FORTIFY
GEOTECH

Proposed Campbelltown Arts Centre Expansion Project - 1 Art Gallery Road, Campbelltown, NSW

CLIENT

Campbelltown City Council

ADDRESS

1 Art Gallery Road
Campbelltown NSW 2560

LEGAL DESCRIPTION

Lot 500 DP777387
Lot B DP157318
Lot 1 DP1038779
Lot 2 DP259807
Lot 3 DP259807

DATE

March 2026

39 Sydenham Road, Marrickville, NSW 2204
PO Box 9225, Deakin ACT 2600

Consulting Engineers

(02) 9188 4033
FortifyGeotech.com.au

10 March 2026
Our ref: S2349_GI_02_Rev1

Campbelltown City Council

Via email: Mieke.Buchhorn@campbelltown.nsw.gov.au
Attention: Mieke Buchhorn

Proposed Campbelltown Arts Centre Expansion Project – Campbelltown Arts Centre, 1 Art Gallery Road, Campbeltown, NSW 2560

Geotechnical Investigation Report

We are pleased to present our geotechnical investigation report for the proposed Campbelltown Arts Centre expansion development, located at 1 Art Gallery Road, Campbelltown, NSW.

The report outlines the methods and results of exploration, describes site subsurface conditions, and provides recommendations for building footing design, excavation conditions, preparation of subgrades, stability of cut and fill batters, design parameters for temporary and permanent excavation support, provides aggressivity test results and exposure classification, point load rock strength index test results, indicative design CBR values, and site drainage advice.

Should you require any further information regarding this report, please do not hesitate to contact our office.

Yours faithfully
Fortify Geotech

Written by;

Joe Stuart
Geotechnical Engineer

Reviewed by;

Manuel Neves
Principal Geotechnical Engineer
MICE CEng RPEQ RPEV PhD
Registered PE of Queensland (RPEQ) # 32190
VIC PE Registration # PE0006524
NSW PE Registration # PRE0002314

About us

We work with our clients to provide practical advice and solutions tailored to each project. Our professional services are reliable, responsive and efficient.

Our highly capable Geotechnical Engineers and Geologists have a comprehensive understanding of the industry. We provide the best engineering solution for complicated geotechnical engineering issues. This has earned us a solid reputation with our Construction Industry, Municipal and Government clients

INDUSTRIES WE WORK IN

- Residential
- Commercial
- Transport Infrastructure
- Industrial Developments of all sizes.

SERVICES

- Geotechnical Site Investigations and Reporting;
- Engineering Geology;
- Mining/Rock Geotechnics;
- Foundation Engineering;
- Dam Engineering; Embankment Design and Specification;
- Geotechnical Design Recommendations;
- Pavement Engineering and Design;
- Pavement Condition Surveys;
- Slope Stability and Risk Assessments;
- Geotechnical and Hydrological Instrumentation and Monitoring;
- Footing and Excavation Supervision and Certifications;
- Excavated soil/rock assessments and VENM assessments;
- Supervision and Certification of Earthworks and Controlled Fill, including Level 1 supervision;
- Geotechnical Construction Specifications;
- Deep Excavation Support; and
- Slope/Retaining Structure Analysis and Design

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Geotechnical Investigation Report

QUALITY INFORMATION

Revision history

Reference/ Revision	Description	Date	Author	Reviewer
S2349_GI_02_Rev0	First Issue	05/03/2026	JOE	MN
S2349_GI_02_Rev1	Revision to incorporate Client's comments	10/03/2026	JOE	MN

Campbelltown City Council

Proposed Campbelltown Arts Centre Expansion Project – 1 Art Gallery Road, Campbelltown, NSW

Geotechnical Investigation Report

1 PROJECT OVERVIEW

1.1 INTRODUCTION

This Geotechnical Investigation Report prepared by Fortify Geotech on behalf of Campbelltown City Council is submitted to the Department of Planning, Housing and Infrastructure (DPHI) in support of a State Significant Development Application (SSDA) for the expansion of the existing Campbelltown Arts Centre (CAC) on land at 1 Art Gallery Road, Campbelltown (the site).

This SSDA seeks approval for:

- Demolition of parts of the existing buildings and structures on site.
- Expansion and redesign of the existing CAC, including the following elements:
  - Reorientation of the building towards Queen Street in the north to create a more substantial, welcoming and visible connection to the City Centre.
  - Addition of a new 350 seat theatre with back of house facilities.
  - Providing rehearsal spaces, creative and educational workshop areas, and community facilities.
  - Provision of ancillary artists' residences.
  - Provision of commercial spaces including a café/restaurant, retail, and conference facilities.
  - Provision of expanded gallery spaces for the exhibition of artists' collections and dedicated storage for loaned artworks and collections.
- Landscaping works including provision of feature planting and paving.
- Expansion and reconfiguration of at grade car parking.
- Extension and augmentation of services and infrastructure as required.

For a further detailed project description, please refer to the Environmental Impact Statement prepared by Colliers Urban Planning, the Architectural Drawings prepared by fjcstudio, and the other accompanying technical documents that form part of the State Significant Development Application.

1.2 THE SITE

The site is located at 1 Art Gallery Road, Campbelltown and is legally identified as Lot 500 DP777387, Lot B DP157318, Lot 1 DP1038779, Lot 2 DP259807 and Lot 3 DP259807, as illustrated in the Site Aerial at Plate 1-1. It is situated within the Campbelltown local government area (LGA) immediately southwest of the Campbelltown City Centre and railway station. The existing development on site consists of the current Campbelltown Arts Centre, characterised by a double storey built form with open space and an at-grade carpark.

The site is bounded by Art Gallery Road to the west, Narellan Road to the south, Oxley Street to the east and Camden Road to the north. The northern part of the site is separated from the southern portion by Art Gallery Road as shown in Plate 1-1. The site comprises a total site area of approximately 18,877m^2.

Plate 1-1: Site Aerial (source: Nearmap / Colliers Urban Planning)

1.3 RELEVANT SEAR TO THIS REPORT

This Geotechnical Investigation Report has been prepared in response to the Secretary's Environmental Assessment Requirements (SEARs) for the proposed development dated 7 August 2024 for SSD-74509208. Specifically, this report has been prepared response to those SEARs outlined in Table 1-1 below.

Table 1-1: Secretary's Environmental Assessment Requirements relevant to this Report

SEAR	SEAR Description	Section this is addressed and summary of response
13. Ground and Water Conditions	Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity and acid sulfate soils.	Whole Report

2 SITE DESCRIPTION & GEOLOGY

3 INVESTIGATION METHODS

An initial investigation in 2025 comprised, twenty (20) boreholes drilled at the site, designated as BH01-BH10, BH12-BH20, & BH33, and drilled to a target depth of 2 m / 8 m. The site investigation was conducted between the 15th - 16th of January 2025, and 18th-19th February 2025, comprising eighteen (18) augered boreholes to a target depth of 2 m/ 5 m or shallower refusal in bedrock, and two (2) augered and cored boreholes to a target depth of 8 m or 3 m into competent bedrock. The boreholes were drilled using both a truck-mounted drill rig, and a CE 180 track mounted drill rig, both fitted with solid flight augers and tungsten carbide (TC) bit. A NMLC triple-tube core barrel (~52mm internal diameter), with diamond impregnated drill-bit, was used to core the bedrock. Water was used as the recirculating fluid. SPT (Standard Penetration Testing) was conducted in boreholes BH14 and BH15 with testing intervals of 1.5 m until refusal, aiming to ascertain the in-situ consistency and inferred density of the soil profiles. Three (3) samples for aggressivity, three (3) samples for Atterberg Limit testing, two (2) samples for California Bearing Ratio (CBR), and two Particle Size Distribution (PSD) tests were taken at varying depths across these boreholes. Deep groundwater monitoring wells were installed in boreholes BH8, BH18, and BH20.

A supplementary site investigation was undertaken on 11 February 2026, comprising a total of (8) boreholes, designated BH01A to BH08A, drilled to depths between 1 m and 2 m within the existing carpark south of the existing Art Gallery, with four (4) boreholes designated for geotechnical investigation. These boreholes were advanced using a ute-mounted drill rig fitted with solid flight augers. Two (2) samples were collected for CBR testing of the subgrade material.

The auger profiles were visually logged in accordance with AS1726-2017 and, where appropriate, the Unified Soil Classification System (USCS). Definitions of geotechnical engineering terms used on the logs and in this report, including a copy of the USCS chart, are provided in Appendix F.

The aim of the investigation was to:

i. Assess the subsurface conditions at the site, including the extent, nature and depth of any fill materials, underlying natural soils and bedrock type, as well as depth to groundwater (including 1 measurement of groundwater monitoring wells).

ii. Provide relevant soil and rock geotechnical parameters to inform the design.

iii. Provide a site classification to AS2870-2011 “Residential Slabs & Footings”.

iv. Advise on suitable footings systems, founding depths, allowable bearing pressures and design parameters for piles, including likely strength reduction factor and exposure classification.

v. Advise on excavation conditions, suitability of excavated material for use in controlled fill platforms and advice for construction of building platforms.

vi. Provide design parameters for temporary and permanent excavation support.

vii. Advise on pavement subgrade preparation and provide indicative design CBR values.

viii. Provide aggressivity test results and exposure classification.

ix. Provide point load rock strength index test results.

x. Assess the earthquake risk classification with accordance with AS 1170.4-2007.

xi. Provide drainage and other geotechnical advice.

4 INVESTIGATION RESULTS

4.1 SUBSURFACE CONDITIONS

Local geology maps document both sites to be underlain by Triassic age Ashfield Shale bedrock, part of the Wianamatta Group, which consists of black to dark grey shale and laminate. Quaternary alluvium has been deposited in and adjacent to Fishers Ghost Creek water course which runs along the northern area of the site. A layer of residual soils is expected to overlay the existing bedrock, which will in turn be underlying fill materials associated with the urban development.

A total of forty-four (44) boreholes have been carried out, in the area of interest, to infer subsurface conditions and assist with the contamination assessment for the proposed development. These exploratory boreholes have been completed across two rounds of investigation, respectively in 2025 and 2026. The inferred subsurface profile is summarised in Tables 4.1 and 4.2, whilst the results of the in-situ Standard Penetration Tests (SPT) conducted during the 2025 investigative works are summarised in Table 4.3.

Table 4-1: Subsurface Conditions

Geological Profile	Unit	Description
FILL	Unit 1	**CONCRETE, ASHPHALT, Silty SAND, Gravelly SAND, Sandy SILT, Sandy GRAVEL;** fine to coarse grained, fine to medium gravel, dark brown, orange brown, brown with black and grey, trace anthro (metal, concrete), trace/with fine to coarse gravels.
NATURAL SOIL (RESIDUAL/ ALLUVIUM)	Unit 2	**Silty CLAY, Sandy SILT, CLAY, Gravelly CLAY, Sandy CLAY, CLAY;** low to medium plasticity, fine to medium gravels, fine to medium sand brown, pale brown, pale grey trace orange, black and red mottled, red brown Trace/with fine to medium sand, trace fine to medium gravels.
WEATHERED SHALE BEDROCK	Unit 3a	**(Class V) SHALE, SILTSTONE; extremely weathered (XW), excavates as Gravelly Silty CLAY, Clayey GRAVEL;** medium plasticity, fine to medium gravels, grey, orange brown, with fine to medium gravels.
	Unit 3b	**(Class IV) SHALE; highly weathered (HW),** excavates as Silty CLAY; low to medium plasticity, dark grey, low strength.
	Unit 3c	**(Class III) SHALE; highly/moderately weathered (MW),** fine grained, dark grey, medium strength.

Table 4-2: Borehole Summary with Depth to Top of Layer

Borehole ID. (Total Depth m)	Depth from existing groundsurface level to top of unit (m)			
	Unit 2	Unit 3a	Unit 3b	Unit 3c
	Residual/Alluvial Soil	Class V Shale	Class IV Shale	Class III Shale
BH1 (0.5)*	*N.E*	*N.E*	*N.E*	*N.E*
BH2 (2.0)	**0.4**	*N.E*	*N.E*	*N.E*
BH3 (3.0)	**0.1**	*N.E*	*N.E*	*N.E*
BH4 (2.0)	**0.3**	*N.E*	*N.E*	*N.E*
BH5 (2.0)	**0.2**	*N.E*	*N.E*	*N.E*
BH6 (2.0)	**0.3**	*N.E*	*N.E*	*N.E*
BH7 (2.0)	**0.4**	**1.0**	*N.E*	*N.E*
BH8 (5.0)	**0.4**	*N.E*	*N.E*	*N.E*
BH9 (3.0)	**0.9**	*N.E*	*N.E*	*N.E*
BH10 (2.0)	*N.E*	**1.5**	*N.E*	*N.E*
BH12 (3.0)	**1.3**	*N.E*	*N.E*	*N.E*
BH13 (3.0)	**0.2**	*N.E*	*N.E*	*N.E*
BH14 (8.0)	**0.9**	*N.E*	*N.E*	*N.E*
BH15 (5.9)	*N.E*	**0.55**	**2.0**	**4.5**
BH16 (3.0)	**1.4**	**2.4**	*N.E*	*N.E*
BH17 (1.7)	**1.0**	**1.2**	**1.6**	*N.E*
BH18 (5.0)	**1.5**	**2.2**	**2.8**	*N.E*
BH19 (2.0)	**0.8**	**1.5**	*N.E*	*N.E*
BH20 (2.0)	**0.1**	**1.7**	*N.E*	*N.E*
BH33 (2.0)	**0.3**	*N.E*	*N.E*	*N.E*
BH01A	**0.3**	**1.5**	*N.E*	*N.E*
BH03A	**0.3**	**1.8**	*N.E*	*N.E*
BH07A	**0.3**	**1.8**	*N.E*	*N.E*
BH08A	**0.3**	*N.E*	*N.E*	*N.E*

N.E – Not encountered, * Borehole terminated in fill material.

Table 4-3: SPT Result Summary

Depth from existing groundsurface levels (m)	N-Value	Geological Profile	Relative Density
1.5	22 (BH14) Refusal (BH15)	RESIDUAL XW Shale	Very Stiff Hard
3	15 (BH14)	RESIDUAL	Stiff
4.5	13 (BH14)	RESIDUAL	Stiff
6	33 (BH14)	RESIDUAL	Very Stiff
7.5	23 (BH14)	RESIDUAL	Very Stiff

4.2 DYNAMIC CONE PENETROMETER (DCP) TESTING

To determine the density/relative consistency of the subsurface profile, eight Dynamic Cone Penetrometer (DCP) tests was conducted on 16/17th January 2025 in accordance with AS1289.6.3.2 "Determination of the penetration resistance of a soil – 9kg dynamic cone penetrometer test". The DCP results are shown in Table 4-4 below. The DCP test was taken from existing groundsurface levels. The approximate location of the DCP test is shown in Figure 2.

Table 4-4: DCP Testing Results (2025 Investigation)

Depth below existing groundsurface (m)	Blows per 100mm penetration							
	DCP01	DCP05	DCP07	DCP09	DCP10	DCP16	DCP17	DCP19
0.1	2	5	2	2	20	3	2	1
0.2	4	11	4	4	20	10	4	5
0.3	7	8	8	4	18	22	3	6
0.4	8	8	14	5	10	18	3	8
0.5	10	8	20	3	12	6	2	6
0.6	9	8	22	4	11	4	3	7
0.7	6	11	20	3	9	4	1	10
0.8	9	17	25	4	8	6	3	15
0.9	8	20	-	5	6	3	6	16
1.0	8	25	-	2	6	5	8	18
1.1	6	-	-	4	5	6	12	22
1.2	6	-	-	4	10	3	30	25
1.3	7	-	-	8	12	2	25	-
1.4	-	-	-	9	9	4	-	-
1.5	-	-	-	11	8	5	-	-
1.6	-	-	-	15	5	6	-	-
1.7	-	-	-	16	10	8	-	-
1.8	-	-	-	12	11	7	-	-
1.9	-	-	-	12	12	11	-	-
2.0	-	-	-	14	-	14	-	-

Table 4-5: DCP Test Results (2026 Investigation)

Depth below existing groundsurface (m)	Blows per 100mm penetration			
	DCP01A	DCP03A	DCP06A	DCP07A
0.1	*E*	*E*	*E*	*E*
0.2	*E*	*E*	*E*	*E*
0.3	*E*	*E*	*E*	*E*
0.4	7	*E*	*E*	*E*
0.5	9	2	*E*	*E*
0.6	9	4	5	*E*
0.7	11	5	8	2
0.8	12	5	7	3
0.9	10	5	6	3
1.0	10	6	4	4
1.1	9	10	4	7
1.2	10	12	3	11
1.3	12	16	8	10
1.4	14	25+	13	14
1.5	25+		25+	25+

NOTE: Excavated - E

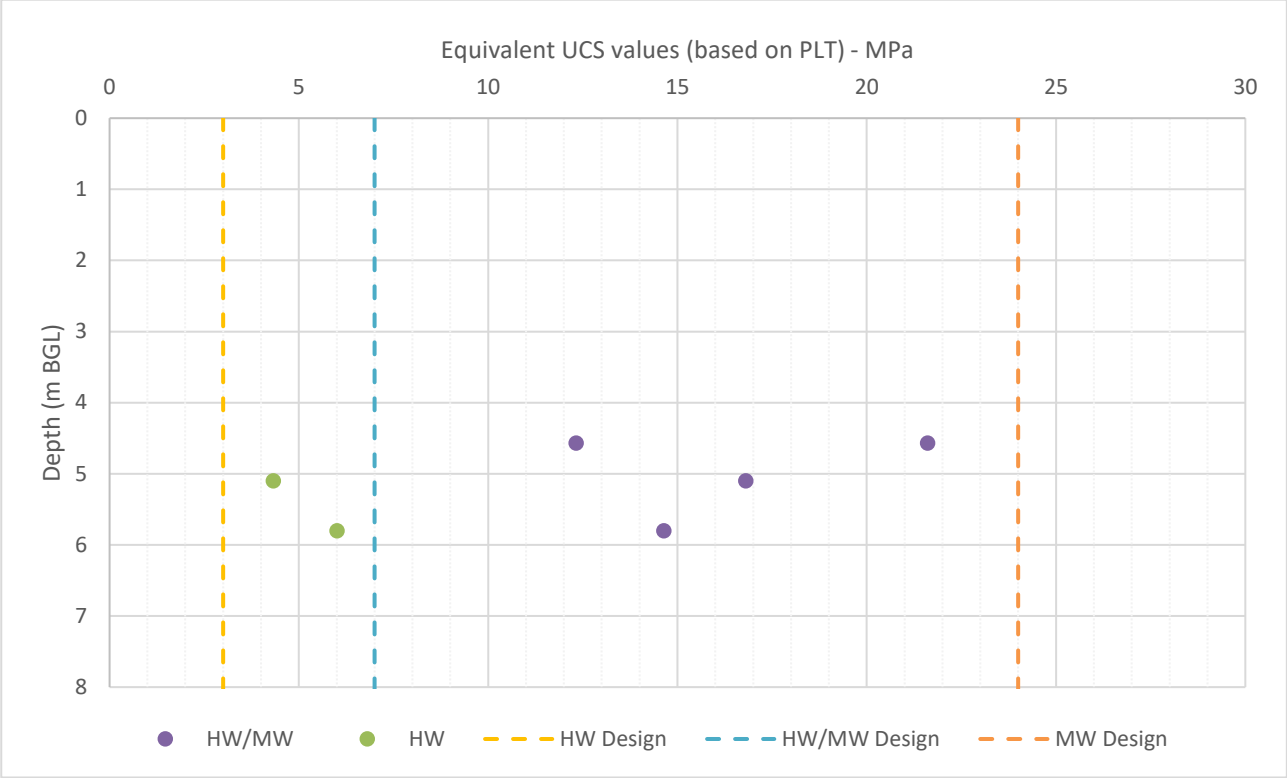
4.3 POINT-LOAD STRENGTH INDEX TESTING

A total of six (6) point-load strength index tests were carried out on selected rock core specimens. The index values were used to derive the approximate compressive strength of the rock by applying the empirical relationship $q_u = 24 \times I_s(50)$ (Broch, E. & Franklin, J. A. (1972), "The Point-Load Strength Test", trans., Inst. Min. Metall.), where q_u is the ultimate compressive strength. The test method and calculation of point-load strength index $I_s(50)$ is in accordance with the test methods outlined by the International Society for Rock Mechanics (ISRM (1972), "Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point-Load Strength Index", Committee on Laboratory Tests - Document No.1, Int. Soc. Rock Mechanics.). Testing was conducted both diametrially, with force applied parallel to the direction of lamination, and axially, with force applied perpendicular to the direction of lamination. Results of the point-load testing are presented in Appendix C. Estimated values of compressive strengths of the site bedrock are summarised in Table 4-6 and plotted versus depth on Plate 4-1.

Table 4-6: Estimated Rock Compressive Strengths

Test Method	Estimated Compressive Strength		Number of Point Load Tests
	Range (MPa)	**Average (MPa)**	
Diametrial	4.33 – 12.4	7.6	6
Uniaxial	14.6 – 21.6	17.6	

Plate 4-1: Equivalent UCS values based on Point Load testing



4.4 GROUNDWATER

As a part of the 2025 site investigation, three (3) groundwater wells (GW1 to GW3) were installed and monitored by Reditus Consulting. The monitoring campaign reported standing ground water levels of between 2.0 m to 3.86 m below top of casing level. Wet soils were also encountered within BH15 between 4-5m depth below ground level, inferred as the existing groundwater table. Groundwater levels may fluctuate depending on climate conditions and temporary perched groundwater seepages may be encountered at shallower depth within any fine-grained pockets of material within the fill materials, particularly after rainfall.

4.5 CONTAMINATED SOILS

Fill material was encountered up to 1.5m depth, however, no noticeable signs of contamination, e.g. traces of asbestos or petroleum/diesel odours, were encountered during the sitework.

5 LABORATORY TESTING

5.1 AGGRESSIVITY SUITE TEST RESULTS

Five representative samples of the soil from auger holes, designated BH14/1-BH14/3 & BH15/1-BH15/2, sampled between 18th – 19th February 2025 were tested in a NATA laboratory for aggressivity (Cl, SO4, pH & EC).

Results of the laboratory tests performed on the soil samples are summarised in Table 5-1. The NATA certificates are attached in Appendix D.

Table 5-1: Aggressivity Suite Laboratory Test Results Summary

Sample No.	BH14/1	BH14/2	BH14/3	BH15/1	BH15/2
Depth of sample	**1.5m**	**2.0m**	**4.5m**	**1.0m**	**4.2m**
Material Description	RESIDUAL; Silty CLAY	RESIDUAL; CLAY	RESIDUAL; CLAY	XW Shale	HW Shale
pH	6.8	6.7	7.8	7.4	8.9
Electrical Conductivity (µS/cm)	380	480	770	120	270
Chloride, Cl (mg/kg)	420	530	970	42	75
Sulphate, SO4 (mg/kg)	110	160	140	38	99

5.2 CALIFORNIA BEARING RATIO (CBR) TESTING

Three representative samples of the soil from BH2, BH6, and BH20 were sampled on 21 February 2025 and have been tested in a NATA accredited laboratory for standard compaction and four-day soaked CBR value.

Results of soaked CBR laboratory tests performed on the soil samples is summarised in Table 5-2. The CBR test specimen were compacted to a nominal 98% Standard Maximum Dry Density (StdMDD) at about Optimum Moisture Content (OMC) and soaked for four days prior to testing. The NATA accredited laboratory test results are included in Appendix C.

Table 5-2: Laboratory CBR Test Results Summary

Sample No./Depth	Standard Compaction		Soaked CBR			
	Max. Dry Density (t/m^3)	Opt. Moisture Content (%)	Placement Moisture Content (%)	Laboratory Density Ratio (%)	Swell After Soak (%)	CBR Value (4-day soak) (%)
BH2: 0.5 – 1.0m	1.72	19.0	19.1	98.0	2.5	2.0
BH6: 0.5-1.0 m	1.75	18.5	18.4	98.0	2.0	3.0
BH20: 0.5 – 1.0m	3.5	1.60	22.4	98.0	1.0	3.5
BH01A-BH07A: 0.5 – 1.0m	1.72	20.0	20.3	98.0	1.0	4.5

BH08A: 0.5 – 1.0m	1.73	18.5	18.2	98.5	0.5	8.0

5.3 ATTERBERG LIMIT TESTING AND PARTICLE SIZE DISTRIBUTION TESTING

The results of the Atterberg Limit Testing and particle size distribution are summarised in Table 5-3.

Table 5-3: Atterberg Limits and Particle Size Distribution Test Results Summary

Sample No./Depth	Particle Size Distribution (%)			Atterberg Limits (%)			
	Fines	Sand	Gravel	LL	PL	PI	LS
BH2: 0.5 – 1.0m	88	11	1	38	20	18	8.0
BH6: 0.5 - 1.0m	92	8	0	38	17	21	10.0
BH17: 0.5 – 1.0m	57	24	19	34	17	17	8.5
BH20: 0.5 – 1.0m	90	8	2	46	19	27	10.0

Where: LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
LS = Linear Shrinkage
NO = Not Obtainable
NP = Non-Plastic

6 DISCUSSION & RECOMMENDATIONS

6.1 SITE CLASSIFICATION

Although AS2870-2011 “Residential Slabs & Footings” provides a site classification based on the expected groundsurface movement specifically for residential footing systems, it has been included in this report as a design guidance.

Due to the presence of uncontrolled fill material up to 1.5m depth, the site is designated as Class “P” (problem) site in accordance with AS2870-2011 “Residential Slabs & Footings”. If the fill is removed, and replaced with controlled fill, or if footings are founded in the natural soil or bedrock below the fill, a Class “M” (moderately reactive) category can be used in design of new footings. The characteristic ground surface movement “Y_s”, as defined by AS2870-2011 for the range of extreme dry to extreme wet moisture conditions is estimated to be between 20mm and 40mm.

Deemed-to-comply footing designs provided by AS2870-2011 are applicable specifically to residential-style one and two-storey structures, or buildings with similar loads and superstructure stiffness, and shall not apply when any of the provisions in Clause 3.1.1 of AS2870-2011 is met.

6.2 GEOTECHNICAL DESIGN PARAMETERS

The key geotechnical parameters of the soil units relevant for the proposed development are summarised in Table 6.1. These have been based on the in-situ testing carried out during the intrusive investigation, in combination with a visual assessment observation of these materials and previous experience with these materials.

Table 6-1: Key Geotechnical Design Parameters

Unit	Typical description	Bulk Density γ_b (kN/m^3)	Effective Cohesion c' (kPa)	Friction Angle φ' (°)	Undrained Shear Strength s_u (kPa)	Design UCS (MPa)	Drained Young's Modulus E' (MPa)	Poisson's Ratio ν
Unit 1: Fill	Silty SAND, Gravelly SAND, Sandy SILT, Sandy GRAVEL	18	0	28	N/A	N/A	8	0.3
Unit 2: Natural Soil	Silty CLAY, Sandy SILT, CLAY, Gravelly CLAY, Sandy CLAY, CLAY	19	5	25	100	N/A	20	0.3
Unit 3a: (Class V) Shale Bedrock		22	10	21	N/R	1	65	0.25
Unit 3b: (Class IV) Shale Bedrock		23	50	23	N/R	2	130	0.25
Unit 3c: (Class III) Shale Bedrock		23	100	28	N/R	7	300	0.2

N/A – Not applicable N/R – Not relevant

Table 6-2 provides preliminary coefficients of lateral earth pressure for the soils and rock encountered during the geotechnical investigation. The coefficients provided are based on a horizontal ground surface.

Table 6-2: Preliminary Coefficients of Lateral Earth Pressure

Unit : Typical description	Coefficient of Earth Pressure at Rest (K_0)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Passive Earth Pressure (K_p)
Unit 1: Fill	0.53	0.36	2.77
Unit 2:Natural Soil	0.58	0.41	2.45
Unit 3a: (Class V) Shale Bedrock	0.64	0.47	2.77

Unit : Typical description	Coefficient of Earth Pressure at Rest (K_0)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Passive Earth Pressure (K_p)
Unit 3b: (Class IV) Shale Bedrock	0.61	0.44	3.00
Unit 3c: (Class III) Shale Bedrock	0.53	0.36	3.69

6.3 STRESS RELIEF

Given the relative young geological age of the rock formation and lack of stress relieving geological conditions, stress relief is expected to occur upon excavation of the bedrock. Such stress relief will result in horizontal movements into the excavation. Within the Ashfield Shale geological formation, such horizontal movements are typically a maximum of 0.15% of the excavation height, and as low as 0.05% of the excavation height. Based on a maximum excavation depth of 4.45m, a horizontal deflection of between 3mm and 9mm is expected. The maximum deflections will occur where there is the least restraint (i.e. in the centre along the longest excavated side of the site).

Active anchoring or propping of the excavation is unlikely to be sufficient to resist the relatively high in-situ horizontal stresses associated with stress relief movements. Therefore, it is recommended that appropriate allowance be made for movements of this order in construction and planning.

It is recommended that monitoring of excavation faces should be carried out to assess vertical and horizontal movements during excavation. Inclinometers could also be installed into soldier pile shoring walls to measure actual horizontal deflections. The geotechnical engineer must be supplied with the monitoring data to check for any unsual or large deflections that may require remediation.

6.4 BUILDING FOOTINGS

The foundations of structures founded at existing grade, footings and thickened sections of slabs forming footings, should be founded below any topsoil or fill material, and founded in the underlying stiff residual soils or weathered bedrock. A depth of ~0.5/1.5m from existing levels may be required to reach a suitable founding stratum. Alternatively, bored piers founded in Class V or better bedrock below ~0.55/8m depth could be used.

If designing footings based on engineering principles, recommended allowable end-bearing pressures for various footing systems and likely foundation materials are provided in Table 6.3.

Table 6-3: Recommended Allowable Bearing Pressure for Footings

Foundation Material Type	Depth Below Existing Surface Level (m)	Allowable End-Bearing Pressure			Allowable Shaft Adhesion on Bored Piers and Anchors	
		Strips	Pads	Bored Piles	Downward Loading	Uplift
Newly Placed Controlled Fill	-	100kPa	125kPa	N/A	N/A	N/A

Foundation Material Type	Depth Below Existing Surface Level (m)	Allowable End-Bearing Pressure			Allowable Shaft Adhesion on Bored Piers and Anchors	
		Strips	Pads	Bored Piles	Downward Loading	Uplift
Unit 2: Stiff Natural Soil	~0.2/1.5	120kPa	150kPa	200kPa	20kPa	15kPa
Unit 3a: (Class V) Shale Bedrock	~0.55/>8	150kPa	175kPa	500kPa	20kPa	10kPa
Unit 3b: (Class IV) Shale Bedrock	~1.6/>8	500kPa	750kPa	1,000kPa	100kPa	50kPa
Unit 3c: (Class III) Shale Bedrock	~4.5/>8	875kPa	1,000kPa	2,000kPa	200kPa	100kPa

All footings should be inspected and approved by an experienced geotechnical engineer to confirm the foundation material and design values, and to ensure the excavations are clean and stable.

Ground slabs can be constructed on the natural soils or newly placed controlled fill. Following excavation to the required level, slab areas on soil should be proof rolled by a pad foot roller to check for any weak, wet or deforming soils that may require replacement.

6.5 EXCAVATION CONDITIONS & USE OF EXCAVATED MATERIAL

Although the proposed depth of excavation is unknown, it is assumed that some deep excavations will be required for this project. Excavations to ~1.6/ >8m will be through fill, residual soils and weak weathered bedrock. The fill, residual soils and weak weathered bedrock are readily diggable by backhoe and medium sized excavator to at least 1.6m depth. Excavations below ~1.6 m depth may encounter strong bedrock which will require rock hammering or use of a larger excavator with a ripper.

The measure of the excavatability of bedrock is dependent on two important factors - (1) the compressive strength of the rock, and (2) the nature and spacing of the defects in the rock. Pettifer and Fookes (1994) (Reference 5) have developed a chart to assist in providing a guide to what plant is required for given rock conditions. A copy of the chart is provided in Figure 4. The green zone on the chart in Figure 4 shows the area corresponding to the expected rock and excavations conditions at this site.

Unsupported excavation slopes should be no steeper than 1H:1V as shale can be prone to slab failures. Temporary shoring or bracing may be required for worker safety within the excavation. Due to the clay-rich nature of the shale, the excavated material is not recommended for use as structural fill under load bearing elements. The excavated shale material, once crushed and screened, can potentially be utilized as general non-structural backfill, subbase material for pavements, or aggregate for concrete mixes after testing confirms the material has suitable engineering properties that meet required specifications. Any surplus excavated shale may be disposed of off-site at an approved facility.

Any low/medium plasticity alluvial and residual soils can be used in controlled fill construction of building platforms, provided any rock particles are broken down to <75mm size and the fill is environmentally suitable for re-use on site. Topsoil and existing uncontrolled fill material and any medium to high and high plasticity, clayey soils should not be used in controlled fill construction.

If imported fill is required, a suitable select fill material would include a low or medium plasticity soil such as clayey sand or gravelly clayey sand, containing less than 35% fines less than 0.075mm size (silt and clay), and no particles greater than 75mm size.

All materials unearthed during excavation processes shall be managed and disposed of in strict adherence to the stipulations set forth in the prevailing legislation and guidelines, encompassed by the Waste Classification Guidelines as delineated by the Environmental Protection Agency (EPA, 2014). This encompasses fill and natural materials that may be extracted from the site.

6.5.1 Excavation Vibrations

Use of heavy vibrational plant/equipment for ripping and hammering of the in-situ bedrock requires particular care to ensure that structures in the surrounding vicinity are not damaged/affected by vibrations. It is expected that the excavation operations may be at a distance ≤ 10m from some surrounding structures. The geology of the surrounding area is expected to have shale bedrock in its subsurface profile. This is of particular concern, as vibrations are readily transmitted through competent bedrock, potentially resulting in damage to footings founded in the bedrock.

It is required that ground vibrations in proximity of the adjacent structure's foundations do not exceed 10mm/s. To ensure this value is not exceeded, it is highly recommended that vibration monitoring using specialised sensors is conducted. Fortify Geotech has the capability to undertake this monitoring.

The monitoring devices should be functioning prior to conducting any excavation operations and will notify the appropriate individual if ground vibrations exceed a critical value (10mm/s). If this value is exceeded, all excavation should be ceased immediately, and an experienced geotechnical engineer must be contacted for reassessment of the site; this is necessary to ensure the stability of the excavation and surrounding structures, and to modify the current excavation methods to ensure that ground vibrations are reduced below the critical value thereafter.

Whilst it is required that ground vibrations do not exceed 10mm/s, it is prudent to design all excavation methods such that ground vibrations do not exceed 5mm/s. Excavation methods and equipment may be designed in accordance with the values provided below in

Table 6-4, which outlines recommendations for excavation equipment such that maximum peak particle velocities (ground vibrations) are not exceeded.

Table 6-4: Recommended Peak Particle Velocity

Distance from nearby building / Structures [m]	Maximum peak particle velocity [5mm/s]		Maximum Peak Particle Velocity [10mm/s]	
	Equipment Type	Operating Limit (% of Maximum Capacity)	Equipment Type	Operating Limit (% of maximum Capacity)
1.5 to 2.5	Hand operated Jack Hammer	100	300kg Rock Hammer	50
2.5 to 5.0	300kg Rock Hammer	50	300kg Rock Hammer 600kg Rock Hammer	100 50

5.0 to 10.0	300kg Rock Hammer 600kg Rock Hammer	100 50	600kg Rock Hammer 900kg Rock Hammer	100 50

NOTE: It is recommended that vibration monitoring is employed if excavation operations are expected to exceed ground vibrations of 5mm/s. Fortify Geotech Pty Ltd are in possession of vibration monitoring equipment and may be consulted to install the sensors and monitor vibrational data thereafter.

Use of other techniques such as rock sawing may be utilised in certain circumstances if it is expected that, or if ground vibrations of > 10mm/s are to be produced/are produced by rock hammering. Saw cutting, although less productive, may eliminate risks of damage to property through vibration effects transmitted via the ground. Saw cutting in runs of at least 1m depth should be conducted prior to hammering, to minimise vibrations propagating through the rock face. However, it is recommended that hammering along the perimeter of the excavation should be conducted under geotechnical supervision in the vicinity of adjacent structures (≤ ~10m).

All excavation plant/equipment must always be used by experienced operators, who should remain diligent to ensure that vibrations resulting from excavations are minimised, and the excavations remain stable and safe. Should any potential safety concerns be identified by an operator, the site foreman and a geotechnical engineer should be informed immediately, and work in the vicinity ceased until it is deemed to be safe by the appropriate personnel.

6.6 CONSTRUCTION METHODOLOGY

1. Installation of vibration monitors prior to earthworks starting. This will also allow baseline testing of background vibrations to be tested and understood.

2. Conventional equipment will be used to dig through the overburden soils and weak rock, to expose the underlying shale bedrock.

3. During bulk excavations excavate and rip to refusal. **HOLD POINT – NO ROCK HAMMERING OR PIERING CAN BE CONDUCTED PRIOR TO INFORMING GEOTECHNICAL ENGINEER.**

4. Conduct rock hammering trials under the supervision of a geotechnical engineer present to monitor vibration levels. This will help to establish what equipment can be used safely, and how far away from the adjacent properties that it can be used. If vibration levels are below 5mm/s, then it is OK to proceed. If not, the geotechnical engineer will provide advice on how to proceed. It may help to commence away from the adjacent properties towards the centre.

6.7 STABLE EXCAVATION BATTERS

Temporary site excavations to 1.5m depth can be formed near vertical, although loose fill and any moisture affected soils should be cut back at 1(H):1(V). Deeper temporary cuts can be formed at 1(H):1(V) in soil and Class V shale bedrock and 0.5(H):1(V) in Class III or better shale bedrock. A geotechnical engineer should inspect all cut batters during construction to confirm stability. Exposed temporary batters should be protected from the weather by black plastic pinned to the face with link-wire mesh, or similar. Recommended maximum slopes for temporary batters are provided in Table 6-5 below.

Table 6-5: Recommended Batter Slopes (Temporary)

Material	Max. Batter Slope (H:V)
Fill	1.5:1

Residual Soil / Extremely Weathered Material	1:1
Low to Medium Strength Shale or Better	1:1[1]

[1]*NOTE:* Following inspection by an Experienced Geotechnical Engineer and any remedial works that may be recommended (e.g., shotcrete, rock bolting), 0.5 (H):1 (V) or near vertical slopes may be recommended.

Permanent cut & fill batter slopes should be formed at no steeper than 2(H):1(V) in soil and be protected against erosion by shotcreting, stone pitching or other suitable methods. Alternatively, permanent excavations can be supported by structural retaining walls.

6.8 EXCAVATION TEMPORARY SUPPORT

Temporary excavations batter should be formed no steeper than 1(H):1(V) in stiff residual/extremely weathered material. Deeper temporary cuts should be formed no steeper than the slopes given in Table 6-5. A geotechnical engineer should inspect all cut batters during construction to confirm stability. The soil batter surfaces should be temporarily protected against deterioration due to the weather by covering in plastic, held by pinned chain-link mesh.

Where space limitations preclude battering back to stable slopes, temporary support options include soldier piers with tie-back anchors, and horizontal lagging or reinforced shotcrete supporting the spaces between piers. Soldier piers, spaced at about three to five pier diameters, socketed below bulk excavation level, and secured by tensioned anchors, may be a suitable option. Soldier pier holes would typically be drilled from existing surface levels prior to bulk excavation. The excavation could then proceed in maximum 3m depth stages, with tie-back anchors installed and tensioned prior to excavation of the next level. Lateral support would also be provided by the passive and cantilever resistance of pier-sections socketing below final excavation level. Horizontal lagging or structural facing shotcrete between piers should be installed in sequence with deepening of the excavation.

6.8.1 Lateral Pressure on Temporary Support Systems

The loads in anchors or struts for tied-back walls used in the temporary support of vertical excavations, such as soldier piers tied back by tensioned ground anchors or internally strutted to floor slabs, can be calculated using a trapezoidal pressure distribution given by:

$$\sigma_h = (5H \times \frac{4z}{H}) + 0.4q \qquad \text{For } z < 0.25H$$

$$\sigma_h = (5H) + 0.4q \qquad \text{For } z > 0.25H$$

where,

σ_h is the apparent horizontal earth/rock pressure acting on the back of the wall, in kPa

H is the total height of the full excavation to be supported, in metres

z is the distance from the top of the excavation, in metres

q is any uniformly distributed vertical surcharge acting on the ground surface at the top of the excavation, in kPa

The above expression takes no account of groundwater pressure, as it is assumed the temporary walls will be fully drained. Where the walls are to be covered by shotcrete and/or where these will be incorporated into permanent retaining walls, synthetic drainage strips should be installed vertically against the excavated face, draining to collector pipes at the base of the excavation, taken to a pump-out sump.

6.8.2 Resistance Parameters for Temporary Support Systems

The allowable horizontal passive resistance provided by socketed sections of sheet piles and soldier piers or other retaining systems in hard soils below the bulk excavation level can be calculated as:

$\sigma_p = 50z$ (Hard soil socket only)
$\sigma_p = 100z$ (Class IV or better bedrock socket only)
$\sigma_p = 150z$ (Class III or better bedrock socket only)

where,

σ_p is the allowable passive pressure acting on the front of the pier/footing at depth z, in kPa

z is the pier socket length below excavation level in weathered bedrock, in metres

In light of the geotechnical investigation at the specified site, the ensuing parameters are suggested for the design of temporary shoring walls:

- The effective width of a socketed pier for calculation of allowable passive resistance can be assumed to be equivalent to twice its actual width, except where the centre-to-centre distance between the piers is two diameters or less, in which case the soldier piers can be considered to act as one continuous wall.

- If internal struts are used, propped to anchor blocks in the lowest slab, the allowable passive resistance provided by the anchor blocks can be calculated using the same pressure distribution given above, although the effective width of the footing or block can be taken as 1.5 times its actual width. In addition, an allowable base friction factor (tanδ) of 0.35, and allowable base adhesion (c) of 5kPa can be used for calculation of sliding resistance of concrete anchor blocks in the hard soil and 50kPa in Class III Shale or better.

- An average ultimate bond value of 50kPa can be assumed for cement-grouted ground anchors in the Class V bedrock, 180kPa for Class IV bedrock, 300kPa for Class III bedrock. It is important that at least a few of the anchors should be proof tested by pull-out tests to confirm or adjust bond values. It is recommended that ground anchors be inclined downward at between 5^o and 20^o, and that the “fixed” (anchored) section be assumed to extend beyond a line inclined upward from the batter toe at 45^o. Tensioned multi-strand cable anchors are recommended rather than using passive (non-tensioned) anchors and bond lengths of at least 3m behind the ‘active’ zone of the excavation are recommended. Proof loading of all anchors to at least 1.33 times the design working load is also recommended and should be witnessed by a suitably qualified geotechnical independent engineer.

- An alternative approach entails a detailed design of anchored or propped retaining walls utilizing computer-based soil structure interaction analysis software like Plaxis 2D. This methodology could potentially offer cost

savings relative to designs predicated on simplified pressure assumptions. Our team is equipped to conduct such analysis upon request.

This comprehensive elucidation intends to guide the design process, ensuring structural integrity and safety in line with the geotechnical conditions revealed at the subject site.

6.9 EXCAVATION PERMANENT SUPPORT

Permanent unsupported batters in soil would need to be formed no steeper than 2(H):1(V). Permanent batters should be protected against erosion by stone pitching, shotcreting, or other suitable means. Permanent retaining walls can be integrated into the temporary excavation support systems, or constructed separately from these, but with the space between backfilled or spanned by horizontal struts.

The walls and floor slabs for retaining walls incorporated with or strutted to the temporary excavation supports should be designed to cater for the pressures given in Section 6.8.1.

Where retaining walls are constructed in open excavation and backfilled later, the wall and floor slabs can be designed to resist lateral pressure using a distribution given by:

$$\sigma_h = (8d) + 0.4q$$

$$\sigma_h = (7d) + 0.4q \leftarrow \text{[for MW and less weathered rock]}$$

where,

d is the depth below the top of the backfill or retained ground, in metres

q is any uniformly distributed surcharge acting on the surface of the backfill, in kPa

The first term of the expression is a triangular pressure distribution, the second a uniform pressure distribution. The design pressure takes no account of hydrostatic pressure, as it is assumed that the walls will be provided with permanent backfill drainage, and that any groundwater is drawn below the bulk excavation level. Backfill materials for walls constructed in open excavation should be clean, granular and free-draining, and preferably the upper backfill can be a clayey soil to reduce infiltration of surface water.

6.10 LOW RETAINING WALLS

Retaining walls constructed in open excavation, with the gap between the excavation face and the wall backfilled later, can be designed for an earth pressure distribution given by:

$$\sigma_h = (K\gamma'h) + Kq$$

where,

σ_h is the horizontal earth pressure acting on the back of the wall, in kPa

K is the dimensionless coefficient of earth pressure; this can be assumed to be 0.4 when the top of the wall is unrestrained horizontally, and 0.5 when the top of the wall is restrained (i.e. by building slabs etc.)

γ' is the effective unit weight of the backfill, and can be assumed to be 20kN/m3 for a lightly compacted soil backfill

h is the height of the backfill, in metres

q is any uniform distributed vertical surcharge acting on the top of the backfill, in kPa

Apart from structural restraints such as floor slabs, resistance to overturning and sliding of retaining walls is provided by frictional and adhesive resistance on the base, and by passive resistance at the toe of the wall. For a natural soil or controlled fill foundation, an ultimate base friction factor (tanδ) of 0.5, base adhesion (c) of 50kPa, and allowable passive earth pressure coefficient Kp=2.5 can be used for calculation of sliding resistance.

Free-draining granular backfill or synthetic fabric drains should be installed behind all walls. These should connect to weep holes and/or a collector drain, and ultimately to the stormwater system. Granular backfill should be wrapped in a suitable filter fabric to minimise infiltration of silt/clay fines.

It is recommended that the initial design of any retaining system, or shoring with a single row of anchors or propping, be predicated on a triangular earth pressure distribution, utilizing the earth pressure coefficients delineated in Table 8. The 'Active' earth pressure coefficient (Ka) values may be employed in scenarios where a certain degree of wall movement is deemed acceptable. Conversely, the 'at rest' earth pressure (K_0) values should be utilized in circumstances necessitating minimized wall movement, such as adjacent to existing structures or utilities.

The design parameters adopted and tabulated in Table 6-1 were formulated based on the information available pertaining to the subject site, coupled with our accrued experience concerning analogous rock and soil types.

6.11 CONTROLLED FILL CONSTRUCTION

For construction of any new fill foundation platforms and road subgrades, it is recommended that:

- Areas be fully stripped of all existing uncontrolled fill and any moisture affected, soft or firm soils. A general stripping depth of 0.1m/1.5m is expected. Stripped foundations should be proof-rolled by a vibratory pad-foot roller of not less than 10 tonne static mass to check for any weak or wet areas that would require replacement. No fill should be placed until a geotechnical engineer has confirmed the suitability of the foundation.

- Controlled fill comprising suitable site excavated or imported materials of not greater than 75mm maximum particle size, be compacted in not greater than 150mm layers to not less than 98%StdMDD at about OMC. If clean sand is used as fill material, it must be compacted to a Density Index of not less than 70%. Any unsuitable existing fill (e.g. silty soils) is not to be used as controlled fill.

- Fill placement and control testing be overviewed and certified by a geotechnical engineer at Level 1 or 2 involvement of AS3798 – 2007 “Guidelines on Earthworks for Commercial & Residential Developments” (Reference 6).

6.12 CARPARK SUBGRADES

Five (5) samples were collected as part of the intrusive investigation for California Bearing Ratio (CBR) testing. Three (3) samples obtained from the northern carpark (Lot 1/DP103779 and Lot 2/DP259807) yielded CBR values of 2%, 3%, and 3.5%. Two (2) samples obtained from the southern carpark (Lot 3/DP259807) yielded CBR values of 4.5% and 8%.

Based on the test results, a design CBR value of 2% is recommended for the northern carpark and 4.5% for the southern carpark. Prepared subgrades should be inspected by a geotechnical engineer to verify that the exposed materials are structurally suitable and to confirm the adopted design CBR values.

The design CBR value is based on laboratory and in situ DCP tests. There is potential that there are zones where the subgrade soils have an in situ CBR of less than the design CBR. Care will be required during construction to confirm the design CBR has been achieved.

Before constructing the proposed carparks, site preparation will be necessary. The earthworks recommendations provided in this report should be supplemented with reference to AS 3798 - 2007 Guidelines on earthworks for commercial and residential developments. The following approach is suggested for preparing the subgrade for pavements and adjusting site levels using engineered filling:

- Remove any existing uncontrolled fill until you reach the level of the underlying alluvial or residual soils/rock.
- When natural soil is exposed, a process called proof rolling of the subgrade will be necessary. This should be done before adding any more fill or constructing slabs. Proof rolling involves six passes of a smooth drum roller, weighing at least 10 tonnes. The final pass should be overseen by a geotechnical engineer to identify any soft or saturated areas. If such areas are found, they should be excavated to a maximum depth of 600 mm and replaced with compacted durable granular material.
- If additional fill is needed to raise surface levels, it should be placed in layers no thicker than 200 mm when loose and compacted to achieve a density between 98% and 100% of the standard dry density. The moisture content should be within ±2% of the optimum moisture content.
- The existing natural, alluvial and residual soil, and rock present on the site can be used as engineered filling as long as their maximum particle size does not exceed 100 mm. Any contamination present in the existing soils should be considered by an environmental consultant prior to its reuse.

6.13 AGGRESSIVITY TEST RESULTS & EXPOSURE CLASSIFICATION

The exposure classification for concrete piles can be determined in accordance with AS2159-2009, Table 6.4.2(C). Soil Conditions B can be used as the tested soils were clayey and mostly above the groundwater table. As the pH value are all within 4.5-5.5, the exposure classification for **concrete piles is non-aggressive**.

The exposure classification for steel piles can be determined in accordance with AS2159-2009, Table 6.5.2(C). All the test results are consistent with an exposure classification of **mild for steel piles**.

The exposure classification for steel piles can be determined in accordance with AS2870-2011, Table 5.1 and Table 5.2. The test results are consistent with an exposure classification for concrete **in saline soils of A1 and in sulfate soils of A1**.

6.14 EARTHQUAKE SITE FACTOR

The Geoscience Australia Earthquake Hazard Map (Reference 8) indicates the earthquake acceleration coefficients (with an annual probability of exceedance of 1/500) for Australia to be used in structural design. These values are equivalent to hazard factor, Z. The Campbelltown area has an acceleration coefficient of 0.06g. AS1170.4 – 2007 – Minimum Design Loads on Structures – Part 4 Earthquake Loads (Reference 9) allows a minimum value of 0.08 to be used for the hazard factor, Z.

Section 4.2 of AS1170.4 “Minimum Design Loads on Structures – Part 4: Earthquake Loads” lists the site sub-soil classes to be considered in structural design. The site is classified as a “Class C_e – Shallow Soil Site”.

6.15 SITE DRAINAGE

Groundwater monitoring indicated groundwater levels at approximately 2.0 m to 3.86 m below the top of casing, which was installed from existing ground level. As the proposed excavations are expected to reach depths of up to 4.45 m below existing ground level, it is anticipated that excavation works will intercept groundwater. Temporary perched seepage may also occur at shallower depths following rainfall; however, this should be readily manageable using sump pumping during construction.

Suitable surface drainage should be provided to ensure rainfall run-off or other surface water cannot pond against buildings or pavements. Drainage should be provided behind all retaining walls, and subsoil drains should be installed along the upslope sides of access roads and carparks.

Fortify Geotech Pty Ltd

REFERENCES

Reference 1 MinView – geological map - https://minview.geoscience.nsw.gov.au - Accessed 10/03/2025

Reference 2 Standards Australia, "AS2870 – Residential Slabs & Footings", 2011.

Reference 3 Standards Australia, "AS2159-2009 – Piling – Design and installation".

Reference 4 Elson, W. K., 1984, ''Design of laterally-loaded piles.'' CIRIA Rep. No. 103, Construction Industry Research and Information Association, London, 86.

Reference 5 Pettifer, G. S. and Fookes, P. G, 1994, A revision of the graphical method for assessing the excavatability of rock, Quart, Journal of Engineering Geology, 27: 145-164.

Reference 6 AS3798 - 2007, "Guidelines on earthworks for commercial and residential developments".

Reference 7 Department of Planning, Industry and Environment of NSW, NSW Soil and Land Information eSPADE - https://www.environment.nsw.gov.au/eSpade2Webapp/#

Reference 8 Geoscience Australia – earthquake hazards map - http://www.ga.gov.au/darwin-view/hazards.xhtml# - Accessed 04/12/2023

Reference 9 Standards Australia, "AS1170.4 – 2007 – Minimum Design Loads on Structures – Part 4 Earthquake Loads".

Figure 0-1: Site Locality

Figure 0-2: Aerial Photograph and Borehole Locations

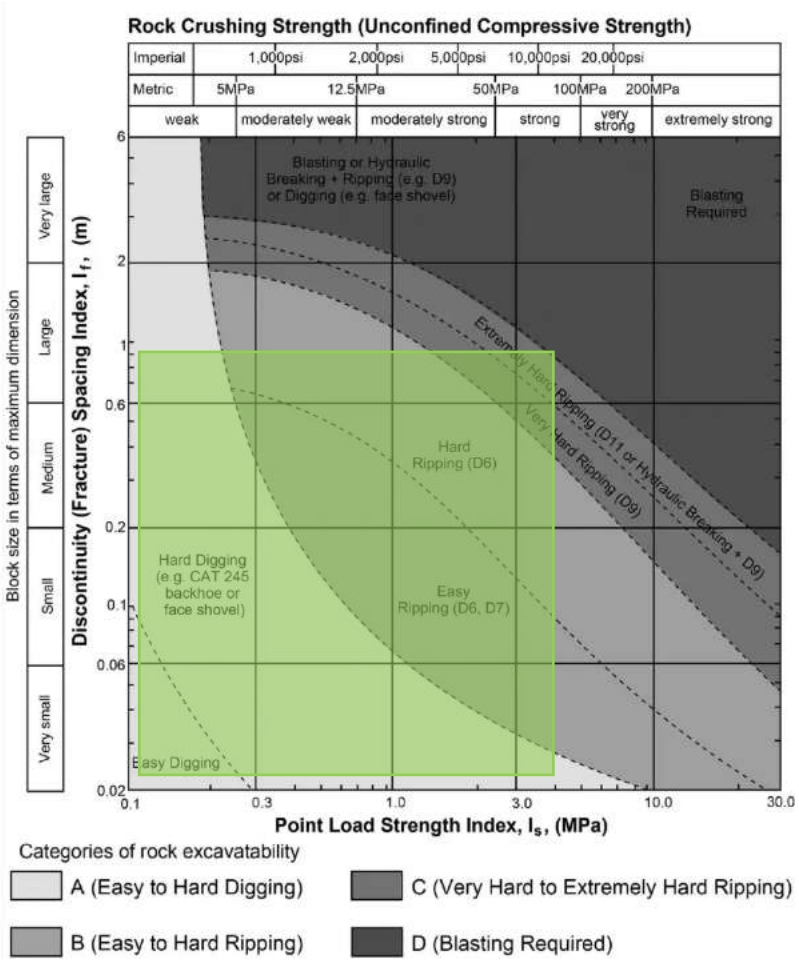


FIGURE 3: EXCAVATION CONDITIONS

S2349

FORTIFY
GEOTECH

Appendix A

2025 Investigation Borehole Logs BH1-BH10,BH12-BH20 & BH33

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH01**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered			0.2		SP	**Silty SAND;** fine to medium grained, dark brown	D	L-MD	DCP 2	TOPSOIL
				0.5		SP	**Silty SAND;** fine to medium grained, dark brown, trace anthro (metal, concrete), with fine to coarse gravels			4 7 8 10	FILL
				1.0			BOREHOLE TERMINATED AT 0.5m Refusal in concrete fill			9 6 9 8 8 6 6 7	
				2.0							
				3.0							
			4.1	4.0							

Dynamic Cone Penetrometer Test, Results in Blows per 100mm

Logged By : JOE Date : 16/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH02**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
			0.05			SWG	**ASPHALT** **Gravelly SAND;** fine to coarse, dark grey, fine to coarse gravels	D	MD		FILL
			0.4			CL-ML	**Silty CLAY;** medium plasticity, pale brown, with fine to medium sand	*w*~PL			RESIDUAL
BH02/1	None Encountered			1.0						GRAB	
			2	2.0			BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
			4.1	4.0					F-St		

Logged By : JOE Date : 16/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH03**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.08 0.1			SW	**ASPHALT**	D	MD		FILL
						ML	**Gravelly SAND; fine to coarse sand, grey, fine to coarse gravels**	*w*~PL	S		RESIDUAL
							Sandy SILT; low plasticity silt, brown, fine sand				
				0.5		CL-ML	**Silty CLAY;** medium plasticity, pale brown		F-St		
				0.8		CL	**CLAY;** medium plasticity, pale brown and pale grey, trace orange		VSt		
				1.0							
				2.0							
			3	3.0			BOREHOLE TERMINATED AT 3m at Target Depth				
			4.1	4.0							

Logged By : JOE Date : 16/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH04**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.04			SP	**ASPHALT**				
							Gravelly SAND; fine to coarse sand, grey with reddish grey, fine to coarse gravels	D	MD		
			0.3			CL-ML	**Silty CLAY;** low to medium plasticity, pale brown trace grey and black, with fine to medium sand	*w*~PL	St		RESIDUAL
				1.0			pale brown with pale grey				
			2	2.0			BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
			4.1	4.0							

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No. **BH05**

Sheet 1 of 1

Job No. S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered			0.2		SP	**Silty SAND;** fine to medium grained, brown	D	L	DCP 5	TOPSOIL
						ML	**Clayey SILT;** low plasticity, orange brown, trace rounded gravels	*w*<PL	St	11 8 8 8 8 11 17 20 25	RESIDUAL
				1.0						Dynamic Cone Penetrometer Test, Results in Blows per 100mm	
				2 2.0			BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
				4.0							
				4.1							

Logged By : JOE Date : 16/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH06**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered			0.3		ML	**Sandy SILT;** low plasticity silt, fine sand, trace fine gravels	D-M	L		TOPSOIL
						CL	**Silty CLAY;** medium plasticity, orange brown, trace fine to medium gravels	D	St	GRAB	RESIDUAL
				1.0							
				1.5		CL	**CLAY;** medium plasticity clay, black and red mottled, with fine to medium sand	*w*<PL	VSt		
				2 2.0			BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
				4.0							
				4.1							

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH07**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered			0.4		ML	**Sandy SILT;** low plasticity silt, dark brown, fine to medium sand, trace grass roots	D	S	DCP 2, 4, 8, 14	TOPSOIL
				1.0		CL	**Silty CLAY;** medium plasticity, orange brown, trace fine to medium gravels		VSt	20, 22, 20, 25	RESIDUAL
				1.8		CL	**Silty CLAY;** medium plasticity, orange brown, with fine to medium gravels				XW SILTSTONE
				2.0		GC	**Clayey GRAVEL;** fine to medium gravels, grey, medium plasticity clay				XW SHALE
							BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
				4.0							
			4.1								

Dynamic Cone Penetrometer Test, Results in Blows per 100mm

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH08**
Sheet	1 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.05			SP	**ASPHALT** **Gravely SAND;** fine to coarse sand, brown with grey and black, fine to coarse gravels	D	MD		
			0.4			CL	**Gravelly CLAY;** medium plasticity, brown, fine to medium gravels	*w*<PL			RESIDUAL
			0.8	1.0		CL	**Gravelly CLAY;** medium plasticity, brown, fine to medium gravels, trace fine to medium sand				
			1.6	2.0		CL	**Sandy CLAY;** medium plasticity clay, brown, fine to medium sand, trace fine to medium gravels	*w*~PL			
			2.5			CL	**CLAY;** medium plasticity clay, red brown		VSt		
			3	3.0		CL	**Silty CLAY;** low to medium plasticity, brown, trace fine gravels		F		
			4.1	4.0				*w*>PL			

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH08**
Sheet	2 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered					CL	**Silty CLAY;** low to medium plasticity, brown, trace fine gravels	*w*>PL	F		
				5.0			BOREHOLE TERMINATED AT 5m at Target Depth				
				6.0							
				7.0							
				8.0							
				8.2							

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH09**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results Dynamic Cone Penetrometer Test, Results in Blows per 100mm	Geological Profile
			0.1			SP	**Silty SAND;** fine to medium grained, dark brown	D	L	DCP 2	TOPSOIL
						SP	**Silty SAND;** fine to medium grained, brown with orange, black mottles, with low plasticity clay		L-MD	4 4 5 3 4 3 4 5	FILL
	None Encountered		0.9	1.0		CL	**Silty CLAY;** low plasticity, brown mottled orange	*w*<PL	St	2 4 4 8 9 11	RESIDUAL
				1.5		CL	**Sandy CLAY;** low plasticity, dark grey with orange brown, with fine sand			15 16 12 12 14	
				3.0			BOREHOLE TERMINATED AT 3m at Target Depth				
			4.1	4.0							

Logged By : JOE Date : 18/2/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH10**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered			0.1		GW	**Sandy GRAVEL;** fine to medium gravel, orange brown, fine to coarse gravel	M	MD	DCP 20	FILL
						SWG	**Gravelly SAND;** fine to coarse sand, grey brown with black and grey, fine to coarse gravels	D		20	
										18	
										10	
										12	
										11	
										9	
										8	
										6	
				1.0						6	
										5	
										10	
										12	
										9	
				1.5						8	
						CL-ML	**Silty CLAY;** low to medium plasticity, brown grey	*w*<PL	VSt	5	XW SHALE
										10	
										11	
				2						12	
				2.0			BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
				4.0							
				4.1							

Dynamic Cone Penetrometer Test, Results in Blows per 100mm

Logged By : JOE	Date : 16/1/25	Checked By : BM	Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH12**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.05			GW	**Sandy GRAVEL;** fine to medium sized gravel, mottled pale brown and grey, fine to coarse sand	D	D		FILL
				1.0			**Clayey Silty SAND;** fine to medium grained, pale yellow, low plasticity, trace medium gravel, becoming orange, brown				
			1.3			CL	**Silty CLAY;** medium plasticity, mottled orange brown, grey, with fine sand	*w*<PL	St		
				2.0							
			3	3.0			BOREHOLE TERMINATED AT 3m at Target Depth				
			4.1	4.0							

Logged By : JOE Date : 18/2/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH13**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered			0.2		SM	**Silty SAND;** fine to medium sand, dark brown	D-M	L-MD		TOPSOIL
				1.0		CL	**CLAY;** medium plasticity clay, mottled plae brown and red, trace fine to medium gravels	*w*~PL	F		RESIDUAL
				2.0		CL	**CLAY;** medium plasticity clay, pale red brown				
				3.0		CL	**Silty CLAY;** low to meidum plasticity clay, dark grey	*w*<PL	S		
				3.0			BOREHOLE TERMINATED AT 3m at Target Depth				
				4.0							
				4.1							

Logged By : JOE Date : 18/2/25 | Checked By : BM Date : 28/2/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH14**
Sheet	1 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
						SP	**Gravelly SAND;** fine to medium sand, brown with grey, fine to medium gravels	D	MD		FILL
				0.9							
				1.0		SC	**Clayey SAND;** fine to medium sand, brown, low plasticity clay				ALLUVIUM
				1.5							
BH14/1	None Encountered					ML	**Silty CLAY;** low to medium plasticity, brown trace grey, with fine sand		VSt	SPT 5, 9, 13 N=22	
				2 2.0		CL	**CLAY;** medium plasticity clay, mottled brown orange and grey	*w*~PL	St		RESIDUAL
BH14/2				3 3.0		CL	**CLAY;** medium plasticity clay, mottled grey, black and brown, trace fine gravels, trace fine to medium sand			SPT 4, 5, 10 N=15	
				4.0				*w*>LL			
			4.1								

Logged By : JOE Date : 18/2/25 | Checked By : BM Date : 28/2/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH14**
Sheet	2 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
						CL	**CLAY;** medium plasticity clay, mottled grey, black and brown, trace fine gravels, trace fine to medium sand	*w*>LL	St		
BH14/3										SPT 4, 4, 9 N=13	
				5.0				*w*~PL			
	None Encountered			6.0		CL	**CLAY;** medium plasticity clay, grey with orange, trace fine gravels				
BH14/4										SPT 9, 14, 19 N=33	
				7.0							
BH14/5										SPT 8, 10, 13 N=23	
				8.0			BOREHOLE TERMINATED AT 8m at Target Depth				
			8.2								

Logged By : JOE Date : 18/2/25 | Checked By : BM Date : 28/2/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Cored Borehole Log

Borehole No. **BH15**

1 of 2

CLIENT: Cambelltown City Council

Job No. S2349

PROJECT Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Horizontal : 90°
Bearing : N.A.

Drill Type : BG Drilling CE180
Barrel Type, Length, Drilling fluid :

Method/Casing	R.Q.D./Lift	Water	RL (m)	Depth	Graphic Log	Soil or Rock Substance Description	Degree of Weathering	Estimated Strength Range (VL L M H VH EH)	Is(50) MPa (D = diaxial, A = axial)	Core Length (mm) (30 100 300 1000 3000)	Defects	Defect Description
AUGERING			0.21			**CONCRETE**						
			0.55			**Sandy GRAVEL;** fine to coarse gravel, dark grey, fine to coarse sand						
				1.0		**Extremely Weathered (XW) Shale recovered as Clayey GRAVEL;** fine to coarse gravel, dark grey, low plasticity clay	EW					
			2	2.0		**Highly Weathered (HW) Shale recovered as Silty CLAY ;** low to medium plasticity clay, dark grey						
				3.0			HW					
			4.1	4.0								

Logged By : JOE Date : 19/2/25

Checked By : BM Date : 28/2/25

CORED BOREHOLE LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Cored Borehole Log

Borehole No. **BH15**

2 of 2

CLIENT: Cambelltown City Council

Job No. S2349

PROJECT Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Horizontal : 90°
Bearing : N.A.

Drill Type : BG Drilling CE180
Barrel Type, Length, Drilling fluid :

Method/Casing	R.Q.D./Lift	Water	RL (m)	Depth	Graphic Log	Soil or Rock Substance Description	Degree of Weathering	Estimated Strength Range (VL L M H VH EH)	Is(50) MPa (D = diaxial, A = axial)	Core Length (mm) (30 100 300 1000 3000)	Defects	Defect Description
AUGERING						**Highly Weathered (HW) Shale recovered as Silty CLAY ;** low to medium plasticity clay, dark grey	HW					
			4.5						D = 12.5 A = 21.6			0 joints, parting,0°, planar, smooth, -, - 0 joints, joint,50°, stepped, rough, -, -
NMLC CORING	53% 100%					**Moderately Weathered (MW) Shale;** fine grained, dark grey						0 joints, parting,0°, planar, smooth, -, -
				5.0					D = 4.3 A = 16.8			0 joints, parting,0°, planar, smooth, -, -
							MW					0 joints, parting,0°, planar, smooth, -, -
	92% 100%											3 joints, joint,0,80°, planar, rough, -, -
												0 joints, joint,60°, planar, rough, -, -
			5.9						D = 6.0 A = 14.6			0 joints, parting,0°, planar, smooth, -, -
				6.0		BOREHOLE TERMINATED AT 5.9m at Target Depth						
				7.0								
				8.0								
			8.2									

Logged By : JOE Date : 19/2/25

Checked By : BM Date : 28/2/25

CORED BOREHOLE LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH15**
Sheet	1 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
							CONCRETE				CONCRETE
			0.21			GW	**Sandy GRAVEL;** fine to coarse gravel, dark grey, fine to coarse sand	M	D		FILL
			0.55			GC	**Extremely Weathered (XW) Shale recovered as Clayey GRAVEL;** fine to coarse gravel, dark grey, low plasticity clay	D			RESIDUAL
				1.0							
BH15/1										SPT 25, 5+ for 90mm N>5	
	None Encountered	AUGERING		2.0		CL-ML	**Highly Weathered (HW) Shale recovered as Silty CLAY ;** low to medium plasticity clay, dark grey				WEATHERED BEDROCK
				3.0							
			4.1	4.0							

Logged By : JOE Date : 19/2/25 | Checked By : BM Date : 28/2/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH15**
Sheet	2 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING				CL-ML	**Highly Weathered (HW) Shale recovered as Silty CLAY ;** low to medium plasticity clay, dark grey	D			WEATHERED BEDROCK
			4.5			GP	**Moderately Weathered (MW) Shale;** fine grained, dark grey				
		NMLC CORING		5.0							
			5.9				BOREHOLE TERMINATED AT 5.9m at Target Depth				
				6.0							
				7.0							
				8.0							
			8.2								

Logged By : JOE Date : 19/2/25 | Checked By : BM Date : 28/2/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Cored Borehole Log

Borehole No. **BH15**

2 of 2

CLIENT: Cambelltown City Council

Job No. S2349

PROJECT Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Horizontal : 90°
Bearing : N.A.

Drill Type : BG Drilling CE180
Barrel Type, Length, Drilling fluid :

Method/Casing	R.Q.D./Lift	Water	RL (m)	Depth	Graphic Log	Soil or Rock Substance Description	Degree of Weathering	Estimated Strength Range (VL L M H VH EH)	Is(50) MPa (D = diaxial, A = axial)	Core Length (mm) (30 100 300 1000 3000)	Defects	Defect Description
AUGERING						**Highly Weathered (HW) Shale recovered as Silty CLAY ;** low to medium plasticity clay, dark grey	HW					
			4.5						D = 12.5 A = 21.6			0 joints, parting,0°, planar, smooth, -, - 0 joints, joint,50°, stepped, rough, -, -
NMLC CORING	53% 100%					**Moderately Weathered (MW) Shale;** fine grained, dark grey						0 joints, parting,0°, planar, smooth, -, -
				5.0					D = 4.3 A = 16.8			0 joints, parting,0°, planar, smooth, -, -
							MW					0 joints, parting,0°, planar, smooth, -, -
	92% 100%											3 joints, joint,0,80°, planar, rough, -, -
												0 joints, joint,60°, planar, rough, -, -
			5.9						D = 6.0 A = 14.6			0 joints, parting,0°, planar, smooth, -, -
				6.0		BOREHOLE TERMINATED AT 5.9m at Target Depth						
				7.0								
				8.0								
			8.2									

Logged By : JOE Date : 19/2/25

Checked By : BM Date : 28/2/25

CORED BOREHOLE LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH16**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.1	0.1		ML	**Sandy SILT;** low plasticity silt, dark brown, fine to medium sand, trace fine to medium gravels	D	S	DCP 3	TOPSOIL
						SM	**Silty SAND;** fine to medium sand, dark brown, with fine to coarse gravels, trace low plasticity clay			10	FILL
			0.4	0.4		CH	**CLAY;** medium to high plasticity, brown and orange mottled with black, trace fine to coarse gravels with fine to coarse sand	*w*~PL	St	22 18 6 4 4 6 3 5 6 3 2 4	
				1.0							
			1.4			CH	**CLAY;** medium to high plasticity, brown and orange mottled with black, trace fine to coarse gravels, with fine to coarse sand			5 6 8 7 11 14	RESIDUAL
				2.0							
			2.4			CL	**Gravelly CLAY;** low to medium plasticity clay, brown grey, fine to medium gravels, trace fine to coarse sand	*w*<PL	VSt		XW SHALE
			3	3.0			BOREHOLE TERMINATED AT 3m at Target Depth				
			4.1	4.0							

Dynamic Cone Penetrometer Test, Results in Blows per 100mm

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH17**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
						ML	**Sandy SILT;** non-plastic, grey	D-M	S	DCP 2	TOPSOIL
				0.2						4	
						SW	**SAND;** fine to medium sand, brown-grey, with medium gravels	D	L-MD	3	FILL
										3	
										2	
BH17/1	None Encountered									3 GRAB	
										1	
										3	
										6	
										8	
				1.0		CL	**CLAY;** medium plasticity clay, pale red brown	*w*<PL	St	12	RESIDUAL
				1.2						30	
						CL	**XW Shale recovered as Gravelly CLAY;** low to medium plasticity clay, pale grey, fine to medium gravels		VSt	25	XW BEDROCK
				1.6							
				1.7			**Highly Weathered (HW) Shale** fine grained, pale grey		H		WEATHERED BEDROCK
							BOREHOLE TERMINATED AT 1.7m refusal in HW Shale				
				2.0							
				3.0							
				4.0							
				4.1							

Dynamic Cone Penetrometer Test, Results in Blows per 100mm

Logged By : JOE Date : 16/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH18**
Sheet	1 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.1			ML	**Sandy SILT;** low plasticity silt, brown, fine to medium sand, trace grass roots	D	S		TOPSOIL
						CLS	**Sandy CLAY;** low to medium plasticity, brown and pale brown mottled trace black and grey, fine to medium sand, trace fine to coarse gravels	*w*~PL	F		FILL
				1.0							
			1.5			CL-CH	**CLAY;** medium to high plasticity, red brown with grey		St		RESIDUAL
				2.0							
			2.2			CL	**Gravelly CLAY;** low to medium plasticity, brown grey, fine to medium gravels, trace fine to coarse sand	*w*<PL	VSt		XW SHALE
			2.8				**HW Shale Recovered as Clayey GRAVEL;** fine to coarse gravels, dark grey, low to medium plasticity clay, trace fine to coarse sand				HW SHALE
				3.0							
				4.0							
			4.1								

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH18**
Sheet	2 of 2
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered						**HW Shale Recovered as Clayey GRAVEL;** fine to coarse gravels, dark grey, low to medium plasticity clay, trace fine to coarse sand	*w*<PL	VSt		HW SHALE
				5.0			BOREHOLE TERMINATED AT 5m at Target Depth				
				6.0							
				7.0							
				8.0							
			8.2								

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH19**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.05			SM	**MULCH** **Silty SAND;** fine to medium sand, brown, trace fine gravels	D	L-MD	DCP 1, 5, 6, 8, 6, 7, 10, 15 (Dynamic Cone Penetrometer Test, Results in Blows per 100mm)	FILL
			0.8	1.0		CL	**CLAY;** medium plasticity clay, red brown	*w*<PL	VSt	16, 18, 22, 25	RESIDUAL
			1.5			CL	**Gravelly CLAY;** low to medium plasticity, brown grey, fine to medium gravels, trace fine to coarse sand				XW SHALE
			2	2.0			BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
			4.1	4.0							

Logged By : JOE Date : 15/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH20**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
				0.1		ML	**Sandy SILT;** non plastic, dark brown, fine sand	*w*>PL	S		TOPSOIL
						CL	**CLAY;** medium to high plasticity, pale brown trace orange, trace fine to medium sand	*w*~PL	F-St		RESIDUAL
BH20/1	None Encountered			0.7		CH	**CLAY;** medium to high plasticity, mottled pale brown, orange and grey		St	GRAB	
				1.0							
				1.7		GC	**Clayey GRAVEL;** fine to medium gravels, grey, medium plasticity clay	*w*<PL	VSt		XW SHALE
				2 2.0			BOREHOLE TERMINATED AT 2m at Target Depth				
				3.0							
				4.0 4.1							

Logged By : JOE Date : 16/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 13/3/25

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH33**
Sheet	1 of 1
Job No.	S2349

CLIENT: Cambelltown City Council

PROJECT: Proposed Development
Art Gallery Road, Campbelltown

Location : See Report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type :
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered		0.05			SM	MULCH **Silty SAND;** fine grained, dark brown, trace fine to medium gravel	D	L		TOPSOIL FILL FILL
			0.3			CL	**Clayey SAND;** medium to coarse grained, red brown, medium plasticity clay	M	F-St		RESIDUAL SOIL
			1.1	1.0		CL	**Sandy CLAY;** medium plasticity, orange brown, fine to medium grained	*w*~PL	St		
			2	2.0			BOREHOLE TERMINATED AT 2m				
				3.0							
			4.1	4.0							

Logged By : JOE Date : 16/1/25 | Checked By : BM Date : 20/1/25

BOREHOLE/EXCAVATION LOG S2349.GPJ EXC.GDT 14/3/25

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Appendix B

2026 Investigation Borehole Logs BH01A, BH03A, BH07A and BH08A

Fortify Geotech
39 Sydenham Road, Marrickville
Phone: (02) 9188 4033

Geotechnical Log - Borehole

BH01A

UTM	: 56H	Drill Rig	: Ute mounted drill rig	Job Number	: S2349.3
Easting (m)	: 297752.72	Driller Supplier	: Geotesta	Client	: Campbelltown City Council
Northing (m)	: 6227470.53	Logged By	: Joe Stuart	Project	: Proposed Development
Ground Elevation	: 80.36 (m)	Reviewed By	: MN	Location	: 1 Art Gallery Rd, Campbelltown NSW 2560, Australia
Total Depth	: 2 m BGL	Date	: 11/02/2026	Loc Comment	:

Drilling Method	Depth (m)	Elevation (m)	Water	Graphic Log	U.S.C.S	Material Description	Consistency	Moisture	DCP (0 5 10 15 20 25 30)	Samples / 20 k distur	Geological Profile
	0.1				Asphl	Pavement Asphalt.					Pavement
					BCO	Pavement Basecourse.					Pavement
	0.3	80.0			CL-CI	SILTY CLAY: low to medium plasticity, dark brown, soft to firm, w = pl.	S-F	w ≈ PL			Residual
	0.5				CI	CLAY: medium plasticity, pale grey and orange, stiff, w < pl.	St	w < PL		0.50-1.00 m: CBR2	Residual
	1.0	79.0									
	1.5				SHA	SHALE (SHA): fine grained, extremely weathered, low strength, dark grey, dry.	LS	D			Rock
						BH01A Terminated at 2 m (at Target)					

Fortify Geotech
39 Sydenham Road, Marrickville
Phone: (02) 9188 4033

Geotechnical Log - Borehole

BH03A

UTM	: 56H	Drill Rig	: Ute mounted drill rig	Job Number	: S2349.3
Easting (m)	: 297768.00	Driller Supplier	: Geotesta	Client	: Campbelltown City Council
Northing (m)	: 6227463.98	Logged By	: Joe Stuart	Project	: Proposed Development
Ground Elevation	: 79.65 (m)	Reviewed By	: MN	Location	: 1 Art Gallery Rd, Campbelltown NSW 2560, Australia
Total Depth	: 2 m BGL	Date	: 11/02/2026	Loc Comment	:

Drilling Method	Depth (m)	Elevation (m)	Water	Graphic Log	U.S.C.S	Material Description	Consistency	Moisture	DCP (0 5 10 15 20 25 30)	Samples / 20 k distur	Geological Profile
	0.1				Asphl	Pavement Asphalt.					Pavement
	0.3				BCO	Pavement Basecourse.					Pavement
	0.5	79.0			Cl-CH	CLAY: medium to high plasticity, mottled red, brown, red, grey, stiff, w = pl.	St	w ≈ PL		0.50-1.00 m: CBR2	Residual
	1.0				Cl	CLAY: medium plasticity, pale grey and orange, stiff, w = pl.	St	w ≈ PL			Residual
	1.5	78.0									
	1.8				SHA	SHALE (SHA): fine grained, extremely weathered, low strength, dark grey, dry.	LS	D			Rock
						BH03A Terminated at 2 m (at Target)					

Fortify Geotech
39 Sydenham Road, Marrickville
Phone: (02) 9188 4033

Geotechnical Log - Borehole

DCP06A

UTM	: 56H	Drill Rig	:	Job Number	: S2349.3
Easting (m)	: 297756.91	Driller Supplier	:	Client	: Campbelltown City Council
Northing (m)	: 6227438.33	Logged By	: Joe Stuart	Project	: Proposed Development
Ground Elevation	: 80.45 (m)	Reviewed By	:	Location	: 1 Art Gallery Rd, Campbelltown NSW 2560, Australia
Total Depth	: 2 m BGL	Date	: 11/02/2026	Loc Comment	:

Drilling Method	Depth (m)	Elevation (m)	Water	Graphic Log	U.S.C.S	Material Description	Consistency	Moisture	DCP (0 5 10 15 20 25 30)	Samples	Geological Profile
	0.5	80.0									
	1.0										
	1.5	79.0									
						DCP06A Terminated at 2 m (at Target)					

Fortify Geotech
39 Sydenham Road, Marrickville
Phone: (02) 9188 4033

Geotechnical Log - Borehole

BH07A

UTM	: 56H	Drill Rig	: Ute mounted drill rig	Job Number	: S2349.3
Easting (m)	: 297762.97	Driller Supplier	: Geotesta	Client	: Campbelltown City Council
Northing (m)	: 6227444.34	Logged By	: Joe Stuart	Project	: Proposed Development
Ground Elevation	: 80.22 (m)	Reviewed By	: MN	Location	: 1 Art Gallery Rd, Campbelltown NSW 2560, Australia
Total Depth	: 2 m BGL	Date	: 11/02/2026	Loc Comment	:

Drilling Method	Depth (m)	Elevation (m)	Water	Graphic Log	U.S.C.S	Material Description	Consistency	Moisture	DCP (0 5 10 15 20 25 30)	Samples	Geological Profile
	0.1	80.0			Asphl	Pavement Asphalt.					Pavement
	0.3				BCO	Pavement Basecourse.					Pavement
	0.5				Cl-CH	CLAY: medium to high plasticity, mottled red, brown, red, grey, stiff, w = pl.	St	w ≈ PL		0.50-1.00 m: CBR2	Residual
	1.0	79.0			Cl	CLAY: medium plasticity, pale grey and orange, stiff, w = pl.	St	w ≈ PL			Residual
	1.5										
	1.8				SHA	SHALE (SHA): fine grained, extremely weathered, low strength, dark grey, dry.	LS	D			Rock
						BH07A Terminated at 2 m (at Target)					

Fortify Geotech
39 Sydenham Road, Marrickville
Phone: (02) 9188 4033

Geotechnical Log - Borehole

BH08A

UTM	: 56H	Drill Rig	: Ute mounted drill rig	Job Number	: S2349.3
Easting (m)	: 297756.91	Driller Supplier	: Geotesta	Client	: Campbelltown City Council
Northing (m)	: 6227438.33	Logged By	: Joe Stuart	Project	: Proposed Development
Ground Elevation	: 80.45 (m)	Reviewed By	: MN	Location	: 1 Art Gallery Rd, Campbelltown NSW 2560, Australia
Total Depth	: 2 m BGL	Date	: 11/02/2026	Loc Comment	:

Drilling Method	Depth (m)	Elevation (m)	Water	Graphic Log	U.S.C.S	Material Description	Consistency	Moisture	DCP (0 5 10 15 20 25 30)	Samples (20 k disturb)	Geological Profile
	0.1				Asphl	Pavement Asphalt.					Pavement
	0.3				BCO	Pavement Basecourse.					Pavement
	0.5	80.0			CL	SILTY CLAY: low plasticity, dark brown, soft, w = pl.	S	w ≈ PL			Residual
	1.0				CI-CH	CLAY: medium to high plasticity, mottled red, brown, red, grey, stiff, w = pl.	St	w ≈ PL		0.50-1.00 m: CBR1	Residual
	1.4	79.0			CI	CLAY: medium plasticity, pale grey and orange, stiff, w = pl.	St	w ≈ PL			Residual
	1.5					BH08A Terminated at 2 m (at Target)					

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Appendix C

Rock Core Photos

BOREHOLE BH15
4.57m to 5.9 m depth

ROCK CORE PHOTOS	S2349

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Appendix D

Point Load Test Results

DIAMETRAL

BH Number	Test No.	Depth	Diameter (cm)	Gauge Reading (kN)	(Is)50	UCS (Mpa)	Weathering	Strength
1		4.57	5.2	1.4	0.52	**12.48**	HW/MW	M
1		5.1	5.2	0.485	0.18	**4.32**	HW	L
1		5.8	5.2	0.665	0.25	**6**	HW	L

UNIAXIAL

BH Number	Test No.	Depth	Diameter (cm)	Equivalent Diameter (cr	Gauge Reading (kN)	(Is)50	UCS (Mpa)	Weathering	Strength
15	4	4.57	3.9	5.08	2.332	**0.9**	**21.6**	HW/MW	M
15	5	5.1	4.1	5.21	1.888	**0.7**	**16.8**	HW/MW	M
15	6	5.8	4	5.15	1.618	**0.61**	**14.64**	HW/MW	M

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Appendix E

Aggressivity Laboratory Test Results

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

CERTIFICATE OF ANALYSIS 373670

Client Details

Client	Fortify Geotech
Attention	Joe Stuart
Address	Unit 2 / 538 Gardneners Rd, ALEXANDRIA, NSW, 2015

Sample Details

Your Reference	**S2349 - Campbelltown Arts Centre**
Number of Samples	5 Soil
Date samples received	21/02/2025
Date completed instructions received	21/02/2025

Analysis Details

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

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

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

Report Details

Date results requested by	28/02/2025
Date of Issue	27/02/2025

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

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Soil Aggressivity						
Our Reference		373670-1	373670-2	373670-3	373670-4	373670-5
Your Reference	UNITS	BH14/1	BH14/2	BH14/3	BH15/1	BH15/2
Depth		1.5m	2.0m	4.5m	1.0m	4.2m
Date Sampled		19/02/2025	19/02/2025	19/02/2025	18/02/2025	18/02/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/02/2025	24/02/2025	24/02/2025	24/02/2025	24/02/2025
Date analysed	-	24/02/2025	24/02/2025	24/02/2025	24/02/2025	24/02/2025
pH 1:5 soil:water	pH Units	6.8	6.7	7.8	7.4	8.9
Electrical Conductivity 1:5 soil:water	µS/cm	380	480	770	120	270
Chloride, Cl 1:5 soil:water	mg/kg	420	530	970	42	75
Sulphate, SO4 1:5 soil:water	mg/kg	110	160	140	38	99

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Soil Aggressivity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			24/02/2025	1	24/02/2025	24/02/2025		24/02/2025	[NT]
Date analysed	-			24/02/2025	1	24/02/2025	24/02/2025		24/02/2025	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	6.8	7.0	3	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	380	400	5	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	420	420	0	104	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	110	140	24	105	[NT]

Result Definitions

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

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

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

FORTIFY
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Appendix F

CBR, Atterberg Limit, and PSD Test Results

Material Test Report

J & A Geotech Testing Pty Ltd

Canberra Laboratory
Unit 2, 25 Dacre Street Mitchell ACT 2911
Phone: (02) 6255 5363
Email: scott.miller@jageotech.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Scott Miller
Lab Manager

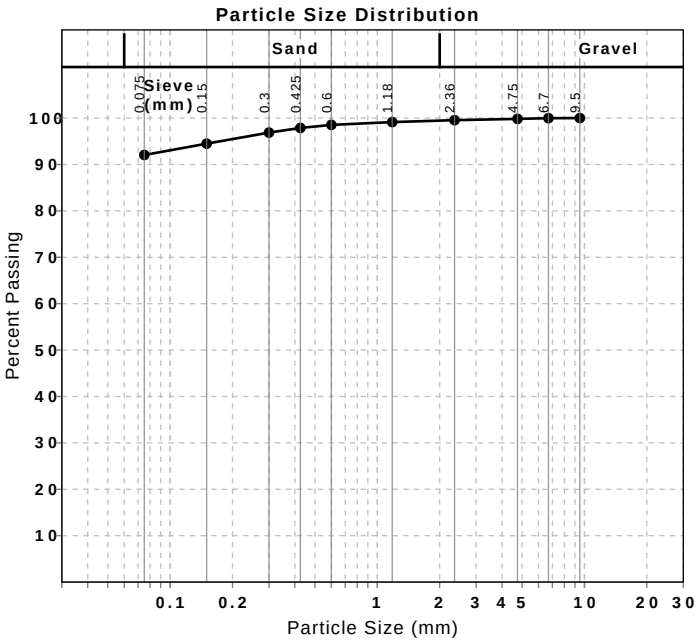
NATA Accredited Laboratory Number: 19979

Report Number:	**CP252240-1**
Issue Number:	1
Date Issued:	04/03/2025
Client:	Fortify Geotech Pty Ltd
	39 Sydenham Rd, Marrickville NSW 2204
Contact:	Allison Baillie
Project Number:	CP252240
Project Name:	Campbelltown Arts Centre
Project Location:	S2349
Client Reference:	S2349
Work Request:	13339
Sample Number:	CS13339A
Date Sampled:	21/02/2025
Dates Tested:	21/02/2025 - 26/02/2025
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH6, Depth: 0.5-1.0m**

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**99**			0		
0.6 mm	**99**			1		
0.425 mm	**98**			1		
0.3 mm	**97**			1		
0.15 mm	**94**			2		
0.075 mm	**92**			2		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	38		
Plastic Limit (%)	17		
Plasticity Index (%)	**21**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**10.0**		
Cracking Crumbling Curling	Cracking		



Material Test Report

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Phone: (02) 6255 5363
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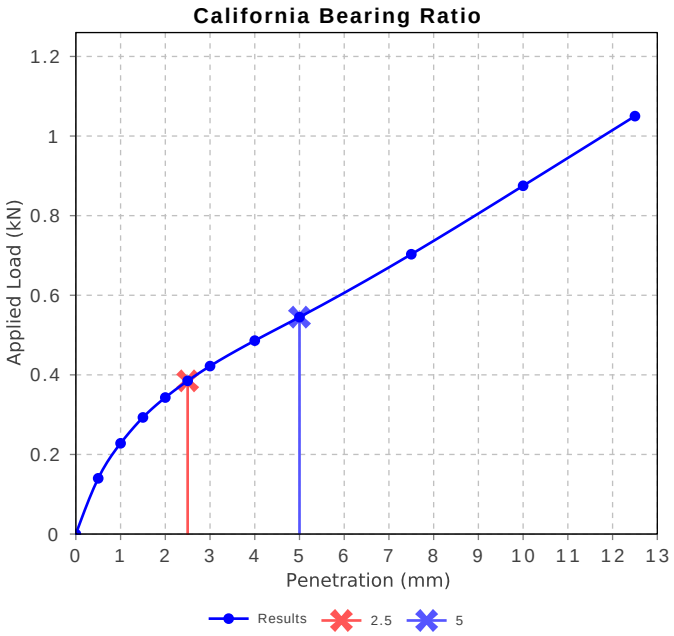
Approved Signatory: Scott Miller
Lab Manager
NATA Accredited Laboratory Number: 19979

Report Number:	**CP252240-1**
Issue Number:	1
Date Issued:	04/03/2025
Client:	Fortify Geotech Pty Ltd
	39 Sydenham Rd, Marrickville NSW 2204
Contact:	Allison Baillie
Project Number:	CP252240
Project Name:	Campbelltown Arts Centre
Project Location:	S2349
Client Reference:	S2349
Work Request:	13339
Sample Number:	CS13339A
Date Sampled:	21/02/2025
Dates Tested:	21/02/2025 - 03/03/2025
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH6, Depth: 0.5-1.0m**

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.75		
Optimum Moisture Content (%)	18.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.68		
Field Moisture Content (%)	14.4		
Moisture Content at Placement (%)	18.4		
Moisture Content Top 30mm (%)	27.2		
Moisture Content Rest of Sample (%)	20.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	49.9		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



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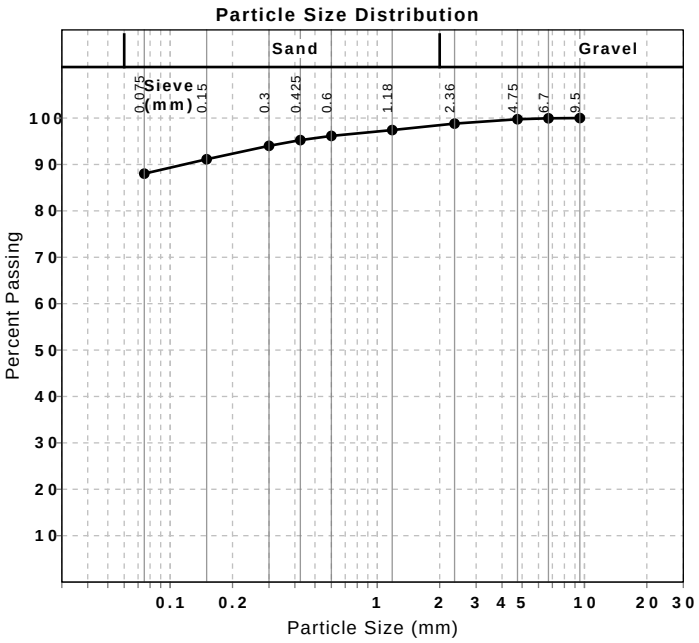
Report Number:	**CP252240-1**
Issue Number:	1
Date Issued:	04/03/2025
Client:	Fortify Geotech Pty Ltd
	39 Sydenham Rd, Marrickville NSW 2204
Contact:	Allison Baillie
Project Number:	CP252240
Project Name:	Campbelltown Arts Centre
Project Location:	S2349
Client Reference:	S2349
Work Request:	13339
Sample Number:	CS13339B
Date Sampled:	21/02/2025
Dates Tested:	21/02/2025 - 26/02/2025
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH2, Depth: 0.5-1.0m**

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**99**			1		
1.18 mm	**97**			1		
0.6 mm	**96**			1		
0.425 mm	**95**			1		
0.3 mm	**94**			1		
0.15 mm	**91**			3		
0.075 mm	**88**			3		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	38		
Plastic Limit (%)	20		
Plasticity Index (%)	**18**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**8.0**		
Cracking Crumbling Curling	Cracking		



Material Test Report

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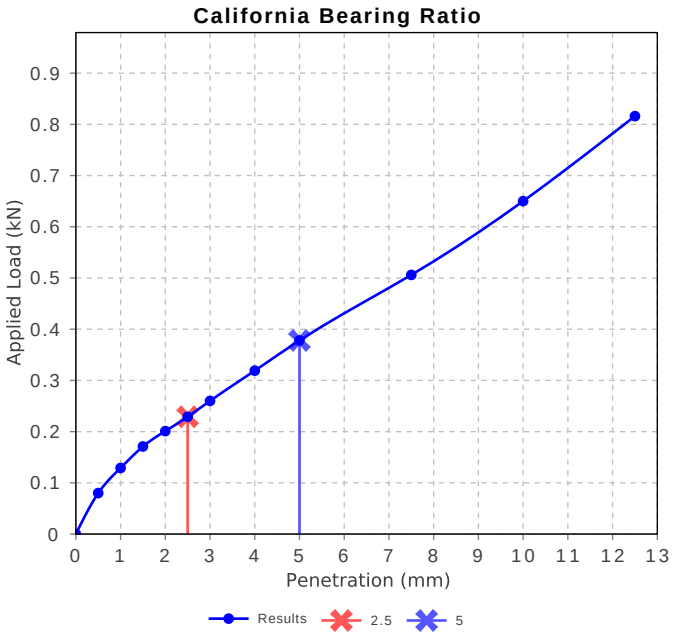
Report Number:	**CP252240-1**
Issue Number:	1
Date Issued:	04/03/2025
Client:	Fortify Geotech Pty Ltd
	39 Sydenham Rd, Marrickville NSW 2204
Contact:	Allison Baillie
Project Number:	CP252240
Project Name:	Campbelltown Arts Centre
Project Location:	S2349
Client Reference:	S2349
Work Request:	13339
Sample Number:	CS13339B
Date Sampled:	21/02/2025
Dates Tested:	21/02/2025 - 03/03/2025
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH2, Depth: 0.5-1.0m**

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	19.0		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.65		
Field Moisture Content (%)	19.4		
Moisture Content at Placement (%)	19.1		
Moisture Content Top 30mm (%)	28.2		
Moisture Content Rest of Sample (%)	21.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	73.7		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

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Approved Signatory: Scott Miller
Lab Manager

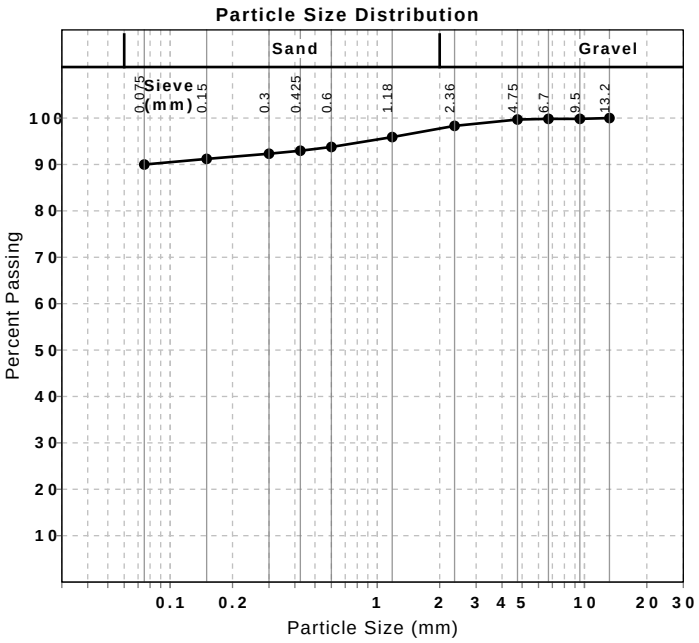
NATA Accredited Laboratory Number: 19979

Report Number:	**CP252240-1**
Issue Number:	1
Date Issued:	04/03/2025
Client:	Fortify Geotech Pty Ltd
	39 Sydenham Rd, Marrickville NSW 2204
Contact:	Allison Baillie
Project Number:	CP252240
Project Name:	Campbelltown Arts Centre
Project Location:	S2349
Client Reference:	S2349
Work Request:	13339
Sample Number:	CS13339C
Date Sampled:	21/02/2025
Dates Tested:	21/02/2025 - 26/02/2025
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH20, Depth: 0.5-1.0m**

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**98**			1		
1.18 mm	**96**			2		
0.6 mm	**94**			2		
0.425 mm	**93**			1		
0.3 mm	**92**			1		
0.15 mm	**91**			1		
0.075 mm	**90**			1		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	46		
Plastic Limit (%)	19		
Plasticity Index (%)	**27**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**10.0**		
Cracking Crumbling Curling	Cracking		



Material Test Report

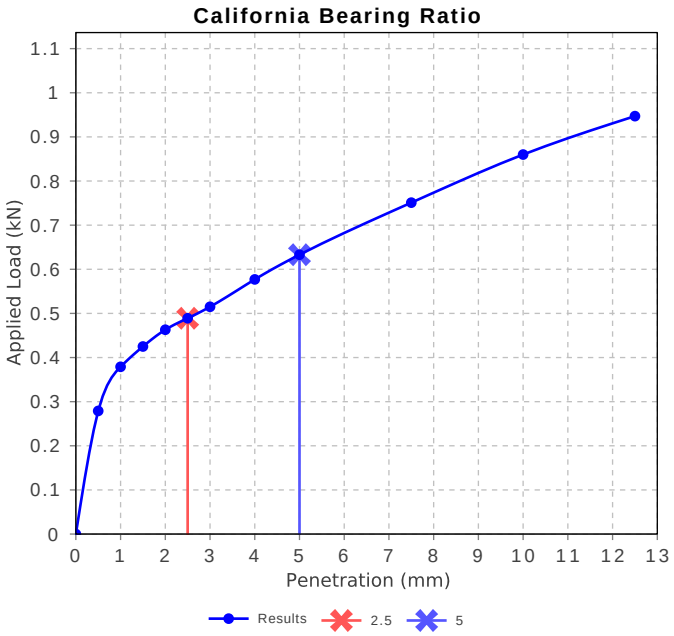
J & A Geotech Testing Pty Ltd

Canberra Laboratory
Unit 2, 25 Dacre Street Mitchell ACT 2911
Phone: (02) 6255 5363
Email: scott.miller@jageotech.com.au
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Scott Miller
Lab Manager
NATA Accredited Laboratory Number: 19979

Report Number:	**CP252240-1**
Issue Number:	1
Date Issued:	04/03/2025
Client:	Fortify Geotech Pty Ltd
	39 Sydenham Rd, Marrickville NSW 2204
Contact:	Allison Baillie
Project Number:	CP252240
Project Name:	Campbelltown Arts Centre
Project Location:	S2349
Client Reference:	S2349
Work Request:	13339
Sample Number:	CS13339C
Date Sampled:	21/02/2025
Dates Tested:	21/02/2025 - 03/03/2025
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH20, Depth: 0.5-1.0m**

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.60		
Optimum Moisture Content (%)	22.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.55		
Field Moisture Content (%)	27.0		
Moisture Content at Placement (%)	22.4		
Moisture Content Top 30mm (%)	31.1		
Moisture Content Rest of Sample (%)	28.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	49.8		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

J & A Geotech Testing Pty Ltd

Canberra Laboratory
Unit 2, 25 Dacre Street Mitchell ACT 2911
Phone: (02) 6255 5363
Email: scott.miller@jageotech.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

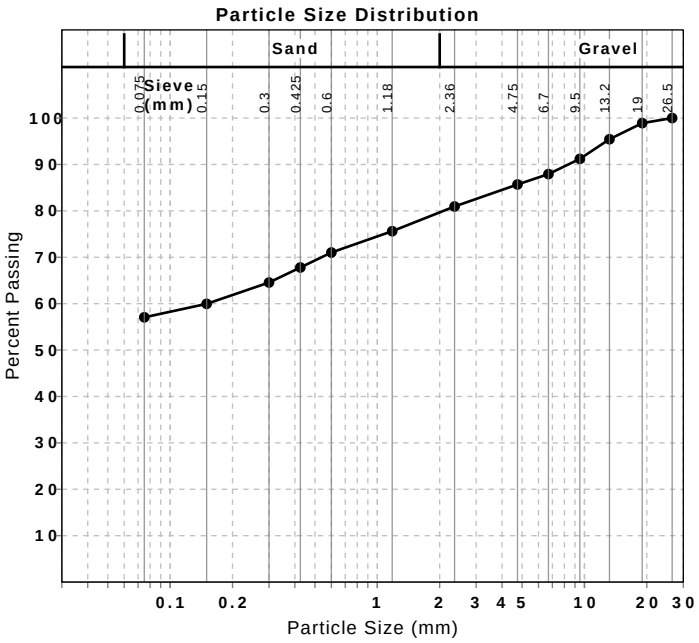
Approved Signatory: Scott Miller
Lab Manager
NATA Accredited Laboratory Number: 19979

Report Number:	**CP252240-1**
Issue Number:	1
Date Issued:	04/03/2025
Client:	Fortify Geotech Pty Ltd
	39 Sydenham Rd, Marrickville NSW 2204
Contact:	Allison Baillie
Project Number:	CP252240
Project Name:	Campbelltown Arts Centre
Project Location:	S2349
Client Reference:	S2349
Work Request:	13339
Sample Number:	CS13339D
Date Sampled:	21/02/2025
Dates Tested:	21/02/2025 - 27/02/2025
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH17, Depth: 0.5-1.0m**

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
26.5 mm	**100**			0		
19 mm	**99**			1		
13.2 mm	**95**			3		
9.5 mm	**91**			4		
6.7 mm	**88**			3		
4.75 mm	**86**			2		
2.36 mm	**81**			5		
1.18 mm	**76**			5		
0.6 mm	**71**			5		
0.425 mm	**68**			3		
0.3 mm	**65**			3		
0.15 mm	**60**			5		
0.075 mm	**57**			3		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	34		
Plastic Limit (%)	17		
Plasticity Index (%)	**17**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**8.5**		
Cracking Crumbling Curling	Cracking		



Material Test Report

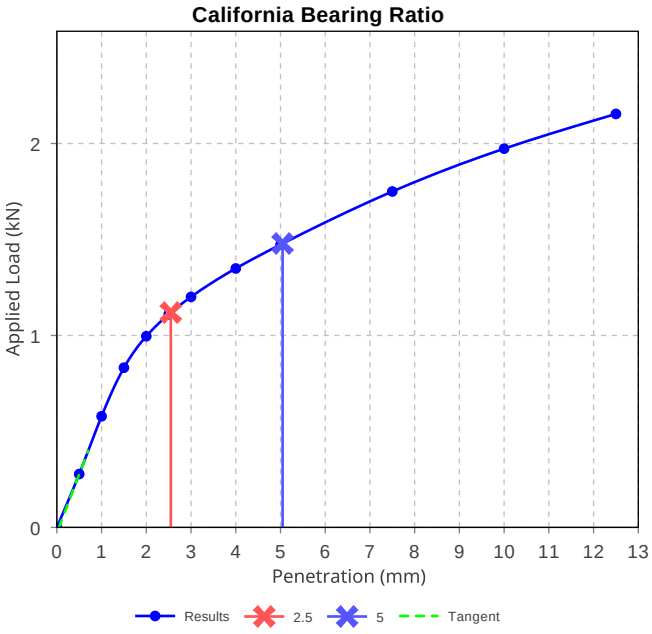
Report Number: **P26010-1**
Issue Number: 1
Date Issued: 25/02/2026
Client: Fortify Geotech Pty Ltd
39 Sydenham Road, Marrickville NSW 2204
Contact: Joe Stuart
Project Number: P26010
Project Name: Cambell Town Arts Centre
Project Location: 1 Art Gallery Road, Campbelltown NSW 2560
Client Reference: S2349
Work Request: 18
Sample Number: S-18A
Date Sampled: 11/02/2026
Dates Tested: 16/02/2026 - 24/02/2026
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH8 , Depth: 0.5-1.0**
Material: On-site Material

Fortify Testing Pty Ltd
39 Sydenham Road Marrickville NSW 2204
Phone: 02 6255 5363
Email: contact email address

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ben Charlton
Assistant Laboratory Manager
Laboratory Number: 21363

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**8**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.73		
Optimum Moisture Content (%)	18.5		
Laboratory Density Ratio (%)	98.5		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.69		
Field Moisture Content (%)	20.2		
Moisture Content at Placement (%)	18.2		
Moisture Content Top 30mm (%)	22.1		
Moisture Content Rest of Sample (%)	19.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	25		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

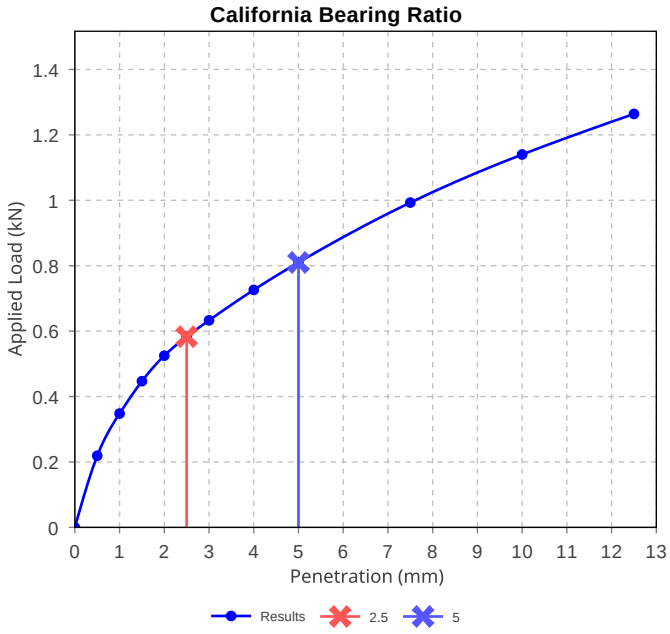
Report Number: **P26010-1**
Issue Number: 1
Date Issued: 25/02/2026
Client: Fortify Geotech Pty Ltd
39 Sydenham Road, Marrickville NSW 2204
Contact: Joe Stuart
Project Number: P26010
Project Name: Cambell Town Arts Centre
Project Location: 1 Art Gallery Road, Campbelltown NSW 2560
Client Reference: S2349
Work Request: 18
Sample Number: S-18B
Date Sampled: 11/02/2026
Dates Tested: 16/02/2026 - 24/02/2026
Sampling Method: Sampled by Client - Tested as Received
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH 1- 7, Depth: 0.5-1.0**
Material: On-site Material

Fortify Testing Pty Ltd
39 Sydenham Road Marrickville NSW 2204
Phone: 02 6255 5363
Email: contact email address

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ben Charlton
Assistant Laboratory Manager
Laboratory Number: 21363

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**4.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	20.0		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.66		
Field Moisture Content (%)	19.6		
Moisture Content at Placement (%)	20.3		
Moisture Content Top 30mm (%)	23.2		
Moisture Content Rest of Sample (%)	21.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	24.5		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



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Appendix G

Definitions of Geotechnical Engineering Terms

DESCRIPTION AND CLASSIFICATION OF SOIL

The methods of description and classification of soils used in this report are based on the Australian Standard 1726 – 2017, Geotechnical site investigations. In general, soils are described along the following characteristics: soil name, plasticity or behavioural or particle characteristics of the primary soil component, colour, secondary soil components' plasticity or behavioural or particle characteristics, condition, structure, inclusions, strength or density and origin.

GENERAL DEFINITION - SOIL

SOIL In engineering usage, soil is a natural aggregate of mineral grains which can be separated by such gentle mechanical means as agitation in water, can be remoulded and can be classified according to the Unified Soil Classification System.

SOIL ORIGIN

Soil origins fall into the following categories:

Residual soil: Soils which have been formed in-situ by the chemical weathering of parent rock. These soils no longer retain any visible structure or fabric of the parent soil or rock material.

Extremely weathered material: Formed directly from in situ weathering of geological formations. Although this material of soil strength it retains the structure and/or fabric of the parent rock material.

Alluvial soil: Deposited by streams and rivers.

Estuarine soil: Deposited in coastal estuaries, and including sediments carried by inflowing rivers and streams, and tidal currents.

Marine soil: Deposited in a marine environment.

Lacustrine soil: Deposited in freshwater lakes.

Aeolian soil: Carried and deposited by wind.

Colluvial soil: Soil and rock debris transported down slopes by gravity, with or without the assistance of flowing water.

Topsoil: Mantle of surface and/or near-surface soil often but not always defined by high levels of organic material, both dead and living.

Fill: Any material which has been placed by anthropogenic processes.

SOIL CLASSIFICATION

PARTICLE SIZE DEFINITIONS

Soil components are described according to the predominating particle size, qualified by the grading of other particles present (e.g. sandy clay) on the following basis:

Classification	Components	Subdivision	Particle Size (mm)
Oversize	Boulders		>200
	Cobbles		63 to 200
Coarse grained soil	Gravel	Coarse	19 to 63
		Medium	6.7 to 19
		Fine	2.36 to 6.7
	Sand	Coarse	0.6 to 2.36
		Medium	0.21 to 0.6
		Fine	0.075 to 0.21
Fine grained soil	Silt		0.002 to 0.075
	Clay		<0.002

MOISTURE CONDITION

Coarse Grained Soil		Fine Grained Soil	
Dry (D)	Non-cohesive and free-running.	Moist, dry of plastic limit (w<W_P)	Hard and friable or powdery.
Moist (M)	Soil feels cool, darkened in colour. Soil tends to stick together.	Moist, near plastic limit (w≈W_P)	Soils can be moulded at a moisture content approximately equal to the plastic limit.
Wet (W)	As for moist, with free water forming when handled.	Moist, wet of plastic limit (w>W_P)	Soils usually weakened and free water forms on hands when handling.
		Wet, near liquid limit (w≈W_L)	Near liquid limit.
		Wet, wet of liquid limit (w>W_L)	Wet of liquid limit.

CONSISTENCY/RELATIVE DENSITY

Cohesive soils are classified on the ease by which the soil can be remoulded and can be either assessed in the field by tactile means, by laboratory testing or through mechanical determination methods. Non-cohesive soils are classified on the basis of relative density, generally from the results of in-situ penetration tests and terms for both are defined as below:

Cohesive Soils			Non-cohesive Soils	
Consistency	**Indicative Undrained Shear Strength s_u(kPa)**	**Field Guide to Consistency**	**Term**	**Relative Density (%)**
Very soft (VS)	≤12	Exudes between the fingers when squeezed in hand.	Very Loose (VL)	≤15
Soft (S)	>12 - ≤25	Can be moulded by light finger pressure.	Loose (L)	>15 - ≤35
Firm (F)	>25 - ≤50	Can be moulded by strong finger pressure.	Medium Dense (MD)	>35 - ≤65
Stiff (St)	>50 - ≤100	Cannot be moulded by fingers.	Dense (D)	>65 - ≤85
Very Stiff (VSt)	>100 - ≤200	Can be indented by thumb nail.	Very Dense (VD)	>85
Hard (H)	>200	Can be indented with difficulty by thumb nail.		
Friable (Fr)	-	Can be easily crumbled or broken into small pieces by hand.		

MINOR COMPONENTS

Descriptive Term	Assessment Guide	Proportion of minor component in:
With	Easily detectable by visual or tactile means and little difference between general properties and properties of primary component.	Coarse grained soils: Fines – 5 to 12% Accessory coarse component – 15 to 30% Fine grained soils: Coarse component - 15 to 30%
Trace	Detectable by visual or tactile means but little or no difference between general properties and properties of primary component.	Coarse grained soils: Fines – <5% Accessory coarse component – <15% Fine grained soils: Coarse component - <15%

CEMENTATION

Where cementation is present in soils, they can be either weakly cemented where they are easily disaggregated by hand in air or water or moderately cemented where effort is required to disaggregate the soil by hand in air or water.

SAMPLING

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

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

Undisturbed samples are generally taken by one of two methods:

1. Driving or pushing a thin walled sample tube into the soil and withdrawing with a sample of soil in a relatively undisturbed state.
2. Core drilling using a retractable inner tube (R.I.T.) core barrel.

Such samples yield information on structure and strength in additions to that obtained from disturbed samples and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

PENETRATION TESTING

The relative density of non-cohesive soils is generally assessed by in-situ penetration tests, the most common of which is the standard penetration test. The test procedure is described in Australian Standard 1289 “Testing Soils for Engineering Purposes” – Test No. F3.1.

The standard penetration test is carried out by driving a 50mm diameter split tube penetrometer of standard dimensions under the impact of a 63kg hammer having a free fall of 750mm.

The “N” value is determined as the number of blows to achieve 300mm of penetration (generally after disregarding the first 150mm penetration through possibly disturbed material). The results of these tests can be related empirically to the engineering properties of the soil.

The test is also used to provide useful information in cohesive soils under certain conditions, a good quality disturbed sample being recovered with each test. Other forms of in situ testing are used under certain conditions and where this occurs, details are given in the report.

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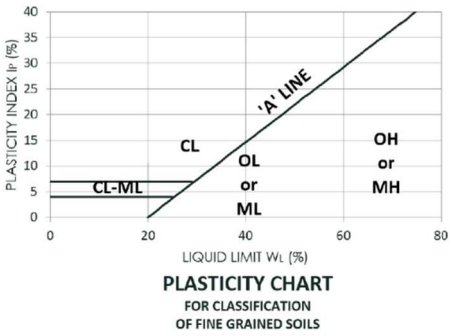
Unified Soil Classification System (Metricated)
Data for Description Identification and Classification of Soils

MAJOR DIVISIONS			DESCRPTION				FIELD IDENTIFICATION						LABORATORY CLASSIFICATION				
			Group Symbol	Graphic Symbol	TYPICAL NAME	DESCRIPTIVE DATA		GRAVELS AND SANDS				Group Symbol	% < 0.075 mm	PLASTICITY OF FINE FRACTION	Coefficient of Uniformity C_u	Coefficient of Curvature C_c	Notes
								GRADATIONS		NATURE OF FINES	DRY STRENGTH						
COARSE GRAINED SOILS	More than 65% by dry mass, less than 63mm is greater than 0.075mm.	GRAVELS More than 50% of coarse grains are greater than 2.36mm.	GW		Well graded gravels and gravel-sand mixtures, little or no fines	Give soil name, indicate approximate percentages of sand and gravel, particle characteristics including particle size subdivision, particle shape, colour, secondary component characteristics and other pertinent descriptive information, symbols in parenthesis. For undisturbed soil add information on structure including zoning, defects and cementing, moisture condition, and relative density. Example: (SP) SAND, trace silt, grey, medium grained, medium dense; dry; Tomago Sand Beds.	COARSE GRAINED SOILS More than 65% of material less than 63mm is greater than 0.075mm. A 0.075mm particle is about the smallest particle visible to the naked eye.	GOOD	Wide range in grain size	"Clean" materials (not enough fines to bond coarse grains)	None	GW	Use the gradation curve of material passing 63mm for classification of fractions according to criteria for major component.	0-5	-	>4	Between 1 and 3	1. Identify fines by the method given for fine grained soils. 2. For fines contents between 5% and 12%, the soil shall be given a dual classification comprising the two group symbols separated by a dash, e.g. for a gravel with between 5% and 12% silt fines, the classification is GP-GM. 3. Soils that are dominated by boulders, cobbles or peat (Pt) are described separately and are not classified.
			GP		Poorly graded gravels and gravel-sand mixtures, little or no fines			POOR	Predominantly one size or range of sizes			GP		0-5	-	Fails to comply with above		
		GRAVELLY SOILS	GM		Silty gravels, gravel-sand-silt mixtures			GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are silty (1)	None to medium	GM		12-50	Below 'A' line and I_P >7	-	-	
			GC		Clayey gravels gravel-sand-clay mixtures					Fines are clayey (1)	Medium to high	GC		12-50	Above 'A' line and I_P >7	-	-	
		SANDS More than 50% of coarse grains are less than 2.36mm.	SW		Well graded sands and gravelly sands, little or no fines			GOOD	Wide range in grain size	"Clean" materials (not enough fines to bond coarse grains)	None	SW		0-5	-	>6	Between 1 and 3	
			SP		Poorly graded sands, little or no fines			POOR	Predominantly one size or range of sizes			SP		0-5	-	Fails to comply with above		
		SANDY SOILS	SM		Silty sand, sand-silt mixtures			GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are silty (1)	None to medium	SM		12-50	Below 'A' line or I_P <4	-	-	
			SC		Clayey sands, sand-clay mixtures					Fines are clayey (1)	Medium to high	SC		12-50	Above 'A' line and I_P >7	-	-	
FINE GRAINED SOILS	More than 35% by dry mass, less than 63mm is less than 0.075mm.	Liquid Limit less than 50%.	ML		Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	Give soil name, indicate degree and character of plasticity, colour, secondary component characteristics other pertinent descriptive information, symbols in parenthesis. For undisturbed soil add information on structure including zoning, defects and cementing, moisture condition, and consistency. Example: (Cl) CLAY, with gravel, red-brown, medium plasticity, very stiff; gravel 20%, fine to medium, sub-rounded; moist, with desiccation cracks; residual.	FINE GRAINED SOILS More than 35% of material less than 63mm is smaller than 0.075mm.	SILT AND CLAY FRACTION Fraction smaller than 0.2 mm AS sieve size												
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			DRY STRENGTH	DILANTANCY	TOUGHNESS		ML		More than 35% of material is less than 63mm passing 0.075mm.	Below 'A' line			
			OL		Organic silts and organic silty clays of low plasticity			None to low	Slow to rapid	Low		CL, CI			Above 'A' line			
		Liquid Limit more than 50%.	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			Medium to high	None to slow	Medium		OL			Below 'A' line			
			CH		Inorganic clays of high plasticity, fat clays			Low to medium	Slow	Low		MH			Below 'A' line			
			OH		Organic clays of medium to high plasticity			Low to medium	None to slow	Low to medium		CH			Above 'A' line			
			Pt		Peat muck and other highly organic soils			High to very high	None	High		OH			Below 'A' line			
								High to high	None to very slow	Low to medium								
							Readily identified by colour, odour, spongy feel and generally fibrous texture					PT		* Effervescence with H_2O_2				



PLASTICITY CHART
FOR CLASSIFICATION
OF FINE GRAINED SOILS

DESCRIPTION AND CLASSIFICATION OF ROCK

The methods of description and classification of rock used in this report are based on the Australian Standard 1726 – 2017, Geotechnical site investigations. In general, descriptions cover the following properties for rock – rock name, grain size, colour, fabric and texture, inclusions or minor components, moisture content, durability, rock material condition including strength and weathering and/or alteration, defects and geological description.

GENERAL DEFINITIONS – ROCK

ROCK In engineering usage, rock is a natural aggregate of minerals connected by strong and permanent cohesive forces. Since "strong" and "permanent" are subject to different interpretations, the boundary between rock and soil is necessarily an arbitrary one. Rock material is intact rock that is bounded by defects.

DEFECT Discontinuity, fracture, break or void in the material or materials across which there is little or no tensile strength.

STRUCTURE The nature and configuration of the different defects within the rock mass and their relationship to each other.

ROCK MASS The entirety of the system formed by all of the rock material and all the defects that are present.

DESCRIPTIVE TERMS

ROCK NAME Simple rock names are used rather than precise geological classification. Rock names fall into category types of sedimentary rocks, igneous rocks, metamorphic rocks and duricrust rocks.

PARTICLE SIZE

Grain size terms for sedimentary rocks with predominantly sand sized grains are:

Coarse grained – mainly 0.6mm to 2mm.

Medium grained – mainly 0.2mm to 0.6mm.

Fine grained – mainly 0.06mm (just visible) to 0.2mm.

In igneous and metamorphic rock types, where significant, the following terms are used to describe the dominant or average grain size and/or the grain size may be recorded in millimetres:

Coarse grained – mainly greater than 2mm.

Medium grained – mainly 0.06mm to 2mm.

Fine grained – mainly less than 0.06mm (just visible).

If readily identifiable, the minerals should be described.

FABRIC

When the arrangement of grains shows an alignment, a preferred orientation or a layering that is visible, descriptive terms for sedimentary rocks are bedding and lamination. Bedding is layering produced by changes in sedimentation. Lamination is similar to bedding but developed in layer thicknesses of less than 20mm. Fabric descriptive terms for metamorphic rocks are foliation, which is the parallel arrangement of minerals due to metamorphic processes and cleavage, which is a type of foliation developed in fine grained metamorphic rocks such as slates. For igneous rocks, flow banding is a layering produced during flow of a partially solidified igneous rock that causes crystals to become oriented.

INDISTINCT FABRIC

Where layering or fabric is just visible. There is little effect on strength properties.

DISTINCT FABRIC

Where layering or fabric is easily visible. The rock may break more easily parallel to the fabric.

ROCK WEATHERING DEFINITIONS

Extremely Weathered (XW)	Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Soil Classification System, but the texture of the original rock is still evident.
Highly Weathered (HW)	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of the chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered (MW)	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly Weathered (SW)	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance, usually limonite, has taken place. The colour and texture of fresh rock is recognisable.
Fresh (FR)	Rock substance unaffected by weathering.

The degrees of rock weathering may be gradational. Intermediate stages are described by dual symbols with the prominent degree of weathering first (e.g. EW-HW).

The various degrees of weathering do not necessarily define strength parameters as some rocks are of low strength, even when fresh, to the extent that they can be broken by hand across the fabric, and some rocks may increase in strength during the weathering process.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics.

Term	**Point Load Strength Index $I_{s(50)}$ MPa**	**Field Guide**	**Approx Unconfined Compressive Strength MPa***
Very Low Strength (VL)	0.03 to 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 30mm thick can be broken by finger pressure.	0.6 to 2
Low Strength (L)	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm 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.	2 to 6
Medium Strength (M)	0.3 to 1	Readily scored with a knife; a piece of core 150mm long x 50mm dia. can be broken by hand with difficulty.	6 to 20
High Strength (H)	1 to 3	A piece of core 150mm long x 50mm dia. cannot be broken by hand but can be broken by a pick with a single firm blow, rock rings under hammer.	20 to 60
Very High Strength (VH)	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	60 to 200
Extremely High Strength (EH)	more than 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.	more than 200

ROCK DEFECT TYPES

This classification applies to the range of possible rock defect types that are types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks.

Term		Description	Diagram
Parting		A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.	
Joint		A surface or crack with no apparent shear displacement an across which the rock has little or no tensile strength, but which is not parallel to layering or to planar anisotropy in the rock material. May be open or closed.	
Sheared Surface		A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.	
Sheared Zone		Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
Seams	Sheared Seam	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, cuved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
	Crushed Seam	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.	
	Infilled Seam	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as a veneer or coating on a joint surface.	
	Extremely Weathered Seam	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.	

The spacing, length (sometimes called persistence), aperture (openness), and seam thickness should generally be described directly in millimetres or metres.

ROCK DEFECT DESCRIPTIONS

DEFECT ROUGHNESS TERMS		DEFECT SHAPE TERMS		DEFECT COATING TERMS	
Term	**Description**	**Term**	**Description**	**Term**	**Description**
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.	Planar	The defect does not vary in orientation.	Clean	No visible coating.
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.	Curved	The defect has a gradual change in orientation.	Stained	No visible coating but surfaces are discoloured.
Smooth	Smooth to touch. Few or no surface irregularities.	Undulating	The defect has a wavy surface.	Veneer	A visible coating or soil or mineral, too thin to measure; may be patchy.
Polished	Shiny smooth surface.	Stepped	The defect has one or more well defined steps.	Coating	A visible coating up to 1mm thick. Thicker soil material should be described using appropriate defect terms (e.g. infilled seam). Thicker rock strength material should be described as a vein.
Slickensided	Grooved or striated surface, usually polished.	Irregular	The defect has many sharp changes of orientation.		

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Appendix H

Limitations of this Report

Limitations in the Use and Interpretation of this Geotechnical Report

Our Professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors/purchasers of the site and/or for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross- sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observes in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and the recommendations considering the changed conditions and time lapse.

The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual. Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

The boring logs and related information depict subsurface conditions only at the specific locations and at the particular time designated on the logs. Soil conditions at the other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations. In making an assessment of a site from a limited number of boreholes or test pits there is the possibility that variations may occur between test locations.

The data derived from the site investigation program and subsequent laboratory testing are extrapolated across the site to form an inferred geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report: nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.