GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
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GTE549-Geotech

27 October 2015

LOGOS PROPERTY
Suite 1202, Level 12
167 Macquarie Street,
Sydney NSW 2000

Attention: Jeff Lord
E-mail: jlord@dblproperty.com

Dear Sir,

RE: PRELIMINARY GEOTECHNICAL INVESTIGATION AND GROUNDWATER ASSESSMENT at 34 Yarrunga Street, Prestons.

This letter presents a geotechnical report on the inspection and testing services associated with the geotechnical investigation undertaken at the above project.

Should you have any questions related to this report please do not hesitate to contact the undersigned.

For and on behalf of
Ground Technologies Pty Ltd

Reviewed By

A. Bennett
Senior Geotechnical Engineer

M. Khan *AMIEAust*
Principal Engineering Officer
(Geotechnical)

Table of Contents

TABLES

1. INTRODUCTION

Ground Technologies Pty Ltd (Ground Tech) has prepared this report to provide a preliminary geotechnical model for No.34 Yarrunga Street, Prestons (herein referred to as the "site"). It is understood that the site is to be re-developed for industrial use and will require minor cut to fill operations in order to create level building pads.

The Geotechnical Investigation and Groundwater Assessment has been undertaken in response to the Secretary's Environmental Assessment Requirements (SEARs) for the Prestons Industrial Estate SSD 7155 prepared by the Department of Planning and the Environment

2. SITE DETAILS

The following information, presented in Table 1, describes the site.

Table 1: Summary of Site Details

Site Address	34 Yarrunga Street, Prestons
Lot & Plan No.	Lot 33, 34, 35, 43 DP2359 Lot 20 DP 117483
Council Area	Liverpool City Council

The subject property is irregular in shape, measuring approximately 625m wide along the Yarrunga Street frontage, and 305m deep along the Bernera Road frontage.

Figure 1 – Location of Site

The subject property covers an area of approximately 20.7ha, with the majority of it vacant and grass covered. A high point is located within lot 34, behind the metal shed, with ground slopes falling away from this point in all directions by grades of up to 3° to 7°.

Lot 33 and 35 are grass covered and vacant. High voltage power lines traverse through the site in a north / south alignment. Lot 34 contains a single storey residential house, a metal shed and equipment for loading cattle onto trucks within the northern (front) portion of the lots. Lot 43 contains a metal shed located centrally within the lot. Lot 20 of DP1173483 is predominately vacant. An old drainage line has been re-aligned within this site with a new culvert placed under Kurrajong Road.

2.1 Geology

The 1:100,000 scale Geological Series Map of the Penrith region indicates that the subject site is underlain by Bringelly Shale of the Wianamatta Group dating back to the Middle Triassic period and generally comprises *shale, carbonaceous claystone, laminate and rare coal / tuff.*

3. GEOTECHNICAL INVESTIGATION

Initial fieldwork was undertaken on the 11th of November 2014 and included six deep boreholes (TS1, TS13-17) and eleven shallow boreholes (TS2-TS12) using a truck mount solid flight auger drill rig at locations shown on Figure 2.

Figure 2 – Borehole Locations

Eight (8) distinct geological units were encountered during the field investigation. These units are detailed in table 2 and the depth of each unit is detailed in table 3. Full Borehole Logs are attached in Appendix B.

Table 2 – Summary of Geological Units

UNIT	SOIL TYPE
UNIT A	TOPDRESSING: Very Silty Clay Filling, grey/brown, brown
UNIT B	FILLING: Admixed Silty Gravelly Clay, brown, grey/brown, pale grey, orange/brown
UNIT C	NATURAL: Clayey SILT (topsoil), dark brown
UNIT D	NATURAL: Silty CLAY, medium plasticity, orange/brown, grey/brown, mottled red and pale grey/brown, orange/brown, yellow/brown with minor red and pale grey very stiff to hard
UNIT E	BEDROCK: SILTSTONE, completely weathered, very low strength, pale grey with red mottling
UNIT F	BEDROCK: SILTSTONE / SHALE, extremely weathered, very low to low strength, grey/brown
UNIT G	BEDROCK: SHALE, extremely weathered, low strength, grey, dark grey, brown, grey, grey/brown
UNIT H	BEDROCK: SHALE, moderately weathered, low to medium strength, dark grey

Table 3 – Depth of each Geological Unit

Borehole	Geological Unit							
	Unit A	Unit B	Unit C	Unit D	Unit E	Unit F	Unit G	Unit H
TS1	-	-	0-0.1m	0.1-0.8m	0.8-1.1m	1.1-3.8m	3.8-7.5m	7.5-9.0m
TS2	-	-	0-0.25m	0.25-1.0m	-	-	-	-
TS3	-	-	0-0.27m	0.15-0.8m	-	-	-	-
TS4	-	-	0-0.15m	0.15-0.7m	-	-	-	-
TS5	0-0.05m	0.05-0.8m	-	-	-	-	-	-
TS6	0-0.45m	0.45-0.7m	0.7-0.9m	-	-	-	-	-
TS7	-	-	0-0.12m	0.12-0.6m	-	-	-	-
TS8	-	-	0-0.24m	0.24-0.6m	-	-	-	-
TS9	-	-	0-0.2m	0.2-0.6m	-	-	-	-
TS10	-	-	0-0.2m	0.2-0.6m	-	-	-	-
TS11	-	-	0-0.2m	0.2-0.6m	-	-	-	-
TS12	-	-	0-0.2m	0.2-0.6m	-	-	-	-
TS13	-	-	0-0.1m	0.1-2.0m	2.0-2.6m		2.6-3.0m	-
TS14	-	-	0-0.3m	0.3-1.9m	1.9-2.2m	-	2.2-3.0m	-
TS15	-	-	0-0.1m	0.1-2.2m	2.2-3.0m	-	-	-
TS16	-	-	0-0.3m	0.3-2.2m	2.2-3.0m	-	-	-
TS17	-	-	0-0.1m	0.1-1.8m	1.8-2.6m	-	2.6-3.0m	-

3.1 Laboratory Test Results

Two (2) soil samples were recovered during the course of the field investigation. These samples were submitted to Ground Technologies NATA accredited laboratory in order to determine the California Bearing Ratio and Shrink / Swell Index of the underlying soil profile. The results are summarized in table 4 below whilst the full report is contained within Appendix B.

Table 4: Summary of Laboratory Test Results

Laboratory	Borehole	Depth	CBR	Shrink / Swell
L1	TS1	0.2-0.6m	4.5%	-
L2	TS4	0.3-0.7m	-	3.3

4. GROUNDWATER

No groundwater was encountered during the course of the investigation. Groundwater is unlikely to be disturbed during the course of the development

5. EARTHWORKS

5.1 Site Specification

This document includes general specifications for earthworks projects for the purpose of geotechnical testing and is written in general accordance with AS3798 – 2007 'Guidelines on Earthworks for Commercial and Residential Development'. Fill placed in accordance with these specifications can be denoted as **"Controlled"** fill.

5.2 Site Stripping

The area on which the fill is to be placed and the area from which the cut is to be removed should be stripped of:

- all vegetation
- any unsuitable soils
- uncontrolled filling

Stripped materials are to be removed from site or placed in temporary stockpiles as directed by the superintendant.

Filling was observed in the natural water course within the south-eastern corner of the site which has been re-aligned and the previous channel has been backfilled. No documentation pertaining to the backfilling was made available to ground technologies at the time of preparing this report and as such the fill is considered to be **"Uncontrolled".** The location of the uncontrolled fill material is highlighted in figure 3.

Figure 3 – Location of Uncontrolled Fill

5.3 Subgrade Inspection

In conjunction with any excavation required to achieve design grade levels, stripping of vegetation and root zone material shall be completed across areas of the site to be occupied by floor slabs and pavements. The grade surface shall be proof rolled using roller compactor (minimum 12t static weight) or similar. Any material responding poorly to proof rolling shall be excavated until a competent base is achieved and excavation backfilled using suitable imported fill placed in maximum 200mm layers with each layer separately and uniformly compacted.

5.4 Imported Fill Material

It is understood that the majority of earthworks within the subject site will comprise cut to fill. It is anticipated that the fill material will be site derived. If the material is to be imported from another site it will need to comply with one of the following:

- Schedule 1 of the Protection of the Environment and Operations Act 1997 defines virgin excavated material (VENM)
- The 'Excavated Natural Material Exemption 2008' as defined by the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A

Excluded materials include;

- Organic soils, such as many topsoils, severely root-affected subsoils and peat
- Materials contaminated through past site usage which may contain toxic substances or soluble compounds harmful to water supply or agriculture
- Materials containing substances which can be dissolved or leached out in the presence of moisture (e.g. gypsum) or which undergo volume change or loss of strength when disturbed and exposed to moisture (e.g. some shales and sandstones) unless these matters are specifically addressed in the design
- Silts, or materials that have deleterious engineering properties of silt
- Other materials with properties that are unsuitable for forming structural fill
- Fill which contains wood, metal, plastic, boulders or other deleterious materials

5.5 Fill Placement

Fill placement shall be in near horizontal layers of uniform thickness placed systematically across the fill area. The compacted layer thickness is not to exceed 300mm with a maximum particle size not to exceed 2/3rd of layer thickness.

Were fill is to be placed against an existing embankment, said embankment is to be benched at 1mH:1mV. This will allow for the fill material to be "keyed" into the embankment and will minimize the risk of soft spots and the development of phreatic surfaces.

5.6 Fill Inspection and Testing

Testing is to be undertaken as per the Level 1 requirements of AS3798 – 2007 'Guidelines on Earthworks for Commercial and Residential Development'.

Table 5: Summary of Earthworks Specifications

DESCRIPTION	SPECIFICATION
Dry or Hilf Density Ratio	98% Standard Compaction
Moisture Variation	+/- 2% OMC
Frequency of Testing	1/500m³ or 3 tests per lot, whichever is greater.

6. PRELIMINARY GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 Site Classification

As defined in AS 2870-2011, Table 2.1 and section 2.2.3, the filled portion of the site will be classified as a **Class "H1"** site. Based on the geology, limited shrink / swell testing and the natural / fill soil profiles encountered on this limited scope investigation, the site is estimated to have a Characteristic Surface Movement (ys) in the range between **55mm** and **65m** which is typical for clay soils derived from shale, which has been extensively weathered. The general definition of a Class "H1" site as presented in Table 2.1 of AS 2870–2011 is described as a highly reactive site which can experience high ground movement from moisture changes.

Within Cut Portions of the site, where bedrock is encountered at depths of less than 1.4m the site classification may be downgraded to a Class M or lower. This is subject to re-classification at the end of bulk earthworks.

6.2 Footings – Allowable End Bearing Capacity

It is envisaged that footings for the superstructures will comprise high level strip or pad type footings. Such strip or pad footings shall be proportioned using a maximum allowable bearing pressure not exceeding 150kPa within the natural clays and controlled fill platform. Adopt minimum founding depths of not less than 0.4m (below surrounding finished surface level) for all strip / pad footings.

Strip or pad footings constructed within the shale / siltstone bedrock (Unit F and Unit G) may be proportioned using a maximum allowable bearing pressure not exceeding 700kPa.

Bored Piers footings constructed within the shale / siltstone bedrock (Unit F and Unit G) may be proportioned using a maximum allowable bearing pressure not exceeding 700kPa and an allowable skin friction of 70kPa. Bored Piers extending to medium strength shale (Unit H) may be proportioned using a maximum allowable bearing pressure not exceeding 1500kPa and an allowable skin friction of 150kPa.

All footing excavations should be free of loose debris and wet soil prior to concrete placement. Groundwater infiltration into footing excavations is not expected, however, minor seepage may occur. If so, all water should be pumped from the base of the footing excavations prior to concrete placement. Concrete placement should proceed as soon as practicable after footing excavation to prevent impending reduction of allowable end bearing pressures as a result of exposure.

All foundation material is to be inspected by a Geotechnical Engineer / Engineering Geologist at the time of footing excavation in order to ensure that all footings found on suitable ground with the anticipated foundation conditions.

6.3 Floor Slabs / Pavements

Preliminary design for floor slabs and pavements can be designed upon a Sub-grade Reaction Modulus (k) of 40 kPa or a CBR of 4.5%. This adopted value is based on the assumption that drainage is suitably detailed to prevent any saturation of sub-grade or pavement materials. Higher values may be achieved within cut portions of the site where shale bedrock is exposed.

Rigid pavements should incorporate a regular spacing of construction joints in order that minor post construction vertical differential movement of the sub-grade does not detrimentally affect pavement performance.

Differential vertical movement within the sub-grade profile present across the site is inevitable beneath pavement areas. Such movement may induce pavement distortion, longitudinal cracking at pavement edges & 'rolling-out' of kerbs. Minimisation of such movements can be achieved by adopting the following

measures:

- continue sub-base crushed rock at least 500mm past kerbs
- Avoid garden beds which can act as a conduit for rainfall (or watering) causing wetting of subgrade clays to adjacent paving.
- Install perimeter cut-off drains at the edge of pavements. Soils drains should penetrate to approx. 200mm below the clay interface & be connected to drainage points.
- Ensure that tree planting does not promote drying of subgrade clays to adjacent pavements.

6.4 Batter Slopes

We understand that excavation operations will form part of the development. Resultant embankments should either be retained or battered back to the following recommended slopes:

- Short term Unretained batters in controlled fill, residual clay (Unit D) and completely weathered siltstone (Unit E) should be cut no steeper than 1 Vertical to 1 Horizontal.
- Short term unretained batters in extremely weathered shale (Unit F and Unit G) should be cut no steeper than 1 Vertical to 0.5 Horizontal.
- Long term Unretained batters in controlled fill and residual clay (Unit D) and completely weathered siltstone (Unit E) should be cut no steeper than 1 Vertical to 2 Horizontal.
- Long term unretained batters in extremely weathered shale (Unit F and Unit G) should be cut no steeper than 1 Vertical to 1 Horizontal.

Exposed medium strength shale bedrock (Unit H) may remain temporarily unretained, subject to confirmation by a suitably qualified Geotechnical Engineer / Engineering Geologist. The Engineering Consultant is to inspect the exposed rock faces at the time of excavation in order to identify potential presence of any rock defects that could induce instability of the exposure. The Geotechnical Consultant will advise on the nature of the required permanent retention, should it be deemed necessary.

Unretained excavations should not extend below the “zone of influence” of adjacent structures. That is, a line drawn 45^{o} down from the foundation level of adjacent structures or features. If excavations are to extend below this line, proposed excavations are to be retained prior to excavation.

6.5 Site Excavations

Excavations within Units A to G should be achieved with bucket attachment to a midsized excavator. Excavations within Unit H, intersecting more competent bedrock may require pre-loosening using rock breaking or ripping attachments.

6.6 Retaining Wall Design Parameters

The material being retained will comprise natural silty clay and completely / extremely weathered bedrock. These materials may be apportioned an effective friction angle of 25 degrees.

For cut slopes in clay the lateral earth pressure is not entirely dependent on the so called coefficient of lateral earth pressure K, as the presence of cohesion between clay particles enables the excavation face to remain stable (to a finite height) providing saturated conditions or tension cracks do not develop.

The lateral earth pressure which should be considered in the design needs to incorporate the reduced lateral earth pressure as a result of cohesion as well as potential swelling pressures and the development of tension cracks which may fill with water. Also the lateral earth pressure exerted by the granular backfill needs to be considered.

Where retaining walls are designed to allow for a small amount of lateral strain (nominally 1/1000th of wall height) the lateral pressure acting on the wall can be calculated assuming distribution of 7.5H (kPa)

where H equals the height of retained material in metres. The resultant lateral thrust will be $3.75H^2$ (KN) and will act at a height of H/3 above the base.

The design of rigid retaining walls should allow for a lateral earth pressure acting on the wall of 10.0H (kPa). The resultant lateral thrust will be $5.0H^2$ (KN) and will act at a height of H/3 above the base.

Surcharge loads (if applicable) will ADD to the earth pressure acting on retaining walls. In the case of non rigid walls, assume K_a x surcharge load will be converted to lateral thrust. For rigid walls assume K_o x surcharge load will be converted to loaded thrust. Allowance should be made for sloping backfill (if applicable).

Walls should be constructed as soon as possible after cutting operations. Subsurface drains should be provided in any backfill material, discharge from subsurface drains should be to an approved discharge point. It is recommended that a minimum of 300mm width of free draining aggregate is provided as a drainage medium behind the retaining walls.

7. CONDITIONS OF THE RECOMMENDATIONS

This report is a preliminary geotechnical report only and the classification stated shall not be regarded as an engineering design nor shall it replace a design by engineering principles although it may contribute information for such designs. Lot Classifications are subject to determination at the completion of bulk earthworks. When this report is to be used as a reference by the engineer or builder or other relevant party, this report must be reproduced in total.

The advice given in this report is based on the assumption that the test results are representative of the overall subsurface conditions. However, it should be noted that actual conditions in some parts of the building site may differ from those found in the test holes. If excavations reveal soil conditions significantly different from those shown in our attached Soil Log(s), Ground Tech must be consulted and excavations stopped immediately.

The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. The description of the foundation material for has been provided for its easy recognition over the whole building site.

Any sketches in this report should be considered as only an approximate pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions or slope information should not be used for any building cost calculations and/or positioning of the building. Dimensions on logs are correct.

8. LIMITATIONS

This type of investigation (as per our commission) is not designed or capable of locating all ground conditions, (which can vary even over short distances). The advice given in this report are preliminary in nature and are based on the assumption that the test results are representative of the overall ground conditions. However, it should be noted that actual conditions in some parts of the site might differ from those found. If excavations reveal ground conditions significantly different from those shown in our findings, Ground Tech must be consulted.

The scope and the period of Ground Tech services are described in the report and are subject to restrictions and limitations. Ground Tech did not perform a complete assessment of all possible conditions or circumstances that may exist at the Site. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Ground Tech in regards to it.

Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by Ground Tech for incomplete or inaccurate data supplied by others.

9. REFERENCES

- AS2870 (2011), Residential Slab and Footings – Construction
- Geological Series Sheet 9029-9129 (EDITION 1) 1985, Map of the Penrith region, scale 1:100,000
- Austroads Pavement Design – A Guide to the Structural Design of Pavements

APPENDIX A

BOREHOLE LOGS

BOREHOLE LOG REPORT

GROUND TECHNOLOGIES

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
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Email: lab@groundtech.com.au

Job No.	**GTE458**
Hole ID.	**BH 01**
Hole Depth:	9.00 m
Sheet:	1 of 2

Project Name:	**PROPOSED INDUSTRIAL SUB-DIVISION**	Start Date:	**10/11/2014**
Location / Site:	**34 Yarrunga Road, Prestons**		
Client:	**AWJ Civil Pty Ltd**	Easting :	-
Drill Method:	**Solid Flight Auger**	Northing :	-
Equipment:	**Toyota Landcruiser Mounted 4WD Rig**	Ground Level :	**approx. RL 50.0m**

WATER	DEPTH (m)	USCS Symbol	GRAPHIC LOG	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	REMARKS
				Start Surface: **Grassed**	
		TOPSOIL		Clayey SILT; low plasticity, dark brown, moist, firm.	
		CI		Silty CLAY; with minor ironstone gravel,medium plasticity, orange brown, moist, very stiff to hard	
	0.5				
		BEDROCK		SILTSTONE; completely weathered, pale brown mottled pale grey, dry, very low strength	
	1				
		BEDROCK		SILTSTONE/SHALE with interbedded SANDSTONE lenses; extremely weathered, fine to medium grained, grey - brown to brown, dry, very low to low strength	assessed as generally easy to excavate using mid-sized excavator with toothed digging bucket
	1.5				
	2				
	2.5				
	3				
	3.5				
		BEDROCK		SHALE; extremely weathered, highly fractured, grey to grey brown, dry, low strength	assessed as can be excavated using mid-sized excavator with toothed digging bucket with difficulty. Ripper attachment will required. easily rippable with dozer
	4				
	4.5			***Continued over page on Sheet 2.....***	

Logged by: **M. Elmir** Date: **10/11/14** Checked By: **M. Elmir** Date: **10/11/14**

BOREHOLE LOG REPORT

GROUND TECHNOLOGIES

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
Fax: (02) 8783 8210
Email: lab@groundtech.com.au

Job No.	**GTE458**
Hole ID.	**BH 01**
Hole Depth:	9.00 m
Sheet:	2 of 2

Project Name:	**PROPOSED INDUSTRIAL SUB-DIVISION**	Start Date:	**10/11/2014**
Location / Site:	**34 Yarrunga Road, Prestons**		
Client:	**AWJ Civil Pty Ltd**	Easting :	-
Drill Method:	**Solid Flight Auger**	Northing :	-
Equipment:	**Toyota Landcruiser Mounted 4WD Rig**	Ground Level :	**approx. RL 50.0m**

WATER	DEPTH (m)	USCS Symbol	GRAPHIC LOG	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	REMARKS
				Start Surface: **Grassed**	
				continued from previous page - Sheet 1.....	
				SHALE; extremely weathered, highly fractured, grey to grey brown, dry, low strength	assessed as can be excavated using mid-sized excavator with toothed digging bucket with difficulty. Ripper attachment will required. easily rippable with dozer
	5				
	5.5				
	6				
	6.5				
	7				
	7.5	BEDROCK		SHALE; moderately weathered, slightly fractured, dark grey, dry, low to medium strength	assessed as difficult to excavate using excavator and ripper attach-ment. Rock hammers required. rippable with D8 Dozer
	8				
	8.5				
	9			*BOREHOLE TERMINATED AT 9.0m BEGL*	

Logged by: **M. Elmir** Date: **10/11/14** Checked By: **M. Elmir** Date: **10/11/14**

TOPSOIL LOG REPORT

GROUND TECHNOLOGIES

Ground Technologies Pty Ltd
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Email: lab@groundtech.com.au

Job No. **GTE458**

Sheet: 1 of 1

Project Name:	**PROPOSED INDUSTRIAL SUB-DIVISION**	Start Date:	**10/11/2014**
Location / Site:	**34 Yarrunga Road, Prestons**		
Client:	**AWJ Civil Pty Ltd**	Easting :	-
Drill Method:	**Solid Flight Auger**	Northing :	-
Equipment:	**Toyota Landcruiser Mounted 4WD Rig**	Ground Level :	**EXISTING**

BOREHOLE	DEPTH	DISCRIPTION
2	**0 - 0.25m** 0.25 - 1.00m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
3	**0 - 0.27m** 0.27 - 0.80m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
4	**0 - 0.15m** 0.15 - 0.70m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
5	**0 - 0.05m** 0.05 - 0.80m	**TOP DRESSING: very Silty Clay Filling, grey brown - brown** FILLING: Admixed Silty Gravelly Clay, grey brown/pale grey/orange brown
6	**0 - 0.45m** 0.45 - 0.70m 0.70 - 0.90m	**TOP DRESSING: very Silty Clay/Clayey Silt Filling, dark brown** FILLING: Admixed Silty Clay with some Gravel, brown NATURAL: Silty CLAY, medium plasticity,orange brown
7	**0 - 0.12m** 012 - 0.60m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
8	**0 - 0.24m** 0.24 - 0.60m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
9	**0 - 0.20m** 0.20 - 0.60m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
10	**0 - 0.20m** 0.20 - 0.60m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
11	**0 - 0.20m** 0.20 - 0.60m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown
12	**0 - 0.20m** 0.20 - 0.60m	**TOPSOIL: Clayey SILT, Dark Brown** NATURAL: Silty CLAY, medium plasticity,orange brown

Logged by: **M. Elmir** Date: **10/11/14** Checked By: **M. Elmir** Date: **10/11/14**

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Ground Technologies Pty Ltd
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PO Box 1121 Green Valley NSW 2168
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Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 13

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
		CI	Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist stiff to very stiff			
	0.5				SA1	
	1					
	1.5				SA2	
	2	BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2.5				SA3	
			SHALE, extremeley weathered, low strength, brown			
	3				SA4	
			Borehole terminated at 3.0m			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

GROUND TECHNOLOGIES
Geotechnical Testing Services

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PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
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Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 14

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
	0.5	CI	Silty Clay, with minor ironstone gravel, medium plasticity, orange/brown, slightly moist, very stiff		SA5	
	1		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist stiff to very stiff			
	1.5				SA6	
	2	BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2.5		SHALE, extremeley weathered, low strength, grey, grey/brown		SA7	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

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Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
Fax: (02) 8783 8210
Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 15

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
		CI	Silty Clay, medium plasticity, grey/brown, moist, stiff			
	0.5		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist, very stiff		SA8	
	1					
	1.5				SA9	
	2					
		BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2.5				SA10	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

GROUND TECHNOLOGIES
Geotechnical Testing Services

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SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 16

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
	0.5	CI	Silty Clay, medium plasticity, grey/brown, moist, stiff		SA11	
	1		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist, very stiff			
	1.5				SA12	
	2					
		BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2.5				SA13	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
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SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 17

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
		CI	Silty Clay, medium plasticity, grey/brown, moist, stiff			
	0.5				SA14	
	1		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist, very stiff			
	1.5				SA15	
		BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2					
	2.5				SA16	
			SHALE, extremeley weathered, low strength, brown			
					SA17	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

APPENDIX B

LABORATORY TEST RESULTS

GROUND TECHNOLOGIES
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CALIFORNIAN BEARING RATIO

Client	Logos Property	Job no :	**GTE549**
Project	Proposed Industrial Development	Test date :	**14-Apr-15**
Location	Lot 34 Yarrunga Street, Prestons	Report No.	**GTE-549-L2**

Sample Number		L1			
Date Sampled		8-Apr-15			
Depth		0.2-0.6m Cut			
Location		See Attached Plan			
Laboratory Compaction AS1289 5.1.1 standard					
Oversize Material 19mm Sieve	%	0.2			
Maximum Dry Density	t/m^3	1.60			
Optimum Moisture Content	%	21.8			
Field Moisture Content	%	16.7			
Test Results AS 1289 6.1.1					
Before Soaking Dry Density	t/m^3	1.61			
Moisture Ratio	%	98.0			
Density Ratio	%	100.0			
After Soaking Dry Density	t/m^3	1.58			
Moisture Content	%	21.4			
Moisture Content after test - remainder	%	23.3			
Moisture Content after test - top 30mm	%	29.4			
Number of days soaking	days	4			
Mass of Surcharge	Kg	4.5			
Swell after soaking	%	1.5			
CBR penetration	mm	2.5			
CBR VALUE	**%**	**4.5**			

Material Description : L1- Mottled Red/Brown Silty Clay

Test Methods: AS1289 6.1.1, 5.1.1, 2.1.1 Sampling : AS1289 1.2.1 (6.5.4)

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No. 14343
Accredited for compliance with ISO/IEC 17025

Approved Signatory
Date 16-Apr-15

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Client:	Logos Property	Job No.	GTE549
Project:	Proposed Industrial Development	Report No.	GTE549-L1
Location:	Lot 34 Yarrunga Street, Prestons	Test date:	8-Apr-15

SHRINK / SWELL TEST RESULTS

Sample identification : **L2** depth (m) **0.3m-0.7m**

Sample description: Brown Silty Clay

SHRINK TEST

bulk density of core specimen	
1.874	t/m^3
moisture content%	**22.3**

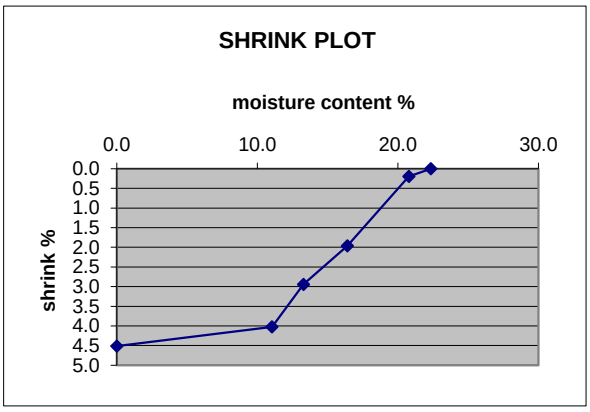
shrink on drying (%)
4.5
amount of crumbling during shrinkage
0

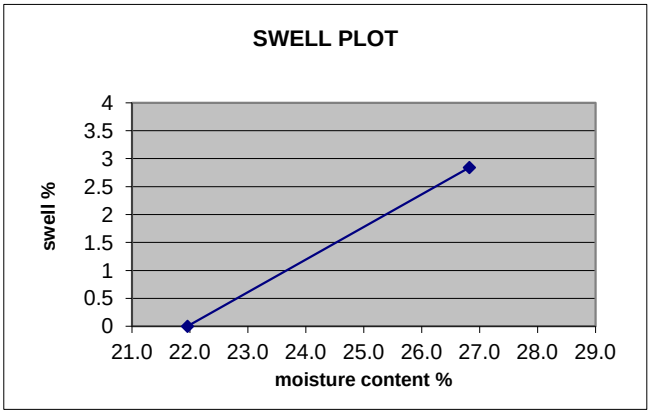
estimated inert material (%)
0.0
amount of cracking during shrinkage
0

SWELL TEST

moisture content (%)		Pocket Penotrometer (Kpa)	
before test	after test	before test	after test
22.0	**26.8**	**340**	**170**

swell on saturation(%)	shrink / swell index: I_{ss} (%)
2.8	**3.3**





Notes: Sampled on 8/4/15 " Undisturbed U50 Sample"

Test Methods					
Shrink/Swell	AS1289 7.7.1	X	AS1289.5.1.1	Standard Compaction	
Moisture Content	AS1289.2.1.1	X	AS1289.5.2.1	Modified Compaction	
Sampling	AS1289 1.2.1				

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LABORATORY TEST RESULTS