GEOTECHNIQUE® PTY LTD

ABN 64 002 841 063

Job No: 14844/1
Our Ref: 14844/1-AA
2 March 2021

Indesco
Suite 401
Level 4 / 24 Hunter Street
PARRAMATTA NSW 2150
Email: Ziwar.Sattouf@indesco.com.au

Attention: Mr Z Sattouf

Re: **Proposed Residential Subdivision**
Lot 4 in DP1213869 - 192 Narellan Road, Campbelltown
Geotechnical & Pavement Design Investigation

This report details the results of a geotechnical investigation for the proposed residential subdivision at the above location. It is understood that the site is registered as Lot 4 in DP1213869, located at 192 Narellan Road, Campbelltown and is approximately 8.25ha.

Proposed Development
We understand that a geotechnical investigation is required to determine the existing surface and subsurface conditions, provide recommendation on pavement design, and identify potential salinity issues at the proposed subdivision development.

In this regard, a geotechnical investigation was required to determine subsurface conditions and develop geotechnical recommendations necessary for the design of the proposed residential subdivision.

Regional Geology
Reference to the Geological Map of Wollongong (1:100,000) indicates that the site is underlain by unnamed sandstone member – fine to medium grained quartz-lithic sandstone. This material belongs to the Wianamatta Group.

Reference to the Soil Landscape Map of Penrith (scale 1:100,000) indicates that the landscape across the site in general belongs to Blacktown Group. However, along the southern portion of site, the landscape belongs to Luddenham Group:

- Blacktown Group is characterised with gently undulating rises on Wianamatta Group shales, with local relief to 30m, ground slope of less than 5 percent, and broad rounded crests. The sub-surface soil within this landscape is likely to be up to 3.0m thick, moderately reactive, highly plastic with poor drainage.
- Luddenham Group comprises of narrow ridges, hillcrests and valleys with extensively cleared open-forest (dry sclerophyll forest). Soils in this landscape are often shallow Brown Podzolic Soils and massive earthy clays on crests; moderately deep Red Podzolic Soils on upper slopes; moderately deep Yellow Podzolic Soils and Prairie Soils on lower slopes and near drainage lines.

Field Work

Field work for this investigation was carried out on 10th February 2021 and included the following:

- A walk over survey to assess existing site conditions.
- Reviewing services plans obtained from "Dial Before You Dig" to determine locations of underground services across the site.
- Scanning test pit locations for underground services to ensure that services were not damaged during field work. A specialist was hired for this purpose.
- Excavating twelve (12) test pits to depths up to 1.5m or refusal on bedrock, using a standard 5 tonne excavator. The test pits were uniformly distributed along the proposed road alignment and their locations are shown on the attached Drawing No 14844/2-AA1.
- Recovery of the representative soil samples from the selected test pits for laboratory testing to determine California Bearing Ratio (CBR) and Atterberg limit values.

Field work was supervised by a Geotechnical Engineer from this company who was responsible for nominating the test pit locations, supervision of in-situ testing, sampling and preparation of field logs.

Sub-surface Conditions

Sub-surface conditions encountered at the site are detailed in the attached test pit logs and summarised in the Table below:

Table 1 – Subsurface Conditions Encountered in Test Pits

Test Pit	Termination Depth (m)	Topsoil (m)	Natural (m)	Bedrock (m)
TP2	2.5	0.0-0.2	0.2-1.6	1.6-2.5
TP4	2.2	0.0-0.2	0.2-2.0	2.0-2.2
TP6	2.2	0.0-0.2	0.2-2.0	2.0-2.2
TP16	1.8	0.0-0.2	0.2-1.6	1.6-1.8
TP18	1.3	0.0-0.2	0.2-1.1	1.1-1.3
TP24	2.0	0.0-0.2	0.2-1.8	1.8-2.0
TP28	1.2	0.0-0.2	0.2-1.0	1.0-1.2
TP34	3.0	0.0-0.2	0.2-3.0	NE
TP37	2.0	0.0-0.2	0.2-1.7	1.7-2.0
TP42	1.3	0.0-0.2	0.2-1.0	1.0-1.3
TP44	3.0	0.0-0.2	0.2-3.0	NE
TP50	2.2	0.0-0.2	0.2-1.8	1.8-2.2

Natural	Silty CLAY, medium plasticity, brown/orange Shaley CLAY, low to medium plasticity, grey Silty CLAY, medium plasticity, grey mottled red, traces of ironstone Silty CLAY, medium plasticity, orange
Bedrock	SHALE, grey, extremely to distinctly weathered, low to medium strength

Based on information presented in Table 1, the sub-surface profile at the site is anticipated to comprise a sequence of natural clayey soils underlain by shale bedrock. Shale bedrock found was assessed as distinctly weathered and low to medium strength.

Groundwater Conditions

Groundwater/seepage was not observed in any of the test pits during the short time they remained open. It should be noted that the levels of groundwater/seepage might vary due to rainfall, temperature, and other factors not evident during test pit excavation.

Laboratory Testing

Chemical Test Results

During field work, five additional soil samples were collected for chemical testing in a NATA accredited laboratory called SGS for salinity, acidity or aggressivity properties. The laboratory test results certificates from SGS are attached at the end of the report and summarised in Table 2 below:

Table 2 : Summary of Chemical Tests Results

Test Pit No	Depth (m)	EC (µS/cm)	Multiplying Factor (MF)	ECe (dS/m)	pH
TP4	0.2-0.4	100	8	0.80	5.9
TP4	1.4-1.6	570	8	4.56	5.6
TP16	0.2-0.4	30	8	0.24	7.0
TP16	1.3-1.5	270	8	2.16	5.0
TP18	0.2-0.4	100	8	0.80	5.4
TP18	0.7-0.9	140	8	1.12	5.2
TP24	0.2-0.6	140	8	1.12	5.5
TP24	1.0-1.2	780	8	6.24	4.8
TP34	0.2-0.4	49	8	0.39	5.5
TP34	1.2-1.4	430	8	3.44	4.5
TP44	0.2-0.4	30	8	0.24	6.1
TP44	1.8-2.0	140	8	1.12	5.2
TP50	0.2-0.4	23	8	0.18	6.2
TP50	0.8-1.0	400	8	3.20	5.1

Salinity Assessment

Salinity refers to the presence of excess salt in the environment, either in soil or water. Salinity is a serious problem for any development due to the many environmental, economic and social impacts. Soil salinity is generally assessed by measuring Electrical Conductivity (EC) of a soil sample made up of 1:5 soil water suspension. Thus, determined Electrical Conductivity (EC) is multiplied by a factor varying from 6 to 23, based on the texture of the soil sample, to obtain Corrected Electrical Conductivity designated as ECe (Reference 1). Alternatively, ECe may be directly measured in soil saturation extracts. Soils are classified as saline if ECe of the saturated extracts exceed 4.0dS/m. The criteria for assessment of soil salinity classes are shown below (Reference 1).

Classification	EC_e (dS/m)	Comments
Non-saline	<2	Salinity effects mostly negligible
Slightly saline	2 – 4	Yields of very sensitive crops may be affected
Moderately saline	4 – 8	Yields of many crops affected
Very saline	8 – 16	Only tolerant crops yield satisfactorily
Highly saline	>16	Only a few tolerant crops yield satisfactorily

Electrical Conductivity (EC) values for fourteen (14) representative soil samples recovered from the test pits at different depths are summarised in Table 2. For the nature of soils encountered across the site, a multiplying factor of 8 is considered to be appropriate. Therefore, Corrected Electrical Conductivity (ECe) for the soils is anticipated to vary from 0.18 to 6.24dS/m. Therefore, it is our assessment that the soils at the proposed residential subdivision site are likely to be non-saline to moderately saline. Concrete structures constructed in non-saline soils will not require any increase in concrete strength or concrete cover or curing period.

This salinity assessment was carried out in accordance with the Environment Protection Authority (EPA) guidelines on investigation and management of salinity. These guidelines are detailed in "Site Investigations for Urban Salinity" and were prepared by the then Department of Land & Water Conservation in 2002.

Aggressivity/Acidity Assessment

Soils with high acidity affect the integrity of concrete structures buried in the soil. Concrete structures constructed in aggressive soils will require increased concrete strength proportional to the increased in soil aggressivity (Reference 2). In addition, the concrete cover and curing period should be increased depending on the degree of aggressivity of the soil.

Acidity (pH) testing was also conducted to determine the aggressivity of the soils to steel and concrete. The various classes of aggressive soils are defined as follows according to AS2870-2011.

Classification	pH
Non-aggressive	>5.5
Mild	4.5-5.5
Moderate	4.0-4.5
Severe	<4.0

Results of acidity tests, which include determination of pH are presented in Table 2. The table shows that the pH values of soils are greater than 4.5. Based on the laboratory test results and the assumption that soils have low permeability, the soils across the site are assessed to be mildly aggressive towards both steel and concrete. Therefore, we recommend use of construction materials, such as concrete and steel that are appropriate to assessed aggressivity.

Soil Erodibility Assessment

Soil dispersivity or erodibility is generally assessed by conducting chemical tests such as Exchangeable Sodium Percentage (ESP) and Sodium Absorption Ratio (SAR), and physical tests such as Emerson Class and Dispersion Percentage. It should be noted that assessment of soil dispersibility based on these methods might differ from each other.

For the proposed work, only ESP values for representative soil samples were determined. Soils with ESP values of 5% or more are considered sodic, and those with ESP more than 15% are considered highly sodic (Reference 6). Sodic soils are dispersive and susceptible to excessive erosion.

ESP results and the assessment based on the above criteria are shown below:

Table 7: ESP Results and Dispersive Assessment

Test Pit No	Sample Depth (m)	ESP (%)	Assessment
TP4	0.2-0.4	8.4	Sodic
TP4	1.4-1.6	29.0	Highly sodic
TP16	0.2-0.4	7.6	Sodic
TP16	1.3-1.5	32.9	Highly sodic
TP18	0.2-0.4	7.1	Sodic
TP18	0.7-0.9	18.8	Highly sodic
TP24	0.2-0.6	11.3	Sodic
TP24	1.0-1.2	26.9	Highly sodic
TP34	0.2-0.4	8.0	Sodic
TP34	1.2-1.4	29.8	Highly sodic
TP44	0.2-0.4	8.6	Sodic
TP44	1.8-2.0	25.2	Highly sodic
TP50	0.2-0.4	5.6	Sodic
TP50	0.8-1.0	25.4	Highly sodic

The recommended thresholds for erodibility assessment are shown below (Reference 6).

Table 6 – Recommended Thresholds for Erodibility

ESP (%)	Assessment
<5	Non sodic
5 – 15	Sodic
>15	Highly sodic

Based on the above results the soils at the site are dispersive to highly dispersive and susceptible to erosion. Therefore, we recommend that the earthworks for the proposed development works should be carried out in accordance with an appropriate soil management plan.

Recommended Bearing Capacity

At the completion of earthworks, the foundation materials at the ground floor levels of future residences will include controlled fill and/or residual soils. Under such circumstances, ground floor slabs for the proposed residences may be designed and constructed as ground bearing slabs or suspended slabs supported by footings designed in accordance with recommendations provided in this report.

Loading conditions for the proposed residences are not known at this stage. However, we consider that appropriate footings would comprise shallow footings (pad and strip footings) founded on controlled fill, residual soils, bedrock shale, or deep footings (bored piers or screw piles) socketed into bedrock. Deep footings would be preferable where footings are required to withstand significant lateral and uplift pressures.

A total of nine (9) Dynamic Cone Penetrometer (DCP) Tests were conducted during the investigation, at the location shown on the attached Drawing No 14844/1-AA1 DCP Nos 1 to 9 and results are shown on the respective test pit logs.

The DCP test results generally indicate that the subsurface materials are stiff to hard. Based on the above results, it is our assessment that the bearing capacity of the existing ground at the tested location is in excess of 150kPa.

The recommended allowable bearing pressures for design of footings are presented in the following Table 3.

Table 3 – Recommended Allowable Bearing Pressures

Founding Material	Founding Depth (m)	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Residual Soils	0.2-1.5	150	3.75
Bedrock Shale	1.5->3.0	700	70.0

As depths to residual soils and bedrock with the recommended allowable bearing pressures could vary across the site, the founding depths of footings to be constructed will also vary. The founding depths presented in Table 3 are measured at test pit locations at the time of geotechnical investigation and should be considered as indicative only.

All footings should be inspected by an experienced Geotechnical Engineer to ensure that they are founded in appropriate materials to achieve the design bearing pressure values.

Pavement Design

Design of internal road pavements depends on traffic load and strength of subgrade, which is usually represented by CBR value.

We anticipate that the internal roads within the proposed subdivision will be classified as Local Roads or Collector Roads. Based on the Campbelltown City Council design specification, the following design traffic loading (ESA) is adopted for the pavement design.

Table 3: Design Traffic Loading (ESA)

Council Road Type	Design Traffic Loading (ESA)
Local/ Access	$3x10^5$
Collector	$1x10^6$

During field work, four subgrade samples were collected for Soaked California Bearing Ratio (CBR) tests. The CBR tests were conducted on samples compacted at 100% standard dry density with optimum moisture content and soaked for four days in a NATA accredited laboratory called Geotech Testing Pty Ltd. The comprehensive results for the laboratory CBR tests conducted are attached at the end of this report and summarised in Table 4.

Table 4: Summary of CBR Tests Results

Test Pit	Sample Depth (m)	Soil Description	MDD (t/m^3)	OMC (%)	FMC (%)	Variation From OMC	Swell (%)	CBR (%)
TP2	0.5-0.8	(CI) Silty CLAY, medium plasticity, brown-orange	1.71	21.5	18.9	2.6 dry	2.0	4.0
TP6	1.0-1.3	(CI) Silty CLAY, medium plasticity, grey mottled red, traces of ironstone	1.77	17.5	15.2	2.3 dry	1.5	3.5
TP28	0.7-1.0	(CI) Silty CLAY, medium plasticity, grey mottled red, traces of ironstone	1.74	19.5	16.1	3.4 dry	1.5	4.5
TP37	0.4-0.7	(CI) Silty CLAY, medium plasticity, brown	1.79	19.0	14.7	4.3 dry	1.5	4.0
TP42	1.0-1.3	SHALE, grey, distinctly weathered, medium strength	1.89	14.0	10.8	3.2 dry	0.5	9.0

MDD: Maximum Dry Density, FMC: Field Moisture Content, OMC: Optimum Moisture Content, CBR: California Bearing Ratio

The soaked CBR values obtained from laboratory testing of selected subgrade soils range from 3.5% to 9%. Based on these results, a design CBR of 3.5% is adopted for the pavement design for all proposed roads.

Based on recommended traffic loads and design subgrade CBR values, the recommended flexible pavement designs for Local and Collector Roads, in accordance with Austroad (5) are presented in the following Table5.

Table 5 – Recommended Pavement Design

Pavement Materials	Thickness for Local Road	Thickness for Collector Road
Asphaltic Concrete	50mm	50mm (AC14)
Two coat hot bitumen seal		
Base-course Material (DGB20)	115mm	135mm
Sub-base course Material (DGS40)	310mm	355mm
Total Thickness	**475mm**	**540mm**

Recommended pavement thicknesses presented in Table 12 are valid only if the subgrade and pavement materials are compacted to the following Minimum Dry Density Ratios.

Basecourse	98% Modified
Sub-basecourse	98% Modified
Subgrade	100% Standard

The pavement design assumes provision of adequate surface and sub-surface drainage of the pavement and adjacent areas.

General

Assessments and recommendations presented in this report are based on site observation and information from test pits only. Although we believe that the sub-surface profile presented in this report is indicative of the general profile across the site, it is possible that the sub-surface profile could differ from that encountered in the test pits. Likewise, comments on groundwater/seepage are based on observation during field work.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

RAM RAVI-INDRAN
Geotechnical Engineer

Attached Drawing No 14844/2-AA1 Test Pit Location Plan & Drawing No 14844/1-AA1 DCP Nos 1 to 9
Engineering Test Pit Logs & Explanatory Notes
Laboratory Test Results (CBR)
Laboratory Test Results (Chemical Testing)

References

1. *Lillicrap, A and McGhie, S., Site Investigation for Urban Salinity, Department of Land and Water Conservation, 2002.*
2. *Australian Standard AS2870-2011 "Residential Slabs and Footings".*
3. *Standard Australia- AS2159-1995, Piling – Design and Installation, 1995.*
4. *Pells, P J N, Mostyn, E and Walker, B F – Foundations on Sandstone and Shale in the Sydney Region, Australian Geomechanics Journal, Dec 1998.*
5. Austroads, Guide to Pavement Technology, Part 2, Structural Design, 2010.
6. *Fell, R., MacGregor, P and Stapledon, D., Geotechnical Engineering of Embankment Dams, 1992.*

N

LEGEND

Test Pit

Slope

Imagery ©2021 NearMap.com

0 3 6 9 12 15m

Scale 1:300

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NOTES

1. Site features are indicative and are not to scale.
2. This drawing has been produced using a base plan provided by others to which additional information e.g test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing

Indesco
Proposed Residential Subdivision
192 Narellan Road
Campbelltown

Site Features and Test Pit Locations

Drawing No: 14844/2-AA1
Job No: 14844/2
Drawn By: MH
Date: 10 February 2021
Checked By: JH

File No: 14844-2
Layers: 0, AA1

Imagery ©2020 NearMap.com

LEGEND

- DCP Test

0 3 6 9 12 15m

Scale 1:300

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Indesco
Proposed Residential Subdivision
192 Narellan Road
Campbelltown

DCP Test Locations

Drawing No: 14844/1-AA1
Job No: 14844/1
Drawn By: MH
Date: 9 February 2021
Checked By: RR

File No: 14844-1
Layers: 0, AA1

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP2
Date : 05/02/2021
Logged/Checked by: JH

Equipment type and model: 5 Ton Excavator
R.L. surface : 97.288
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
				COVER	0			TOPSOIL: Silty Clay, low to medium plasticity, brown, trace of root fibres				
				3			CI	Silty CLAY, medium plasticity, brown-orange	M≤PL	F		Residual
				3								
				6								
				8								
				9	0.5							
			DB	8								
				10								
				9								
				15			CL-CI	Shaley CLAY, low to medium plasticity, grey	M≤PL	H		
				9	1							
				20								
Dry					1.5			SHALE, grey, extremely weathered, low strength				Bedrock
					2							
					2.5			Test Pit TP2 terminated at 2.5m				
					3							
					3.5							
					4							
					4.5							

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP4
Date : 05/02/2021
Logged/Checked by: JH

Equipment type and model: 5 Ton Excavator
R.L. surface : 93.059
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
					0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
			DS		0.5		CI	Silty CLAY, medium plasticity, orange	M≤PL	F-St		Residual
			DS		1.5		CL-CI	Silty CLAY, low to medium plasticity, grey	M≤PL	H		
Dry					2			SHALE, grey, distinctly weathered, medium strength				
					2.5			Test Pit TP4 terminated at 2.2m due to refusal on bedrock				
					3							
					3.5							
					4							
					4.5							

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP6
Date : 05/02/2021
Logged/Checked by: JH

Equipment type and model: 5 Ton Excavator
R.L. surface : 92.565
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
				CONE 2	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
				2 4 7 12 9 12 15 12 14	0.5		CI	Silty CLAY, medium plasticity, orange	M≤PL	St		Residual
			DB	12 27 R	1 1.5		CI	Silty CLAY, medium plasticity, grey mottled red, trace of ironstone	M≤PL	VSt		
Dry					2			SHALE, grey, distinctly weathered, medium strength				Bedrock
					2.5 3 3.5 4 4.5			Test Pit TP6 terminated at 2.2m due to refusal on bedrock				

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP16
Date : 05/02/2021
Logged/Checked by: JH

Equipment type and model: 5 Ton Excavator
R.L. surface : 98.095
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
					0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
			DS		0.5		Cl	Silty CLAY, medium plasticity, orange	M≤PL	St		Residual
			DS		1		Cl	Silty CLAY, medium plasticity, grey	M≤PL	St		
Dry					1.5			SHALE, grey, distinctly weathered, medium strength				Bedrock
					2			Test Pit TP16 terminated at 1.8m due to refusal on bedrock				
					2.5							
					3							
					3.5							
					4							
					4.5							

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP18
Date : 05/02/2021
Logged/Checked by: JH

Equipment type and model: 5 Ton Excavator
R.L. surface : 96.903
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Dry				CONE 3	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
			DS	3 3 3 3 3 5	0.5		CI	Silty CLAY, medium plasticity, orange	M≤PL	St		Residual
			DS	5 5 R	1		CI	Silty CLAY, medium plasticity, grey				
								SHALE, grey, distinctly weathered, medium strength				Bedrock
					1.5			Test Pit TP18 terminated at 1.3m due to refusal on bedrock				
					2							
					2.5							
					3							
					3.5							
					4							
					4.5							

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP24
Date : 05/02/2021
Logged/Checked by: JH

Equipment type and model: 5 Ton Excavator
R.L. surface : 109.365
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
					0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
			DS		0.5		CI	Silty CLAY, medium plasticity, orange	M≤PL	St		Residual
			DS		1		CI	Silty CLAY, medium plasticity, grey mottled red, trace of ironstone	M≤PL	St		
dry					1.5			SHALE, grey, distinctly weathered, medium strength				Bedrock
					2			Test Pit TP24 terminated at 2.0m due to refusal on bedrock				
					2.5							
					3							
					3.5							
					4							
					4.5							

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP28
Date : 08/02/2021
Logged/Checked by: JH/XZ

Equipment type and model: 5 Ton Excavator
R.L. surface : 102.404
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Dry				CONE 3	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
				2			CI	Silty CLAY, medium plasticity, orange	M≤PL	F		Residual
				2								
				3								
				7								
				8	0.5		CI	Silty CLAY, medium plasticity, grey mottled red, trace of ironstone fragments	M≤PL	F		
				7								
				6								
			DB	7								
				12								
				22	1			SHALE, grey, distinctly weathered, medium strength				Bedrock
				R								
								Test Pit TP28 terminated at 1.2m due to refusal on bedrock				
					1.5							
					2							
					2.5							
					3							
					3.5							
					4							
					4.5							

GEOTECHNIQUE
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engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP34
Date : 08/02/2021
Logged/Checked by: JH/XZ

Equipment type and model: 5 Ton Excavator
R.L. surface : 101.990
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Dry					0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
			DS		0.5		CI	Silty CLAY, medium plasticity, orange	M≤PL	F		Residual
			DS		1.5		CI	Silty CLAY, medium plasticity, grey	M≤PL			
					3			Test Pit TP34 terminated at 3.0m				

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP37
Date : 08/02/2021
Logged/Checked by: JH/XZ

Equipment type and model: 5 Ton Excavator
R.L. surface : 94.377
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
dry				C O N E 3	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
				3			CI	Silty CLAY, medium plasticity, brown	M≤PL	F		Residual
				3								
				7								
			DB	8	0.5							
				7								
				8								
				11								
				12			CI	Silty CLAY, medium plasticity, orange	M≤PL	F		
				16	1							
				20								
				20			CI	Silty CLAY, low plasticity, grey	M≤PL	F		
					1.5							
								SHALE, grey, distinctly weathered, medium strength				Bedrock
					2			Test Pit TP37 terminated at 2.0m due to refusal on bedrock				
					2.5							
					3							
					3.5							
					4							
					4.5							

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engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP42
Date : 08/02/2021
Logged/Checked by: JH/XZ

Equipment type and model: 5 Ton Excavator
R.L. surface : 96.520
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Dry				COVER 3	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
				3			CI	Silty CLAY, medium plasticity, orange	M≤PL	F		Residual
				3								
				6								
				13	0.5		CI	Silty CLAY, medium plasticity, grey	M≤PL	F		
				12								
				12								
				16								
				16								
				16	1			SHALE, grey, distinctly weathered, medium strength				Bedrock
			DB	16								
				R								
								Test Pit TP42 terminated at 1.3m due to refusal on bedrock				
					1.5							
					2							
					2.5							
					3							
					3.5							
					4							
					4.5							

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP44
Date : 08/02/2021
Logged/Checked by: JH/XZ

Equipment type and model: 5 Ton Excavator
R.L. surface : 91.735
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Dry				COVE 4 4	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
			DS	4 4 6 18 15	0.5		CI	Silty CLAY, medium plasticity, orange	M≤PL	F		Residual
				20 20	1		CI	Silty CLAY, medium plasticity, grey	M≤PL	St		
			DS		1.5		CL-CI	Shaley CLAY, low to medium plasticity, grey	M≤PL	H		
					2							
					2.5							
					3			Test Pit TP44 terminated at 3.0m				
					3.5							
					4							
					4.5							

GEOTECHNIQUE PTY LTD

engineering log - excavation

Client : Indesco
Project : Proposed Residential Subdivision
Location : 192 Narellan Road, Campbelltown

Job No : 14844/1
Pit No : TP50
Date : 08/02/2021
Logged/Checked by: JH/XZ

Equipment type and model: 5 Ton Excavator
R.L. surface : 95.575
Excavation dimensions : 2.0 **m long** 0.45 **m wide**
datum : AHD

groundwater	env samples	PID reading (ppm)	geo samples	field tests	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
				C O N E 4 4 4 4 6 18 15 20 20	0			TOPSOIL: Silty Clay, low plasticity, brown, trace of root fibres				
			DS		0.5		CI	Silty CLAY, medium plasticity, orange	M≤PL	F		Residual
			DS		1		CI	Silty CLAY, medium plasticity, grey	M≤PL	F		
Dry					1.5							
					2			SHALE, grey, distinctly weathered, medium strength				Bedrock
					2.5			Test Pit TP50 terminated at 2.2m due to refusal on bedrock				
					3							
					3.5							
					4							
					4.5							

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Log Symbols & Abbreviations (Non-cored Borehole Log)

Log Column	Symbol/Value	Description
Drilling Method	V-bit TC-bit RR DB BB	Hardened steel 'V' shaped bit attached to auger Tungsten Carbide bit attached to auger Tricone (Rock Roller) bit Drag bit Blade bit
Groundwater	Dry  	Groundwater not encountered to the drilled or auger refusal depth Groundwater level at depths shown on log Groundwater seepage at depths shown on log
Environment Sample	GP G P	Glass bottle and plastic bag sample over depths shown on log Glass bottle sample over depths shown on log Plastic bag sample over depths shown on log
PID Reading	100	PID reading in ppm
Geotechnical Sample	DS DB U_{50}	Disturbed Small bag sample over depths shown on log Disturbed Bulk sample over depths shown on log Undisturbed 50mm tube sample over depths shown on log
Field Test	N=10 3,5,5 N=R 10,15/100	Standard Penetration Test (SPT) 'N' value. Individual numbers indicate blows per 150mm penetration. 'R' represents refusal to penetration in hard/very dense soils or in cobbles or boulders. The first number represents10 blows for 150mm penetration whereas the second number represents 15 blows for 100mm penetration where SPT met refusal
	DCP/PSP: 5 6 R/10	Dynamic Cone Penetration (DCP) or Perth Sand Penetrometer (PSP). Each number represents blows per 100mm penetration. 'R/10' represents refusal after 10mm penetration in hard/very dense soils or in gravels or boulders.
Classification	GP GW GM GC SP SW SM SC ML MI MH CL CI CH	Poorly Graded GRAVEL Well graded GRAVEL Silty GRAVEL Clayey GRAVEL Poorly graded SAND Well graded SAND Silty SAND Clayey SAND SILT / Sandy SILT / clayey SILT, low plasticity SILT / Sandy SILT / clayey SILT, medium plasticity SILT / Sandy SILT / clayey SILT, high plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, low plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, medium plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, high plasticity
Moisture Condition Cohesive soils Cohesionless soils	 M<PL M=PL M>PL D M W	 Moisture content less than Plastic Limit Moisture content equal to Plastic Limit Moisture content to be greater than Plastic Limit Dry - Runs freely through hand Moist - Tends to cohere Wet - Tends to cohere
Consistency Cohesive soils	 VS S F St VSt H	**Term** / **Undrained shear strength, C_u (kPa)** / **Hand Penetrometer (Qu)** Very Soft / ≤12 / <25 Soft / >12 & ≤25 / 25 – 50 Firm / >25 & ≤50 / 50 – 100 Stiff / >50 & ≤100 / 100 – 200 Very Stiff / >100 & ≤200 / 200 – 400 Hard / >200 / >400
Density Index Cohesionless soils	 VL L M D VD	**Term** / **Density Index, I_D (%)** / **SPT 'N' (blows/300mm)** Very Loose / ≤15 / ≤5 Loose / >15 & ≤35 / >5 & ≤10 Medium Dense / >35 & ≤65 / >10 & ≤30 Dense / >65 & ≤85 / >30 & ≤50 Very Dense / >85 / >50
Hand Penetrometer	100 200	Unconfined compressive strength (q_u) in kPa determined using pocket penetrometer, at depths shown on log
Remarks	 Residual Alluvium Colluvial Aeolian Marine	Geological origin of soils Residual soils above bedrock River deposited Alluvial soils Gravity deposited Colluvial soils Wind deposited Aeolian soils Marine Soils

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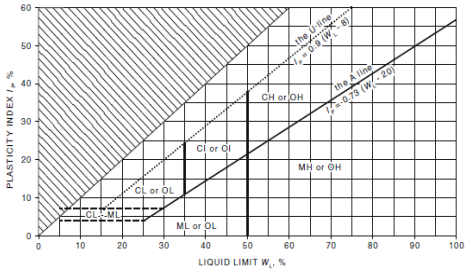
AS1726 : 2017– Unified Soil Classification System

Major Divisions		Particle size (mm)	Group Symbol	Typical Names	Field Identifications Sand and Gravels			Laboratory classification				
OVERSIZE	BOULDERS	>200						Use the gradation of material passing 63mm for classification of fractions according to the criteria given in 'Major Divisions'	% Fines (2)	Plasticity of Fine Fraction	$C_u = D_{60}/D_{10}$	$C_c = (D_{30})^2/(D_{10}D_{60})$	Notes
	COBBLES	63										
COARSE GRAINED SOIL (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm)	Coarse 19	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>4	between 1 and 3	1. Identify lines by the method given for fine grained soils 2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.075mm size) is greater than 5% and less than 12%. Borderline classifications require the use of dual symbols e.g. SP-SM, GW-GC
		Medium 6.7	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			GM	Silty gravels, gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line or I_p>7	-	-	
	SAND (more than half of coarse fraction is smaller than 2.36mm)	Coarse 0.6	SW	Well-graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>6	between 1 and 3	
		Medium 0.21	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			SM	Silty sands, sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 0.075	SC	Clayey sand, sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line of I_p>7	-	-	
FINE GRAINED SOIL (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit<50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	**Dry Strength**	**Dilatancy**	**Toughness**		More than 35% passing 0.075mm	Below 'A' line			
					None to low	Slow to rapid	Low						
			CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	None to very slow	Medium			Above 'A' line			
			OL	Organic silts and organic silty clays of low plasticity	Low to medium	Slow	Low			Below 'A' line			
	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit>50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Low to medium	None to slow	Low to medium			Below 'A' line			
			CH	Inorganic clays of medium to high plasticity, fat clays	High to very high	None	High			Above 'A' line			
			OH (1)	Organic clays of medium to high plasticity, organic silts	Medium to high	None to very slow	Low to medium			Below 'A' line			
	HIGHLY ORGANIC SOILS		Pt (1)	Peat and highly organic soils	Identified by colour, odour, spongy feel and generally by fibrous texture				Effervesces with H_2O_2				



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Log Symbols & Abbreviations (Cored Borehole Log)

Log Column	Symbol / Abbreviation	Description	
Core Size		Nominal Core Size (mm)	
	NQ	47	
	NMLC	52	
	HQ	63	
Water Loss	◀	Complete water loss	
	◁	Partial water loss	
Weathering (AS1726:2017)	RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported
	XW	Extremely Weathered	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
	HW	Highly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
	MW	Moderately Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock
	SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change in strength from fresh rock
	FR	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes
		Note : Where it is not possible to distinguish between HW and MW rock the term Distinctly Weathered (DW) may be used. DW is defined as 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased by deposition of weathering products in pores'	
Strength (AS1726:2017)		**Term**	**Point Load Strength Index (I_{s50}, MPa)**
	VL	Very Low	≥0.03 ≤0.1
	L	Low	>0.1 ≤0.3
	M	Medium	>0.3 ≤1
	H	High	>1 ≤3
	VH	Very High	>3 ≤10
	EH	Extremely High	>10
Defect Spacing		**Description**	**Spacing (mm)**
		Extremely closely spaced	<20
		Very closely spaced	20 to 60
		Closely spaced	60 to 200
		Medium spaced	200 to 600
		Widely spaced	600 to 2000
		Very widely spaced	2000 to 6000
		Extremely widely spaced	>6000
Defect Description (AS1726:2017) Type			
	Pt	Parting	
	Jo	Joint	
	Sh	Sheared Surface	
	Sz	Sheared Zone	
	Ss	Sheared Seam	
	Cs	Crushed Seam	
	Is	Infilled Seam	
	Ews	Extremely Weathered Seam	
Macro-surface geometry	St	Stepped	
	Cu	Curved	
	Un	Undulating	
	Ir	Irregular	
	Pl	Planar	
Micro-surface geometry	Vro	Very Rough	
	Ro	Rough	
	Sm	Smooth	
	Po	Polished	
	Sl	Slickensided	
Coating or infilling	cn	clean	
	sn	stained	
	vn	veneer	
	cg	coating	

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AS1726 – Identification of Sedimentary Rocks for Engineering Purposes

Grain Size mm		Bedded rocks (mostly sedimentary)							
More than 20	20	Grain Size Description			At least 50% of grains are of carbonate			At least 50% of grains are of fine-grained volcanic rock	
	6	RUDACEOUS		CONGLOMERATE Rounded boulders, cobbles and gravel cemented in a finer matrix	LIMESTONE and DOLOMITE (undifferentiated)	Calcirudite		Fragments of volcanic ejecta in a finer matrix	SALINE ROCKS
	2			Breccia Irregular rock fragments in a finer matrix				Rounded grains AGGLOMERATE Angular grains VOLCANIC BRECCIA	Halite Anhydrite
	0.6	ARENACEOUS	Coarse	SANDSTONE Angular or rounded grains, commonly cemented by clay, calcite or iron minerals		Calcarenite		Cemented volcanic ash TUFF	Gypsum
	0.2		Medium	Quartzite Quartz grains and siliceous cement					
	0.06		Fine	Arkose Many feldspar grains Greywacke Many rock chips					
	0.002	ARGILLACEOUS		MUDSTONE	SILTSTONE Mostly silt	Calcareous Mudstone	Calcisiltite	CHALK	Fine-grained TUFF
	Less than 0.002			SHALE Fissile	CLAYSTONE Mostly clay		Calcilutite		Very fine-grained TUFF
Amorphous or crypto-crystalline				Flint: occurs as hands of nodules in the chalk Chert: occurs as nodules and beds in limestone and calcareous sandstone					COAL LIGNITE
				Granular cemented – except amorphous rocks					
				SILICEOUS	CALCAREOUS			SILICEOUS	CARBONACEOUS
				SEDIMENTARY ROCKS Granular cemented rocks vary greatly in strength, some sandstones are stronger than many Igneous rocks. Bedding may not show in hand specimens and is best seen in outcrop. Only sedimentary rocks, and some metamorphic rocks derived from them, contain fossils Calcareous rocks contain calcite (calcium carbonate) which effervesces with dilute hydrochloric acid					

AS1726 – Identification of Metamorphic and Igneous Rocks for Engineering Purposes

Obviously foliated rocks (mostly metamorphic)		Rocks with massive structure and crystalline texture (mostly igneous)						Grain size (mm)
Grain size description			Grain size description	Pegmatite			Pyrosenite	More than 20
		MARBLE						20
	GNEISS Well developed but often widely spaced foliation sometimes with schistose bands	QUARTZITE		GRANITE	Diorite	GABBRO	Peridorite	6
COARSE		Granulite	COARSE	These rocks are sometimes phorphyritic and are then described, for example, as porphyritic granite				
	Migmatite Irregularly foliated: mixed schists and gneisses	HORNFELS						2
	SCHIST Well developed undulose foliation; generally much mica	Amphibolite		Micorgranite	Microdiorite			0.6
MEDIUM		Serpentine	MEDIUM	These rocks are sometimes phorphyritic and are then described as porphyries		Dolerite		0.2
								0.06
	PHYLLITE Slightly undulose foliation; sometimes 'spotted'			RHYOLITE	ANDESITE			0.002
FINE	SLATE Well developed plane cleavage (foliation)		FINE	These rocks are sometimes phorphyritic and are then described as porphyries		BASALT		Less than 0.002
	Mylonite Found in fault zones, mainly in igneous and metamorphic areas			Obsidian	Volcanic glass			Amorphous or cryptocrystalline
CRYSTALLINE				Pale<----------->Dark				
SILICEOUS		Mainly SILICEOUS		ACID Much quartz	INTERMEDIATE Some quartz	BASIC Little or no quartz	ULTRA BASIC	
METAMORPHIC ROCKS Most metamorphic rocks are distinguished by foliation which may impart fissility. Foliation in gneisses is best observed in outcrop. Non-foliated metamorphics are difficult to recognize except by association. Any rock baked by contact metamorphism is described as 'hornfels' and is generally somewhat stronger than the parent rock Most fresh metamorphic rocks are strong although perhaps fissile			IGNEOUS ROCKS Composed of closely interlocking mineral grains. Strong when fresh; not porous Mode of occurrence : 1 Batholith; 2 Laccoliths; 3 Sills; 4 Dykes; 5 Lava Flows; 6 Veins					

GEOTECH TESTING PTY LTD®
ABN 71 076 676 321

INDESCO
SUITE 401, LEVEL 4, 24 HUNTER STREET
PARRAMATTA NSW 2150

GEOTECHNICAL- SALINITY & PAVEMENT DESIGN INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION, 192 NARELLAN ROAD, CAMPBELLTOWN

CALIFORNIA BEARING RATIO TEST REPORT

CBR Test Procedure	Laboratory Compaction Method	Sampling Method	Date of Test
AS1289 6.1.1	AS1289 5.1.1	AS1289 1.2.1 Clause 6.5.4	19/02/2021
Job No: 14844/1	Tested By: DP	Checked By: MM	Lab Prestons

Laboratory Number	14844/1-1	14844/1-2	14844/1-3	14844/1-4
Test Pit No	2	6	28	37
Depth (m)	0.5-0.8	1.0-1.3	0.7-1.0	0.4-0.7
Date Sampled	9-Feb-21	9-Feb-21	9-Feb-21	9-Feb-21
Sample Description	(CH) Silty Clay, high plasticity, brown/orange	(CI) Silty Clay, medium plasticity, grey mottled red, traces of ironstone.	(CI-CH) Silty Clay, medium plasticity, grey mottled red, traces of ironstone fragments.	(CI) Silty Clay, medium plasticity, brown.
Maximum Dry Density t/m3	1.71	1.77	1.74	1.79
Optimum Moisture Content %	21.5	17.5	19.5	19.0
Field Moisture Content %	18.9	15.2	16.1	14.7
% Retained 19mm	0.0	0.0	0.0	0.0
Excluded (Yes / No / Not Applicable)	Not Applicable	Not Applicable	Not Applicable	Not Applicable

CBR TEST RESULTS

Dry Density t/m^3	Before soaking	1.69	1.76	1.73	1.78
	After soaking	1.68	1.74	1.71	1.75
Density Ratio %	Before soaking	99.0	99.5	99.5	99.5
Moisture Content %	Before soaking	21.5	17.6	19.5	19.1
	After soaking	22.5	20.9	21.6	21.3
Moisture Ratio %	Before soaking	100.0	100.5	100.0	100.5
Number of Days Soaked		4	4	4	4
Surcharge	kg	9.0	9.0	9.0	9.0
Moisture Content after test %	Top 30mm	21.7	21.7	22.8	21.3
	Whole Sample	22.4	20.8	21.5	21.2
Swell after soaking %		2.0	1.5	1.5	1.5
Penetration mm		2.5	2.5	2.5	2.5
CBR VALUE %		**4**	**3.5**	**4.5**	**4**

Form No R003 Version 04 06/13 - issued by ER

NATA
Nata Accreditation Number 2734
Corporate Site Number 14227

Accredited for compliance with ISO/IEC 17025 - Testing.

M Morley 26/02/2021
Approved Signatory

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GEOTECH TESTING PTY LTD®
ABN 71 076 676 321

INDESCO
SUITE 401, LEVEL 4, 24 HUNTER STREET
PARRAMATTA NSW 2150

SITE INVESTIGATION STAGES 1 AND 2 (Limited Sampling)
PROPOSED RESIDENTIAL SUBDIVISION, 192 NARELLAN ROAD, CAMPBELLTOWN

CALIFORNIA BEARING RATIO TEST REPORT

CBR Test Procedure	Laboratory Compaction Method	Sampling Method	Date of Test
AS1289 6.1.1	AS1289 5.1.1	AS1289 1.2.1 Clause 6.5.4	19/02/2021
Job No: 14844/2	Tested By: DP	Checked By: MM	Lab Prestons

Laboratory Number	14844/2-5			
Test Pit No Depth (m) Date Sampled	42 1.0-1.3 9-Feb-21			
Sample Description	SHALE, grey, distinctly weathered, medium strength.			
Maximum Dry Density t/m3	1.89			
Optimum Moisture Content %	14.0			
Field Moisture Content %	10.8			
% Retained 19mm	19			
Excluded (Yes / No / Not Applicable)	Yes			

CBR TEST RESULTS

Dry Density t/m^3	Before soaking	1.87			
	After soaking	1.86			
Density Ratio %	Before soaking	99.0			
Moisture Content %	Before soaking	13.9			
	After soaking	16.1			
Moisture Ratio %	Before soaking	99.5			
Number of Days Soaked		4			
Surcharge	kg	9.0			
Moisture Content after test %	Top 30mm	16.1			
	Whole Sample	16.0			
Swell after soaking %		0.5			
Penetration mm		2.5			
CBR VALUE %		**9**			

Form No R003 Version 04 06/13 - issued by ER

M Morley 26/02/2021
Approved Signatory

NATA
Nata Accreditation Number 2734
Corporate Site Number 14227

Accredited for compliance with ISO/IEC 17025 - Testing.

34 Borec Road, Penrith NSW 2750
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ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

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Client	Geotechnique
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Email	ram@geotech.com.au
Project	**14844-1 Campbelltown**
Order Number	(Not specified)
Samples	14

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE216359 R0**
Date Received	9/2/2021
Date Reported	16/2/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Dong LIANG
Metals/Inorganics Team Leader

pH in soil (1:5) [AN101] Tested: 16/2/2021

PARAMETER	UOM	LOR	TP4 SOIL 0.2-0.4 9/2/2021 SE216359.001	TP4 SOIL 1.4-1.6 9/2/2021 SE216359.002	TP16 SOIL 0.2-0.4 9/2/2021 SE216359.003	TP16 SOIL 1.3-1.5 9/2/2021 SE216359.004	TP18 SOIL 0.2-0.4 9/2/2021 SE216359.005
pH	pH Units	0.1	5.9	5.6	7.0	5.0	5.4

PARAMETER	UOM	LOR	TP18 SOIL 0.7-0.9 9/2/2021 SE216359.006	TP24 SOIL 0.2-0.6 9/2/2021 SE216359.007	TP24 SOIL 1.0-1.2 9/2/2021 SE216359.008	TP34 SOIL 0.2-0.4 9/2/2021 SE216359.009	TP34 SOIL 1.2-1.4 9/2/2021 SE216359.010
pH	pH Units	0.1	5.2	5.5	4.8	5.5	4.5

PARAMETER	UOM	LOR	TP44 SOIL 0.2-0.4 9/2/2021 SE216359.011	TP44 SOIL 1.8-2.0 9/2/2021 SE216359.012	TP50 SOIL 0.2-0.4 9/2/2021 SE216359.013	TP50 SOIL 0.8-1.0 9/2/2021 SE216359.014
pH	pH Units	0.1	6.1	5.2	6.2	5.1

Conductivity and TDS by Calculation - Soil [AN106] Tested: 16/2/2021

PARAMETER	UOM	LOR	TP4 SOIL 0.2-0.4 9/2/2021 SE216359.001	TP4 SOIL 1.4-1.6 9/2/2021 SE216359.002	TP16 SOIL 0.2-0.4 9/2/2021 SE216359.003	TP16 SOIL 1.3-1.5 9/2/2021 SE216359.004	TP18 SOIL 0.2-0.4 9/2/2021 SE216359.005
Conductivity of Extract (1:5 as received)	µS/cm	1	90	510	25	230	83
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	100	570	30	270	100

PARAMETER	UOM	LOR	TP18 SOIL 0.7-0.9 9/2/2021 SE216359.006	TP24 SOIL 0.2-0.6 9/2/2021 SE216359.007	TP24 SOIL 1.0-1.2 9/2/2021 SE216359.008	TP34 SOIL 0.2-0.4 9/2/2021 SE216359.009	TP34 SOIL 1.2-1.4 9/2/2021 SE216359.010
Conductivity of Extract (1:5 as received)	µS/cm	1	130	120	660	43	390
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	140	140	780	49	430

PARAMETER	UOM	LOR	TP44 SOIL 0.2-0.4 9/2/2021 SE216359.011	TP44 SOIL 1.8-2.0 9/2/2021 SE216359.012	TP50 SOIL 0.2-0.4 9/2/2021 SE216359.013	TP50 SOIL 0.8-1.0 9/2/2021 SE216359.014
Conductivity of Extract (1:5 as received)	µS/cm	1	26	120	20	380
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	30	140	23	400

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) [AN122] Tested: 16/2/2021

PARAMETER	UOM	LOR	TP4 SOIL 0.2-0.4 9/2/2021 SE216359.001	TP4 SOIL 1.4-1.6 9/2/2021 SE216359.002	TP16 SOIL 0.2-0.4 9/2/2021 SE216359.003	TP16 SOIL 1.3-1.5 9/2/2021 SE216359.004	TP18 SOIL 0.2-0.4 9/2/2021 SE216359.005
Exchangeable Sodium, Na	mg/kg	2	310	990	300	1100	240
Exchangeable Sodium, Na	meq/100g	0.01	1.3	4.3	1.3	4.7	1.0
Exchangeable Sodium Percentage*	%	0.1	8.4	29.0	7.6	32.9	7.1

PARAMETER	UOM	LOR	TP18 SOIL 0.7-0.9 9/2/2021 SE216359.006	TP24 SOIL 0.2-0.6 9/2/2021 SE216359.007	TP24 SOIL 1.0-1.2 9/2/2021 SE216359.008	TP34 SOIL 0.2-0.4 9/2/2021 SE216359.009	TP34 SOIL 1.2-1.4 9/2/2021 SE216359.010
Exchangeable Sodium, Na	mg/kg	2	440	410	1600	190	860
Exchangeable Sodium, Na	meq/100g	0.01	1.9	1.8	6.9	0.82	3.7
Exchangeable Sodium Percentage*	%	0.1	18.8	11.3	26.9	8.0	29.8

PARAMETER	UOM	LOR	TP44 SOIL 0.2-0.4 9/2/2021 SE216359.011	TP44 SOIL 1.8-2.0 9/2/2021 SE216359.012	TP50 SOIL 0.2-0.4 9/2/2021 SE216359.013	TP50 SOIL 0.8-1.0 9/2/2021 SE216359.014
Exchangeable Sodium, Na	mg/kg	2	300	780	170	600
Exchangeable Sodium, Na	meq/100g	0.01	1.3	3.4	0.76	2.6
Exchangeable Sodium Percentage*	%	0.1	8.6	25.2	5.6	25.4

Moisture Content [AN002] Tested: 10/2/2021

PARAMETER	UOM	LOR	TP4 SOIL 0.2-0.4 9/2/2021 SE216359.001	TP4 SOIL 1.4-1.6 9/2/2021 SE216359.002	TP16 SOIL 0.2-0.4 9/2/2021 SE216359.003	TP16 SOIL 1.3-1.5 9/2/2021 SE216359.004	TP18 SOIL 0.2-0.4 9/2/2021 SE216359.005
% Moisture	%w/w	1	13.0	10.8	15.0	17.3	16.8

PARAMETER	UOM	LOR	TP18 SOIL 0.7-0.9 9/2/2021 SE216359.006	TP24 SOIL 0.2-0.6 9/2/2021 SE216359.007	TP24 SOIL 1.0-1.2 9/2/2021 SE216359.008	TP34 SOIL 0.2-0.4 9/2/2021 SE216359.009	TP34 SOIL 1.2-1.4 9/2/2021 SE216359.010
% Moisture	%w/w	1	9.1	14.4	15.3	11.9	10.6

PARAMETER	UOM	LOR	TP44 SOIL 0.2-0.4 9/2/2021 SE216359.011	TP44 SOIL 1.8-2.0 9/2/2021 SE216359.012	TP50 SOIL 0.2-0.4 9/2/2021 SE216359.013	TP50 SOIL 0.8-1.0 9/2/2021 SE216359.014
% Moisture	%w/w	1	15.4	15.4	12.5	6.6

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN122	Exchangeable Cations, CEC and ESP: Soil sample is extracted in 1M Ammonium Acetate at pH=7 (or 1M Ammonium Chloride at pH=7) with cations (Na, K, Ca & Mg) then determined by ICP OES/ICP MS and reported as Exchangeable Cations. For saline soils, these results can be corrected for water soluble cations and reported as Exchangeable cations in meq/100g or soil can be pre-treated (aqueous ethanol/aqueous glycerol) prior to extraction. Cation Exchange Capacity (CEC) is the sum of the exchangeable cations in meq/100g.
AN122	The Exchangeable Sodium Percentage (ESP) is calculated as the exchangeable sodium divided by the CEC (all in meq/100g) times 100. ESP can be used to categorise the sodicity of the soil as below: ESP < 6% non-sodic ESP 6-15% sodic ESP >15% strongly sodic Method is referenced to Rayment and Lyons, 2011, sections 15D3 and 15N1.-

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		
***	Indicates that both * and ** apply.				

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

STATEMENT OF QA/QC PERFORMANCE

SE216359 R0

CLIENT DETAILS

Contact	Ram Ravi-Indran
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
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Facsimile	02 4722 6161
Email	ram@geotech.com.au
Project	**14844-1 Campbelltown**
Order Number	(Not specified)
Samples	14

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE216359 R0**
Date Received	09 Feb 2021
Date Reported	16 Feb 2021

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Analysis Date	Moisture Content	14 items

SAMPLE SUMMARY

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	Client	Sample cooling method	None
Samples received in correct containers	Yes	Sample counts by matrix	14 Soil
Date documentation received	10/2/2021	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	N/A
Sample temperature upon receipt	20.7°C	Sufficient sample for analysis	Yes
Turnaround time requested	Standard		

HOLDING TIME SUMMARY

SE216359 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP4	SE216359.001	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP4	SE216359.002	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP16	SE216359.003	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP16	SE216359.004	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP18	SE216359.005	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP18	SE216359.006	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP24	SE216359.007	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP24	SE216359.008	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP34	SE216359.009	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP34	SE216359.010	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP44	SE216359.011	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP44	SE216359.012	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP50	SE216359.013	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021
TP50	SE216359.014	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021	16 Feb 2021

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR)

Method: ME-(AU)-[ENV]AN122

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP4	SE216359.001	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP4	SE216359.002	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP16	SE216359.003	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP16	SE216359.004	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP18	SE216359.005	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP18	SE216359.006	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP24	SE216359.007	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP24	SE216359.008	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP34	SE216359.009	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP34	SE216359.010	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP44	SE216359.011	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP44	SE216359.012	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP50	SE216359.013	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021
TP50	SE216359.014	LB218674	09 Feb 2021	09 Feb 2021	09 Mar 2021	16 Feb 2021	09 Mar 2021	16 Feb 2021

Moisture Content

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP4	SE216359.001	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP4	SE216359.002	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP16	SE216359.003	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP16	SE216359.004	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP18	SE216359.005	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP18	SE216359.006	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP24	SE216359.007	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP24	SE216359.008	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP34	SE216359.009	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP34	SE216359.010	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP44	SE216359.011	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP44	SE216359.012	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP50	SE216359.013	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†
TP50	SE216359.014	LB218384	09 Feb 2021	09 Feb 2021	23 Feb 2021	10 Feb 2021	15 Feb 2021	16 Feb 2021†

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP4	SE216359.001	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP4	SE216359.002	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP16	SE216359.003	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP16	SE216359.004	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP18	SE216359.005	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP18	SE216359.006	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP24	SE216359.007	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP24	SE216359.008	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP34	SE216359.009	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP34	SE216359.010	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021

HOLDING TIME SUMMARY

SE216359 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

pH in soil (1:5) (continued) — **Method: ME-(AU)-[ENV]AN101**

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP44	SE216359.011	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP44	SE216359.012	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP50	SE216359.013	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021
TP50	SE216359.014	LB218665	09 Feb 2021	09 Feb 2021	16 Feb 2021	16 Feb 2021	17 Feb 2021	16 Feb 2021

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB218665.001	Conductivity of Extract (1:5 as received)	µS/cm	1	<1
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	0

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR)

Method: ME-(AU)-[ENV]AN122

Sample Number	Parameter	Units	LOR	Result
LB218674.001	Exchangeable Sodium, Na	mg/kg	2	0

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may give a different calculated RPD.

Conductivity and TDS by Calculation - Soil — Method: ME-(AU)-[ENV]AN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE216359.010	LB218665.014	Conductivity of Extract (1:5 as received)	µS/cm	1	390	350	31	9
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	430	92.710762331	30	9
SE216359.014	LB218665.019	Conductivity of Extract (1:5 as received)	µS/cm	1	380	370	31	2
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	400	95.274647887	31	2

Moisture Content — Method: ME-(AU)-[ENV]AN002

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE216359.008	LB218384.011	% Moisture	%w/w	1	15.3	15.6	36	2
SE216359.014	LB218384.018	% Moisture	%w/w	1	6.6	6.7	45	1

pH in soil (1:5) — Method: ME-(AU)-[ENV]AN101

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE216359.010	LB218665.014	pH	pH Units	0.1	4.5	4.5	32	1
SE216359.014	LB218665.019	pH	pH Units	0.1	5.1	5.1	32	0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB218665.002	Conductivity of Extract (1:5 as received)	µS/cm	1	310	303	85 - 115	101
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	NA	303	85 - 115	101

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR)

Method: ME-(AU)-[ENV]AN122

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB218674.002	Exchangeable Sodium, Na	meq/100g	0.01	0.19	0.194	80 - 120	100

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB218665.003	pH	pH Units	0.1	7.4	7.415	98 - 102	100

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

MATRIX SPIKE DUPLICATES

SE216359 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
***	Indicates that both * and ** apply.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to relevant report comments for further information.

GEOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

P O Box 880
PENRITH NSW 2751

Tel: (02) 4722 2700
Fax: (02) 4722 6161
email: info@geotech.com.au

TO:	SGS ENVIRONMENTAL SERVICES UNIT 16 33 MADDOX STREET ALEXANDRIA NSW 2015	Sampling By:	JH	Job No	14844-1
				Project:	proposed residential subdivision
PH:	02 8594 0400 FAX: 02 8594 0499	Project Manager:	RR	Location:	Campbelltown
ATTN:	Ms Emily Yin				

Sampling details / Results required by:

	Location	Depth	Soil	Water	EC (1:5)	pH	Sulphate	Chloride	ESP				Notes	Keep Sample
1	TP4	0.2-0.4	DSP		✓	✓			✓				ESP=Exchnageable Sodium Percentage	✓
2		1.4-1.6	DSP		✓	✓			✓					✓
3	TP16	0.2-0.4	DSP		✓	✓			✓					✓
4		1.3-1.5	DSP		✓	✓			✓					✓
5	TP18	0.2-0.4	DSP		✓	✓			✓					✓
6		0.7-0.9	DSP		✓	✓			✓					✓
7	TP24	0.2-0.6	DSP		✓	✓			✓					✓
8		1.0-1.2	DSP		✓	✓			✓					✓
9	TP34	0.2-0.4	DSP		✓	✓			✓					✓
10		1.2-1.4	DSP		✓	✓			✓					✓
11	TP44	0.2-0.4	DSP		✓	✓			✓					✓
12		1.8-2.0	DSP		✓	✓			✓					✓
13	TP50	0.2-0.4	DSP		✓	✓			✓					✓
14		0.8-1.0	DSP		✓	✓			✓					✓

SGS EHS Sydney COC
SE216359

Please Use Geotechnical Engineering Templete for Reporting

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	
jack	JSH	9/02/2021	Suba		09/02/21 @ 3:55

Legend:

WG	USG	Undisturbed soil sample (glass j	DSP	Disturbed soil sample (small plastic bag)	* Purge & Trap
WP	DSG	Disturbed soil sample (glass jar	✓	Test required	# Geotechnique Screen

SAMPLE RECEIPT ADVICE

SE216359

CLIENT DETAILS

Contact	Ram Ravi-Indran
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	ram@geotech.com.au
Project	**14844-1 Campbelltown**
Order Number	(Not specified)
Samples	14

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Tue 9/2/2021
Report Due	Tue 16/2/2021
SGS Reference	**SE216359**

SUBMISSION DETAILS

This is to confirm that 14 samples were received on Tuesday 9/2/2021. Results are expected to be ready by COB Tuesday 16/2/2021. Please quote SGS reference SE216359 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	Client	Sample cooling method	None
Samples received in correct containers	Yes	Sample counts by matrix	14 Soil
Date documentation received	10/2/2021	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	N/A
Sample temperature upon receipt	20.7°C	Sufficient sample for analysis	Yes
Turnaround time requested	Standard		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

SE216359

CLIENT DETAILS

Client Geotechnique

Project 14844-1 Campbelltown

SUMMARY OF ANALYSIS

No.	Sample ID	Conductivity and TDS by Calculation - Soil	Exchangeable Cations and Cation Exchange Capacity	Moisture Content	pH in soil (1:5)
001	TP4 0.2-0.4	2	3	1	1
002	TP4 1.4-1.4	2	3	1	1
003	TP16 0.2-0.4	2	3	1	1
004	TP16 1.3-1.5	2	3	1	1
005	TP18 0.2-0.4	2	3	1	1
006	TP18 0.7-0.9	2	3	1	1
007	TP24 0.2-0.6	2	3	1	1
008	TP24 1.0-1.2	2	3	1	1
009	TP34 0.2-0.4	2	3	1	1
010	TP34 1.2-1.4	2	3	1	1
011	TP44 0.2-0.4	2	3	1	1
012	TP44 1.8-2.0	2	3	1	1
013	TP50 0.2-0.4	2	3	1	1
014	TP50 0.8-1.0	2	3	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .