Residential Subdivision The Gardens - Stage 4 Site Classification

Nos. 688 to 730 Medowie Road, Medowie

NEW19P-0143G-AA
9 September 2022

Qualtest
LABORATORY (NSW) PTY LTD

GEOTECHNICAL I LABORATORY I EARTHWORKS I QUARRY I CONSTRUCTION MATERIAL TESTING

9 September 2022

McCloy Project Management Pty Ltd
Suite 2, Ground Floor, 317 Hunter Street
NEWCASTLE NSW 2300

Attention: Mr Bryson Cox

Dear Sir,

RE: RESIDENTIAL SUBDIVISION – THE GARDENS – STAGE 4
Nos. 688 TO 730 MEDOWIE ROAD, MEDOWIE
SITE CLASSIFICATION (LOTS 401 TO 420)

Please find enclosed our geotechnical report for Stage 4 of "The Gardens" residential subdivision, located at Nos. 688 to 730 Medowie Road, Medowie.

The report provides site classification with respect to reactive soils, in accordance with the requirements of AS2870-2011 '*Residential Slabs and Footings*', for Stage 4 (Lots 401 to 420), following completion of site regrade works.

If you have any questions regarding this report, please do not hesitate to contact Ben Bunting, Shannon Kelly, or the undersigned.

For and on behalf of Qualtest Laboratory (NSW) Pty Ltd

Jason Lee
Principal Geotechnical Engineer

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Attachments:

1.0 Introduction

Qualtest Laboratory NSW Pty Ltd (Qualtest) is pleased to present this geotechnical report on behalf of McCloy Development Management Pty Ltd (McCloy), for Stage 4 of 'The Gardens' residential subdivision, located at Nos. 688 to 730 Medowie Road, Medowie.

Based on the brief and sales plan provided by McCloy, Stage 4 is understood to include 20 residential allotments (Lots 401 to 420).

The scope of work for the geotechnical investigation included providing site classification with respect to reactive soils, in accordance with the requirements of AS2870-2011 '*Residential Slabs and Footings*', for Stage 4 following completion of site regrade works which included controlled filling of Lots 407 to 414.

This report presents the results of the field work investigations and laboratory testing, and provides recommendations for the scope outlined above.

2.0 Desktop Study

The scope of work has included a review of the following reports completed by Qualtest:

- Geotechnical Assessment, 'Proposed Residential Subdivision, Medowie Gardens, Medowie Road, Medowie, (Report Reference: NEW19P-0143-AA, dated 27 November 2019);
- Site Classification, 'Residential Subdivision, The Gardens – Stage 1', (Report Reference: NEW19P-00143-AC, dated 1 July 2020);
- Site Classification, 'Residential Subdivision, The Gardens – Stage 3', (Report Reference: NEW19P-00143F-AA, dated 19 May 2022); and,
- Level 1 Site Re-grade Assessment Report, 'The Gardens Subdivision – Stage 4, Medowie Road, Medowie', (Report Reference: NEW21P-0009D-AB, dated 8 September 2022).

This report includes a summary of selected results from the previous reports where applicable.

3.0 Field Work

Field work investigations were carried out on 22 August 2022, comprising of:

- Excavation of eleven (11 no.) boreholes (BH401 to BH411) using a 2.7 tonne excavator with a 300mm diameter auger, to depths of 2.00m;
- Undisturbed samples (U50 tubes) were taken for subsequent laboratory testing; and,
- Boreholes were backfilled with the excavation spoil and compacted using the excavator auger and tracks.

Investigations were carried out by an experienced Geotechnical Engineer from Qualtest who located the boreholes, carried out the testing and sampling, produced field logs of the boreholes, and made observations of the site surface conditions.

Approximate borehole locations are shown on the attached Figure AA1.

Engineering logs of the boreholes are presented in Appendix A.

4.0 Site Description

4.1 Site Regrade Works

Initial Site Re-grade Works – Performed During Stage 3 Bulk Earthworks

Following an initial site visit, stripping assessment and recommendations performed on 14 and 17 January 2022 (Qualtest ref. NEW21P-0009C-SR03, dated 02/02/22), initial site re-grading works were conducted between 17 January 2022 and 21 March 2022.

The initial re-grade works included filling within all or portions of Lots 410 to 412, along with filling within the westbound lane of Macadamia Circuit between approx. Ch. 1250m and 1310m. This filling was performed during the Stage 3 bulk earthworks, and was associated with the backfill of an existing farm dam.

Subsequent Site Re-grade Works – Performed During Stage 4 Bulk Earthworks

Following a subsequent site visit, stripping assessment and recommendations performed on 11 April 2022 (Qualtest ref. NEW21P-0009D-SR01, dated 19/04/22), additional site re-grading works were conducted between 19 April 2022 and 17 May 2022.

Re-grade works included filling within all or portions of Lots 411 to 414 and portions of Lot 508. Filling within these lots consisted predominantly of the placement of remaining required fill to bring lots to finished design levels. Filling was also performed within a small isolated area covering portions of Lots 407 to 409, which was associated with the replacement of existing uncontrolled fill material, understood to have been placed previously on the site.

Filling Method Performed

Prior to filling, re-grade areas were stripped of topsoil and unsuitable material to expose the suitable natural foundation profile. Preparation works were then performed, which consisted of tyning, re-conditioning and re-compaction of the stripped surface, prior to filling with approved site fill to design finish levels

Filling was performed using site stockpiled material won from excavations cut from around the site. The fill material could generally be described as mixtures of Residual (CI-CH) Sandy CLAY, medium to high plasticity, red / brown / grey in colour, with fine to coarse grained Sand.

The approximate depth of fill placed ranged in the order of 0.1m to about 5.7m, with the deepest areas being within the footprint of the previous farm dam, predominately located within Lots 411 to 413.

The approximate maximum depth of fill placed was in the order of:

- Lot 407 to 409 – 1.8m;
- Lot 410 – 5.0m;
- Lot 411 to 413 – 5.7m; and,
- Lot 414 – 0.6m.

The fill was compacted in maximum lifts of 0.3m thickness. Any unsuitable or deleterious material within the fill was removed by hand or mechanical means prior to final compaction of the material.

As the geotechnical testing authority engaged for the project, Qualtest state that the filling performed for the re-grade areas within Stage 4 (as noted above and shown approximately on Figure AA1) was carried out to Level 1 criteria as defined in Clause 8.2 – Section 8 of AS3798-2007, "*Guidelines on Earthworks for Commercial and Residential Developments*".

The recommendations of this report are based on our understanding of lot regrade works from the Level 1 fill supervision by Qualtest, and placement of low reactivity topsoil material such that total depth of topsoil and uncontrolled fill does not exceed 0.4m. Qualtest should be informed without delay if additional earthworks are known to have been carried out.

4.2 Surface Conditions

The site is located east of Medowie Road, Medowie. The site comprises Stage 4 of the Medowie Gardens residential subdivision at Nos. 688 to 730 Medowie Rd, Medowie. The site comprises 20 proposed residential allotments and associated road pavements. The site area of the proposed subdivision is shown on Figure AA1.

Stage 4 is bounded to the north by existing residential allotments, and to the south, east, and west by future or existing stages of The Gardens subdivision (Stage 1, future Stage 5, and Stage 3, respectively).

On the day of the investigation, inter-allotment drainage systems had been installed, and pavements had been constructed (but not sealed), and the site was judged to be reasonably well drained.

Photographs of the site taken on the day of the site investigations are shown below.

Photograph 1: From eastern boundary of Lot 401, facing west.

Photograph 2: From eastern boundary of Lot 401, facing north.

Photograph 3: From near western boundary of Lot 405, facing north.

Photograph 4: From near western boundary of Lot 405, facing east.

Photograph 5: From near north-eastern corner of Lot 410, facing south.

Photograph 6: From near north-eastern corner of Lot 410, facing west.

Photograph 7: From near north-western corner of Lot 411, facing east.

Photograph 8: From near north-western corner of Lot 411, facing south.

Photograph 9: From near eastern boundary of Lot 415, facing east.

Photograph 10: From near eastern boundary of Lot 415, facing north.

Photograph 11: From near eastern boundary of Lot 418, facing west.

Photograph 12: From near eastern boundary of Lot 418, facing north.

4.3 Subsurface Conditions

Reference to the 1:100,000 Newcastle Coalfield Regional Geology Sheet 9231 indicates the site to be underlain by the Permian Aged Tomago Coal Measures, which are characterised by Siltstone, Sandstone, Coal, Tuff and Claystone rock types.

Table 1 presents a summary of the typical soil types encountered on site during the field investigations, divided into representative geotechnical units.

Table 2 contains a summary of the distribution of the above geotechnical units at the borehole locations.

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES

Unit	Soil Type	Description
1A	FILL – TOPSOIL	Sandy CLAY – low to medium plasticity, dark grey-brown, fine to coarse grained (mostly fine grained) sand, trace fine to medium grained angular gravel, with some sticks.
1B	UNCONTROLLED FILL	Not encountered during current investigations.
1C	CONTROLLED FILL	Sandy CLAY / CLAY – medium to high plasticity, red-brown, pale grey to white, brown to pale orange-brown, grey-brown and dark brown, fine to coarse grained (mostly fine to medium grained) sand, with some fine to medium grained rounded and angular to sub-angular gravel in places.
2	TOPSOIL	Sandy CLAY – low plasticity, dark grey-brown, fine grained sand, with some sticks, root affected in places.
3	COLLUVIUM / SLOPEWASH	Not encountered during current investigations.
4	RESIDUAL SOIL	CLAY / Sandy CLAY – medium to high plasticity, pale brown, pale orange-brown, red-brown, with trace pale grey to white in places, fine to coarse grained (mostly fine grained) sand, trace fine grained angular to sub-rounded gravel in places. Gravelly CLAY – medium plasticity, red-brown with some pale grey to white, fine to medium grained sub-rounded to sub-angular gravel, with some fine to coarse grained sand.
5	EXTREMELY WEATHERED (XW) ROCK with soil properties	Not encountered within depth of excavation during current investigation.

No groundwater was encountered in the boreholes during the limited time that they remained open on the day of the field investigation.

It should be noted that groundwater conditions can vary due to rainfall and other influences including regional groundwater flow, temperature, permeability, recharge areas, surface condition, and subsoil drainage.

TABLE 2 – SUMMARY OF GEOTECHNICAL UNITS ENCOUNTERED AT BOREHOLE LOCATIONS

Location	Unit 1A FILL – Topsoil	Unit 1B Uncontrolled Fill	Unit 1C Controlled Fill	Unit 2 Topsoil	Unit 3 Colluvium / Slopewash	Unit 4 Residual Soil	Unit 5 XW Rock
	Depth in metres (m)						
Current Investigation							
BH401	-	-	-	0.00 – 0.25	-	0.25 – 2.00	-
BH402	-	-	-	0.00 – 0.20	-	0.20 – 2.00	-
BH403	0.00 – 0.30	-	-	-	-	0.30 – 2.00	-
BH404	0.00 – 0.10	-	0.10 – 1.25	-	-	1.25 – 2.00	-
BH405	0.00 – 0.35	-	-	-	-	0.35 – 2.00	-
BH406	0.00 – 0.20	-	0.20 – 2.00	-	-	-	-
BH407	-	-	0.00 – 2.00	-	-	-	-
BH408	0.00 – 0.15	-	0.15 – 0.80	-	-	0.80 – 2.00	-
BH409	-	-	-	0.00 – 0.20	-	0.20 – 2.00	-
BH410	-	-	-	0.00 – 0.25	-	0.25 – 2.00	-
BH411	-	-	-	0.00 – 0.25	-	0.25 – 2.00	-
Previous Investigation (NEW19P-0143F-AA, dated 19 May 2022)							
BH301	-	-	-	0.00 - 0.40	-	0.40 - 2.00	-
BH302	-	-	-	0.00 - 0.30	0.30 - 0.40	0.40 - 2.00	-
BH303	-	-	0.00 - 0.40	-	0.40 - 0.50	0.50 - 2.00	-
BH304	0.00 - 0.20	-	0.20 - 0.55	-	-	0.55 - 2.00	-

Location	Unit 1A FILL – Topsoil	Unit 1B Uncontrolled Fill	Unit 1C Controlled Fill	Unit 2 Topsoil	Unit 3 Colluvium / Slopewash	Unit 4 Residual Soil	Unit 5 XW Rock
	Depth in metres (m)						
BH305	0.00 - 0.40	-	0.40 - 1.00	-	-	1.00 - 2.20	-
Previous Investigation (NEW19P-0143-AC, dated 1 July 2020)							
TP109	-	-	-	0.00 - 0.30	0.30 - 0.80	0.80 - 1.40	1.40 - 2.00
TP110	-	-	-	0.00 - 0.25	0.25 - 0.80	0.80 - 1.80	1.80 - 2.00
TP111	-	-	-	0.00 - 0.20	0.20 - 0.50	0.50 - 2.00	-
Previous Investigation (NEW19P-0143-AA, dated 27 November 2019)							
TP04	-	-	-	0.00 - 0.30	0.30 - 0.40	0.40 - 1.95	-
TP06	-	-	-	0.00 - 0.20	-	0.20 - 1.50^	-
TP09	-	-	-	0.00 - 0.20	0.20 - 0.70	0.70 - 2.00	-
TP10	-	-	-	0.00 - 0.25	0.25 - 0.60	0.60 - 1.95	-
TP11	-	0.00 – 0.10	-	0.10 - 0.30	0.30 - 0.45	0.45 - 1.90^	-
TP12	-	-	-	0.00 - 0.35	0.35 - 0.45	0.45 - 1.90^	-
TP16	-	-	-	0.00 - 0.25	0.25 - 0.70	0.70 - 2.00	-
TP17	-	-	-	0.00 - 0.20	0.20 - 0.70	0.70 - 2.00	-
Note:	^ denotes slow to very slow progress / close to practical refusal of 2.7 tonne excavator during previous investigation.						

5.0 Laboratory Testing

Samples collected during the field investigations were returned to our NATA accredited Newcastle Laboratory for testing which comprised of:

- (12 no.) Shrink / Swell tests; and,
- (2 no.) Atterberg Limits tests.

Two shrink/swell tests were replaced by Atterberg Limits classification tests due to the friable nature of the soils.

Results of the laboratory testing are included in Appendix B, with a summary of the Shrink/Swell and Atterberg Limits test results presented in Table 3 and Table 4 respectively, including selected results from previous investigations where applicable.

TABLE 3 – SUMMARY OF SHRINK / SWELL TESTING RESULTS

Location	Depth (m)	Material Description	I_{ss} (%)
Current Investigation			
BH401	0.50 - 0.65	(CI) Sandy CLAY	1.6
BH403	0.50 - 0.80	(CI) Sandy CLAY	1.9
BH404	0.50 - 0.70	(CI) Sandy CLAY	1.0
BH406	0.30 - 0.50	FILL: (CH) Sandy CLAY / CLAY	1.3
BH406	1.00 - 1.15	FILL: (CI) Sandy CLAY	1.3
BH407	0.30 - 0.45	FILL: (CI) Sandy CLAY	1.3
BH407	1.00 - 1.30	FILL: (CI) Sandy CLAY	1.9
BH408	0.30 - 0.45	FILL: (CI) Sandy CLAY	1.8
BH408	0.90 - 1.05	(CI) Sandy CLAY	2.2
BH409	0.90 - 1.10	(CI) Sandy CLAY	1.2
BH410	0.50 - 0.65	(CI) Sandy CLAY	2.4
BH411	0.80 - 1.00	(CI) Sandy CLAY	1.6
Previous Investigation (NEW19P-0143F-AA, dated 19 May 2022)			
BH301	0.60 - 0.75	(CI) CLAY	1.7
BH302	0.90 - 1.05	(CH) CLAY	2.9
BH303	0.05 - 0.25	FILL: (CI) Sandy CLAY	1.3
BH304	0.40 - 0.55	FILL: (CI) Sandy CLAY	0.9
BH305	0.70 - 0.85	FILL: (CH) Sandy CLAY	1.7

Location	Depth (m)	Material Description	I_{ss} (%)
Previous Investigation (NEW19P-0143-AC, dated 1 July 2020)			
TP109	0.80 - 1.00	(CH) CLAY	2.0
TP110	0.90 - 1.05	(CH) CLAY	1.9
TP111	0.30 - 0.50	(CI) Sandy CLAY	1.4
Previous Investigation (NEW19P-0143-AA, dated 27 November 2019)			
TP04	0.60 - 0.80	(CH) CLAY	2.8
TP06	0.45 - 0.85	(CH) CLAY	1.7
TP09	0.45 - 0.70	(CL) CLAY	2.2
TP10	0.30 - 0.55	(CL) CLAY	1.7
TP11	0.45 - 0.70	(CH) CLAY	1.2
TP12	0.85 - 1.05	(CH) CLAY	2.4
TP16	0.50 - 0.70	(CL) CLAY	1.1
TP17	0.80 - 1.00	(CH) CLAY	1.4

TABLE 4 – SUMMARY OF ATTERBERG LIMITS TESTING RESULTS

Location	Sample Depth (m)	Material Description	Liquid Limit (%)	Plastic limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH402	0.80 - 1.00	(CH) CLAY	69	27	42	17.5
BH405	0.80 - 1.00	(CI) Sandy CLAY	58	25	33	16.0

6.0 Site Classification to AS2870-2011

Based on the results of the field work and laboratory testing, residential lots located within Stage 4 of The Gardens residential subdivision located at Nos. 688 to 730 Medowie Road, Medowie, as shown on Figure AA1, are classified in their current condition in accordance with AS2870-2011 '*Residential Slabs and Footings*', as shown in Table 5.

TABLE 5 – SITE CLASSIFICATION TO AS2870-2011

Stage	Lot Numbers	Site Classification
4	401 to 406, and 416 to 420	**M**
	407 to 415	**H1**

A characteristic free surface movement in the range of 20mm to 40mm is estimated for lots classified as **Class 'M'**.

A characteristic free surface movement in the range of 40mm to 60mm is estimated for lots classified as **Class 'H1'**.

The effects of changes to the soil profile by additional cutting and filling and the effects of past and future trees should be considered in selection of the design value for differential movement.

If site re-grading works involving cutting or filling are performed after the date of this assessment the classification may change and further advice should be sought.

Final site classification will be dependent on the type of fill and level of supervision carried out. Re-classification of lots should be confirmed by the geotechnical authority at the time of construction following any site re-grade works.

Footings for the proposed development should be designed and constructed in accordance with the requirements of AS2870-2011.

The classification presented above assumes that:

- All footings are founded in controlled fill (if applicable) or in the natural clayey soils or rock below all non-controlled fill, topsoil material and root zones, and fill under slab panels meets the requirements of AS2870-2011, in particular, the root zone must be removed prior to the placement of fill materials beneath slabs;
- The performance expectations set out in Appendix B of AS2870-2011 are acceptable, and that site foundation maintenance is undertaken to avoid extremes of wetting and drying;
- Footings are to be founded outside of or below all zones of influence resulting from existing or future service trenches;
- The constructional and architectural requirements for reactive clay sites set out in AS2870-2011 are followed;
- Adherence to the detailing requirement outlined in Section 5 of AS2870-2011 '*Residential Slabs and Footings*' is essential, in particular Section 5.6, '*Additional requirements for Classes M, H1, H2 and E sites*' including architectural restrictions, plumbing and drainage requirements; and,
- Site maintenance complies with the provisions of CSIRO Sheet BTF 18, *"Foundation Maintenance and Footing Performance: A Homeowner's Guide"*, a copy of which is attached in Appendix C.

All structural elements on all lots regardless of their site classification should be supported on footings founded beneath all uncontrolled fill, layers of inadequate bearing capacity, soft/loose, or other potentially deleterious material.

If any areas of uncontrolled fill of depths greater than 0.4m are encountered during construction, footings should be designed in accordance with engineering principles for Class 'P' sites.

7.0 Limitations

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical design practices and standards. To our knowledge, they represent a reasonable interpretation of the general conditions of the site.

The extent of testing associated with this assessment is limited to discrete test locations. It should be noted that subsurface conditions between and away from the test locations may be different to those observed during the field work and used as the basis of the recommendations contained in this report.

If subsurface conditions encountered during construction differ from those given in this report, further advice should be sought without delay.

Data and opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement by Qualtest. If this report is reproduced, it must be in full.

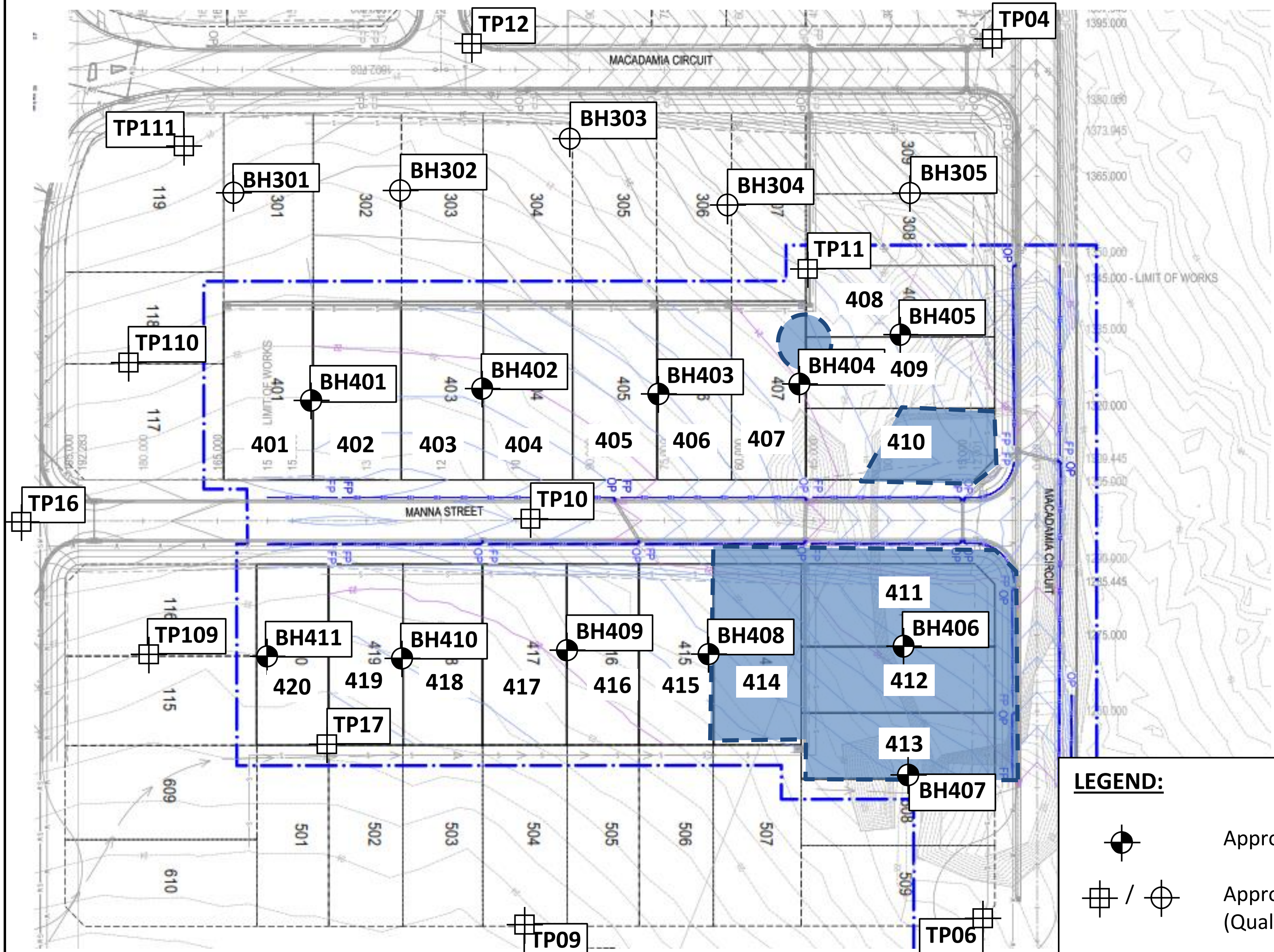
If you have any further questions regarding this report, please do not hesitate to contact Ben Edwards, Shannon Kelly or the undersigned.

For and on behalf of Qualtest Laboratory (NSW) Pty Ltd.

Jason Lee
Principal Geotechnical Engineer

FIGURE AA1:

Site Plan and Approximate Test Locations



Based on site layout plan prepared by ACOR Consultants Pty Ltd
(Project No. NSW210542, Dwg No. C409-010, Iss. 10, dated 16/02/2022)

LEGEND:

Approximate borehole test location.

Approximate test pit / borehole location (Qualtest, 2019 to 2022).

Approximate extent of site re-grade filling.

Qualtest LABORATORY (NSW) PTY LTD

Client:	McCLOY PROJECT MANAGEMENT PTY LTD	Drawing No:	FIGURE AA1
Project:	THE GARDENS - STAGE 4	Project No:	NEW19P-0143G
Location:	Nos. 688 to 730 MEDOWIE ROAD, MEDOWIE	Scale:	N.T.S.
Title:	SITE PLAN AND APPROXIMATE TEST LOCATIONS	Date:	8/09/2022

APPENDIX A:

Engineering Logs of Boreholes

ENGINEERING LOG - BOREHOLE

CLIENT: MCCLOY PROJECT MANAGEMENT PTY LTD
PROJECT: THE GARDENS - STAGE 4
LOCATION: MEDOWIE

BOREHOLE NO: BH401
PAGE: 1 OF 1
JOB NO: NEW19P-0143G
LOGGED BY: BB
DATE: 22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER
BOREHOLE DIAMETER: 300 mm
SURFACE RL:
DATUM:

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.00–0.25m	CL	TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine grained sand, with some sticks.	$M \sim W_P$				TOPSOIL / POSSIBLE FILL-TOPSOIL
				0.25–0.50m	CI	Sandy CLAY - medium plasticity, pale brown, fine grained sand.	$M > W_P$	VSt	HP	230	RESIDUAL SOIL
		0.50m U50 0.65m		0.50–0.80m	CI	Sandy CLAY - medium plasticity, pale orange-brown, trace red-brown, fine grained sand, trace fine grained angular gravel.	$M > W_P$	VSt	HP	250	
				0.80–1.70m	CI	CLAY - medium plasticity, red-brown with some pale orange-brown, with some fine grained sand, trace fine grained angular gravel.	$M \sim W_P$	VSt	HP / HP	320 / 380	
				1.70–2.00m	CH	CLAY - medium to high plasticity, red-brown, trace pale grey to white and pale orange-brown, with some fine grained sand.	$M \sim W_P$	H	HP	490	
				2.00m		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	**BOREHOLE NO:**	**BH402**
PROJECT:	THE GARDENS - STAGE 4	**PAGE:**	1 OF 1
LOCATION:	MEDOWIE	**JOB NO:**	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**
BOREHOLE DIAMETER: 300 mm **DATUM:**

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered				CL	TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine grained sand, with some sticks.	M ~ W_P				TOPSOIL / POSSIBLE FILL-TOPSOIL
				0.20m	CI	Sandy CLAY - medium plasticity, pale brown, fine grained sand.	M > W_P	VSt	HP	210	RESIDUAL SOIL
				0.40m, 0.5	CI	Sandy CLAY - medium plasticity, pale orange-brown, trace red-brown, fine grained sand, trace fine grained angular gravel.			HP	300	
		0.80m U50 1.00m		0.80m	CH	CLAY - medium to high plasticity, red-brown with some pale orange-brown, with some fine grained sand, trace fine grained angular gravel.	M ~ W_P	VSt - H	HP	380	
				1.00m, 1.0, 1.5	CH	CLAY - medium to high plasticity, red-brown, trace pale orange-brown, with some fine grained sand. Red-brown, trace pale grey to white.		H	HP	500	
									HP	520	
				2.00m, 2.0		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Qualtest LABORATORY (NSW) PTY LTD

ENGINEERING LOG - BOREHOLE

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	**BOREHOLE NO:**	**BH403**
PROJECT:	THE GARDENS - STAGE 4	**PAGE:**	1 OF 1
LOCATION:	MEDOWIE	**JOB NO:**	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**
BOREHOLE DIAMETER: 300 mm **DATUM:**

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.00–0.30m		CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine to coarse grained (mostly fine grained) sand, trace fine to medium grained angular gravel, with some sticks.	M ~ Wp				FILL - TOPSOIL
				0.30m		CI	Sandy CLAY - medium plasticity, pale brown, fine grained sand.	M > Wp	VSt	HP	280	RESIDUAL SOIL
		0.50m U50 0.80m		0.50m		CI	Sandy CLAY - medium plasticity, pale orange-brown, trace red-brown, fine grained sand, trace fine grained angular gravel.	M > Wp	VSt	HP	350	
				0.80m		CI	CLAY - medium plasticity, red-brown with some pale orange-brown, with some fine grained sand, trace fine grained angular gravel.	M > Wp	VSt - H	HP	410	
				1.10m		CH	CLAY - medium to high plasticity, red-brown, trace pale grey to white and pale orange-brown, with some fine grained sand.	M ~ Wp	H	HP	550	
						CH	Red-brown with some pale grey to white, trace pale orange-brown.	M < Wp	H	HP	580	
										HP	510	
				2.00m			Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		**UCS (kPa)**
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	**BOREHOLE NO:**	**BH404**
PROJECT:	THE GARDENS - STAGE 4	**PAGE:**	1 OF 1
LOCATION:	MEDOWIE	**JOB NO:**	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**

BOREHOLE DIAMETER: 300 mm **DATUM:**

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.10m	CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine to coarse grained (mostly fine grained) sand, trace fine to medium grained angular gravel, with some sticks.	M > W$_P$				FILL - TOPSOIL
				0.80m	CH	FILL: Sandy CLAY - medium to high plasticity, red-brown, pale grey to white, and brown to pale orange-brown, fine to coarse grained (mostly fine to medium grained) sand, with some fine to medium grained angular gravel.		St - VSt	HP HP	280 150	FILL - CONTROLLED
		0.50m U50 0.70m		0.5							
				1.25m	CH	FILL: Sandy CLAY - medium to high plasticity, brown to dark brown with some red-brown and pale orange-brown, fine to coarse grained (mostly fine to medium grained) sand, with some fine to medium grained angular gravel.			HP HP HP	200 180 230	
				1.0							
				2.00m	CI	Gravelly CLAY - medium plasticity, red-brown with some pale grey to white, fine to medium grained sub-rounded to sub-angular gravel, with some fine to coarse grained sand.	M < W$_P$	H / Fb			RESIDUAL SOIL
				1.5							
				2.0		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U$_{50}$	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W$_p$	Plastic Limit
W$_L$	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	**BOREHOLE NO:**	**BH405**
PROJECT:	THE GARDENS - STAGE 4	**PAGE:**	1 OF 1
LOCATION:	MEDOWIE	**JOB NO:**	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**

BOREHOLE DIAMETER: 300 mm **DATUM:**

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered				CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine to coarse grained (mostly fine grained) sand, trace fine to medium grained angular gravel, with some sticks. Lens of Clay fill (~50mm thick) at 0.20m. Possible natural topsoil underneath.	M < W_p				FILL - TOPSOIL
				0.35m	CI	Sandy CLAY - medium plasticity, pale brown, fine grained sand.	M > W_p	VSt	HP	230	RESIDUAL SOIL
		0.80m U50 1.00m		0.50m	CH	Sandy CLAY - medium to high plasticity, pale orange-brown, trace red-brown, fine grained sand, trace fine grained angular gravel.			HP HP	280 300	
				1.30m	CI	CLAY - medium plasticity, red-brown with some pale orange-brown, with some fine to coarse grained (mostly fine grained) sand, trace fine grained sub-angular gravel.	M ~ W_p	H	HP	450	
				1.50m	CI	Gravelly CLAY - medium plasticity, red-brown with some pale grey to white, fine to medium grained sub-rounded to sub-angular gravel, with some fine to coarse grained sand.		H / Fb			
				2.00m		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		**UCS (kPa)**
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	BOREHOLE NO:	BH406
PROJECT:	THE GARDENS - STAGE 4	PAGE:	1 OF 1
LOCATION:	MEDOWIE	JOB NO:	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**

BOREHOLE DIAMETER: 300 mm **DATUM:**

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.20m	CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine to coarse grained (mostly fine grained) sand, trace fine to medium grained angular gravel, with some sticks.	M ~ W_P				FILL - TOPSOIL
		0.30m U50 0.50m		0.5 / 0.70m	CI	FILL: CLAY / Sandy CLAY - medium plasticity, brown with some red-brown, pale orange-brown and grey-brown, fine to coarse grained (mostly fine grained) sand, trace fine grained angular gravel.	M > W_P	St - VSt	HP HP HP	150 170 160	FILL - CONTROLLED
		1.00m		1.0 / 1.00m	CI	FILL: Sandy CLAY - medium plasticity, red-brown and pale orange-brown, fine grained sand.	M > W_P	VSt	HP	280	
		U50 1.15m		1.40m	CI	FILL: Sandy CLAY - medium plasticity, red-brown with some pale grey to white, fine to coarse grained (mostly fine to medium grained) sand, with some fine to medium grained angular gravel.	M ~ W_P	VSt - H	HP HP	410 350	
				1.5 / 2.0 / 2.00m	CI	FILL: Sandy CLAY - high plasticity, pale brown to pale orange-brown with some red-brown, fine to coarse grained (mostly fine to medium grained) sand, trace fine grained angular gravel.	M ~ W_P	VSt - H	HP HP	220 310	
						Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT: MCCLOY PROJECT MANAGEMENT PTY LTD
PROJECT: THE GARDENS - STAGE 4
LOCATION: MEDOWIE

BOREHOLE NO: BH407
PAGE: 1 OF 1
JOB NO: NEW19P-0143G
LOGGED BY: BB
DATE: 22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER
BOREHOLE DIAMETER: 300 mm
SURFACE RL:
DATUM:

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.00	CH	FILL: Sandy CLAY - medium plasticity, brown with some red-brown and pale orange-brown, fine to medium grained sand.	M ~ Wp	St - VSt			FILL - CONTROLLED
		0.30m U50 0.45m					M > Wp		HP	200	
				0.5		Trace pale grey to pale brown.			HP	130	
									HP	180	
									HP	150	
		1.00m U50 1.30m		1.00m	CI	FILL: Sandy CLAY - medium plasticity, grey-brown to pale brown, fine grained sand.			HP	200	FILL - CONTROLLED / POSSIBLE RESIDUAL SOIL
				1.30m	CI	FILL: Sandy CLAY - medium plasticity, pale brown with some red-brown, fine grained sand.		VSt	HP	250	
				1.60m	CI	FILL: CLAY - medium to high plasticity, red-brown with some pale grey to white, with some fine to medium grained sand.	M ~ Wp		HP	350	
									HP	380	
				2.00m		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	**BOREHOLE NO:**	**BH408**
PROJECT:	THE GARDENS - STAGE 4	**PAGE:**	1 OF 1
LOCATION:	MEDOWIE	**JOB NO:**	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**

BOREHOLE DIAMETER: 300 mm **DATUM:**

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.00–0.15m		CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine to medium grained sand, trace fine grained angular gravel, with some sticks.	M > W_P				FILL - TOPSOIL
		0.30m U50 0.45m		0.15–0.80m		CI	FILL: Sandy CLAY - medium plasticity, brown with some red-brown, pale grey to grey-brown and pale orange-brown, fine to coarse grained (mostly fine to medium grained) sand, with some fine to medium grained angular gravel.	M > W_P	St	HP HP HP	120 100 110	FILL - CONTROLLED
		0.90m U50 1.05m		0.80–1.10m		CI	Sandy CLAY - medium plasticity, pale orange-brown to orange-brown, trace red-brown, fine grained sand.	M > W_P	VSt	HP	250	RESIDUAL SOIL
				1.10–2.00m		CI	Sandy CLAY - medium plasticity, pale orange-brown and red-brown, fine to medium grained sand, with some fine to medium grained rounded to sub-angular gravel. Red-brown with some pale grey to white.	M ~ W_P	VSt	HP HP	350 380	
				2.00m			Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	**BOREHOLE NO:**	**BH409**
PROJECT:	THE GARDENS - STAGE 4	**PAGE:**	1 OF 1
LOCATION:	MEDOWIE	**JOB NO:**	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER
SURFACE RL:
BOREHOLE DIAMETER: 300 mm
DATUM:

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.00–0.20m	CL	TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine grained sand, with some sticks.	M > Wp				TOPSOIL / POSSIBLE FILL-TOPSOIL
				0.20–0.40m	CI	Sandy CLAY - medium plasticity, pale brown, fine grained sand.	M > Wp	St - VSt	HP	220	RESIDUAL SOIL
		0.90m U50 1.10m		0.40–1.20m	CI	Sandy CLAY - medium plasticity, pale orange-brown, trace red-brown, fine grained sand, trace fine grained angular gravel.	M > Wp	St - VSt	HP HP	280 310	
				1.20–2.00m	CH	Sandy CLAY - medium to high plasticity, red-brown with some pale grey to white, fine to coarse grained (mostly fine grained) sand, with some fine to medium grained sub-angular to sub-rounded gravel.	M ~ Wp	VSt - H	HP HP HP	420 390 410	
				2.00m		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		**UCS (kPa)**
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	BOREHOLE NO:	BH410
PROJECT:	THE GARDENS - STAGE 4	PAGE:	1 OF 1
LOCATION:	MEDOWIE	JOB NO:	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**
BOREHOLE DIAMETER: 300 mm **DATUM:**

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered				CL	TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine grained sand, with some sticks.	M ~ W_P				TOPSOIL / POSSIBLE FILL-TOPSOIL
				0.25m	CI	Sandy CLAY - medium plasticity, pale brown, fine grained sand.	M > W_P	St - VSt	HP	210	RESIDUAL SOIL
		0.50m U50 0.65m		0.5 (0.50m)	CI	Sandy CLAY - medium plasticity, pale orange-brown and red-brown, fine grained sand, trace fine grained angular gravel.	M ~ W_P	VSt	HP	380	
				1.0 (1.10m)	CH	Sandy CLAY - medium to high plasticity, red-brown with some pale grey to white, fine to coarse grained (mostly fine grained) sand, with some fine grained angular gravel.		H	HP	450	
				1.5					HP	480	
				2.0 (2.00m)		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

ENGINEERING LOG - BOREHOLE

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	MCCLOY PROJECT MANAGEMENT PTY LTD	BOREHOLE NO:	**BH411**
PROJECT:	THE GARDENS - STAGE 4	PAGE:	1 OF 1
LOCATION:	MEDOWIE	JOB NO:	NEW19P-0143G
		LOGGED BY:	BB
		DATE:	22/8/22

DRILL TYPE: 2.7 TONNE EXCAVATOR WITH AUGER **SURFACE RL:**
BOREHOLE DIAMETER: 300 mm **DATUM:**

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered			0.00–0.25m	CL	TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown, fine grained sand, with some sticks.	M > W_P				TOPSOIL / POSSIBLE FILL-TOPSOIL
				0.25–0.40m	CI	Sandy CLAY - medium plasticity, pale brown, fine grained sand.		St - VSt	HP	230	RESIDUAL SOIL
		0.80m U50 1.00m		0.40–1.10m	CI	Sandy CLAY - medium plasticity, pale orange-brown, fine grained sand, trace fine grained angular gravel. Pale orange-brown with some red-brown.		VSt	HP HP	300 350	
				1.10–2.00m	CH	Sandy CLAY - medium to high plasticity, red-brown with some pale pale orange-brown, fine to medium grained (mostly fine grained) sand. Red-brown, trace pale grey to white, trace fine grained angular gravel. Red-brown with some pale grey to white.	M ~ W_P	VSt VSt - H	HP HP HP	350 410 450	
				2.00m		Hole Terminated at 2.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW19P-0143G-AA DRAFT LOGS.GPJ <<DrawingFile>> 09/09/2022 10:51 10.02.00.04 Datgel Lab and In Situ Tool

APPENDIX B:

Results of Laboratory Testing

QUALTEST Laboratory (NSW) Pty Ltd (20708)
2 Murray Dwyer Circuit, Mayfield West, NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW22W-3061-S01
Issue No: 1

Shrink Swell Index Report

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
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WORLD RECOGNISED ACCREDITATION

Approved Signatory: Kyle Spencer
(Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/09/2022

Sample Details

Sample ID:	NEW22W-3061-S01		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH401 - (0.50 - 0.65m)		
Date Tested:	29/08/2022		

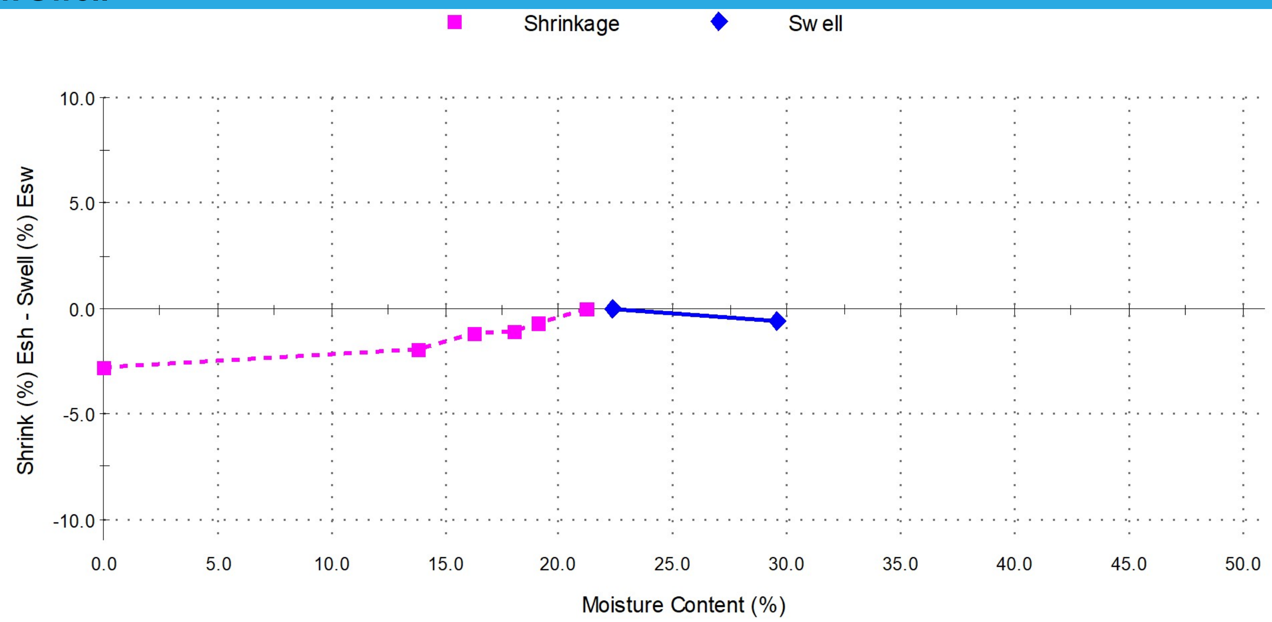
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.6
Moisture Content before (%):	22.4
Moisture Content after (%):	29.6
Est. Unc. Comp. Strength before (kPa):	270
Est. Unc. Comp. Strength after (kPa):	300

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	2.8
Shrinkage Moisture Content (%):	21.2
Est. inert material (%):	1%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 1.6

Comments

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F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: MAT:NEW22W-3061-S02
Issue No: 1

Material Test Report

Client: McCLOY GROUP
Suite 2, Ground Floor, 317 Hunter Street
Newcastle NSW 2300

Project No.: NEW19P-0143G
Project Name: The Gardens Stage 4
Project Location: 688 - 730 Medowie Road, Medowie

NATA
WORLD RECOGNISED ACCREDITATION

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Results provided relate only to the items tested or sampled.

B. Cullen

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 1/09/2022

Sample Details

Sample ID: NEW22W-3061-S02
Date Sampled: 22/08/2022
Date Received: 23/08/2022
Source: On-Site Insitu
Material: Sandy Clay
Specification: No Specification
The results outlined below apply to the sample as received
Sample Location: BH402 - (0.80 - 1.00m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	17.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	69	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	27	
Plasticity Index (%)	AS 1289.3.3.1	42	
Date Tested		29/08/2022	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
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T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Shrink Swell Index Report

Report No: SSI:NEW22W-3061-S03
Issue No: 1

Client: McCLOY GROUP
Suite 2, Ground Floor, 317 Hunter Street
Newcastle NSW 2300

Project No.: NEW19P-0143G
Project Name: The Gardens Stage 4
Project Location: 688 - 730 Medowie Road, Medowie

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID: NEW22W-3061-S03
Sampling Method: The results outlined below apply to the sample as received
Material: Sandy Clay
Date Sampled: 22/08/2022
Source: On-Site Insitu
Date Submitted: 23/08/2022
Specification: No Specification
Sample Location: BH403 - (0.50 - 0.80m)
Date Tested: 29/08/2022

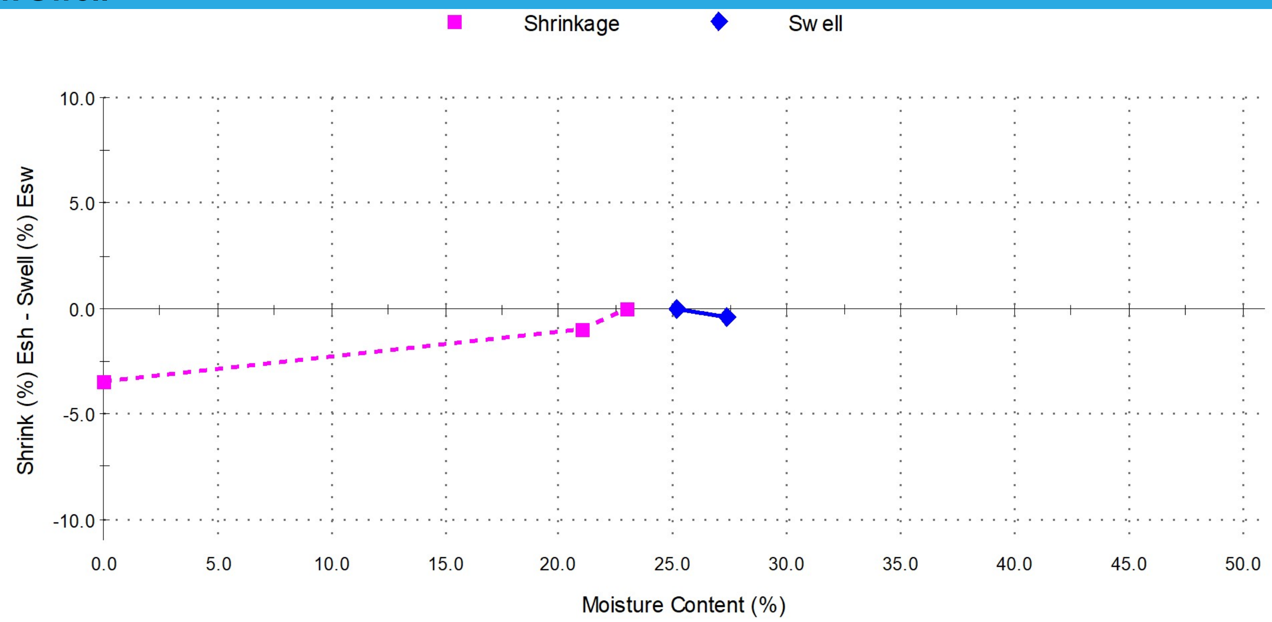
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.4
Moisture Content before (%):	25.1
Moisture Content after (%):	27.4
Est. Unc. Comp. Strength before (kPa):	230
Est. Unc. Comp. Strength after (kPa):	200

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	3.5
Shrinkage Moisture Content (%):	23.0
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 1.9

Comments

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2 Murray Dwyer Circuit, Mayfield West, NSW 2304
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F: 02 4960 9775
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W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW22W-3061-S04
Issue No: 1

Shrink Swell Index Report

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
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Results provided relate only to the items tested or sampled.

NATA
WORLD RECOGNISED ACCREDITATION

B. Cullen
Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S04		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH404 - (0.50 - 0.70m)		
Date Tested:	29/08/2022		

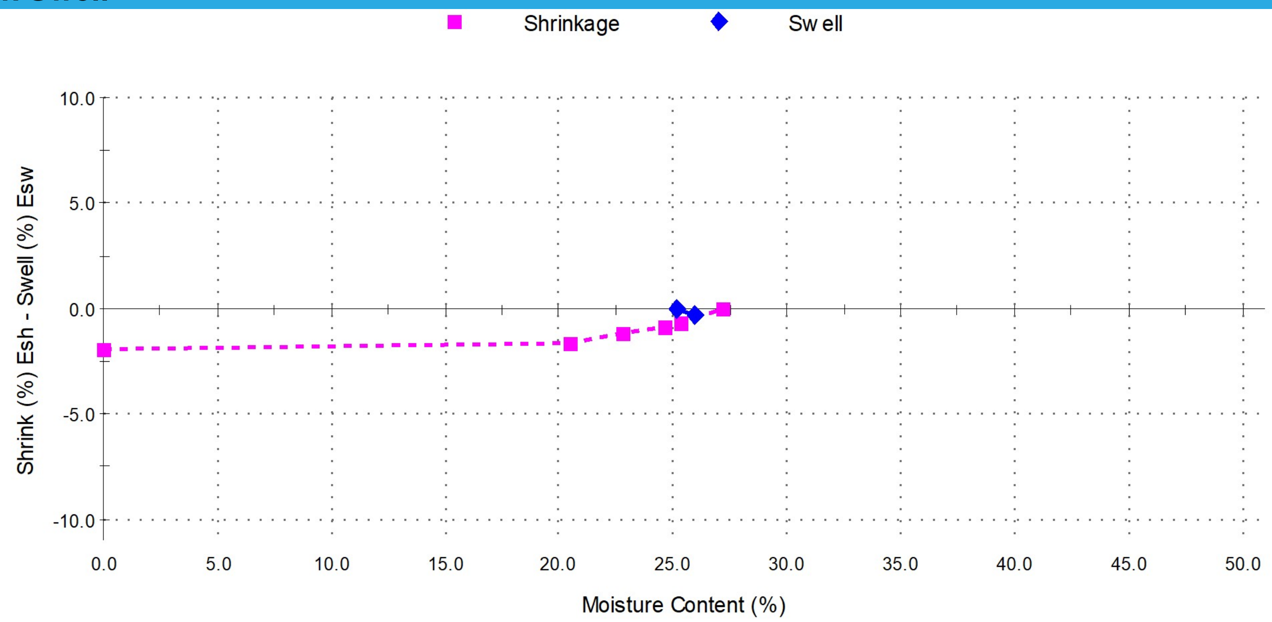
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.3
Moisture Content before (%):	25.2
Moisture Content after (%):	26.0
Est. Unc. Comp. Strength before (kPa):	420
Est. Unc. Comp. Strength after (kPa):	360

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	1.9
Shrinkage Moisture Content (%):	27.2
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 1.0

Comments

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W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: MAT:NEW22W-3061-S05
Issue No: 1

Material Test Report

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
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Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 1/09/2022

Sample Details

Sample ID:	NEW22W-3061-S05
Date Sampled:	22/08/2022
Date Received:	23/08/2022
Source:	On-Site Insitu
Material:	Sandy Clay
Specification:	No Specification
	The results outlined below apply to the sample as received
Sample Location:	BH405 - (0.80 - 1.00m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	16.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	58	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	25	
Plasticity Index (%)	AS 1289.3.3.1	33	
Date Tested		29/08/2022	

Comments

N/A

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F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW22W-3061-S06
Issue No: 1

Shrink Swell Index Report

Client: McCLOY GROUP
Suite 2, Ground Floor, 317 Hunter Street
Newcastle NSW 2300

Project No.: NEW19P-0143G
Project Name: The Gardens Stage 4
Project Location: 688 - 730 Medowie Road, Medowie

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NATA WORLD RECOGNISED ACCREDITATION

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID: NEW22W-3061-S06
Sampling Method: The results outlined below apply to the sample as received
Material: Sandy Clay
Source: On-Site Insitu
Specification: No Specification
Sample Location: BH406 - (0.30 - 0.50m)
Date Tested: 29/08/2022
Date Sampled: 22/08/2022
Date Submitted: 23/08/2022

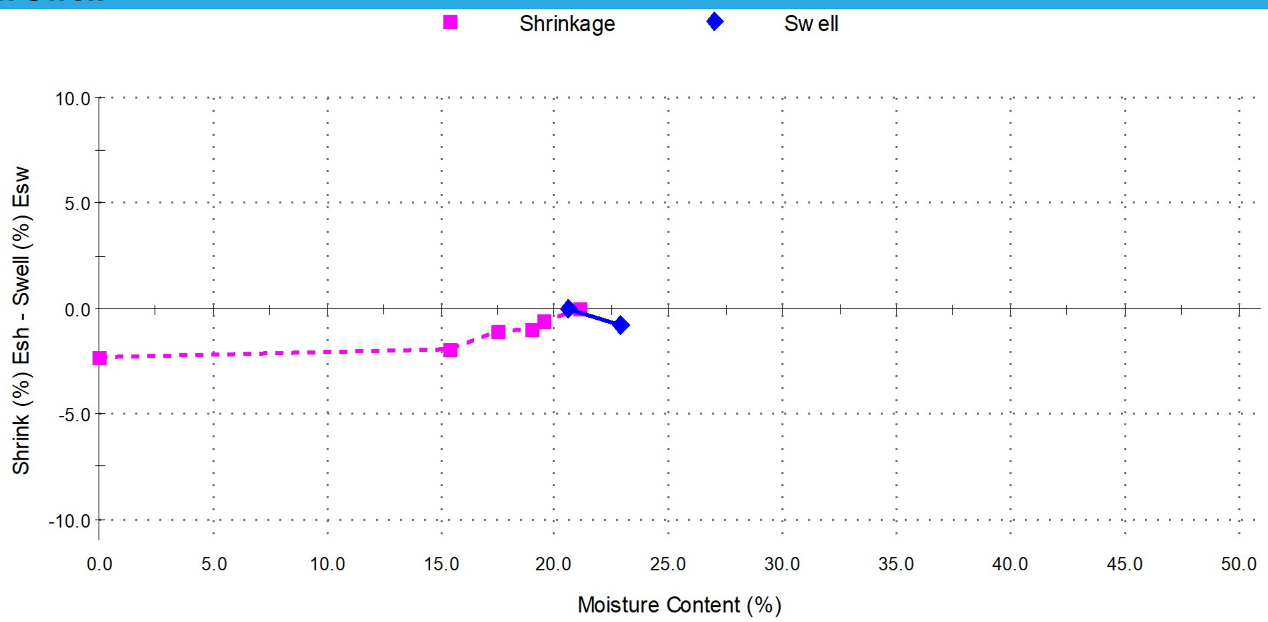
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.8
Moisture Content before (%):	20.6
Moisture Content after (%):	22.9
Est. Unc. Comp. Strength before (kPa):	410
Est. Unc. Comp. Strength after (kPa):	460

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	2.3
Shrinkage Moisture Content (%):	21.1
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Minor

Shrink Swell



Shrink Swell Index - Iss (%): 1.3

Comments

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2 Murray Dwyer Circuit, Mayfield West, NSW 2304
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F: 02 4960 9775
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ABN: 98 153 268 896

Report No: SSI:NEW22W-3061-S07
Issue No: 1

Shrink Swell Index Report

Client: McCLOY GROUP
Suite 2, Ground Floor, 317 Hunter Street
Newcastle NSW 2300

Project No.: NEW19P-0143G
Project Name: The Gardens Stage 4
Project Location: 688 - 730 Medowie Road, Medowie

NATA
WORLD RECOGNISED ACCREDITATION

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Results provided relate only to the items tested or sampled.

B. Cullen
Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID: NEW22W-3061-S07
Sampling Method: The results outlined below apply to the sample as received
Material: Sandy Clay
Date Sampled: 22/08/2022
Source: On-Site Insitu
Date Submitted: 23/08/2022
Specification: No Specification
Sample Location: BH406 - (1.00 - 1.15m)
Date Tested: 29/08/2022

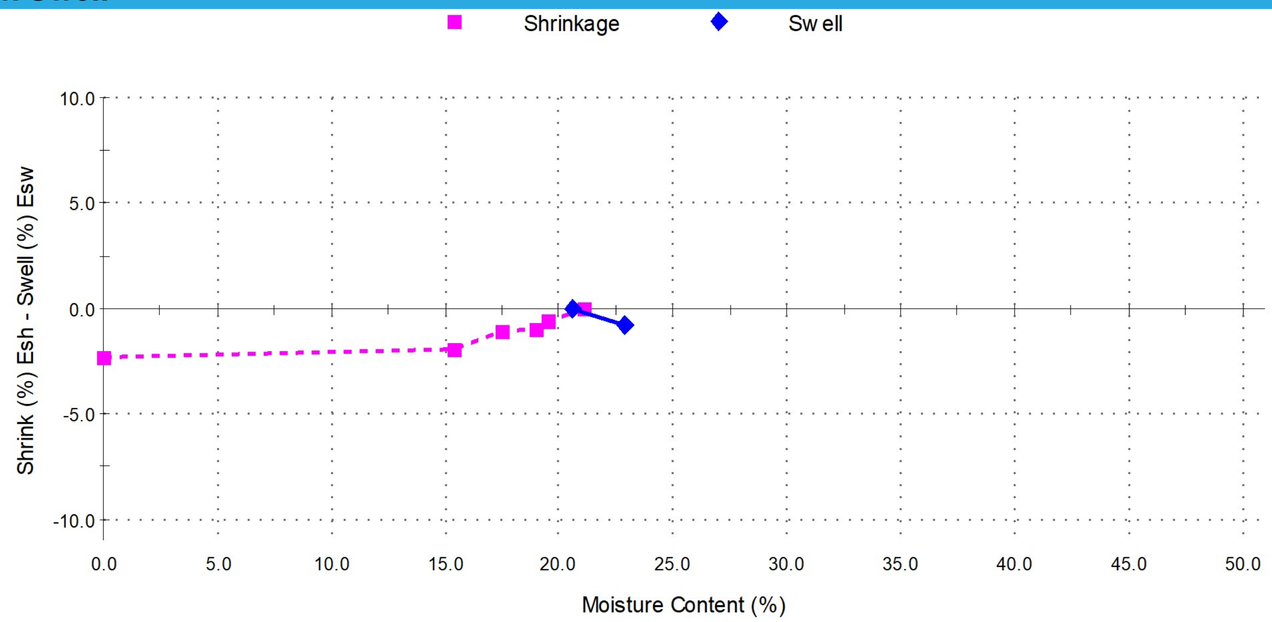
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.8
Moisture Content before (%):	20.6
Moisture Content after (%):	22.9
Est. Unc. Comp. Strength before (kPa):	410
Est. Unc. Comp. Strength after (kPa):	460

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	2.3
Shrinkage Moisture Content (%):	21.1
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Minor

Shrink Swell



Shrink Swell Index - Iss (%): 1.3

Comments

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F: 02 4960 9775
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W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW22W-3061-S08
Issue No: 1

Shrink Swell Index Report

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

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NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S08		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH407 - (0.30 - 0.45m)		
Date Tested:	29/08/2022		

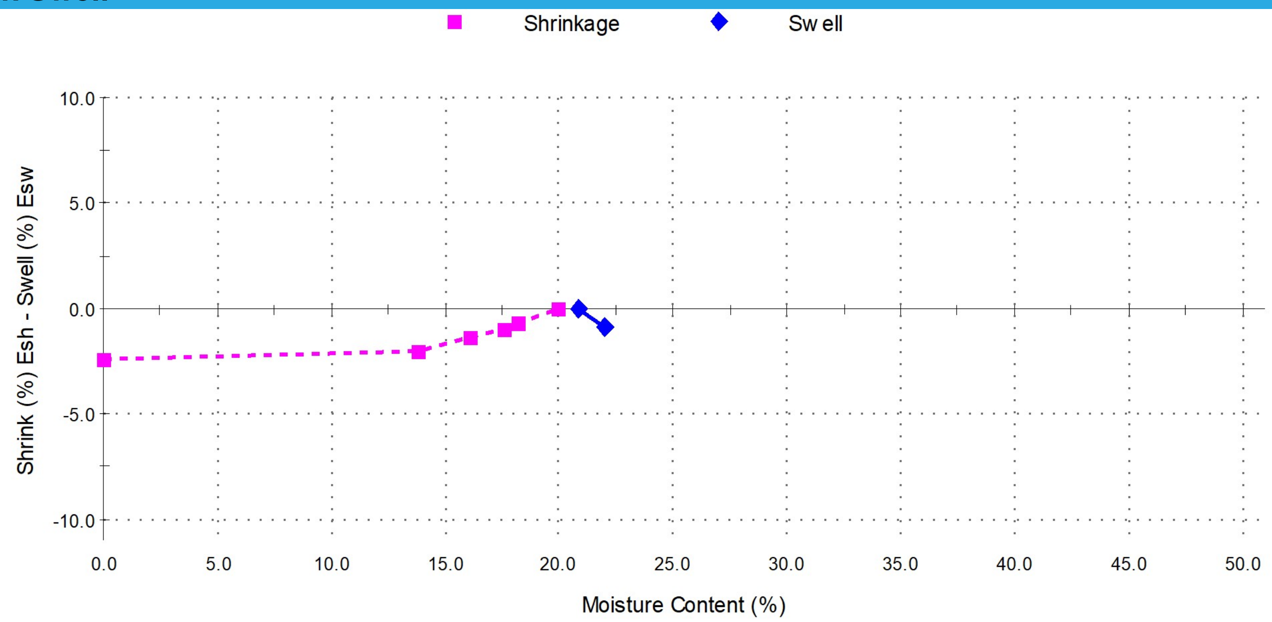
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.9
Moisture Content before (%):	20.9
Moisture Content after (%):	22.0
Est. Unc. Comp. Strength before (kPa):	240
Est. Unc. Comp. Strength after (kPa):	210

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	2.4
Shrinkage Moisture Content (%):	20.0
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Minor

Shrink Swell



Shrink Swell Index - Iss (%): 1.3

Comments

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2 Murray Dwyer Circuit, Mayfield West, NSW 2304
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ABN: 98 153 268 896

Shrink Swell Index Report

Report No: SSI:NEW22W-3061-S09
Issue No: 1

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
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Results provided relate only to the items tested or sampled.

NATA
WORLD RECOGNISED ACCREDITATION

B. Cullen
Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S09		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH407 - (1.00 - 1.30m)		
Date Tested:	29/08/2022		

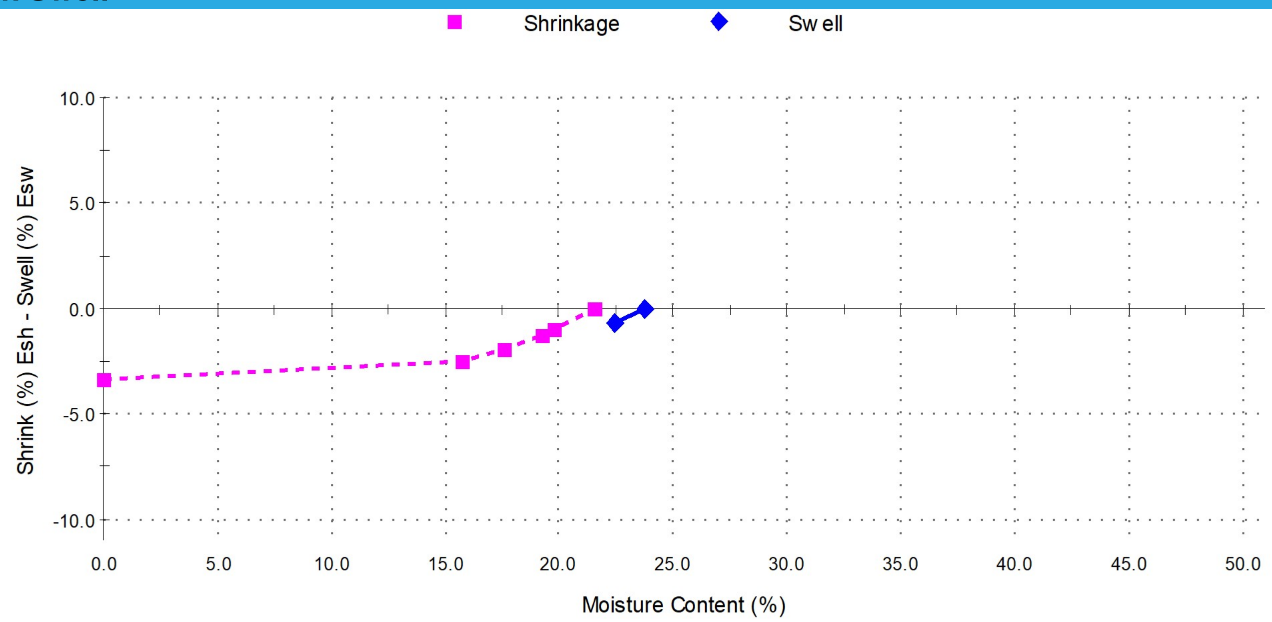
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.7
Moisture Content before (%):	23.7
Moisture Content after (%):	22.4
Est. Unc. Comp. Strength before (kPa):	180
Est. Unc. Comp. Strength after (kPa):	200

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	3.4
Shrinkage Moisture Content (%):	21.5
Est. inert material (%):	3%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Minor

Shrink Swell



Shrink Swell Index - Iss (%): 1.9

Comments

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ABN: 98 153 268 896

Report No: SSI:NEW22W-3061-S10
Issue No: 1

Shrink Swell Index Report

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

B. Cullen

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S10		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH408 - (0.30 - 0.45m)		
Date Tested:	29/08/2022		

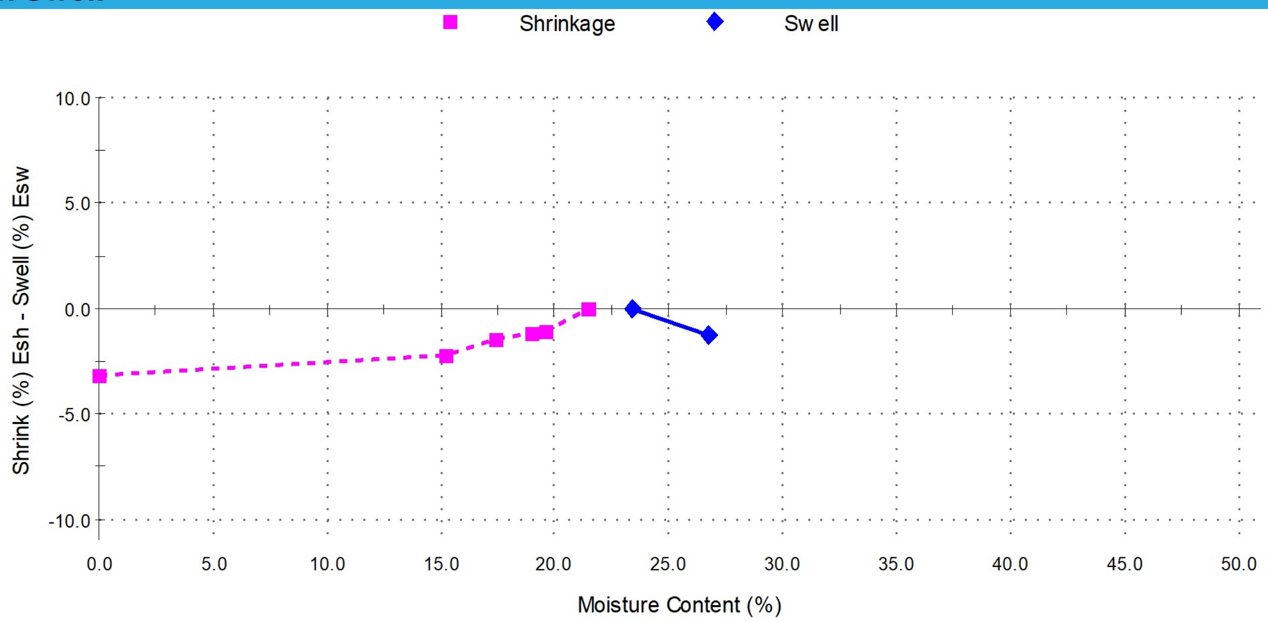
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-1.2
Moisture Content before (%):	23.4
Moisture Content after (%):	26.7
Est. Unc. Comp. Strength before (kPa):	60
Est. Unc. Comp. Strength after (kPa):	90

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	3.2
Shrinkage Moisture Content (%):	21.5
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Minor

Shrink Swell



Shrink Swell Index - Iss (%): 1.8

Comments

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ABN: 98 153 268 896

Shrink Swell Index Report

Report No: SSI:NEW22W-3061-S11
Issue No: 1

Client: McCLOY GROUP
Suite 2, Ground Floor, 317 Hunter Street
Newcastle NSW 2300

Project No.: NEW19P-0143G
Project Name: The Gardens Stage 4
Project Location: 688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S11
Sampling Method:	The results outlined below apply to the sample as received
Material:	Sandy Clay
Source:	On-Site Insitu
Specification:	No Specification
Sample Location:	BH408 - (0.90 - 1.05m)
Date Tested:	29/08/2022
Date Sampled:	22/08/2022
Date Submitted:	23/08/2022

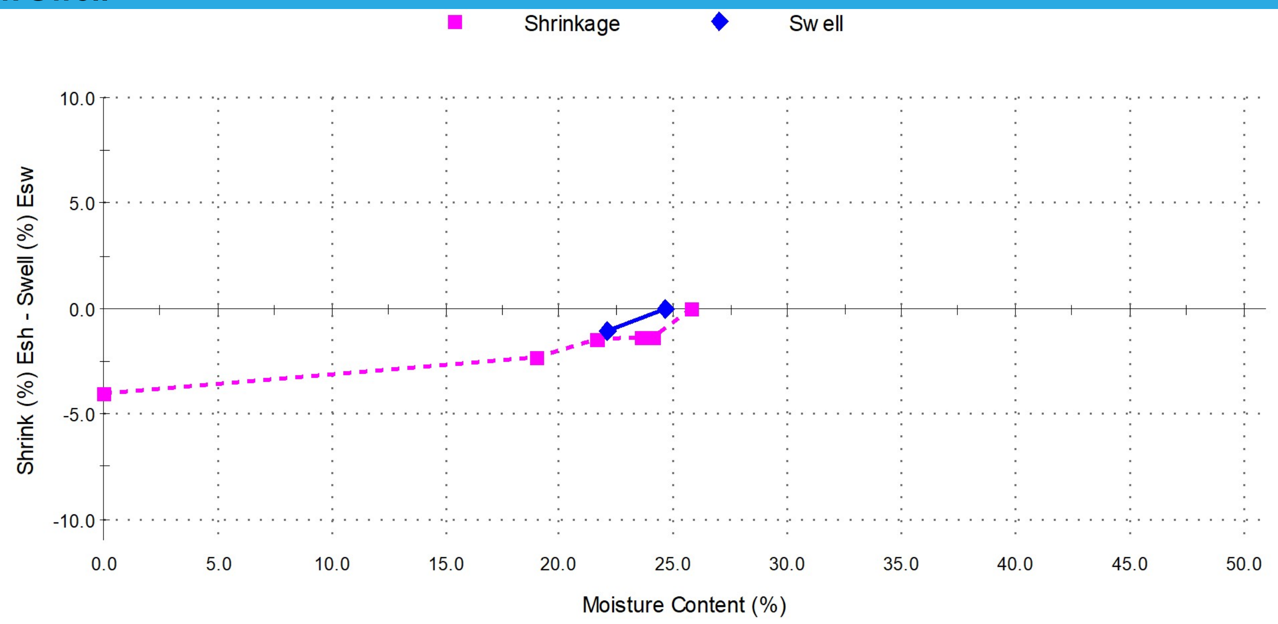
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-1.0
Moisture Content before (%):	24.6
Moisture Content after (%):	22.1
Est. Unc. Comp. Strength before (kPa):	210
Est. Unc. Comp. Strength after (kPa):	220

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	4.0
Shrinkage Moisture Content (%):	25.8
Est. inert material (%):	1%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 2.2

Comments

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W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW22W-3061-S12
Issue No: 1

Shrink Swell Index Report

Client: McCLOY GROUP
Suite 2, Ground Floor, 317 Hunter Street
Newcastle NSW 2300

Project No.: NEW19P-0143G
Project Name: The Gardens Stage 4
Project Location: 688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S12		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH409 - (0.90 - 1.10m)		
Date Tested:	29/08/2022		

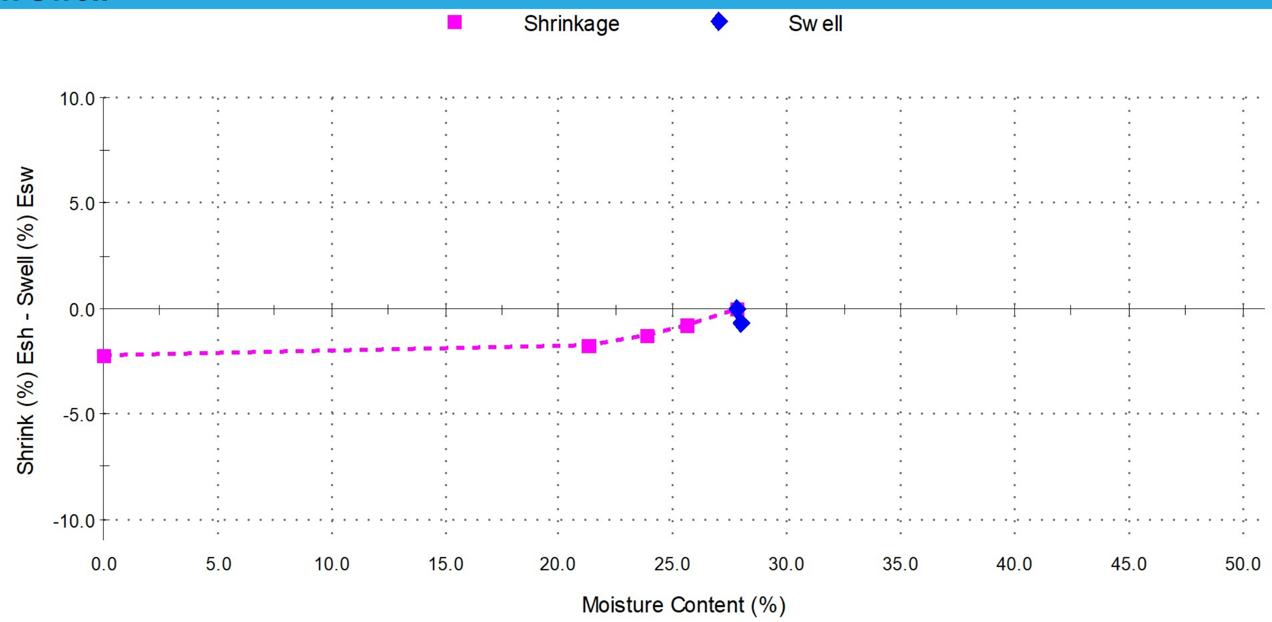
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.7
Moisture Content before (%):	27.8
Moisture Content after (%):	28.0
Est. Unc. Comp. Strength before (kPa):	500
Est. Unc. Comp. Strength after (kPa):	450

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	2.2
Shrinkage Moisture Content (%):	27.7
Est. inert material (%):	1%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Major

Shrink Swell



Shrink Swell Index - Iss (%): 1.2

Comments

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Shrink Swell Index Report

Report No: SSI:NEW22W-3061-S13
Issue No: 1

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

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WORLD RECOGNISED ACCREDITATION

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S13		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH410 - (0.50 - 0.65m)		
Date Tested:	29/08/2022		

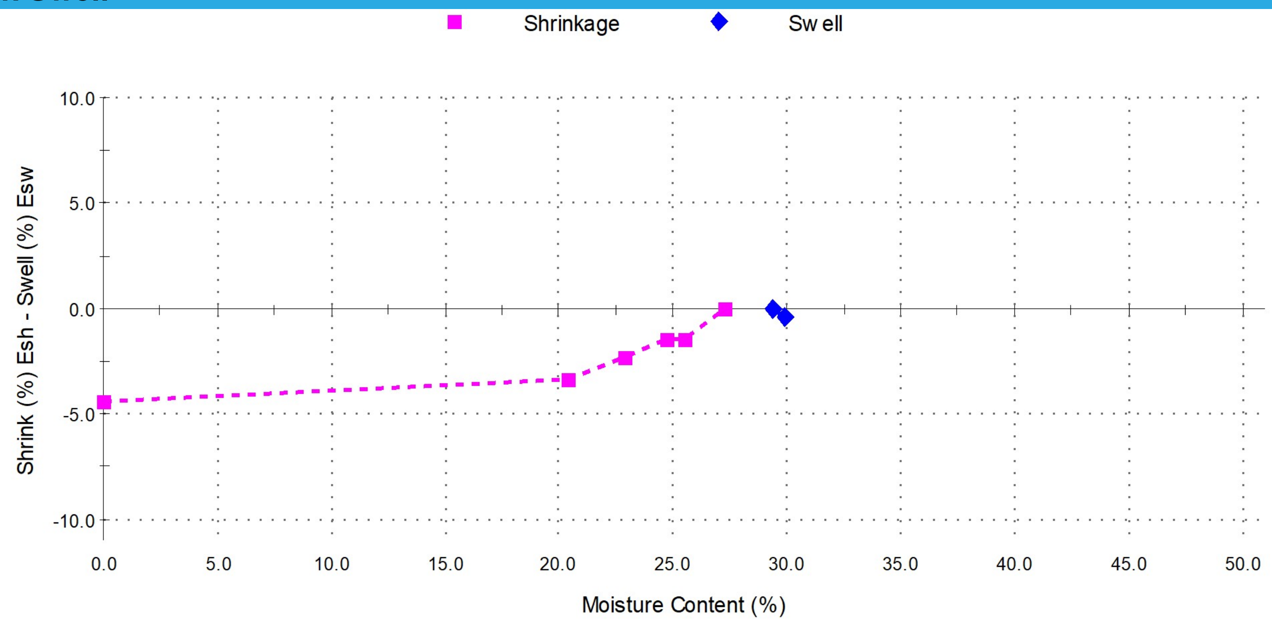
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.4
Moisture Content before (%):	29.4
Moisture Content after (%):	29.9
Est. Unc. Comp. Strength before (kPa):	340
Est. Unc. Comp. Strength after (kPa):	340

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	4.4
Shrinkage Moisture Content (%):	27.3
Est. inert material (%):	1%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 2.4

Comments

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Report No: SSI:NEW22W-3061-S14
Issue No: 1

Shrink Swell Index Report

Client:	McCLOY GROUP Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Project No.:	NEW19P-0143G
Project Name:	The Gardens Stage 4
Project Location:	688 - 730 Medowie Road, Medowie

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 2/09/2022

Sample Details

Sample ID:	NEW22W-3061-S14		
Sampling Method:	The results outlined below apply to the sample as received		
Material:	Sandy Clay	**Date Sampled:**	22/08/2022
Source:	On-Site Insitu	**Date Submitted:**	23/08/2022
Specification:	No Specification		
Sample Location:	BH411 - (0.80 - 1.00m)		
Date Tested:	29/08/2022		

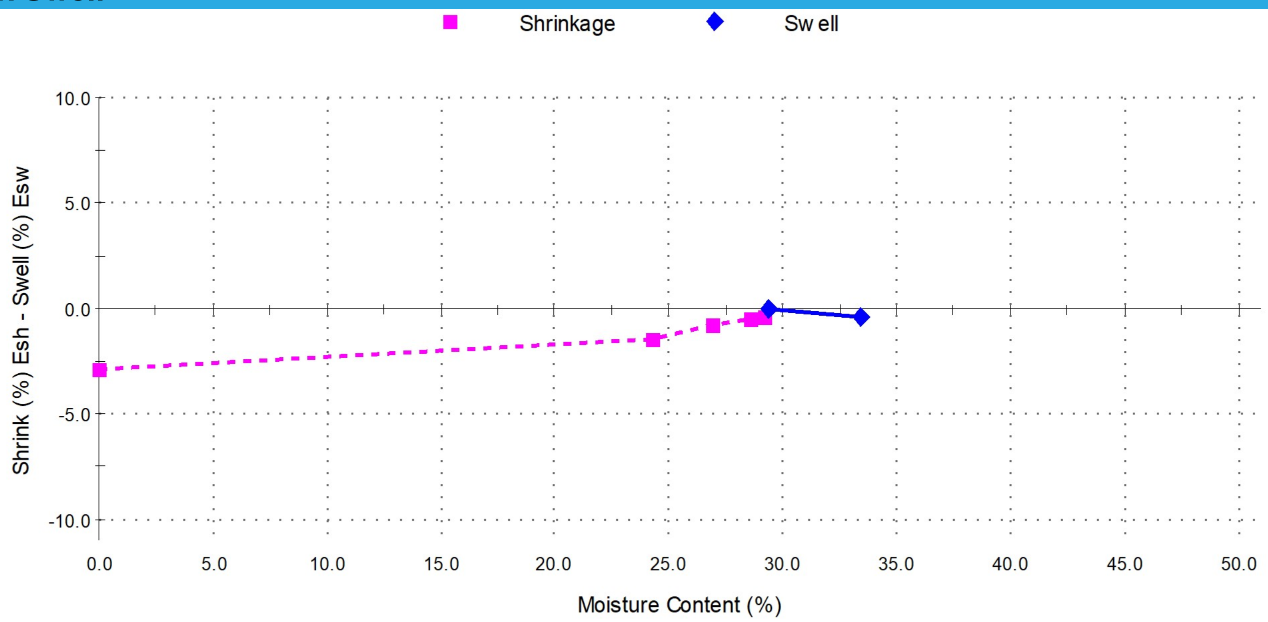
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.4
Moisture Content before (%):	29.4
Moisture Content after (%):	33.4
Est. Unc. Comp. Strength before (kPa):	360
Est. Unc. Comp. Strength after (kPa):	340

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	2.9
Shrinkage Moisture Content (%):	-98.7
Est. inert material (%):	1%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Major

Shrink Swell



Shrink Swell Index - Iss (%): 1.6

Comments

APPENDIX C:

CSIRO Sheet BTF 18

Foundation Maintenance and Footing Performance: A Homeowner's Guide

Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

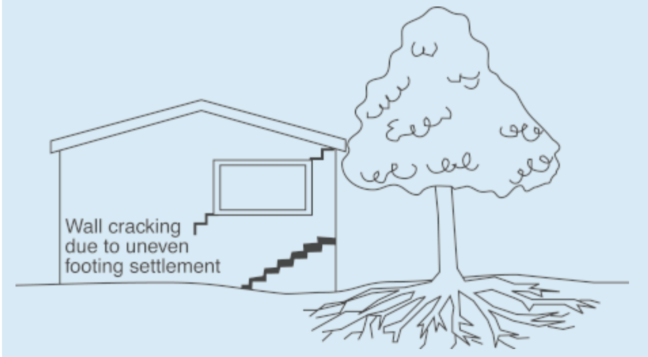
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

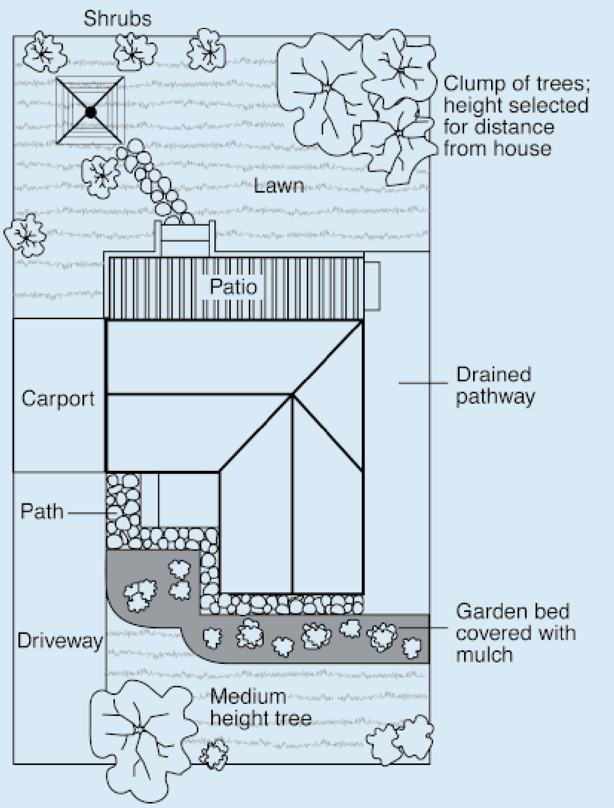
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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