FMG ENGINEERING

Preliminary Geotechnical Investigation Report

Job Number	281686
Client	City of Darebin
Site	42 James Street, NORTHCOTE, VIC 3070
Date	27/07/2022
Revision	0

Document Status

REV NO.	STATUS	AUTHOR	REVIEWER		APPROVED FOR ISSUE	
			Name	Date	Name	Date
0	FINAL	Adele Liu	Reza Shahbazian	27/07/2022	Ian Yang	27/07/2022

Contents

1.0 Introduction

FMG Engineering (FMG) has been commissioned to undertake a geotechnical investigation at 42 James Street, NORTHCOTE, VIC 3070. The approximate site extents are shown below in Figure 1.

Figure 1: Site location

1.1 Objectives and scope

The objectives of this geotechnical investigation are to

- Undertake site investigation to understand the subsurface conditions and bearing capacity
- Drilling of two boreholes to a maximum depth of 3m or refusal (whichever comes first)
- Undertaking Dynamic Cone Penetrometer Tests (DCPs) at each borehole location for bearing capacity
- Logging of boreholes via the visual tactile method in accordance with AS1726-2017
- Provide a geotechnical investigation factual report

2.0 Preliminary / Desktop study

2.1 Site description

The given investigated site is located at 42 James Street, NORTHCOTE, VIC 3070. The site is surrounded by existing residential developments on north and south. The site's access is via a little access road heading to house no 42.

There are some adjacent trees that may cause abnormal moisture conditions for any proposed structure and moisture/tree root barrier may be required.

2.2 Geology

The review of GeoVic shows that the proposed site is underlain by Red Bluff Sandstone (Nbr): generic described as Sandstone, conglomerate: pale yellow and brown; fine to coarse-grained, massive to well bedded; cross-bedded; local ironstone and by Melbourne Formation(Sxm): generic described as Siltstone and sandstone: mainly thin-bedded; most beds show undisturbed Bouma sequences (see below Figure 1).

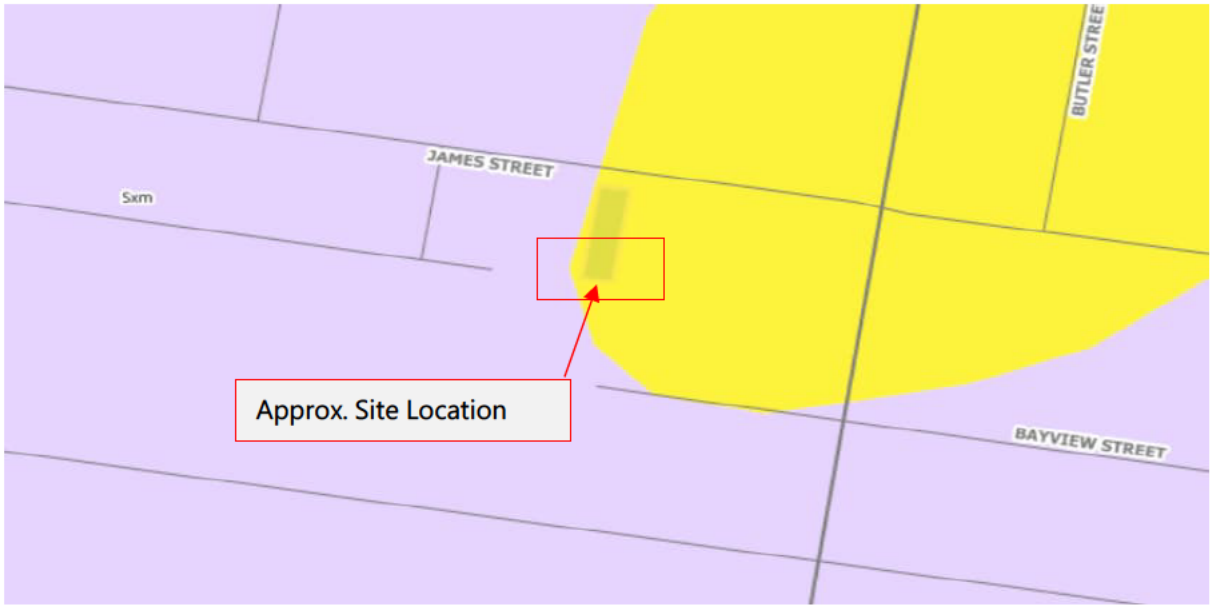


Figure 2: Local geology (yellow=Red Bluff Sandstone, purple= Melbourne Formation)

2.3 Regional groundwater

The review of Visualizing Victoria's Groundwater overlay maps indicated that there is groundwater table at a depth of approx.20-50m below ground level (bgl) adjacent to the subject site (see below Figure 2).

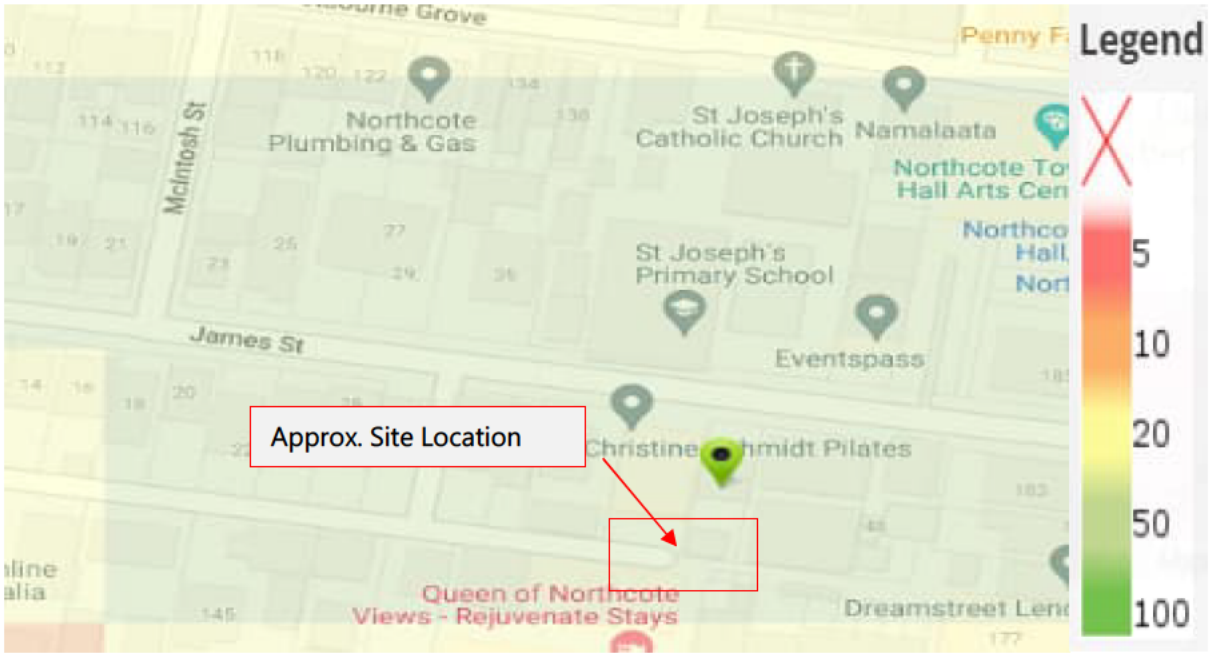


Figure 3: Regional groundwater depths

3.0 Site investigation and results

3.1 Methodology

Boreholes were drilled using a hand-post auger owned and operated by ML & Associates on 20 June 2022. In addition, total of two (2) DCP tests were undertaken at each borehole locations.

Holes were terminated by refusal and recovered samples were logged by the FMG site engineer then delivered to FMG research laboratory.

Borehole/test locations are shown on the site plan included in Figure 1. A summary of achieved depths is shown in Table 1.

Table 1: Summary of achieved depths

TEST	DEPTH ACHIEVED (mbgl)
BH01	1.7 (refusal possibly based on very dense sand)
BH02	1.1 (refusal possibly based on very dense sand)

3.2 Summary of subsoil conditions

A description of the materials encountered during the site investigation is included in the borehole log (refer to Appendix A) and a summary can be found below and in Table 2.

The encountered subsoils generally include:

- Fill: Silty Sand (SM) and Silty Clay (CI) low to medium plasticity, black, brown, orange, grey, fine to coarse grained, rounded to sub-rounded, moist.
- Natural: Silty SAND (SM), Clayey SAND(SC-SM), Sandy CLAY(CI), low to medium plasticity, and colour changed along the depth, moist, medium dense to dense.

Table 2: Summary of subsurface soil profile

MATERIAL	DEPTH ENCOUNTERED (mbgl)	
	BH01	**BH02**
Fill	0.0-0.8	0.0-0.35
Natural	0.8 – 1.7	0.35 – 1.1

3.3 Dynamic cone penetrometer results

The DCP results generally align with the consistency/density shown on the borehole log. The results are included in Appendix A.

3.4 Groundwater

Groundwater was not observed during drilling. It should be noted that the occurrence of groundwater may vary seasonally with rainfall intensity and duration.

3.5 Earthquake site class

Boreholes by FMG are of limited depth and unsuitable to provide an earthquake classification using the Classification System presented in AS1170.4-2007 "Structural design actions Part 4: Earthquake actions in Australia". However, based on the expected geology at depth, it is assessed that the following should be adopted:

- Site sub-soil class: C_e
- Hazard Factor (Z): 0.09

3.6 Site classification

Swell y_s values have been calculated in accordance with AS2870-2011. Although AS2870-2011 is considered appropriate for this application, the design should be also based on engineering principles.

The site in its current condition is classified as CLASS **P** (problem site) due to the presence of significant number of trees at surrounding area, which would cause abnormal moisture condition.

However, taking into account the effects of trees in accordance with AS2870-2011, the characteristic surface movement of 20mm may be adopted. It should be noted that the y_s = 20mm is between S-M classification. The values provided do not include any allowance for controlled fill nor for removal of existing structures. The structural designer should consider the possible effects of future works, including but not limited to retaining wall removal, removal of vegetation, controlled fill operations, and construction that straddles edges of existing retaining wall with different sub-surface conditions.

It must be emphasised that in classifying this site, FMG Engineering did not place sole reliance on the borehole log by means of being an absolute representation of all existing subsurface conditions at this site. The followings have also been taken into consideration.

- The broad experience of FMG Engineering
- Well established and relevant local knowledge of the general behavioural characteristics of foundation soils in the vicinity of the site
- Specific geotechnical reports and classification on adjacent sites which were referred to
- FMG Engineering's vast experience relating to past performance of existing structures in the general area
- Published geological maps

4.0 Laboratory testing

4.1 Atterberg limit & particle size distribution

Atterberg limit, Particle Size Distribution (PSD) testing, moisture content, plastic limit, plasticity index and etc. were performed to assist in assessing the engineering characteristics of the material. Tests were carried out in accordance with Australian Standard AS1289, "Methods of Testing Soil for Engineering Purposes".

The laboratory testing results have been attached in Appendix B and a summary of the testing results is presented in below Table 3 and 4.

Table 3: Summary of laboratory results

SAMPLE ID (DEPTH)	DESCRIPTION	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Moisture content (%)	Linear Shrinkage	Emerson Class Number
BH01(0.80-1.30m)	clayey SAND (SC)	65	23	42	6.1	16.5	4
BH02(0.35-0.95m)	clayey SAND (SC)	43	16	27	6.1	11.5	4

Table 4: Summary of Particle Size Distribution Results

Sieve Size(mm)	BH01 (0.80-1.30m) (% Passing)	BH02 (0.35-0.95m) (% Passing)
9.5	100	100
6.7	99	100
4.75	98	98
2.36	89	89
1.18	73	62
0.6	55	37
0.425	47	26
0.3	44	21
0.15	41	19
0.075	39	18

5.0 Geotechnical comments

5.1 Geotechnical parameter for retaining structure

Retaining structures may be designed using the following tabulated parameters. The below parameter is based on limited two boreholes drilling on top of the existing 42 James Street, NORTHCOTE, VIC 3070.

Table 5: Retaining wall geotechnical parameters

MATERIAL	γ (kN/m^3)	Ø′ (°)	C′ (kPa)	SHORT/LONG TERM LATERAL EARTH PRESSURE COEFFICIENT		
				Active (K_a)	Passive (K_p)	At rest (K_0)
FILL	17-19	28	0-1	0.36	2.77	0.53
Clayey SAND / Sandy CLAY	17-19	28	0-2	0.36	2.77	0.53

Where:

- γ = estimated material unit weight
- C′ = drained cohesion
- Φ′ = estimated friction angle for lateral earth pressure coefficient based on limited investigation and scope of work

- K_a = active earth pressure coefficient, ignoring wall friction. Assumes horizontal ground surface
- K_o = at-rest earth pressure coefficient
- K_p = passive earth pressure coefficients, ignoring wall friction.

Retaining structure must cater for:

- Unbalanced hydrostatic pressure
- Any surcharge loading

Adequate surface and subsurface drainage measures must be provided to prevent the formation of a hydrostatic pressure behind the wall. Such measures could include weepholes, or an agricultural drain or strip drain, connected to an approved and functional outlet. The retention of water behind the retaining wall could lead to the development of relatively lateral soil swelling pressures in the Pooraka Formation. Such pressures could be markedly higher than the at-rest earth pressure. The drainage system should be designed specifically to prevent the possibility of surface water flowing back and surcharging behind retaining walls.

The effects from potential collapse of any cut/fill and/or loading at the surface, such as soil stockpiles during construction, would need to be considered in the construction phase of retaining walls for safety purposes.

In addition, the recommended allowable bearing capacities are based on field DCP testing results and summarised in below Table 6.

Table 6: Summary of allowable bearing capacities

DEPTH (mbgl)	ALLOWABLE BEARING CAPACITY (kPa)
0 to 0.3	25 to 50
0.3 to 0.8	100 to 200
0.8 to 1.7	≥200

All further proposed footing excavation shall be inspected by a suitably experienced geotechnical engineer to ensure that the required founding material for the footing has been exposed throughout and its assumed soil strength is confirmed. Any unusual features (ie., soft, loose, wet or spongy zones at the surface of the excavation) must be reported to FMG immediately, to ensure that the recommendations as outlined in this report remain relevant. This report is based on approved scope of work, the slope stability analysis, detailed footing design and settlement analysis are not included. FMG shall be contacted if further relevant recommendation would be needed.

5.2 General construction considerations

The below general consideration is provided as construction recommendation and might not be all applicable/relevant to the proposed specific project.

5.2.1 Scheduling of earthworks

During the wetter months of the year, particularly during winter and spring when evaporation rates are low, it is anticipated that it may be difficult to conduct earthworks at the site. Where possible all earthworks should be scheduled during the drier months of the year.

5.2.2 Working platform and trafficability

Given fill materials and natural sub-surface soil profile, the trafficability of the site would be expected to be worsen during or following periods of wet weather/event where the surface is not sealed. This may cause problems with construction vehicles getting bogged.

5.2.3 Excavation potential

All soils encountered are expected to be readily excavated using conventional earthmoving equipment such as bucket type excavators.

Although refusal was met in all boreholes conventional earthmoving equipment is expected to be adequate during site works. Excavation within FILL material and SAND based soils may experience short term instability and shoring and/or over excavation may be required.

5.2.4 Service trenches and easements

Where service trenches or easements are close to the footings, the footings are to be supported on piers constructed to sufficient depth that a line drawn at 30 degrees for FILL and sandy soils and 45 degrees for clayey soils from the base of the pier/s cuts the service trench line below the base of the service trench.

Service trenches in the extremely weathered rock may be stable in the short term if cut vertical. However, service trenches may require shoring, or appropriate benching and battering to comply with WHS Guidelines.

5.2.5 Site drainage

The construction area is to be graded away from the structures so water drains to collection sumps and cannot pond beside or adjacent to the footings. On the cut side, water must drain away along the base of the cut. Provide a spoon drain if necessary. During construction provide temporary stormwater drains.

The condition of the subgrade soils is expected to be generally suitable to support construction traffic for subgrade preparation, and to allow specified minimum compaction standards for the subgrade and overlying pavement layers to be achieved. However, it will be important to maintain good surface drainage of the pavement subgrade at all times during construction. Any subgrade soil that does become over-wet and soft should not continue to be compacted but instead should be allowed to dry out. Alternatively, the over-wet, soft/loose soil can be boxed out and replaced with backfill.

5.2.6 Existing fill

The existing fill is considered uncontrolled, and not suitable to support permanent loads. The existing fill may be used as temporary formwork to support ground slabs provided:

- Total imposed loads including construction loads and weight of plastic concrete does not exceed 5kPa
- Thickness of existing fill is confirmed to not exceed 0.40m

- Exposed fill subgrade is proof-rolled with a vibrating roller minimum 2tons compactive effort and minimum 4 passes in each of two orthogonal directions.

6.0 Important notes about the interpretation and use of this geotechnical report

These notes are offered to help in the interpretation of your Geotechnical Report.

The level of investigation and degree of certainty required is dependent upon the complexity of the proposed construction.

Should a more conclusive assessment be required regarding the subsoil conditions at the property, FMG Engineering can arrange to undertake a more detailed study including further sampling and laboratory testing. There will always be uncertainties arising from the practical limitations of the extent and nature of site testing and localised changes in soil conditions may not be found in any cause.

This report should be read as a whole. Borehole logs should not be separated from the body of the report and interpreted independently. The whole of this report should be provided to contractors in order to provide the best available information to the contractors. To avoid any misinterpretation of the contents of the report consult the geotechnical engineer for any queries or proposed changes or unexpected conditions.

6.1 The limitations of a geotechnical investigation

Although the information provided by a geotechnical investigation can reduce exposure to such risks, no geotechnical investigation, however diligently carried out, can eliminate them. Even a rigorous professional assessment may fail to detect all subsoil and ground water variations on a site. The geology of the site may make predicting changes difficult.

A geotechnical investigation is based upon a unique set of project conditions.

Your report should not be used:

- When the nature of the proposed development or use is changed, for example if a residential development is proposed instead of a commercial one
- When the size or configuration of the proposed development is altered
- When the location or orientation of the proposed structure is modified
- When there is a change of ownership
- For application to an adjacent site.

The circumstances about a particular development or contract may require a specified approach to the assessment of soil and groundwater conditions.

To help avoid costly problems, refer to your consultant to determine how any factors which have changed subsequent to the date of the report may affect our recommendations.

6.2 Geotechnical 'findings' are professional estimates

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing is interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions and the nature and homogeneity of subsurface conditions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration programme, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise its impact. For this reason, owners should retain the services of their consultants through the development stage, to identify variations, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site or during the tender process.

A report prepared for the purposes of the geotechnical engineer's direct client may not meet the objectives of a third party or contractor. Consult the geotechnical engineer for guidance in the application of the report to your purposes.

6.3 Unforeseen conditions

Should conditions encountered on site be markedly different from those anticipated and described in this report then FMG Engineering should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows reinterpretation and assessment of the implications for future work.

6.4 Safety in design

This Geotechnical Report presents factual information about the soil conditions at the subject site. This may be used for design purposes. At the time that this report was prepared, FMG Engineering were not informed of the details at the proposed retaining structure to be constructed. Consequently, FMG Engineering have not carried out a Preliminary Hazard Analysis nor been able to consider Safety in Design for the proposed development. It is the responsibility of the designer to use the information contained within this report when undertaking a Safety in Design assessment for the specific development.

Please contact FMG Engineering if Safety in Design analysis is required as the project develops.

Appendix A

Borehole logs

ENGINEERING

Investigation No.
BH01
Page 1 of 1

Engineering Log - Pavement

Project No.: 281686

Client: City Of Darebin
Project Name: 42 James Street, Northcote, Vic 3070.
Hole Location: Refer to Plan

Commenced: 20/06/2022
Completed: 20/06/2022
Logged By: S.
Checked By: S

Drill Model: CHPD 78 Post Drive
Drill Operator: ML & Associates
Hole Diameter: 78mm

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density		Blows	Structure and Additional Observations
		Groundwater Not Encountered			1		SM	FILL silty SAND, fine to coarse grained, black,low plasticity, root & root fibres	M	L - MD		0 1 3 3	
							Cl	FILL silty CLAY, medium plasticity, orange, brown, grey, with sand, fine to coarse grained, trace gravel, fine to medium grained, rounded to sub-rounded.	<PL	St		6 8 7 6	
							Cl	ALLUVIUM sandy CLAY, medium plasticity, orange, red, grey, sand, fine to coarse grained.	<PL	VSt		15 22 11 6 13	
							SC	ALLUVIUM clayey SAND, fine to coarse grained, orange, grey, mottled red, low plasticity, trace gravel, fine to medium grained, rounded to sub-rounded. Hole Terminated at 1.70m - Refusal	M	D - VD		19 25 25	

DCP Results: 5, 10, 15, 20

Photo

Pavement

Method

Penetration
No resistance
range to
refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Plastic Limit
> PL
= PL
< PL

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

FMG ENGINEERING

Investigation No.
BH02
Page 1 of 1

Engineering Log - Pavement

Project No.: 281686

Client: City Of Darebin
Project Name: 42 James Street, Northcote, Vic 3070.
Hole Location: Refer to Plan

Commenced: 20/06/2022
Completed: 20/06/2022
Logged By: S.
Checked By: S

Drill Model: CHPD 78 Post Drive
Drill Operator: ML & Associates
Hole Diameter: 78mm

Drilling Information						Soil Description						Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	DCP Results 5 10 15 20 / Blows	Structure and Additional Observations
		Groundwater Not Encountered					SM	FILL silty SAND, black, fine to coarse grained, low plasticity, trace gravel, fine to medium grained, rounded to sub-rounded, roots & root fibres.	M	L	1 1 2 6	
							SC-SM	ALLUVIUM, clayey silty SAND, fine to coarse grained, orange, mottled grey, red, low plasticity.	M	MD - D	13 20 22 25	
				-1	1		SM	ALLUVIUM, silty SAND, fine to coarse grained, orange, grey, low plasticity, trace gravel, fine to medium grained, rounded to sub-rounded. Hole Terminated at 1.10m - Refusal	M	VD		

Photo

Pavement

Method

Penetration
No resistance
range to
refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Plastic Limit
> PL
= PL
< PL

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Appendix B

Laboratory Testing Report

FMG Research - SA
Branch: FMG Research - VIC
ABN: 58 083 071 185
Unit 1, 21 Macaulay St
Williamstown North VIC 3016
Tel: 03 9815 7650 | Fax: 08 8362 1348

Report No: MAT:32200232-S01
Issue No: 1

Material Test Report

Client: City of Darebin
PO Box 91

PRESTON VIC 3072

Project: 281686 City of Darebin : 42 James Street, NORTHCOTE, VIC 3070

Accredited for compliance with ISO/IEC 17025 - Out of Scope

NATA Accredited Laboratory Number 320

Approved Signatory s.33(1)
(Laboratory Technical Manager)
Date of Issue: 20/07/2022

Sample Details

Sample ID	32200232-S01
Sampling Method	Sampled By Client
Location	42 James Street, Northcote, Victoria 3070
Sample Location	BH01 0.80m - 1.30m
Soil Description	sandy CLAY (CH)
Specification	AS Grading -75mm

Other Test Results

Description	Method	Result	Limits
Moisture Content [AS 1289.2.1.1]			
Moisture Content (%)		6.1	
Atterberg Limits Casagrande [AS 1289.3.1.2, AS 1289.3.2.1, AS 1289.3.3.1, AS 1289.3.4.1]			
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	16.5	
Mould Length (mm)		249.75	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.2	65	
Plastic Limit (%)	AS 1289.3.2.1	23	
Plasticity Index (%)	AS 1289.3.3.1	42	
Date Tested		15/07/2022	
Emerson Class Number [AS 1289.3.8.1]			
Emerson Class Number		4	
Soil Description		Sandy Clay	
Type of Water		Distilled	
Date Tested		18/07/2022	

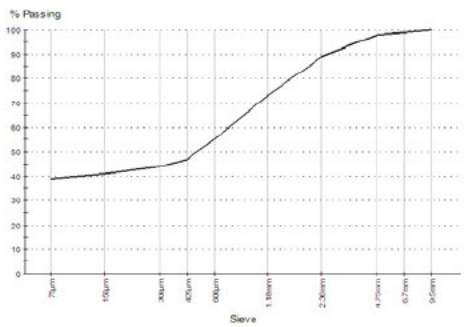
Particle Size Distribution

Method: Grading [AS 1289.3.6.1]
Drying by: Oven
Date Tested: 15/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	99	
4.75mm	98	
2.36mm	89	
1.18mm	73	
600µm	55	
425µm	47	
300µm	44	
150µm	41	
75µm	39	

Chart



Comments

Sample tested as provided by client

FMG Research - SA
Branch: FMG Research - VIC
ABN: 58 083 071 185
Unit 1, 21 Macaulay St
Williamstown North VIC 3016
Tel: 03 9815 7650 | Fax: 08 8362 1348

Report No: MAT:32200232-S02
Issue No: 1

Material Test Report

Client: City of Darebin
PO Box 91

PRESTON VIC 3072

Project: 281686 City of Darebin : 42 James Street, NORTHCOTE, VIC 3070

Accredited for compliance with ISO/IEC 17025 - Testing.
Out of Scope
NATA Accredited Laboratory Number 320
Approved Signatory: s.33(1)
(Laboratory Technical Manager)
Date of Issue: 20/07/2022

Sample Details

Sample ID	32200232-S02
Sampling Method	Sampled By Client
Location	42 James Street, Northcote, Victoria 3070
Sample Location	BH02 0.35m - 0.95m
Soil Description	clayey SAND (SC)
Specification	AS Grading -75mm

Other Test Results

Description	Method	Result	Limits
Moisture Content [AS 1289.2.1.1]			
Moisture Content (%)		6.1	
Atterberg Limits Casagrande [AS 1289.3.1.2, AS 1289.3.2.1, AS 1289.3.3.1, AS 1289.3.4.1]			
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	11.5	
Mould Length (mm)		249.71	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.2	43	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	27	
Date Tested		15/07/2022	
Emerson Class Number [AS 1289.3.8.1]			
Emerson Class Number		4	
Soil Description		Clayey Sand	
Type of Water		Distilled	
Date Tested		18/07/2022	

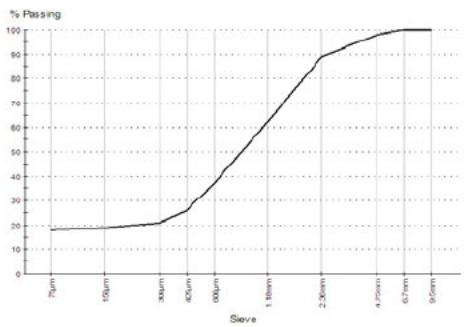
Particle Size Distribution

Method: Grading [AS 1289.3.6.1]
Drying by: Oven
Date Tested: 15/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	98	
2.36mm	89	
1.18mm	62	
600µm	37	
425µm	26	
300µm	21	
150µm	19	
75µm	18	

Chart



Comments

Sample tested as provided by client

Borelogs and laboratory test results

Soil description notes

The dominant soil constituents are given in capital letters followed by secondary textures. The dominant feature is determined from the Unified Soil Classification System and a soil symbol is used to define a soil layer as follows:

Borelog symbols

USC SYMBOL	SYMBOL MEANING
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
CI	Clay of intermediate plasticity
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty soil

The appropriate symbols are selected on the results of visual examination, field tests and available laboratory tests, such as, sieve analysis, liquid limit and plasticity index.

Plasticity

The potential for undergoing change in volume with moisture change is assessed from its degree of plasticity. The classification of the degree of plasticity in terms of the Liquid Limit (%) is as follows:

Description of plasticity

DESCRIPTION OF PLASTICITY	LIQUID LIMIT FOR SILT (%)	LIQUID LIMIT FOR CLAY (%)
Low	$\leq$ 50	$\leq$ 35
Medium	Not Applicable	>35 - $\leq$ 50
High	>50	>50

Condition

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are fixed by the shear strength of the soil as observed visually by the pocket penetrometer values and resistance to deformation to hand moulding.

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silt and sandy materials, and these are usually based on resistance to drilling penetration. Other condition terms, such as friable, powdery or crumbly may also be used.

Moisture content

For cohesive soils, the following code is used:

Code for cohesive soils

SYMBOL	PLASTIC CONDITION	MOISTURE CONDITION
MC≈LL	Moisture content near the liquid limit	Moist to wet
MC<LL	Moisture content less than liquid limit	Moist to wet
MC>PL	Moisture content greater than plastic limit	Damp to moist
MC≈PL	Moisture content near the plastic limit	Damp to moist
MC<≈PL	Moisture content less than or equal to plastic limit	Dry to damp to moist
MC<PL	Moisture content less than plastic limit	Dry to damp
MC«PL	Moisture content much less than plastic limit	Dry

For cohesionless soils, the following code is used:

Code for cohesionless soils

MOISTURE CONDITION	DEGREE OF SATURATION
Dry	0
Humid	1 to 25
Damp	25 to 50
Moist	50 to 75
Wet	75 to 99
Saturated	100

Cohesive consistency – Pocket penetrometer (PP)

The instrument is used in the field or the laboratory to provide approximate determination of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

Values for cohesive consistency

STRENGTH	SYMBOL	READINGS (kPa)
Very Soft	VS	<25
Soft	S	25 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very Stiff	VSt	200 to 400
Hard	H	>400

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