Development Application (DA) process.

1.2 Scope of work

This report entails the geotechnical investigation undertaken for the proposed new childcare centre development. The investigated fieldwork was undertaken on the 14th of May 2018 and comprised of four (4) boreholes and four (4) Dynamic Cone Penetration (DCP) testing at selected locations across the site, where physical and legal access was available (see **Figure 3** in **Appendix B** for test locations).

Specifically, the purpose of this report is to provide information on and discuss the following geotechnical aspects:

- Develop a preliminary understanding of the geological and geotechnical conditions;
- Identify potential geotechnical constraints for assessment and planning;
- Excavation conditions (i.e. excavatability, stability etc.) at the proposed development site;
- Groundwater, and;
- Foundation conditions including site / lot classification in accordance with AS2870, and recommendations on suitable footing types.

This report has been prepared with reference to the following information, collated from publicly available sources:

- Geological maps and notes;
- Soil landscape maps and notes;
- Aerial imagery (i.e. Google Earth);
- Design/Architectural drawings of the proposed development, and;
- Limited observations made during the geotechnical investigations across the proposed development site.

2. Site setting

2.1 Site Identification Details

The subject site (**Figure 2** contained in **Appendix B**) being considered for development is part of an existing property compromising of a single storey brick type structure, most likely supported on shallow foundations founded on residual clay soils. Other notable structures include a detached car port structure adjacent to the eastern boundary line. The site located at 110-112 Mount Vernon Road, Mount Vernon, is approximately 1.8km northeast of Kemps Creek.

The subject site is bounded by Mount Vernon Road, which defines its southern boundary lines. Residential buildings lie immediately adjacent to its northern, western and eastern boundary lines.

The subject allotment is almost rectangular in shape providing a total site area of approximately 1.026 ha.

2.2 Environmental Setting

2.2.1 Topography

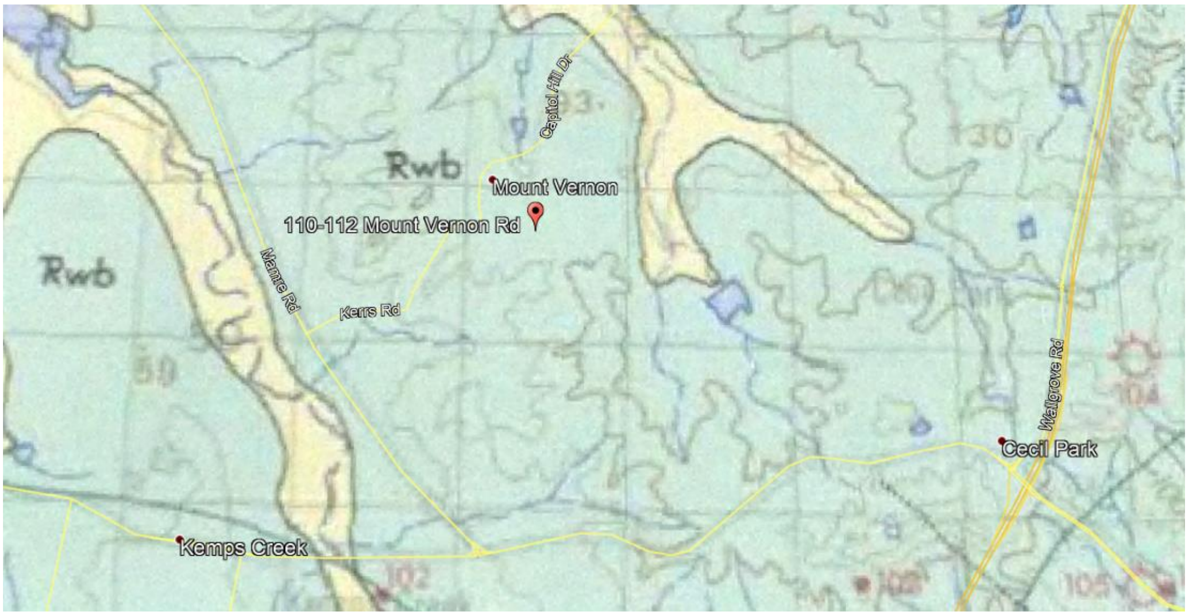
Imagery available on the Department of Lands and Spatial Information Exchange website shows that Mount Vernon is located at an approximate elevation of 100m AHD. The elevation provided in this report is provided as a guideline and should not be relied upon.

Locally, the site terrain appears moderately flat and consistent. The topography of the surrounding area also appears to be flat and consistent, generally undulating with broad rounded crests and ridges with gently declined slopes.

2.2.2 Regional geology

The 1:100,000 scale Penrith Geological Series Sheet (Geological Survey of NSW, Department of Minerals and Energy, Sheet 9130, 1983) indicates that the proposed development site is underlain by Bringelly Shale of the Wianamatta Group. This stratum occurs extensively throughout the Penrith Basin and comprises of shale, carbonaceous claystone, claystone, laminate, fine to medium grained lithic sandstone with rare coal and tuff. A map excerpt of the Penrith Geological map is provided in **Figure 1** below.

Figure 1 Geology Map Excerpt



Rwb - **Bringelly Shale of the Wianamatta Group**

2.3 Acid Sulfate Soils

No known occurrence of acid sulfate soils has been reported in this environment. Furthermore, the elevated terrain (as described in sub Section 2.2.1) is inconsistent with typical acid sulfate soil environments. Therefore, development and construction activities are not likely to be affected by acid sulfate soil materials.

2.4 Salinity Potential

The Salinity Potential in Western Sydney map (Department of Infrastructure, Planning and Natural Resources, 2002) indicates that in general, the site comprises moderate salinity potential. It is noted that more saline areas may occur in this zone, which have not yet been identified or may occur if risk factors change.

Notwithstanding the above, in Western Sydney, saline effects are typically manifested in low lying areas, for example, in the vicinity of creeks, as the groundwater is often saline. The subject site is located across a moderately steep hillside (i.e. not low lying), however, and as noted above, there are creeks in the vicinity of the site.

3. Investigation results

3.1 Preliminaries

In accordance with Greywacke Geotechnics occupational health and safety policy, a Project Health Safety and Environmental (HSE) Plan was prepared prior to conducting fieldwork. All site staff were briefed on the requirements set out in the plan by the supervising geotechnical engineer.

Prior to the site investigation, relevant plans of buried utilities obtained from 'Dial Before You Dig' service were collated and reviewed. The plans showed no buried services or utilities were present adjacent to test locations.

3.2 Fieldwork

The geotechnical site investigation was carried out on the 14th of May 2018 under the full-time supervision of an experienced Greywacke geotechnical engineer, who nominated the test positions and recorded its location using a hand held autonomous GPS (accuracy ±3m).

The investigation comprised the drilling of four (4) boreholes (BH 1, BH 2, BH 3, and BH 4) at selected locations to a maximum of 3.5m depth (BH 1). Dynamic Cone Penetrometer (DCP) tests were conducted adjacent to the boreholes to provide a soil consistency / strength correlation. The boreholes were drilled using a 4-WD mounted drilling rig and was advanced through the soil and rock profiles using a solid flight auger fitted with a Tungsten Carbide bit (TC-bit). All boreholes were terminated past the target depth.

The borehole and DCP locations are shown in **Figure 3** contained in **Appendix B** and summarised in **Table 1** below. The borehole log sheets and DCP records are provided in **Appendix C**. These should be read in conjunction with the attached General Notes in **Appendix A**.

Table 1 Borehole and DCP Summary

Test ID	Approximate Location (MGA)		Investigation Depth (m)
	Easting	Northing	
BH 1 / DCP 1	297534.188	6250918.804	3.5 / 2.3
BH 2 / DCP 2	297553.074	6250909.259	3.0 / 2.3
BH 3 / DCP 3	297554.678	6250935.921	2.5 / 2.3
BH 4 / DCP 4	297564.147	6250951.815	2.7 / 2.3

3.3 Subsurface Profile

3.3.1 General

In general terms, subsurface conditions encountered across the proposed development site comprised shallow topsoil and/or fill materials overlying very stiff residual clay soils in turn overlying extremely weathered shale bedrock. This sequence is consistent with our expectations, based on the geological conditions described in **Section 2**.

Notwithstanding the above, **Table 2** below summarises the sub-surface profile encountered at each of the boreholes at the site. The more pertinent aspects of the subsurface conditions are described in sections 3.3.2 to 3.3.4 below.

Reference to the individual borehole log sheets (**Appendix C**) should be made for a detailed description of the conditions encountered during the investigations.

Table 2 Summary of Subsurface Profiles

Test ID	Topsoil/Fill (mbgl)	Residual Clay (mbgl)	Shale Bedrock (mbgl)
BH 1	0.0 - 0.5	0.5 - 3.0	3.0-3.5^{+}
BH 2	0.0 - 0.6	0.6 - 3.0^{+}	-
BH 3	0.0 - 0.5	0.5 - 2.5^{+}	-
BH 4	0.0 - 0.6	0.6 - 2.7^{+}	-

Notes: 1. '+' Refers to depth of material extending beyond the termination depths.
2. 'mbgl' Refers to metres depth below the ground surface.

3.3.2 Topsoil and/or Fill

This material was encountered at all test locations overlying the residual clay soil. The topsoil typically comprised clayey sand with minor proportions of gravel and trace clay/silt. Organic material (i.e. leaves, grass and rootlets) were present in minor / variable proportions. The fill material typically comprised low plasticity clay with traces of fine to medium gravel.

3.3.3 Residual Clay

This material was encountered at all test locations underlying the topsoil and/or fill materials and typically comprised medium plasticity clay with minor proportions of fine size gravel with traces of shale fragments found near the end depths of each boreholes. This material was typically of stiff to very stiff consistency, generally increasing in stiffness with depth.

3.3.4 Bedrock

The general bedrock stratigraphy encountered at the site is summarised below. We note that, and based on the scope of works, no coring of bedrock material was undertaken at the site, and as such, bedrock description and strength values was inferred from tactile and visual observations.

Nevertheless, where it has been considered necessary for the purpose of the engineering discussion, the weathered bedrock unit observed has been classified using the rock classification system developed for the Sydney Sandstones and Shales as per the Australian Geomechanics publication (Pells et al., 1998).

In summary:

- Extremely weathered shale was encountered in one of the boreholes (BH1) and fragments of shale were noticed in the residual clay layer for the remaining boreholes (BH 2, BH 3 and BH 4) and was noted to be brown-grey-red, at depth, laminated, extremely weathered to highly weathered, extremely low to very low strength (i.e. Class V to Class IV).

3.4 Laboratory Testing and Results

Geotechnical classification testing was undertaken on a soil sample recovered from Borehole BH 3 and was submitted to Australian Soil and Concrete Testing Pty Ltd (ASCT), a NATA accredited laboratory located in Wetherill Park NSW. The testing undertaken comprised:

- Atterberg Limit (1 no.) tests to assess soil plasticity and confirm soil descriptions obtained in the field.

The laboratory test results are summarised in **Table 3** and the laboratory test certificates are included in **Appendix D**. A summary and discussion of the test results are presented below

These should be read in conjunction with the General Notes, which explain the limitations of the testing undertaken.

Table 3 Summary of geotechnical laboratory testing

Test location	Depth (mbgl)	Material Description	LL (%)	PL (%)	PI (%)	LS (%)
BH 2	1.0 - 1.2	CLAY	48	27	21	6

LL - Liquid Limit
Pl - Plastic Limit
PI - Plasticity Index
LS - Linear Shrinkage

The results of the testing (refer **Table 3**) indicate the following:

- The tested soil is predominantly medium plasticity clay.

3.5 Groundwater

During drilling, standing groundwater/ groundwater seepage was not observed in any of the open boreholes.

We note that, and based on the scope of works, monitoring of groundwater levels at the site has not been undertaken.

4. Geotechnical Assessment

4.1 General

The proposed development site (see **Figure 3**) is situated over a generally flat and consistent terrain with minor ground crack formations noticed along the midpoint of the lot area. This may indicate presence of highly

It is understood based on architectural drawings that the proposed development and civil earthworks related activities at the site will include, but not limited to:

- The demolition of the existing structure and other notable structures prior to construction.
- Construction of a new childcare centre, a carpark with associated driveways for access and other notable outdoor structures.
- Excavations in predominantly clay material will be required for the purpose of levelling the site and for the proposed swimming pool prior to the development of the proposed residence.

4.2 Excavation Conditions

It is understood that for the construction of the proposed residence minor to moderate excavations will be required, as such, excavations will be predominantly through existing shallow topsoil and/or fill, and residual clay soils.

It is envisaged that excavations for the proposed structures are likely to be carried out with an excavator of the order of 10 to 15 tonne mass fitted with a toothed bucket through the soil and if encountered, weathered shale bedrock profile.

Care should be taken for detailed excavation across the site and at the founding levels of the proposed structures. The shale bedrock unit, which may include boulders and the possibility of floaters (large rock inclusions not coupled to parent rock material), could be easily disturbed / loosened below the founding levels or excavation faces if large excavation plant or typical ripping methods are used. If disturbance of loose material below founding levels does occur we recommend that removal and replacement of the loosened material with mass concrete backfill be used.

We note that, unwanted material will need to be disposed of offsite in accordance with DECC (2009) Waste Classification Guidelines.

4.3 Temporary Excavation Stability

The requirements for the excavation support at the site will be governed by the geotechnical conditions and occupational health and safety requirements.

For cut operations through soil layers deeper than 1.5m, unsupported batter slopes should not exceed **2H:1V**. Where this is not practicable due to site constraints, the installation / construction of an appropriate shoring system will be required.

We understand that a vertical excavation may provide the most practicable form of construction in terms of minimising the footprint of ground disturbed at the surface and, thereby, also minimising the volume of excavated material (i.e. spoil). The duration that such an excavation can be relied upon to remain self-supporting before installation of a support system is reliant on the strength/cohesion of the strata forming the excavation sides, unfavourable rock mass defect orientations and the presence of groundwater (if any) may require excavation support or stabilisation to be put in place at a shallower depth.

The above should be reviewed by an experienced geotechnical engineer if unexpected ground conditions are encountered.

4.3.1 Temporary and Permanent Support

Typical material properties for the design of temporary or permanent support (e.g. as part of the basement garage) are given in **Table 4**. These have been derived from the results of the in-situ tests (i.e. DCPs).

Table 4 Typical Material Properties

Parameter		Stiff Residual Clay	Very Stiff Residual Clay	Shale Bedrock (Class V)
Φ' (degrees)		26	28	30
Lateral Earth Pressure Coefficients	K_a	0.39	0.36	0.33
	K_0	0.56	0.53	0.5
	K_p [1]	2.56	2.76	3.0
Bulk Unit Weight (kN/m^3)		19	20	22

Notes: 1. 1/2 Kp is recommended for passive resistance calculations due to strain compatibility considerations.

The temporary (short term) support may be designed for active pressure (K_a) conditions. The design of permanent (long term) support structures should be conducted using at-rest earth pressures (K_0). The nominal values of K_0 for the residual soils and extremely weathered shale bedrock are presented in **Table 4** above.

Note that the at-rest lateral earth pressure coefficient (K_0) is dependent on the over-consolidated state of the materials, which varies in depth, and may be complicated by the effects of soil desiccation and repeated wetting and drying cycles. Furthermore, the DCP test can be sensitive to conditions un-associated with soil strength, such as soil fabric and/or coarse particles.

For the design of both temporary excavation support and lateral earth pressures on retaining walls, we recommend the following lateral loading criteria:

- The structure be designed for the critical case considering 'at-rest' (K_0) earth pressures using triangular pressure distribution (plus surcharge) calculated as the summation of $K_0\sigma'_v$ for the component strata given in **Table 4** and where σ'_v is the effective vertical stress. Further, we suggest that increased lateral stress due to backfill compaction be considered as described in AS4678 Cl J9.
- Lateral thrust from surcharge loads (for example, from construction loads and nearby structures) and from groundwater pressure, should be added to the above lateral earth pressures.

4.4 Reuse of Excavated Material

We expect that the excavated residual clay material would be the most economic source of backfill. The backfill could include all excavated material free of rock, cemented lumps or clay clods larger than say 150mm size.

We note that the residual clay soils encountered in the boreholes was generally of low plasticity. These materials may be used as general backfill, but will require care in moisture conditioning and compaction.

The topsoil and/or fill material will be unsuitable for reuse as backfill, and should be disposed of off-site. The upper sections of the fill should simulate the proposed design levels, particularly in trafficable areas.

Any material to be disposed of off-site should be subject to waste classification in accordance with the DECC (2009) Waste Classification Guidelines.

4.5 Foundation Conditions

4.5.1 Site Classification

Australian Standard AS 2870 - Residential Slabs and Footing (2011) establishes performance requirements and specific designs for common foundation conditions as well as providing guidance on the design of footing systems using appropriate engineering principals and judgement. Site classes as defined in Table 2.1 and 2.3 of AS 2870 are reproduced in **Table 5** below.

Table 5 General Definition of Site Classification

Site Class	Foundation	Characteristic Surface Movement
A	Most sand and rock sites with little or no ground movement from moisture changes	-
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	0 – 20mm
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes	20 – 40mm
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	40 – 60mm
H2	Highly reactive clay sites, which may experience high ground movement from moisture changes	60 – 75mm
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes	> 75mm
A to P sites	Filled sites (refer to clause 2.4.6 of AS 2870)	
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip, mine subsidence; collapsing soil; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.	

Based on the soil profile encountered and information reviewed and collated herein, the site is classified, in accordance with AS 2870 - 2011 (Residential Slabs and Footings Standard) as:

- **Class 'P'**

We note however that, the site classification can be adjusted to **Class 'H1'** based on the assumption that the founding levels (i.e. foundations) of the proposed structure will be supported on very stiff residual clay soil.

4.5.2 Footings

General

All foundations systems shall be designed and constructed in accordance with AS2870, with reference to the site classification as presented above.

Shallow Footings

In terms of foundation support to the proposed structure, shallow footing systems (e.g. slab on ground with stiffened edge beams, pad footings to support concentrated loads or pre-cast floor elements) founded on very stiff clay (undisturbed) are considered suitable, provided that reactive clay shrink-swell effects are taken into account. Suggested design parameters for shallow footings founded on stiff to hard residual clays are provided in **Table 6**.

Piled / Piered Footings

Alternatively, to the above, if shallow footing systems are not favourable, piled foundations in very stiff residual clay or shale bedrock (Class V/IV) may be adopted.

Suggested design parameters for reinforced concrete cast in-situ piles founded on residual clays and/or shale bedrock (Class V/IV) are provided in **Table 6**. These should be used in conjunction with the design procedure of AS 2159-2009. The design parameters are for single piles in downward compression only. Piles should be spaced apart sufficiently to avoid group effects.

Table 6 Suggested Geotechnical Design Values for footing design

Material	Allowable End Bearing Pressure [1] (kPa)	Allowable Shaft Adhesion [2] (kPa)	Elastic Modulus E_{field} (MPa)
Very Stiff Residual Clay	150	20	30
Shale Bedrock (Class V/IV)	700-1000	80	200

Table 5 Notes: 1. Pile base at least 75% free of debris is required.
2. For uncased portion of shaft in rock only. Values should be reduced if sidewall smear occurs.

In addition to the allowable geotechnical capacity of piles, pile design should consider settlement of the pile as settlement / serviceability requirements often control the geotechnical capacity of the piles. Typical modulus (E_{field}) values are provided in **Table 6** for this purpose.

Note, that for rock socket lengths of less than one pile diameter, 30 to 100% of the axial load is likely to be carried in end bearing.

An experienced geotechnical engineer should confirm the foundation conditions (e.g. bedrock/socket levels, bedrock quality, socket cleanliness, etc.) during construction for quality and design verification purposes. Pile base clean out should be confirmed immediately prior to placement of concrete and/or reinforcing steel.

The design parameters provided in **Table 6** are based on simple design calculation procedures presented in AS2159 - 2009. More sophisticated methods such as elastic, side slip or non-linear analysis are available and higher pile capacities are likely to be achievable using more rigorous geotechnical design methods. If required, Greywacke can provide additional services in this regard.

4.6 Groundwater

As noted in **Section 3.5**, groundwater was not encountered in any of the boreholes during the investigation stages. Therefore, it is likely that construction activities within the investigated depths (i.e. shallower than say 3.5m depth below the ground surface) may not be affected by groundwater.

Notwithstanding the above groundwater levels may be subjected to seasonal variations, prolonged rainfall periods, topography of the surrounding area and may therefore fluctuate, which has not been assessed.

5. Limitations

This report has been prepared by Greywacke Geotechnics (Greywacke) for Cornerstone (Client) and may only be used and relied on by the Client for the purpose agreed between Greywacke and the Client as set out in Section 1.2 of this report.

Greywacke otherwise disclaims responsibility to any person other than the Client arising in connection with this report. Greywacke also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by Greywacke in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Greywacke has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

Greywacke has prepared this report on the basis of information provided by the Client and others who provided information to Greywacke, which Greywacke has not independently verified or checked beyond the agreed scope of work. Greywacke does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by particular site conditions, such as the location and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this report. Greywacke does not accept responsibility arising from, or in connection with, any change to the site conditions. Greywacke is also not responsible for updating this report if the site conditions change.

This report should be read in conjunction with the Explanatory Notes (contained in Appendix A).

6. References

1. Geological Survey of NSW, Department of Minerals and Energy, *Penrith 1:100,000 scale Geological Series Sheet,* Sheet 9130 Edition 1, 1983;
2. Soil Conservation Service, NSW, *Penrith 1:100,000 scale Soil Landscape Series Sheet*, Sheet 9130, 1989;
3. Standards Australia, *AS 4678-2002, Earth Retaining Structures, 2002;*
4. Standards Australia, *AS 2870-2001, Residential Slabs and Footings,* 2011;
5. Standards Australia, *AS 2159-2009, Piling – Design and Installation;*
6. P.J.N. Pells, G. Mostyn and B.F. Walker, *Foundations on Sandstone and Shale in the Sydney Region,* Australian Geomechanics, December 1998, pp 17-29;
7. NSW Department of Natural Resources website, NSW Natural Resource Atlas, http://nratlas.nsw.gov.au, May 2016.

For and on behalf of Greywacke Geotechnics

Rev No.	Author	Reviewer	Signature	Position	Approved for Issue
					Date
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Appendices

Appendix A – General Notes

GENERAL NOTES

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CONSULTING GEOTECHNICAL ENGINEERS

This report contains the results of a geotechnical investigation conducted for a specific purpose and client. The results should not be used by other parties, or for any other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Moreover, the location of test holes should be considered approximate, unless noted otherwise (refer report). Reference should also be made to the relevant standard sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

GROUNDWATER

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeabilities (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report are normally based on a site evaluation from discrete test hole data, often with only approximate locations (e.g. GPS). Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in the generalised ground conditions do occur in the natural environment, particularly between discrete test hole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to this company for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system and/or to conduct monitoring as a result of this natural variability. Allowance for verification by appropriate geotechnical personnel must be recognised and programmed for construction.

FOUNDATION

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, caissons, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, design and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions must include at least all of the relevant test hole and test data, together with appropriate Standard Description sheets and remarks made in the written report of a factual or descriptive nature.

Ref. GW1.1.1 Issue 1.0 DATE:06/06/2016

STANDARD SHEETS

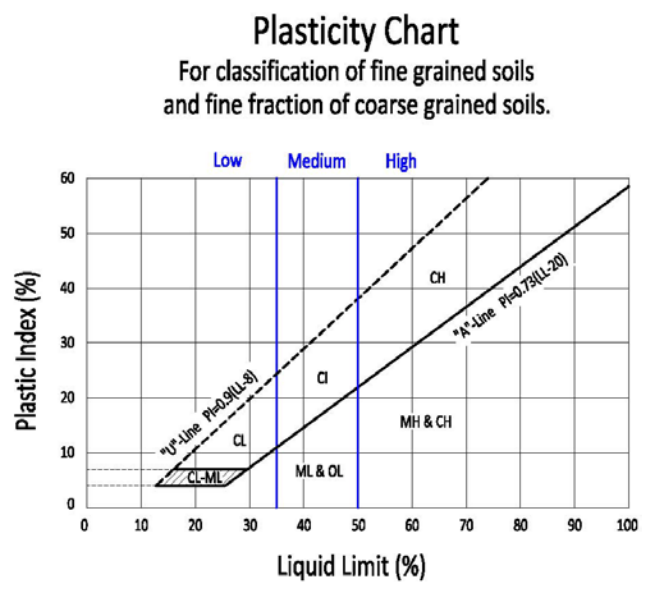
The following information is intended to assist in the interpretation of terms and symbols used in geotechnical borehole logs, test pit logs and reports issued by Greywacke Geotechnical Consultants. More detailed information relating to specific test methods is available in the relevant Australian Standards.

Soil Descriptions

Description and Classification of Soils for Geotechnical Purposes: Refer to AS1726-1993 (Appendix A).

The following chart (adapted from AS1726-1993, Appendix A, Table A1) is based on the Unified Soil Classification System (USCS).

Major Divisions		Particle size mm	USCS Group Symbol	Typical Names	Laboratory Classification					
						% < 0.075 mm (2)	Plasticity of fine fraction	$C_u = \frac{D_{60}}{D_{10}}$	$C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})}$	NOTES
COARSE GRAINED SOILS (more than half of material less than 63 mm is larger than 0.075 mm)	BOULDERS	200								
	COBBLES	63								
	GRAVELS (more than half of coarse fraction is larger than 2.36 mm)	coarse	GW	Well graded gravels and gravel-sand mixtures, little or no fines	Use the gradation curve of material passing 63 mm for classification of fractions according to the criteria given in 'Major Divisions'	0-5	—	>4	Between 1 and 3	(1) Identify fines by the method given for fine-grained soils.
		20	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels		0-5	—	Fails to comply with above		
		medium	GM	Silty gravels, gravel-sand-silt mixtures (1)		12-50	Below 'A' line or PI<4	—	—	
		6 fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures (1)		12-50	Above 'A' line and PI>7	—	—	(2) Borderline classifications occur when the percentage of fines (fraction smaller than 0.075 mm size) is greater than 5% and less than 12%. Borderline classifications require the use of SP-SM, GW-GC.
	SANDS (more than half of coarse fraction is smaller than 2.36 mm)	coarse	SW	Well graded sands and gravelly sands, little or no fines		0-5	—	>6	Between 1 and 3	
		0.6	SP	Poorly graded sands and gravelly sands, little or no fines		0-5	—	Fails to comply with above		
		medium 0.2	SM	Silty sands, sand silt mixtures (1)		12-50	Below 'A' line or PI<4	—	—	
		fine 0.075	SC	Clayey sands, sand-clay mixtures (1)		12-50	Above 'A' line and PI>7	—	—	
FINE GRAINED SOILS (more than half of material less than 63 mm is smaller than 0.075 mm)	SILTS & CLAYS (Liquid Limit ≤50%)		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity						
			CL CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays						
			OL	Organic silts and clays of low plasticity						
	SILTS & CLAYS (Liquid Limit >50%)		MH	Inorganic silts, mic- aceous or diato-maceous fine sands or silts, elastic silts						
			CH	Inorganic clays of high plasticity, fat clays						
			OH	Organic silts and clays of high plasticity						
	HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils						



GREYWACKE GEOTECHNICS

Soil Colour: Is described in the moist condition using black, white, grey, red, brown, orange, yellow, green or blue. Borderline cases can be described as a combination of two colours, with the weaker followed by the stronger. Modifiers such as pale, dark or mottled, can be used as necessary. Where colour consists of a primary colour with secondary mottling, it should be described as follows:

(Primary) mottled (Secondary). Refer to AS 1726-1993, A2.4 and A3.3.

Soil Moisture Condition: Is based on the appearance and feel of soil. Refer to AS 1726-1993, A2.5.

Term	Description
Dry	Cohesive soils; hard and friable or powdery, well dry of plastic limit. Granular soils; cohesionless and free-running.
Moist	Soil feels cool, darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	Soil feels cool, darkened in colour. Cohesive soils usually weakened and free water forms on hands when handling. Granular soils tend to cohere and free water forms on hands when handling.

Consistency of Cohesive Soils: May be estimated using simple field tests, or described in terms of a strength scale. In the field, the undrained shear strength (s_u) can be assessed using a simple field tool appropriate for cohesive soils, in conjunction with the relevant calibration. Refer to AS 1726-1993, Table A4.

Consistency - Essentially Cohesive Soils					
Term	**Field Guide**	**Symbol**	**SPT "N" Value**	**Undrained Shear Strength s_u (kPa)**	**Unconfined Compressive Strength q_u (kPa)**
Very soft	Oozes between fingers when squeezed in hand.	VS	0-2	<12	<25
Soft	Easily moulded with fingers.	S	2-4	12-25	25-50
Firm	Can be moulded by strong pressure of fingers.	F	4-8	25-50	50-100
Stiff	Not possible to mould with fingers.	St	8-15	50-100	100-200
Very stiff		VSt	15-30	100-200	200-400
Hard	Can be indented with difficulty by thumb nail.	H	>30	>200	>400

Soil Particle Sizes	
Term	**Size Range**
BOULDERS	>200 mm
COBBLES	63-200 mm
Coarse GRAVEL	20-63 mm
Medium GRAVEL	6-20 mm
Fine GRAVEL	2.36-6 mm
Coarse SAND	0.6-2.36 mm
Medium SAND	0.2-0.6 mm
Fine SAND	0.075-0.2 mm
SILT	0.002-0.075 mm
CLAY	<0.002 mm

Note: SPT - N to q_u correlation from Terzaghi and Peck, 1967. (General guide only).

Consistency of Non-Cohesive Soils: Is described in terms of the density index, as defined in AS 1289.0-2000. This can be assessed using a field tool appropriate for non-cohesive soils, in conjunction with the relevant calibration. Refer to AS 1726-1993, Table A5; BS5930-1999, p117.

Consistency - Essentially Non-Cohesive Soils				
Term	**Symbol**	**SPT N Value**	**Field Guide**	**Density Index (%)**
Very loose	VL	0-4	Foot imprints readily	0-15
Loose	L	4-10	Shovels Easily	15-35
Medium dense	MD	10-30	Shovelling difficult	35-65
Dense	D	30-50	Pick required	65-85
Very dense	VD	>50	Picking difficult	85-100

Standard Penetration Test (SPT): Refer to. AS 1289.6.3.1-2004. Example report formats for SPT results are shown below:

Test Report	Penetration Resistance (N)	Explanation / Comment
4, 7, 11	N=18	Full penetration; N is reported on engineering borehole log
18, 27, 32	N=59	Full penetration; N is reported on engineering borehole log
4, 18, 30/15 mm	N is not reported	30 blows causes less than 100 mm penetration (3rd interval) – test discontinued
30/80 mm	N is not reported	30 blows causes less than 100 mm penetration (1st interval) – test discontinued
rw	N<1	Rod weight only causes full penetration
hw	N<1	Hammer and rod weight only causes full penetration
hb	N is not reported	Hammer bouncing for 5 consecutive blows with no measurable penetration – test discontinued

Rock Descriptions

Refer to AS 1726-1993 (Appendix A3.3) for the description and classification of rock material composition, including:

(a) Rock type (Table A6, (a) and (b))

(b) Grain size

(c) Texture and fabric

(d) Colour (describe as per soil).

The condition of a rock material refers to its weathering characteristics, strength characteristics and rock mass properties. Refer to AS 1726-1993 (Appendix A3 Tables A8, A9 and A10).

Weathering Condition (Degree of Weathering):

The degree of weathering is a continuum from fresh rock to soil. Boundaries between weathering grades may be abrupt or gradational.

Rock Material Weathering Classification		
Weathering Grade	**Symbol**	**Definition**
Residual Soil	RS	Soil-like material developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the material has not been significantly transported.
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded in water, but substance fabric and rock structure still recognisable.
Highly Weathered Rock	HW	Strong discolouration is evident throughout the rock mass, often with significant change in the constituent minerals. The intact rock strength is generally much weaker than that of the fresh rock.
Moderately Weathered Rock	MW	Modest discolouration is evident throughout the rock fabric, often with some change in the constituent minerals. The intact rock strength is usually noticeably weaker than that of the fresh rock.
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh Rock	FR	Rock shows no sign of decomposition or staining.

Notes:

1. Minor variations within broader weathering grade zones will be noted on the engineering borehole logs.
2. Extremely weathered rock is described in terms of soil engineering properties.
3. Weathering may be pervasive throughout the rock mass, or may penetrate inwards from discontinuities to some extent.
4. The ‘Distinctly Weathered (DW)’ class as defined in AS 1726-1993 is divided to incorporate HW and MW in the above table. The symbol DW should not be used.

Strength Condition (Intact Rock Strength):

Strength of Rock Material (Based on Point Load Strength Index, corrected to 50 mm diameter – $I_{s(50)}$. Field guide used if no tests available. Refer to AS 4133.4.1-2007.				
Term	**Symbol**	**Point Load Index (MPa) $I_{s(50)}$**		**Field Guide to Strength**
Extremely Low	EL	≤0.03		Easily remoulded by hand to a material with soil properties.
Very Low	VL	>0.03	≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3 cm thick can be broken by finger pressure.
Low	L	>0.1	≤0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	>0.3	≤1.0	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
High	H	>1	≤3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	VH	>3	≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High	EH	>10		Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes:

1. These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects.
2. Anisotropy of rock material samples may affect the field assessment of strength.

Discontinuity Description: Refer to AS 1726-1993, Table A10.

Anisotropic Fabric	
BED	Bedding
FOL	Foliation
LIN	Mineral lineation
Defect Type	
LP	Lamination Parting
BP	Bedding Parting
FP	Cleavage / Foliation Parting
J, Js	Joint, Joints
SZ	Sheared Zone
CZ	Crushed Zone
BZ	Broken Zone
HFZ	Highly Fractured Zone
AZ	Alteration Zone
VN	Vein

Roughness (e.g. Planar, Smooth is abbreviated Pl / Sm)		Class
Stepped (Stp)	Rough or irregular (Ro)	I
	Smooth (Sm)	II
	Slickensided (Sl)	III
Undulating (Un)	Rough (Ro)	IV
	Smooth (Sm)	V
	Slickensided (Sl)	VI
Planar (Pl)	Rough (Ro)	VII
	Smooth (Sm)	VIII
	Slickensided (Sl)	IX

Aperture		**Infilling**		
Closed	CD	No visible coating or infill	Clean	Cn
Open	OP	Surfaces discoloured by mineral/s	Stain	St
Filled	FL	Visible mineral or soil infill <1mm	Veneer	Vr
Tight	Tl	Visible mineral or soil infill >1mm	Coating	Ct

Other	
Cly	Clay
Fe	Iron
Co	Coal
Carb	Carbonaceous
Sinf	Soil Infill Zone
Qz	Quartz
CA	Calcite
Chl	Chlorite
Py	Pyrite
Int	Intersecting
Inc	Incipient
DI	Drilling Induced
H	Horizontal
V	Vertical

Discontinuity Spacing: On the geotechnical borehole log, a graphical representation of defect spacing vs depth is shown. This representation takes into account all the natural rock defects occurring within a given depth interval, excluding breaks induced by the drilling / handling of core. Refer to AS 1726-1993, BS5930-1999.

Defect Spacing			Bedding Thickness (Sedimentary Rock Stratification)	
Spacing/Width (mm)	**Descriptor**	**Symbol**	**Descriptor**	**Spacing/Width (mm)**
			Thinly Laminated	< 6
<20	Extremely Close	EC	Thickly Laminated	6 – 20
20 – 60	Very Close	VC	Very Thinly Bedded	20 – 60
60 – 200	Close	C	Thinly Bedded	60 – 200
200 – 600	Medium	M	Medium Bedded	200 – 600
600 – 2000	Wide	W	Thickly Bedded	600 – 2000
2000 – 6000	Very Wide	VW	Very Thickly Bedded	> 2000
>6000	Extremely Wide	EW		

Defect Spacing in 3D	
Term	**Description**
Blocky	Equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section

Defect Persistence (areal extent)
Trace length of defect given in metres

Symbols

The list below provides an explanation of terms and symbols used on the geotechnical borehole, test pit and penetrometer logs.

Test Results			
PI	Plasticity Index	c'	Effective Cohesion
LL	Liquid Limit	c_u	Undrained Cohesion
LI	Liquidity Index	c'_R	Residual Cohesion
DD	Dry Density	ϕ'	Effective Angle of Internal Friction
WD	Wet Density	ϕ_u	Undrained Angle of Internal Friction
LS	Linear Shrinkage	ϕ'_R	Residual Angle of Internal Friction
MC	Moisture Content	c_v	Coefficient of Consolidation
OC	Organic Content	m_v	Coefficient of Volume Compressibility
WPI	Weighted Plasticity Index	$c_{\alpha\varepsilon}$	Coefficient of Secondary Compression

Test Symbols	
DCP	Dynamic Cone Penetrometer
SPT	Standard Penetration Test
CPTu	Cone Penetrometer (Piezocone) Test
PANDA	Variable Energy DCP
PP	Pocket Penetrometer Test
U50	Undisturbed Sample 50 mm (nominal diameter)
U100	Undisturbed Sample 100mm (nominal diameter)
UCS	Uniaxial Compressive Strength
Pm	Pressuremeter

Test Results			
WLS	Weighted Linear Shrinkage	e	Voids Ratio
DoS	Degree of Saturation	ϕ'_{cv}	Constant Volume Friction Angle
APD	Apparent Particle Density	q_t / q_c	Piezocone Tip Resistance (corrected / uncorrected)
s_u	Undrained Shear Strength	q_d	PANDA Cone Resistance
q_u	Unconfined Compressive Strength	$I_{s(50)}$	Point Load Strength Index
R	Total Core Recovery	*RQD*	Rock Quality Designation

Test Symbols	
FSV	Field Shear Vane
DST	Direct Shear Test
PR	Penetration Rate
A	Point Load Test (axial)
D	Point Load Test (diametral)
L	Point Load Test (irregular lump)

▽ 28/11/13 Groundwater level on the date shown	▶ Water Inflow	◁ Water Outflow

SOIL SYMBOLS

Main Components

SAND

CLAY

SILT

GRAVEL

FILL

TOPSOIL

Minor Components

sandy

clayey

silty

gravelly

vegetation, roots

Note: Natural soils are generally a combination of constituents, e.g. sandy CLAY

ROCK SYMBOLS

Sedimentary

SANDSTONE

SHALE

CLAYSTONE

CONGLOMERATE

SILTSTONE

COAL

Igneous

GRANITIC ROCK

IGNEOUS DYKE

BASALTIC ROCK

Note: Additional rock symbols may be allocated for a particular project.

Appendix B – Figures

Paper Size A3
Scale
NTS
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Proposed Development

GREYWACKE GEOTECHNICS

Cornerstone Construction & Development
Proposed Childcare Centre
Geotechnical Site Investigation

Job Number	COCD0206
Revision	A
Date	15-May-18

SITE LOCALITY PLAN

Figure 2

F:\Projects\CornerstoneConstruction&Development\Figures\Fig2_SiteLocalityPlan.pdf

Paper Size A3

Scale

NTS

Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Borehole/DCP Test Locations

GREYWACKE GEOTECHNICS

Cornerstone Construction & Development
Proposed Childcare Centre
Geotechnical Site Investigation

Job Number	COCD0206
Revision	A
Date	15-May-18

TEST LOCATION PLAN

Figure 3

F:\Projects\CornerstoneConstruction&Development\Figures\Fig3_TestLocationPlan.pdf

Appendix C – Borehole Logs and DCP Records

BOREHOLE LOG SHEET

Client :	Cornerstone Construction and Development
Project :	Proposed New Childcare Centre
Location :	110-112 Mt Vernon Rd, Mt Vernon

HOLE No. BH1

SHEET 1 OF 1

Position : Refer to test location plan	**Surface RL:**	**Angle from Horiz. :** 90°	**Processed :** S.H
Rig Type : Cristie **Mounting:** Mounting 4-WD	**Contractor :**	**Driller :** D.S	**Checked :** K.O
Date Started : 14/5/2018	**Date Completed :** 14/5/2018	**Logged by :** M.S	**Date:**

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	TC-bit auger	Nil	None Encountered		0.10		-	Clayey SAND; dark brown, fine to medium grained sand, traces of fine gravel, traces of organic content (i.e. grass rootlets etc.) (topsoil).		-	
					0.50			Silty CLAY; brown-yellow, low to medium plasticity, with fine to coarse grained gravel.	D	St-VSt	
1							CI	CLAY; red brown, medium plasticity, traces of fine gravel, with silt.	D	VSt	
								At 1.5m, as above, but colour changes to grey-red-orange.	SM	VSt	
2								At 2.5m, as above, but with shale fragments.		VSt	
3					3.00						
					3.50			Extremely weathered SHALE; brown-grey-red.		St	
4								End of borehole at 3.5 metres. Target Depth.			

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
COCD0206 - GEO AA

DYNAMIC CONE PENETROMETER LOG SHEET

Client: Cornerstone Construction and Development

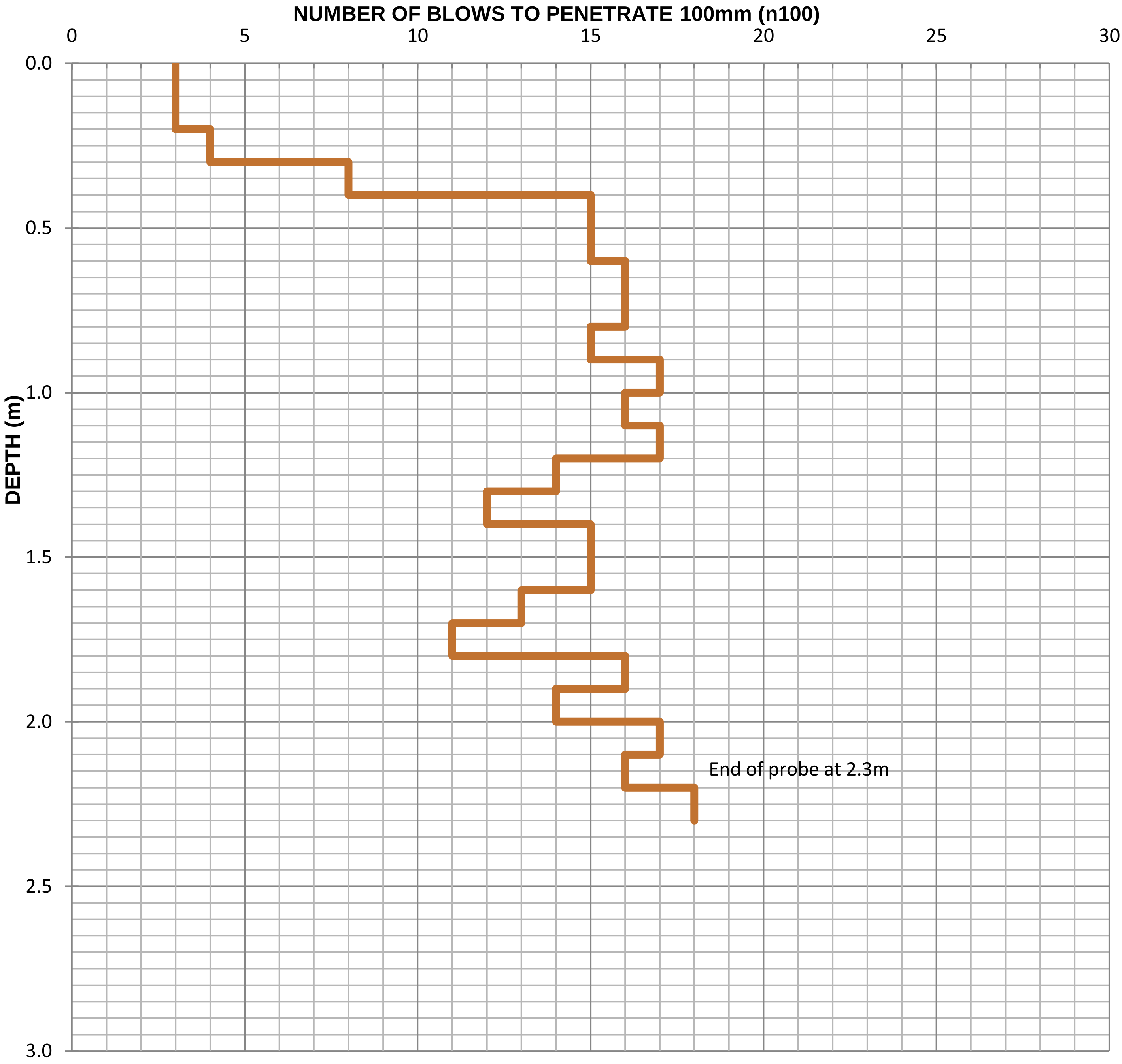
Project: Proposed New Childcare Centre

Location: **110-112 Mt Vernon Rd, Mt Vernon**

PROBE: DCP 1

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** -	**Operator:**	MS & SH
Elevation: -	**Offset:** -	**Date:**	14/05/2018
Adjacent Test Hole / Pit:		**Checked:**	
Position Relative to Test Hole / Pit:		**Date:**	



Comments:

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BOREHOLE LOG SHEET

Client : Cornerstone Construction and Development		**HOLE No. BH2**
Project : Proposed New Childcare Centre		
Location : 110-112 Mt Vernon Rd, Mt Vernon		**SHEET 1 OF 1**
Position : Refer to test location plan	**Surface RL:**	**Angle from Horiz. :** 90°	**Processed :** S.H
Rig Type : Cristie	**Mounting:** Mounting 4-WD **Contractor :**	**Driller :** D.S	**Checked :** K.O
Date Started : 14/5/2018	**Date Completed :** 14/5/2018	**Logged by :** M.S	**Date:**

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
	TC-bit auger	Nil	None Encountered		0.10			Clayey SAND; dark brown, fine to medium grained sand, traces of fine gravel, traces of organic content (i.e. grass rootlets etc.) (topsoil).			
					0.60			Silty CLAY; brown-yellow, low to medium plasticity, with fine to coarse grained gravel, with silt.	SM	St-VSt	
1							CI	CLAY; red brown, medium plasticity, traces of fine gravel.	SM	VSt	
								At 0.9m, as above, but colour changes to grey-orange-red.	SM	VSt	
2											
					3.00			At 2.7m, as above, but with shale fragments		VSt	
3								End of borehole at 3 metres. Target Depth.			
4											

See standard sheets for details of abbreviations & basis of descriptions

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DYNAMIC CONE PENETROMETER LOG SHEET

Client: Cornerstone Construction and Development

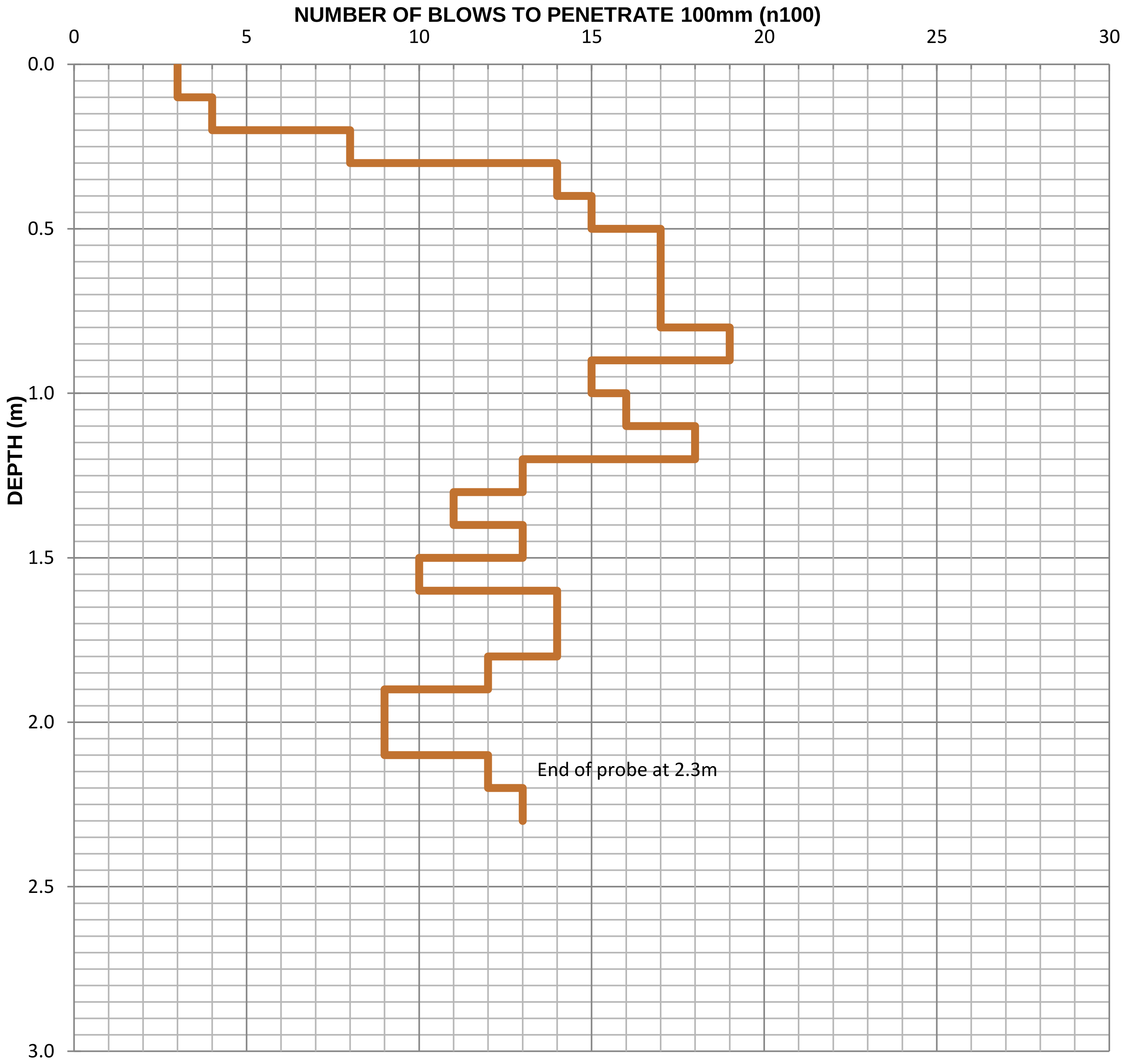
Project: Proposed New Childcare Centre

Location: **110-112 Mt Vernon Rd, Mt Vernon**

PROBE: DCP 2

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** -	**Operator:** MS & SH
Elevation: -	**Offset:** -	**Date:** 14/05/2018
Adjacent Test Hole / Pit:		**Checked:**
Position Relative to Test Hole / Pit:		**Date:**



Comments:

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BOREHOLE LOG SHEET

Client : Cornerstone Construction and Development		**HOLE No. BH3**	
Project : Proposed New Childcare Centre			
Location : 110-112 Mt Vernon Rd, Mt Vernon		**SHEET 1 OF 1**	
Position : Refer to test location plan	**Surface RL:**	**Angle from Horiz. :** 90°	**Processed :** S.H
Rig Type : Cristie **Mounting:** Mounting 4-WD	**Contractor :**	**Driller :** D.S	**Checked :** K.O
Date Started : 14/5/2018	**Date Completed :** 14/5/2018	**Logged by :** M.S	**Date:**

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	TC-bit auger	Nil	None Encountered		0.10			Clayey SAND; dark brown, fine to medium grained sand, traces of fine gravel, traces of organic content (i.e. grass rootlets etc.) (topsoil).			
					0.50			Silty CLAY; brown-yellow, low to medium plasticity, with fine to coarse grained gravel.	D	St-VSt	
1							CI	CLAY; red brown, medium plasticity, traces of fine gravel, with silt.	D	VSt	
								At 1.2m, as above, but colour changes to grey-red.	D	VSt	
2					2.50			At 2.3m, as above, but with shale fragments.		VSt	
3								End of borehole at 2.5 metres. Target Depth.			
4											

See standard sheets for details of abbreviations & basis of descriptions

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DYNAMIC CONE PENETROMETER LOG SHEET

Client: Cornerstone Construction and Development

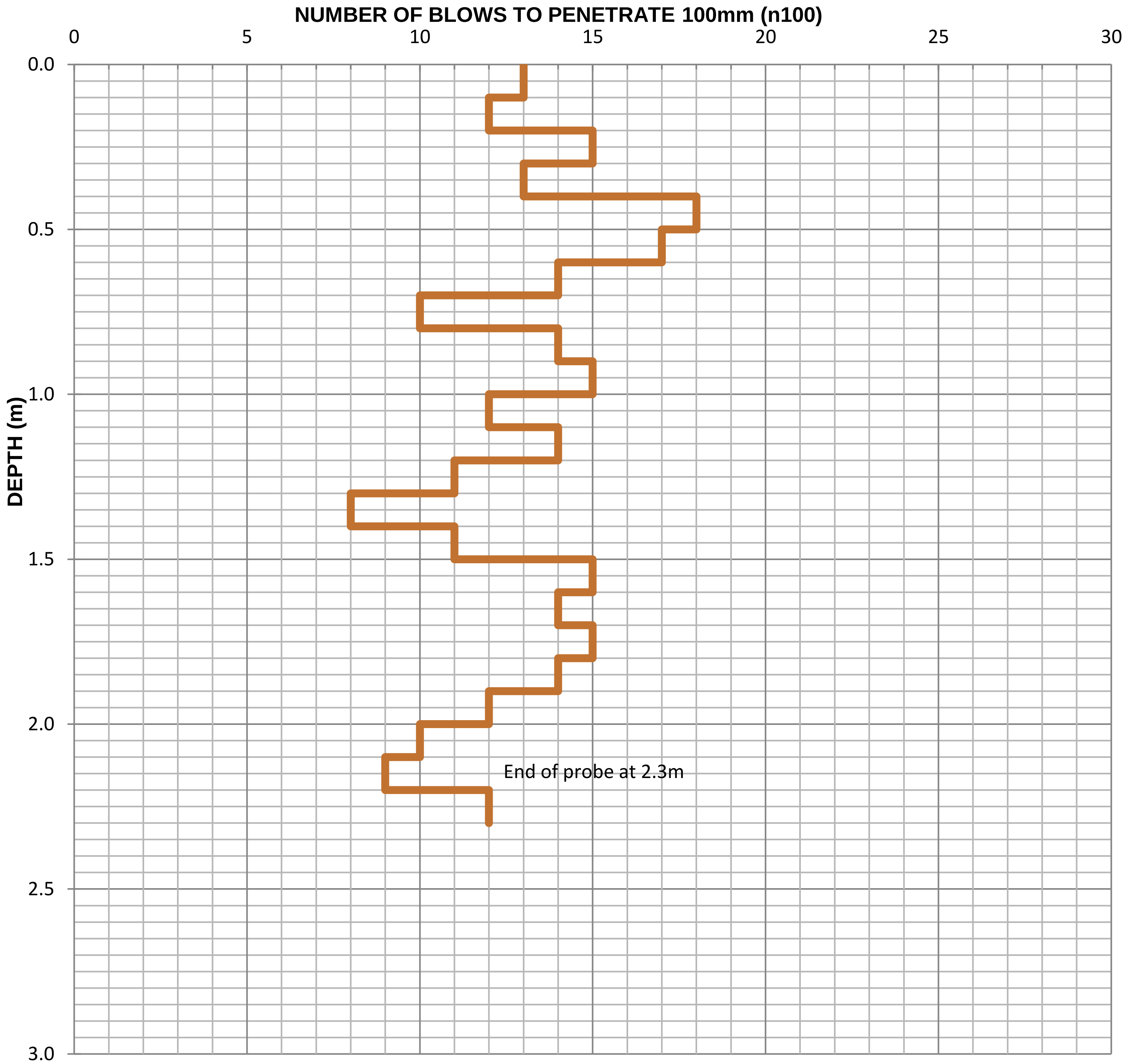
Project: Proposed New Childcare Centre

Location: **110-112 Mt Vernon Rd, Mt Vernon**

PROBE: DCP 3

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** -	**Operator:**	MS & SH
Elevation: -	**Offset:** -	**Date:**	14/05/2018
Adjacent Test Hole / Pit:		**Checked:**	
Position Relative to Test Hole / Pit:		**Date:**	



Comments:

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BOREHOLE LOG SHEET

Client : Cornerstone Construction and Development
Project : Proposed New Childcare Centre
Location : 110-112 Mt Vernon Rd, Mt Vernon

HOLE No. BH4

SHEET 1 OF 1

Position : Refer to test location plan		**Surface RL:**	**Angle from Horiz. :** 90°	**Processed :** S.H	
Rig Type : Cristie	**Mounting:** Mounting 4-WD	**Contractor :**	**Driller :** D.S	**Checked :** K.O	
Date Started : 14/5/2018		**Date Completed :** 14/5/2018	**Logged by :** M.S	**Date:**	

Note: * indicates signatures on original issue of log or last revision of log

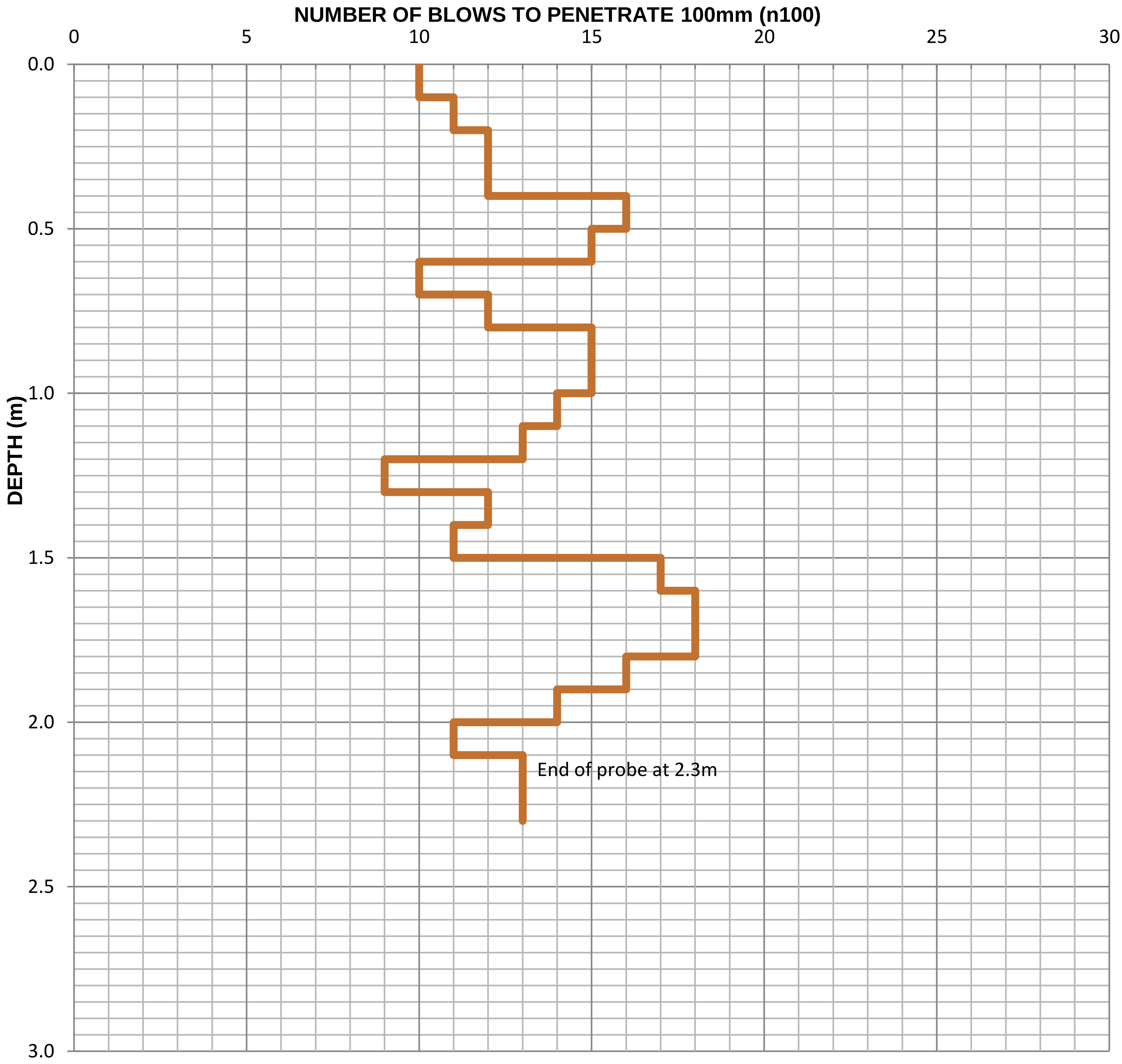
DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	TC-bit auger	Nil	None Encountered		0.10			Clayey SAND; dark brown, fine to medium grained sand, traces of fine gravel, traces of organic content (i.e. grass rootlets etc.) (topsoil).			
					0.60			Silty CLAY; brown-yellow, low to medium plasticity, with fine to coarse grained gravel.	SM	St-VSt	
1							CI	CLAY; red brown, medium plasticity, traces of fine gravel, with silt.	SM	VSt	
								At 1.3m, as above, but colour changes to grey-red.		VSt	
2					2.70						
3								End of borehole at 2.7 metres. Target Depth.			
4											

See standard sheets for details of abbreviations & basis of descriptions

DYNAMIC CONE PENETROMETER LOG SHEET

Client:	Cornerstone Construction and Development	**PROBE: DCP 4**
Project:	Proposed New Childcare Centre	
Location:	**110-112 Mt Vernon Rd, Mt Vernon**	AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** -	**Operator:**	MS & SH
Elevation: -	**Offset:** -	**Date:**	14/05/2018
Adjacent Test Hole / Pit:		**Checked:**	
Position Relative to Test Hole / Pit:		**Date:**	



Comments:

CONSULTING GEOTECHNICAL ENGINEERS
Unit 3, 20-22 Barry Road, Chipping Norton, NSW, 2170 Australia
Telephone: 61 2 7900 2489 Mob: 61 434 837 859 Email: admin@greywacke.com.au
GREYWACKE GEOTECHNICS

Job No.
COCD0206 - GEO AA

Appendix D – Laboratory Test Certificates

AUSTRALIAN SOIL AND CONCRETE TESTING (A.S.C.T.)

ASCT Sydney South Laboratory
Unit 18, 2-8 Daniel Street, Wetherill Park NSW

Telephone: (02) 9725 5842
E-Mail: sydney.south@asct.com.au
Mobile: 0410 609 142
A.B.N. 92 328 384 368

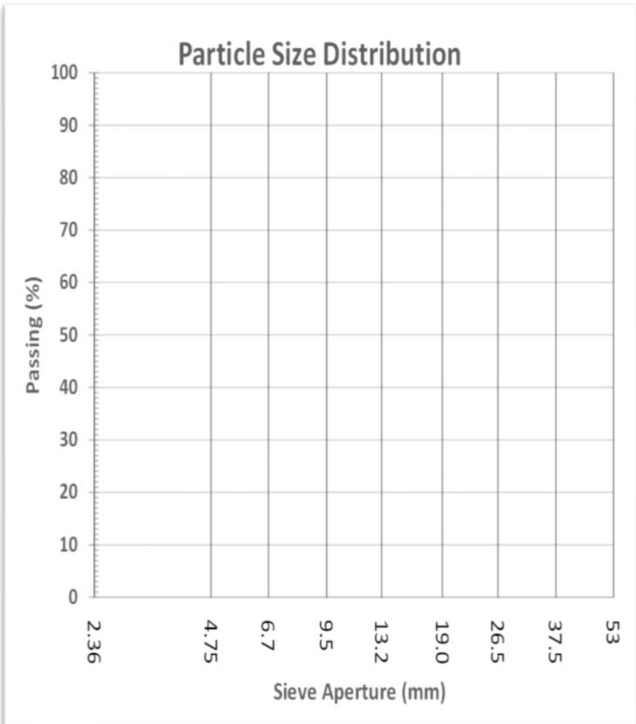
Report on PSD (AS1289.3.6.1) and AS Atterbergs

Client:	Greywacke Geotechnics	Report No:	**2**
Client Address:	1, 182 Waldron Road, Chester Hill, NSW 2162	Report Date:	29/05/2018
Project:	110-112 Mt Vernon Road, Mount Vernon	Report Page:	Page 1 of 2
Works Component:	BH3	Project No:	59
Material Used:	Existing	Test Request:	ID:1
Material Description:	Silty Clay	Lot Number:	Borehole 3
		ITP/PCP Number:	N/A
Lot Comments:	-	Control Line:	N/A

Sample Number	Sample Date	Chainage/Location	Offset	Level of Test	Test Depth
8022	**Client**	**N/A**	**N/A**	**1.0-1.2m**	**N/A**

Test Parameter	Units	Result	Specification Limits
Pre-Treatment	Units	**Result**	**Specification Limits**
Retained 53.0mm Sieve	%		
Pretreatment by Weathering	%		
Pretreatment by Compaction	%		
Particle Size Distribution	Units	**Result**	**Specification Limits**
Passing Sieve - 150mm	%		
Passing Sieve - 125mm	%		
Passing Sieve - 100mm	%		
Passing Sieve - 75mm	%		
Passing Sieve - 53mm	%		
Passing Sieve - 37.5mm	%		
Passing Sieve - 26.5mm	%		
Passing Sieve - 19.0mm	%		
Passing Sieve - 13.2mm	%		
Passing Sieve - 9.5mm	%		
Passing Sieve - 6.7mm	%		
Passing Sieve - 4.75mm	%		
Passing Sieve - 2.36mm	%		
Passing Sieve - 1.18mm	%		
Passing Sieve - 0.600mm	%		
Passing Sieve - 0.425mm	%		
Passing Sieve - 0.300mm	%		
Passing Sieve - 0.150mm	%		
Passing Sieve - 0.075mm	%		

Specification Name



Sampling & Test Methods
AS 1289.1.4.2: Stratified Random Number Method
AS1141.3.1, Cl 9.3: Sampling aggregates - Powered - Backblading
AS 1289.1.1: Preparation of disturbed soil samples for testing
AS 1289.3.6.1: Particle Size Distribution of a soil (Standard, by Sieving)
AS 1289.3.1.1: Liquid Limit, Four point Casagrande
AS 1289.3.2.1: Plastic Limit of a soil
AS 1289.3.3.1: Plasticity Index of a soil
AS 1289.3.4.1: Linear Shrinkage of a soil

Report Remarks & Endorsement

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA Accreditation number: 20078

Issued By: D.Heathcote
Approved Signatory

ASCT Doc # WB12 - Rev 2, 30/04/2018

AUSTRALIAN SOIL AND CONCRETE TESTING (A.S.C.T.)

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Report on PSD (AS1289.3.6.1) and AS Atterbergs

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Project:	110-112 Mt Vernon Road, Mount Vernon	Report Page:	Page 2 of 2
Works Component:	BH3	Project No:	59
Material Used:	Existing	Test Request:	ID:1
Material Description:	Silty Clay	Lot Number:	Borehole 3
Lot Comments:	-	ITP/PCP Number:	N/A
		Control Line:	N/A

PSD Curve Characteristics	Units	**Result**	**Specification Limits**	**Remarks**
Ratio A - 0.425mm/2.36mm	--			
Ratio B - 0.075mm/0.425mm	--			
Ratio C - 0.0135mm/0.075mm	--			
D60	mm			
D30	mm			
D10	mm			
Coefficient of Uniformity (Cu):	--			
Coefficient of Curvature (Cc):	--			
Plasticity	Units	**Result**	**Specification Limits**	**Remarks**
Liquid Limit	%	**48**		Oven Dried & Dry Sieved
Plastic Limit	%	**27**		Oven Dried & Dry Sieved
Plastic Index	%	**21**		Oven Dried & Dry Sieved
Linear Shrinkage	%	**6.0**		Oven Dried & Dry Sieved. Cracked/Broken Bar
WPI (Weighted Plasticity Index)	--			
WLS (Weighted Linear Shrinkage)	--			

www.greywacke.com.au

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