BLACK GEOTECHNICAL

Consulting Geotechnical Engineers

ACN 005 777 060

BACCHUS MARSH PROPERTY GROUP PTY LTD

HOPETOUN PARK NORTH RESIDENTAL DEVELOPMENT

GEOTECHNICAL INVESTIGATION FOR HOPETOUN PARK ROAD

REPORT NO V2211-2R2, MAY 2023

Black Geotechnical Pty Ltd
258 Hyde Street, Yarraville, Victoria 3013, Australia
Ph: 03 9689 0200
office@blackgeotechnical.com.au www.blackgeotechnical.com.au

CONSULT AUSTRALIA

DOCUMENT INFORMATION

project number:	V2211-2	
author:	George Black	
name of client:	Bacchus Marsh Property Group Pty Ltd	
name / address of project:	Hopetoun Park Road, Hopetoun Park North	
document version:	R2	

version	date issued	reviewed by	issued to
RD1	24/02/2023	Billy Burke & Ned Smith	Ross Closter, Urban Land Developments (ross@urbanld.com.au) Mike Jordon, Urban Land Developments (mike@urbanld.com.au
R1	24/03/2023	Billy Burke	as above
R2	16/05/2023	Billy Burke	as above

version	version description/comments
RD1	draft issue for client comment
R1	second issue after client comment
R2	third issue after council comment

Information about this document

This document has been produced for Urban Land Developments with specific reference to the proposed development or specific structures as detailed in this document. The use of this document for development or structures outside of those detailed may not be suitable. The use of this document is restricted to the client only and may only be relied upon by others with written permission from Black Geotechnical. This document must be viewed as a whole with no part used in isolation. This document presents the conditions encountered at the time of the fieldwork and is not intended to be a complete and exhaustive statement of all conditions present. The information in this document is limited by the investigation scope and/or extent, as well as other information provided to, or obtained by, Black Geotechnical.
Site conditions and legal requirements may change over time from various influences, including (but not limited to) anthropogenic, climatic and regulatory variations, which may invalidate recommendations provided in this document.
Conditions may differ between investigation points or below investigation depths, which may invalidate recommendations provided in this document.

 continued...

CONTENTS

1.0 GENERAL 4
1.1 Purpose of investigation 4
1.2 Proposed development 5
1.3 Existing conditions 5
1.4 Traffic survey 10
2.0 SUBSURFACE CONDITIONS 11
2.1 Reported geology 11
2.2 Fieldwork 11
2.3 Subsurface profile 13
2.4 Laboratory testing 13
3.0 DISCUSSION & RECOMMENDATIONS 15
3.1 Soil reactivity 15
3.2 Subgrade strength 15
3.3 Design traffic 16
3.4 Pavement thickness 17
3.4.1 Required thickness 17
3.4.2 Measured thickness 18
3.5 Material properties 18
3.6 Pavement surfacing 18
3.7 Conclusion 19
APPENDIX A 20
Figure 1 Test location Plan
Figure 1A Soil classification sheet
Logs BH 01 to BH07, inclusive
Results Geotechnical laboratory tests

1.0 GENERAL

1.1 Purpose of investigation

This report presents the results of a geotechnical investigation performed along the north-south part of Hopetoun Park Road within the proposed Hopetoun Park North residential subdivision. A locality plan is shown in Image 1 below.

Image 1 – Locality Plan (Source MapshareVic)

A close-up plan is shown in Image 2.

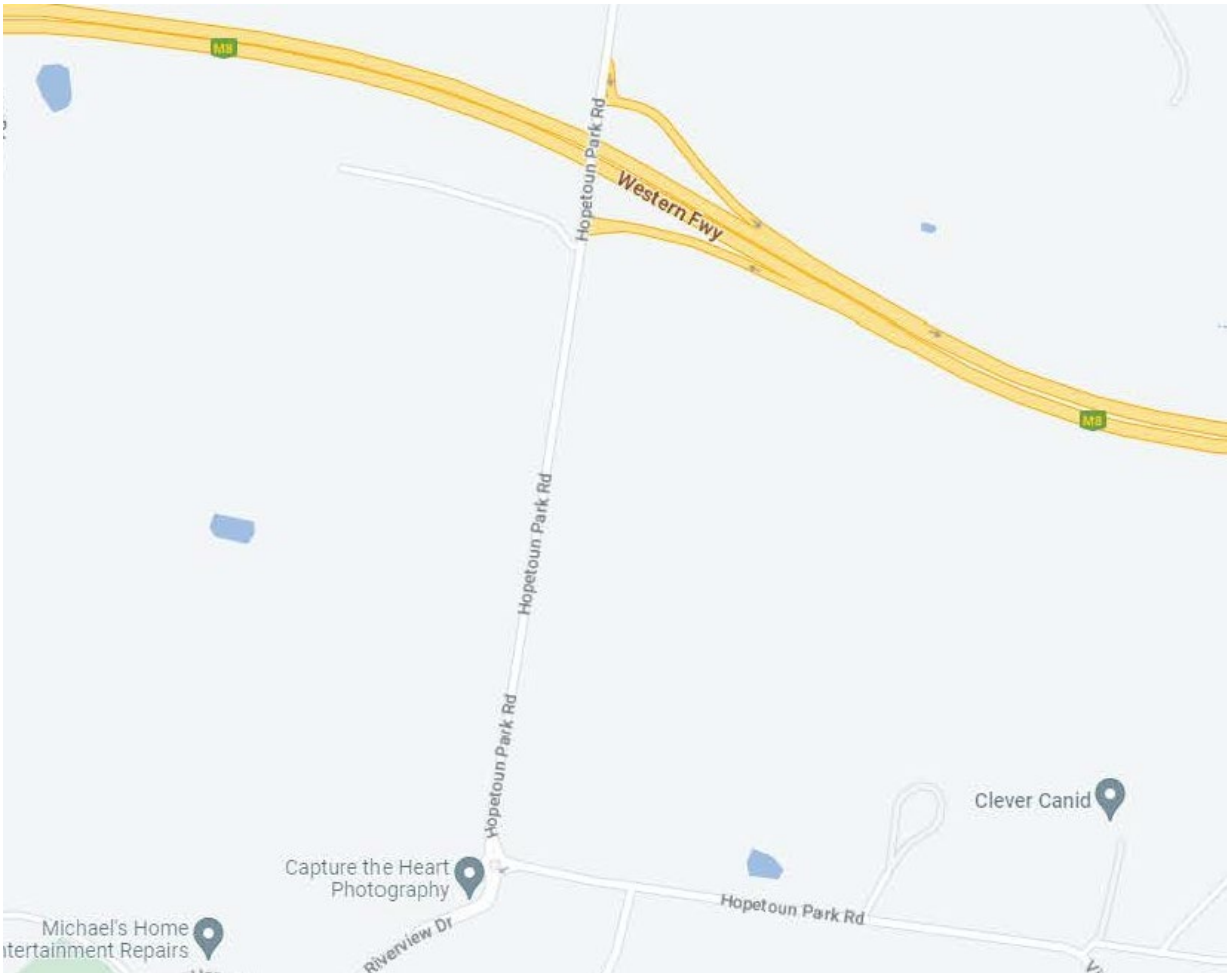


Image 2 – Close-up locality plan (Source Google Maps)

GENERAL

Purpose of investigation continued…

The purpose of the investigation was to determine the condition of the Hopetoun Park Road pavement and to consider how the proposed development described in Section 1.2 below may affect the existing pavement, and what improvements, if any, may be required.

Specifically, the purpose was to:

- Determine the subsurface conditions along the road.
- Discuss the condition and life expectancy of the existing pavement.
- Provide recommendations for pavement subgrade preparation if required.
- Provide recommendations for flexible pavement thickness and make-up if required.
- Discuss construction & drainage.

1.2 Proposed development

The site is an 800 m, or so, length of existing sealed road between the Western Freeway westbound exit ramp at the north end (-37.68789, 144.50233) and Riverview Drive at the south end (-37.684921, 144.501026) .

The proposed subdivision occupies about 150 hectares and with potentially up to 600 lots.

This includes 400 lots on the west side of Hopetoun Park Road and up to 200 lots on the east side.

There is an existing residential subdivision (Hopetoun Park) immediately to the south of the proposed subdivision. The existing subdivision occupies about 350 hectares and contains 260 lots, most of which appear to have been developed. It is understood that the existing subdivision was developed in the early 2000s.

The existing subdivision is shown as pink in Image 1 and is surrounded by the Werribee River to the west and south and by Melton Reservoir to the east.

The only access out of Hopetoun Park is Hopetoun Park Road and the only future increase in traffic on Hopetoun Park Road is from the proposed subdivision. Due to the topography of the proposed subdivision, any development to the east or west of the proposed subdivision will not use Hopetoun Park Road.

1.3 Existing conditions

Hopetoun Park Road is a straight, relatively level, 2-lane, sealed road that dips gently to the south with a level difference of about 9 m over a length of about 800 m.

The northern half of the road has an 80 km/hr speed limit and the southern half has a 60 km/hr limit.

The surfacing is mostly a sprayed seal, which is in a very good condition with no obvious cracking/failures.

A second sprayed seal has been applied at some time to the sprayed seal section of the road and in places is not quite as wide as the previous seal.

The road has gravel shoulders, which are in good condition, table drains, and a grass verge with occasional trees in a wide road reserve.

At the north end, as the road approaches the Western Freeway interchange, there is a 100 m, or so, length of pavement where there is an asphalt surface with a cement treated crushed rock base. The roundabout at the south end of the road where Hopetoun Park Road meets Riverview Drive also has an asphalt surface.

Whereas, the sprayed seal is in an excellent condition, the asphalt in the south end roundabout is cracked with widespread ‘crocodile’ cracking with some line and edge cracking.

The north end asphalt surface is also cracked, but not to the extent of the south end, and the north end cracks are mainly longitudinal, not crocodile.

GENERAL

Existing conditions continued…

The surfacing is further discussed in Section 3.6 of this report.

Photos of the asphalt cracking are shown in Images 3 to11.

Image 3 – crocodile cracking, east side of roundabout, with some line cracking

Image 4 – crocodile cracking, south side of roundabout looking north

Image 5 – crocodile cracking, south west side of roundabout

Image 6 – crocodile cracking, south side of roundabout

Image 7 – crocodile cracking, northbound lane immediately north of roundabout

Image 8 – crocodile and edge cracking, southbound lane , north of roundabout where the asphalt abuts the sprayed seal

GENERAL Existing conditions continued…

Image 9 – line cracking in asphalt at north end. The sprayed seal can be seen as the darker pavement to the south

Image 10 – minor crocodile cracking in asphalt at north end and also showing the adjoining sprayed seal pavement

Image 11 – line cracking in north end asphalt, looking north

GENERAL Existing conditions continued…

There are overhead power lines in the west side of the road reserve. A BYDA enquiry revealed a few low voltage cables below the road connecting users to power poles.

Telstra cables are in the east side of the road reserve with occasional user connection cables below the road.

There is a high voltage underground cable at the south end of the western side of the road reserve.

Powercor and Telstra plans are shown in Images 12 and 13.

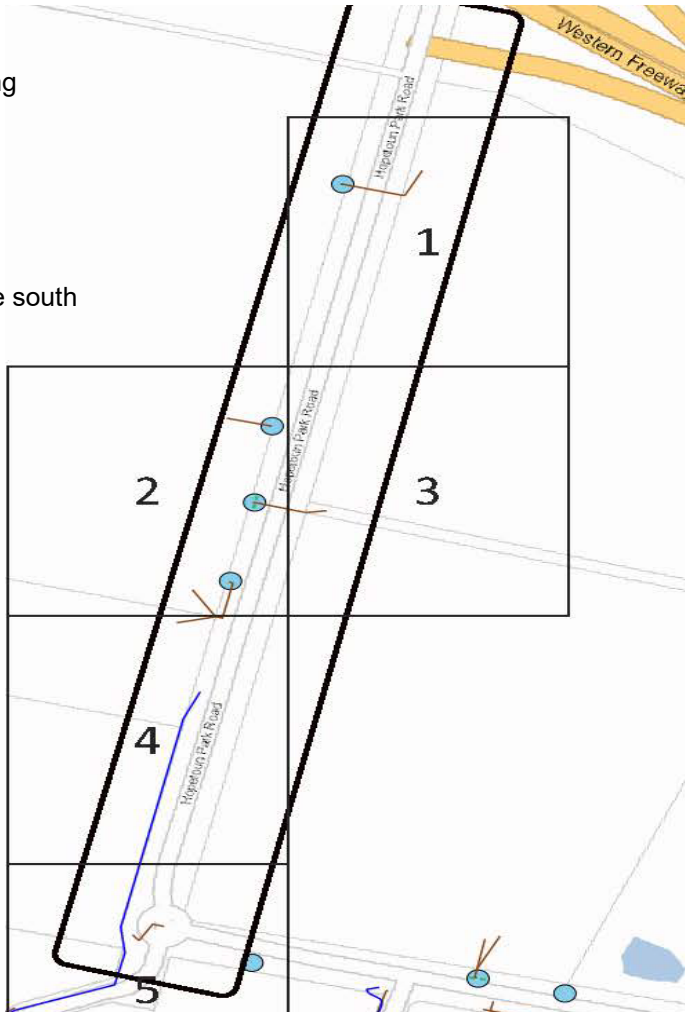


Image 12 - Powercor cable plan. North is to the top of the image

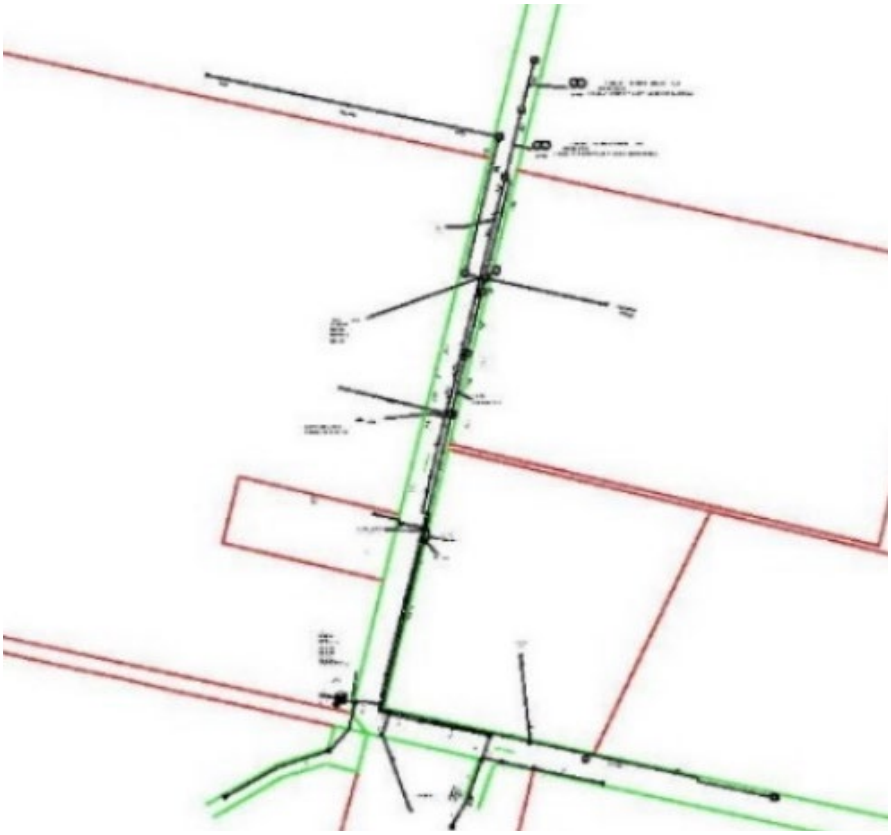


Image 13 – Telstra cable plan. North is to the top of the image

GENERAL **Existing conditions** continued…

Photos of the sprayed seal pavement are shown in Images 14-16.

Image 14 – Change of pavement makeup about 100 m south of the Western Freeway, with the asphalt seal and cement treated crushed rock base on the right

Image 15 – Edge of pavement near BH06 showing the overlay seal

Image 16 – Sprayed seal and pavement gravel in BH03.

GENERAL continued…

1.4 Traffic survey

A traffic count was conducted by Nationwide Traffic Surveys in October 2022. The results of the survey were emailed to Black Geotechnical by Mike Jordon on 13 February 2023. A summary from the survey report is shown below in Image 17.

Street Name :	Hopetoun Park Rd	Location :	North of Riverview Drive
Suburb/Locality :	Hopetoun Park	Start Date :	Tuesday 11 October 22
		Finsh Date :	Monday 17 October 22
Site ID Number :	6441_01	Speed Zone :	60
Prepared By :	Counters Plus	Road Classification :	
Date :	Wed 26 Oct 22		
File Name :	W:\2023 Job Files\V2211 - Hopetoun Park North\traffic M\Copy of S3 6441_01 Hopetoun Park Rd North of Riverview Dr Results.xlsm		

			Direction of Travel		
			Two-Way	Northbound	Southbound
Traffic Volume :		Week Days Only	2,142	1,073	1,069
[Vehicles/Day]		7 Day Average	2,073	1,037	1,037
Peak Hour	**AM**	8:00	206	153	53
Volume:	**PM**	15:00	197	65	132
Speeds :		85th Percentile	77	75	79
[Km/Hr]		Average	68.1	66.3	69.9
Classification % :		Class 1*	90.6%	90.7%	90.5%
Notes : (Observations)					
* Class 1 - Short Vehicles up to 5.5m					

Image 17 – Summary from Nationwide Traffic Surveys report

The table indicates a traffic volume of 8.24 vehicles per lot. It is understood that Council have suggested a preference for 10 vehicles per lot to determine annual average daily traffic (AADT). Design traffic is discussed in Section 3.2.

It is understood that it is proposed to initially develop 100 lots on the west side over the first three years followed by the remaining 300 lots on the west side during Years 3-5. The east side (up to 200 lots) will be developed during Years 8-20.

2.0 SUBSURFACE CONDITIONS

2.1 Reported geology

The GeoVic3 online, 1: 50,000 series, Seamless Geology (2007-2014), shows that the site surface geology along the length of the road is Quaternary/Neogene period Darley Gravel Formation (Nxr). The formation consists of unconsolidated deposits of gravel, sand, and silt.

At the north end of the road, Quaternary/Neogene period Newer Volcanics (Neo) are shown immediately east of the site. At the south end of the road, Newer Volcanics are shown about 1 km to the east.

Both the Newer Volcanics and the Darley Gravel are of a similar age (0.1-25 Ma). At this site, the Darley Gravel is younger than the Newer Volcanics.

An extract from the GeoVic3 database is shown in Image 18.

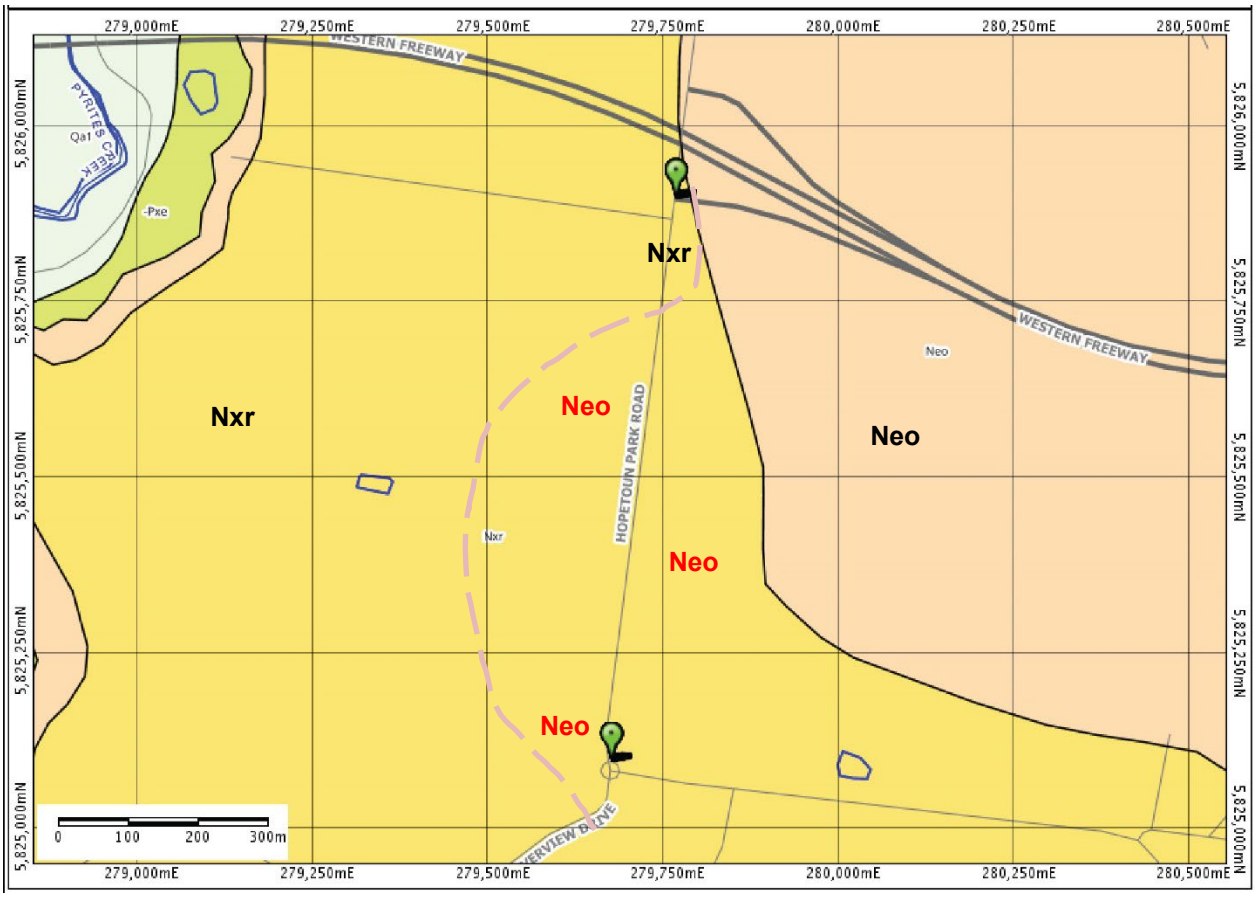


Image 18 – GeoVic3 extract. Hopetoun Park Road is between the two green teardrops.

However, as discussed in Section 2.4, it appears that, apart from the north end, most of Hopetoun Park Road is within the Newer Volcanics (Neo). The north end appears to be within the Darley Formation (Nxr). A suggested boundary between the two formations is shown as the dashed pink line in Image 18.

The GeoVic3 database puts the positional accuracy of the boundary between the Darley Formation and the Newer Volcanics as 250 m. On this basis, it is entirely reasonable that the boundary is further to the west than shown on the database.

2.2 Fieldwork

To assess the site sub-surface conditions, seven rotary drill pavement dipping boreholes were drilled at the locations shown in Image 19 and also shown in Appendix A (Figure 1).

Engineering logs of the boreholes together with a summary of the descriptive terms used in logging are included in Appendix A. Dynamic cone penetrometer tests (DCPs) were conducted in the boreholes. The test results are shown on the logs.

SUBSURFACE CONDITIONS **Fieldwork** continued…

The recovered soil may be inspected by prior arrangement at Black Geotechnical's office, 258 Hyde Street, Yarraville. The samples will be disposed of 12 months after the issuing of this report.

Drilling was conducted by Construction Sciences from Sunshine West. A photo of the rig is shown in Image 20. The borehole locations were cleared for underground services by Seeker Utility Engineering from Bayswater. Traffic management was provided by First Traffic Management from Bulleen.

Image 19 – Borehole location plan

Image 20 – Drilling rig on BH06

SUBSURFACE CONDITIONS continued…

2.3 Subsurface profile

The pavement dipping boreholes encountered relatively uniform sub-surface conditions as summarised in Table 2.3.1. All depths and thicknesses are in metres. The table also includes the DCPs over the top 200 mm of natural clay subgrade.

The natural clay in BH01 was a sandy clay compared to a silty clay encountered in the other six boreholes. It was also a different colour.

Table 2.3.1. Borehole summary

bore no	seal[1]	fill		natural clay subgrade		
	thickness	type[2]	thickness	type	depth top	DCP
BH01	0.075	CTCR to 0.2 m, sandy gravel to 0.4, clayey sand to 0.6	0.525	sandy clay, friable, medium plasticity, red mottled white & grey	0.6	4, 4
BH02	0.03	sandy gravel to 0.3, gravelly clayey sand to 0.6	0.57	silty clay, very stiff, brown mottled grey	0.6	5, 5
BH03	0.02	sandy gravel to 0.25, gravelly sand to 0.7	0.68	silty clay, friable, medium plasticity, dark brown mottled grey	0.7	7, 6
BH04	0.02	sandy gravel to 0.3, gravelly sand to 0.7	0.68	silty clay, friable, medium plasticity, brown, mottled red	0.7	4, 5
BH05	0.02	sandy gravel to 0.35, gravelly sand to 0.7	0.68	silty clay, friable, medium plasticity, brown, mottled red/pale grey	0.7	7, 8
BH06	0.02	sandy gravel to 0.5, gravelly sand to 0.85	0.83	silty clay, stiff, medium plasticity, brown mottled orange/grey	0.85	refusal in overlying sand
BH07	0.02	sandy gravel to 0.45, gravelly sand to 0.7	0.7	silty clay, friable, medium plasticity, dark brown mottled brown/red	1.4	as above

[1]BH01 encountered an asphalt seal, all other boreholes encountered a sprayed seal
[2]The sandy gravel and gravelly sand encountered in the boreholes was in a dense condition.

No groundwater was encountered in the boreholes at the time of drilling.

2.4 Laboratory testing

Atterberg limits determinations, particle size distributions, and California bearing ratios were performed on soil samples recovered from boreholes.

The tests were conducted by Construction Sciences' Sunshine West laboratory.

The test certificates are included in Appendix A. The test results are summarised in Table 2.4.1.

Table 2.4.1. Summary of laboratory test results

log ID	depth, m	Soil	W	W_L	W_P	I_P	OMC	%<75 µm	CBR	% swell
BH01	0.65-0.9	natural sandy clay	12.6	32	17	15	14.5	50	8	1
BH03	0.3-0.5	gravelly sand fill	3.3	20	13	7	6.0	17	9	0.5
BH05	0.7-1.5	natural silty clay	19	43	19	24	21	64	2.5	2
BH07	0.4-0.6	gravelly sand fill	2.9	20	13	3	6.5	21	10	0.5

where: W = natural moisture content, W_L = Liquid Limit, W_P = Plastic Limit, I_p = Plasticity Index, OMC = optimum moisture content, %<75 µm = silt/clay content, CBR = California Bearing Ratio, % swell = CBR sample swell over a four-day soak.

The CBR test is conducted on a sample that is compacted at the optimum moisture content and then soaked for four days before testing. The 4-day soak is to simulate an increase in the subgrade moisture content to an equilibrium moisture content in the protected environment below the pavement.

It is usual with a clay that is protected from moisture changes due to precipitation, poor drainage, evaporation and evapotranspiration, that after pavement construction, the moisture content (W) will increase to an equilibrium value that is well above the plastic limit (W_P).

SUBSURFACE CONDITIONS

Laboratory testing continued…

The comparison between the natural moisture content (W), the optimum moisture content (OMC), the 4-day soak moisture contents, and the plastic limit (W_P), for the two clay samples is shown in Table 2.4.2.

The 4-day soak moisture content is measured for the top 30 mm of the soaked sample and also for the remainder of the sample. The CBR is measured over a plunger penetration into the sample of 2.5 mm. Therefore, the top 30 mm moisture content is the most relevant for the comparison.

Table 2.4.2. Comparison between W, W_P, OMC and 4-day soak moisture contents

log ID	depth, m	Soil	W	W_P	OMC	4-day soak	
						top 30 mm	remainder
BH01	0.65-0.9	natural sandy clay	12.6	17	14.5	19.2	17.9
BH05	0.7-1.5	natural silty clay	19	19	21	26.3	23.2

The table shows the natural moisture content below the pavement is significantly lower than the relevant 4-day soak moisture content (6.6% and 7.3% lower in BH01 and BH05, respectively), and also similar to (BH05), or lower than (BH01) the plastic limit. The plastic limit is the moisture content at which a remoulded sample cannot be rolled into a thread without cracking. This illustrates a clay subgrade in a protected environment that has a much lower moisture content than expected.

Also the natural moisture content of the two sand samples is consistent with a ‘dry’ condition.

The low moisture content is significant and is discussed in Section 3.2.

As noted and Section 2.2, the natural clay in BH01 was a sandy clay that was red with mottled white and grey, whereas the natural clay in the other six boreholes was a silty clay that was predominantly dark brown. The sandy clay had a high laboratory CBR of 8 and the silty clay in BH05 had a low laboratory CBR of 2.5.

A likely explanation is that the boundary between the Darley Formation and the Newer Volcanics is to the west of Hopetoun Park Road and not to the east as shown on the map extract in Image 10, and that BH01 is within the Darley Formation and all the other boreholes are in the Newer Volcanics area. This has been previously noted in Section 2.1.

continued...

3.0 DISCUSSION & RECOMMENDATIONS

3.1 Soil reactivity

The Atterberg Limits determinations for the natural clay in BH01 indicates that the clay does not have expansive clay minerals and is not reactive.

The Atterberg Limits determinations for the natural clay in BH05 indicates that the clay is just below the Liquid Limit versus Plasticity Index line that indicates the presence of montmorillonite, which is an expansive clay mineral. This may suggest the clay is reactive.

The last paragraph in Section 2.4, suggests the road is mostly within the Newer Volcanics, which typically has a high potential for volume change with moisture variation.

Apart from the Atterberg Limits and the soaked CBR results, there is no indication on site that the clay is reactive. This may be because of the unusual topography, the site is so well drained that normal high clay equilibrium soil moisture contents do not exist and are replaced by a low equilibrium soil moisture content. This is discussed in Section 3.2.

3.2 Subgrade strength

It is important to recognise that this pavement has been in use for 20 years and the subgrade soil has long ago reached an equilibrium moisture content in the protected environment in which it exists.

Therefore, visual and tactile observation, insitu testing (DCPs) and insitu moisture contents take precedence over laboratory testing performed at a moisture content that has no similarity to the in situ moisture content.

Similarly, deemed properties for the subgrade are also not relevant, For example, residual basaltic clay is generally deemed to have a CBR < 3 and requires a 150 mm minimum thickness capping layer to allow a CBR 3 to be adopted.

A soaked CBR of 2.5 for the clay subgrade in BH05 is consistent with a residual basaltic clay. However, the CBR test was conducted at a soil moisture content of 26.3% compared to an in situ moisture content of 19%. Also for BH05, the in situ moisture content of 19% is lower than the optimum moisture of 21%, rather than being much higher, which is usual in residual basaltic clay.

The DCP test in BH05 indicates a much higher CBR and natural moisture than the 4-day soak moisture content. Vicroads TB No. 40, Fig. 5.3, which correlates CBR with DCP test results for cohesive soil, indicates a CBR value >10 for 7 blows/100 mm (see Table 2.3.1 of this report).

The average subgrade DCP over the top 200 mm of clay subgrade in BH01-BH05 was 5.5 ± 1.5 (one standard deviation). Adopting a conservative DCP of 4, the VicRoads correlation is a CBR of 8.

The pavement material could not be penetrated by the DCP in BH06 and BH07 and no tests were conducted in the clay subgrade in those two boreholes.

Unlike BH05, the Darley Formation clay in BH01 gave the same laboratory and DCP CBR of 8. This indicates that the subgrade clay in BH01 has a different origin than the subgrade clay in BH05. This is consistent with the apparent surface geology discussed in Section 2.

The laboratory CBR of the gravelly sand subbase was 9 and 10 for BH03 and BH07, respectively. Being a cohesionless soil, the CBR is not overly influenced by moisture content.

To recap, the pavement has been in use for 20, or so, years, and in the environment in which the pavement exists, the subgrade clay has a much lower moisture content than would generally be expected. However, this is the real moisture content for a clay that has been in a protected environment for 20 years and laboratory tests and deemed properties that are used to predict the performance of a yet to be constructed pavement are not relevant.

The overall evidence suggests that the subgrade is very well and permanently drained. This is why the pavement is in such good condition for a pavement with a residual basaltic clay subgrade.

DISCUSSION & RECOMMENDATIONS continued…

3.3 Design traffic

Four annual average daily traffic (AADT) stages have been considered as shown in Table 3.3.1.

Table 3.3.1. Development stages AADT

stage	location	when developed	total no. of lots	lot multiplier	total AADT
A	existing subdivision	Years - 20 to + 20	260	10	5,200
B1	proposed subdivision - west side	Years 0-3	360	10	3,600
B2	proposed subdivision - west side	Years 3-8	660	10	6,600
B3	proposed subdivision - east side	Years 8-20	860	10	8,600

The design traffic has been based on traffic survey described in Section 1.4 and Austroads 'Guide to Pavement Technology Part 2: Pavement Structural Design', Edition 4.3, 2019.

The existing and proposed subdivisions are unique in that, due to the topography, they are unlikely to ever attract traffic from locations outside the subdivision and there will be no ongoing industrial, commercial, or agricultural traffic. The only ongoing heavy vehicle use will be for construction during the proposed subdivision building phase, Council waste/recycling collection trucks and maybe bus traffic. Therefore, it is considered reasonable to define Hopetoun Park Road as a collector as shown in Austroads, Fig.12.1, which is reproduced in Image 12.

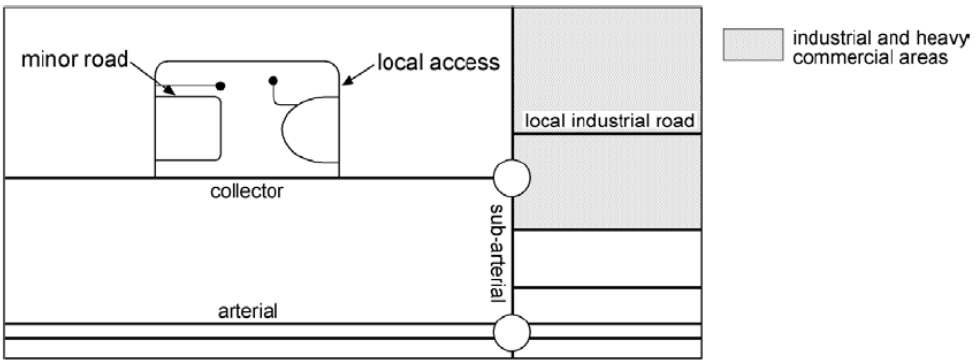


Figure 12.1: Lightly-trafficked street categories

Image 12 – Fig 12.1 from Austroads 'Guide to Pavement Technology Part 2, Edition 4.3, 2019.

Table 12.2 (reproduced below in Image 13) from the Austroads publication provides indicative heavy vehicle axle group parameters for 'lightly trafficked urban streets'.

Table 12.2: Indicative heavy vehicle axle group volumes for lightly-trafficked urban streets

Street type	AADT two-way	Heavy vehicles (%)	Design AADHV (single lane)	Design period (years)	Annual growth rate (%)	Cumulative growth factor (Table 7.4)	Axle groups per heavy vehicle	Cumulative HVAG over design period	ESA/HVAG	Indicative design traffic (ESA)
Minor with single lane traffic	30	3	0.9	20	0	20	2.0	13 140	0.2	3×10^3
				40	0	40	2.0	26 280	0.2	5×10^3
Minor with two lane traffic	90	3	1.35	20	0	20	2.0	19 710	0.2	4×10^3
				40	0	40	2.0	39 420	0.2	8×10^3
Local access with no buses	400	4	8	20	1	22.0	2.1	128 480	0.3	4×10^4
				40	1	48.9	2.1	285 576	0.3	9×10^4
Local access with buses	500	6	15	20	1	22.0	2.1	240 900	0.3	8×10^4
				40	1	48.9	2.1	535 455	0.3	1.5×10^5
Local access in industrial area	400	8	16	20	1	22.0	2.3	256 960	0.4	1.5×10^5
				40	1	48.9	2.3	571 152	0.4	3×10^5
Collector with no buses	1200	6	36	20	1.5	23.1	2.2	607 068	0.6	4×10^5
				40	1.5	54.3	2.2	1 427 004	0.6	10^6
Collector with buses	2000	7	70	20	1.5	23.1	2.2	1 180 410	0.6	8×10^5
				40	1.5	54.3	2.2	2 774 730	0.6	2×10^6

Image 13 – Table 12.2 from Austroads 'Guide to Pavement Technology Part 2, Edition 4.3, 2019

The 'Collector with buses' street type is considered appropriate for Hopetoun Park Road. Due to the uniqueness of the two subdivisions in terms of heavy traffic, the parameters in Table 12.2 are considered very conservative.

DISCUSSION & RECOMMENDATIONS **Design traffic** continued…

The Design Traffic, N_{DT}, is determined from the following expression:

N_{DT} = 365 x AADT x DF x %HV/100 x LDF x CGF x N_{HVAG}, where:

- AADT = annual average daily traffic.
- DF = direction factor (proportion of 2-way traffic travelling in the design lane).
- %HV = percentage of heavy vehicles.
- LDF = lane distribution factor (proportion of heavy vehicles in the design lane).
- CGF = cumulative growth factor = design life in years if there is no growth,
- N_{HVAG} = average number of axle groups per heavy vehicle.

The traffic generated in each stage shown in Table 3.3.1 is cumulative. As stated in Section 1.2, the only access out of Hopetoun Park is Hopetoun Park Road and the only future increase in traffic in Hopetoun Park Road is from the proposed subdivision. Due to the topography of the proposed subdivision, any development to the east or west of the proposed subdivision will not use Hopetoun Park Road. Therefore, the CFG for the four stages assumes **no** growth, because there is no scope for growth. The CGF is therefore the number of years the AADT is applied as shown in Table 3.3.3.

The following assumptions have been made for the remaining items in the above equation:

- DT = 0.5. Both lanes are assumed to have equal traffic.
- %HV = 7. From Image 13 (Austroads Guide to Pavement Technology Part 2, Table 12.2).
- LDF = 1.0. Both lanes are assumed to have equal heavy vehicle traffic.
- N_{HVAG} = 2.2. From Image 13 (Austroads Guide to Pavement Technology Part 2, Table 12.2).

To obtain the number of Equivalent Standard Axles (ESAs), it is assumed that the total number of ESAs = 0.6*N_{HVAG} (refer Image 13).

Based on the foregoing, the number of ESA for each stage, from Year -20 to Year +20, is shown in Table 3.3.2.

Table 3.3.2. Design traffic loading (DTL) in ESA

stage	stage A	stage B1	stage B2	stage B3
No. of ESA	8.8×10^5	1.8×10^5	5.6×10^5	1.74×10^6
The total number of ESAs for Year -20 to Year +20 of Hopetoun Park traffic is **3.36×10^6**				

The makeup of the numbers in Table 3.3.2 is shown in more detail in Table 3.3.3.

Table 3.3.3. DTL makeup

stage	existing lots	new lots	CFG	vpd/lot	%HV	N_{HVAG}	ESA/N_{HVAG}	ESA
A	260	0	20	10	7	2.2	0.6	876,876
B1	260	100	3	10	7	2.2	0.6	182,120
B2	260	300	5	10	7	2.2	0.6	556,479
B3	260	600	12	10	7	2.2	0.6	1,740,262
							total	3,355,737

3.4 Pavement thickness

3.4.1 Required thickness

Required pavement thickness, t mm, can be determined from the Design Traffic Loading (DTL) and the subgrade CBR using the expression t = ((219-211(logCBR) + 58(logCBR)^2))*log(ESA/120) from Austroads Guide to Pavement Technology Part 2.

The subgrade CBR has been discussed in Section 3.2. The in situ testing for the residual basaltic clay and the Darley clay suggested a CBR of 8%. The flexible pavement thickness for a DTL of 3.36×10^6 ESA, and the a of CBR 8% is 337 mm. If the CBR is rounded down to 5%, the thickness is 444 mm.

In the extreme case of CBR 2.5% (the laboratory test value), the thickness is 641 mm. As discussed in Section 3.2, the subgrade clay moisture content and strength after 20 years in a well-drained protected environment indicates that a CBR 2.5% will never occur.

 continued...

DISCUSSION & RECOMMENDATIONS

Pavement thickness continued…

3.4.2 Measured thickness

The pavement makeup thicknesses (range, average and one standard deviation) recorded in BH02-BH07 are shown in Table 3.4.2. The pavement makeup for BH01 was different than that for BH02-BH07. BH01 is discussed later in this section.

Table 3.4.2. Measured pavement thickness

course	type	range	average	one standard deviation	average less 1 stdev
base[1]	sandy gravel	300-500	375	80	295
subbase	gravelly sand	300-400[2]	350[2]	35[2]	315
	totals	600-850[2]	710[2]	90[2]	620

[1]includes sprayed seal
[2]does not include BH07 where the subbase thickness and total thickness were 0.95 m and 1.4 m, respectively.

Tables 3.4.1, and the table notes, show that the measured pavement thickness in boreholes BH02-BH07 ranges from 600-1,400 mm. This can be compared to a required thicknesses of 337 mm, 444 mm and 641 mm for subgrade CBRs of 8%, 5% and 2.5%, respectively, with a CBR 8% subgrade realistic and a CBR 2.5% subgrade unrealistic.

Council referred to VicRoads RC500.22 Fig 5.1, which shows the minimum cover required for an expansive clay subgrade. For DTL of 3.36 x 10^6, the minimum thickness is just over 600 mm. The pavement thickness of 600-1400 mm recorded in BH02-BH07 is consisted to satisfy this requirement, even though the subgrade is not acting as an expansive subgrade.

BH01, which represents the section of pavement with a Darley Formation subgrade, with an in situ and laboratory CBR of 8% and with an existing pavement thickness of 600 mm satisfies the required thickness of 337 mm.

3.5 Material properties

For a DTL >10^5 ESA, VicRoads publication RC500.22, 2018 requires a base course CBR of 80. No testing was conducted on the base course gravel. However, considering the condition of the pavement after 20, or so, years in use, it is reasonable to assume that the base course has the required strength.

The measured base course thickness in all boreholes of 300-500 mm compares favourably with a required pavement thickness of 313 mm for a DTL of 3.36 x 10^6 and a subbase gravelly sand laboratory CBR of 9%.

Testing on the gravelly sand subbase indicates that it satisfies the grading and plasticity requirements for a 20 mm natural sand and gravel subbase.

3.6 Pavement surfacing

As noted in Section 1.3, the only evidence of pavement distress is in the asphalt surfaces at the south end roundabout and, to a lesser extent, at the north end of the road.

The cracking at the south end is mostly crocodile cracking and at the north end is mostly line cracking.

Crocodile cracking can be due to a number of causes including excess loading (turning single axle buses transmit high loads to the pavement), a weak subgrade, poor drainage, poor construction, temperature effects, and so on. The distress is usually due to a combination of causes.

Cracks should be repaired before on-going traffic and rainfall make the surface start to unravel and potholes develop.

Before any repairs are undertaken, it is recommended that the pavement thickness, make-up and subgrade strength are determined to confirm, or otherwise, that surface repairs will be effective. If it is determined that repairs are appropriate, a specialist pavement contractor should be consulted.

DISCUSSION & RECOMMENDATIONS

Pavement surfacing continued…

It should be noted that at the location where the sprayed seal meets the asphalt surface, it is highly likely that the flexible pavement thickness, makeup, and subgrade type and strength, are identical. However, at this location, the sprayed seal is in an excellent condition and the immediately adjoining asphalt surface is cracked.

The line cracking at the north end of the road is most likely due to reflection cracking from the CTCR base course. To limit future damage, a specialist pavement contractor should be consulted, and the cracks repaired.

It is understood that Council have raised the question as to whether an asphalt surfacing should be considered to replace the sprayed seal.

Sprayed seals were developed by the CRB as a low-cost sealed surface and have proved to be a highly successful all-weather surfacing in Australia and New Zealand for many years. They require skill and attention to detail to be constructed and it is apparent that this skill and attention has been applied to Hopetoun Park Road.

For the straight section of the Hopetoun Park Road flexible pavement, there is no reason to change the existing sprayed seal surface, which has performed well, compared to an asphalt surface.

There is no evidence on site that a flexible pavement with an asphalt surface will perform any better in higher stress areas, such as the roundabout and driveways, than a flexible pavement with a sprayed seal.

3.7 Conclusion

Based on the foregoing, the conclusion is that with the design traffic loading discussed in Section 3.3, the pavement can be expected to perform satisfactorily for a new design life of 20 years.

The design traffic analysis has assumed that all traffic uses the full length of Hopetoun Park Road. It is understood that the main entrances to the proposed subdivision are around the midpoint of the road, so the traffic volumes on the southern portion of Hopetoun Park Road will be significantly less.

The main cause of pavement distress where the pavement has a clay subgrade is typically excess moisture in the subgrade, which has not been observed in this investigation. There are no signs of any distress or cracking in the existing sprayed seal pavement. Good pavement performance along Hopetoun Park Road to date is due to good drainage and it is extremely important that this good drainage is maintained for the new design life. Due to the proposed subdivision having few lots fronting the road, and the only proposed works are localised widening for entrances, drainage should not be adversely affected by this development.

The good drainage can be attributed to the fact that road runs through the centre of a relatively flat plateau that generally dips gently away from the road in both directions. The road is also locally slightly raised with table drains on each side and a relatively wide road reserve.

It is noted that in the 20 year, or so, pavement life to date, there has been at least one additional seal applied, and it may be necessary to reapply the seal from time to time as per normal maintenance practice.

It is stressed that the ongoing good performance of the road depends on ongoing good drainage and this will require ongoing maintenance consistent with good practice, which has obviously been conducted to date. This would be required irrespective of whether this development proceeds.

The cause of the asphalt surface cracking in the south end roundabout should be investigated and the asphalt repaired.

BLACK GEOTECHNICAL PTY LTD

APPENDIX A

Figure 1	**Test location Plan**
Figure 1A	**Soil classification sheet**
Logs	**BH 01 to BH07, inclusive**
Results	**Geotechnical laboratory tests**

IMAGE SOURCED FROM NEARMAP. IMAGE CAPTURED 03 OCTOBER 2022

BLACK GEOTECHNICAL

BLACK GEOTECHNICAL PTY LTD
258 Hyde Street, Yarraville, VIC 3013
ABN: 87 005 777 060
P: +61 (0) 3 9689 0200
F: +61 (0) 3 9689 0155
office@blackgeotechnical.com.au
www.blackgeotechnical.com.au

REVISION	DETAILS OF AMENDMENT	DATE
A	First Issue	**/01/2023

NORTH

ELEVATION DATUM: -

COORDINATE DATUM / PROJECTION: -

PROJECT TITLE / ADDRESS: PROPOSED RESIDENTIAL DEVELOPMENT
HOPETOUN PARK

DRAWING TITLE: BOREHOLE LOCATION PLAN

SCALE	SIZE	DRAWN	CHECKED	PROJECT NO.	DRAWING NO.	REV.
1:5000	A4	NDS	GB	V2211	FIGURE 1	A

Plot Date: 13/01/2023
File: W:\2023 Job Files\V2211 - Hopetoun Park North\Drawings\V2211 FIG 1.dwg
Version 2.6, 15 JULY 2016

DESCRIPTIVE TERMS & GRAPHIC SYMBOLS FOR SOIL

FIG. 1A

Doc. Ver. 2.5

CLASSIFICATION BASED ON UNIFIED SOIL CLASSIFICATION. AS1726 – 1993

WATER

▽	Water level at time of drilling.	GROUNDWATER NOT OBSERVED Groundwater observation was not possible due to water used in drilling process. Groundwater may be present.
▼	Static water level.	
→	Water inflow to borehole or test pit.	GROUNDWATER NOT ENCOUNTERED No groundwater was encountered at time of drilling or excavation in the borehole or test pit.
←	Water loss in borehole.	

SAMPLES AND TESTS

SPT	Standard Penetration Test (AS1289.6.3.1 – 2004). Blows per 150 mm. N = Blows for 300 mm after 150 mm seating.	SV	Shear Vane. Measures Shear Strength (s_u). Peak Strength/Residual Strength.
DCP	Dynamic Penetrometer Test (AS1289.6.3.2 – 1997). Blows per 100 mm.	N	SPT with sample collected from spoon.
U63	Undisturbed sample (Push Tube) – 63 mm diameter. 50 mm tube may be used (U50).	N*	SPT with no sample collected in spoon.
PP	Pocket Penetrometer. Measures Unconfined Compressive Strength (UCS).	Nc	SPT with solid cone. No sample.
D	Disturbed sample.	N'(60)	Corrected normalised N-value. Also known as $N_{1,60}$.
B	Bulk disturbed sample.	R	DCP / SPT refusal.

SOIL GRAPHICS (Sample)

CLAY (CL, CI, CH) | FILL | SILT (ML, MH)

GRAVEL (GW, GP) | SAND (SW, SP) | COBBLES AND BOULDERS

Graphic representation of mixed materials, such as silty clay, would be a combination of these symbols.

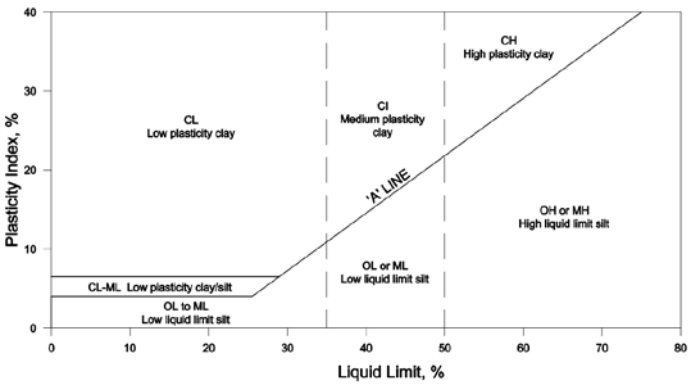
DRILLING METHOD

SSA	Solid Stem Auger	WB	Washbore
HSA	Hollow Stem Auger	ODEX	ODEX Retractable Bit System
HA	Hand Auger	AIRH	Down-the-hole Air Hammer
EX	Excavator	HE	Hand Excavation
BH	Backhoe	CC	Concrete Coring
NMLC	52mm Diamond Core	RCB	Rock Core Barrel
NDD	Non-Destructive Drilling	MC	Macro Core

PARTICLE SIZE

Boulders		> 200mm
Cobbles		63 to 200mm
Gravel	Coarse	20 to 63mm
	Medium	6.0 to 20mm
	Fine	2.0 to 6.0mm
Sand	Coarse	0.6 to 2.0mm
	Medium	0.2 to 0.6mm
	Fine	0.075 to 0.2mm
Silt		0.002 to 0.075mm
Clay		< 0.002mm

PLASTICITY PROPERTIES



PLASTICITY

Description	*Liquid Limit*
Low	< 35%
Medium	30 to 50%
High	> 50%

SECONDARY COMPONENT

Trace	0 to 5%
Presence just detectable by feel or eye	
With	5 to 12%
Presence easily detectable by feel or eye	

MOISTURE CONDITION

Dry	Looks and feels dry
Moist	Feels cool, darkened in colour, no free water or remoulding
Wet	Feels cool, darkened in colour, free water or remoulding
W	Natural moisture content
Wp	Plastic limit

CONSISTENCY

s_u kPa, AS1726 Table A4

TERM	very soft	soft	firm	stiff	very stiff	hard
s_u kPa	12	25	50	100	200	

If a soil crumbles on test it is described as friable.

DENSITY INDEX

I_d %, AS1726 Table A5

TERM	very loose	loose	medium dense	dense	very dense
I_d %	15	35	65	85	

LOG ID: BH01

SHEET : 1 OF 1

Client:	Urban Land Developments	**Contractor:**	Construction Scienes	**Easting:**	279760.712
Project:	Hopetoun Park residential development	**Drilling Rig:**	Truck mounted drill rig	**Northing:**	5825825.964
Location:	Hopetoun Park North	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020 MGA Zone 55
Job No.:	V2211	**Logged By:**	NDS	**Surface RL:**	140.64 m AHD
Date:	10/01/2023	**Checked By:**	BB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	DCP (Blows per 100 mm)
0.0				140.57	0.08			FILL: 75 mm asphalt	
				140.44	0.20			FILL: Cement treated crushed rock	
	SSA			140.24	0.40		GW	FILL: Sandy GRAVEL, dense, fine to coarse grained, moist to dry, brown	22
				140.04	0.60		SC	FILL Clayey SAND, medium dense, fine to medium grained, moist to dry, grey	30
			B (0.65-0.9m)	139.74	0.90		CI	Sandy CLAY, friable, medium plasticity, red mottled white-grey, W<Wp	11 4 4
1.0								End BH01 at 0.90 m. No Groundwater Encountered.	
2.0									
3.0									
4.0									
5.0									
6.0									

DCP scale: 0, 8, 16, 24

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES:

LOG ID: BH02

SHEET : 1 OF 1

Client:	Urban Land Developments	**Contractor:**	Construction Scienes	**Easting:**	279750.801
Project:	Hopetoun Park residential development	**Drilling Rig:**	Truck mounted drill rig	**Northing:**	5825749.261
Location:	Hopetoun Park North	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020 MGA Zone 55
Job No.:	V2211	**Logged By:**	NDS	**Surface RL:**	139.67 m AHD
Date:	10/01/2023	**Checked By:**	BB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	DCP (Blows per 100 mm)
0.0				139.64	0.03			FILL: 30 mm asphalt	
				139.37	0.30		GW	FILL: Sandy GRAVEL, dense, fine to coarse grained, grey-brown, moist to dry	18, 24
	SSA		D (0.5-0.6m)	139.07	0.60		SC	FILL: Gravelly Clayey SAND, medium dense to dense, fine to medium grained, brown, moist to dry	11, 12
1.0				138.57	1.10		CH	Silty CLAY, very stiff, high plasticity, brown mottled grey, W=Wp, trace gravel	6, 5, 5
								End BH02 at 1.10 m. No Groundwater Encountered.	

DCP axis: 0, 8, 16, 24

2.0 3.0 4.0 5.0 6.0

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES:

LOG ID: BH03

SHEET : 1 OF 1

Client:	Urban Land Developments	**Contractor:**	Construction Scienes	**Easting:**	279739.966
Project:	Hopetoun Park residential development	**Drilling Rig:**	Truck mounted drill rig	**Northing:**	5825665.381
Location:	Hopetoun Park North	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020 MGA Zone 55
Job No.:	V2211	**Logged By:**	NDS	**Surface RL:**	138.35 m AHD
Date:	10/01/2023	**Checked By:**	BB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	DCP (Blows per 100 mm)
0.0				138.33	0.02		GW	FILL: 20 mm asphalt	
				138.10	0.25			FILL: Sandy GRAVEL, dense, fine to coarse grained, pale brown, moist to dry	
	SSA		B (0.3-0.5m)				SP	FILL: Gravelly SAND, medium dense to dense, fine to coarse grained, brown, moist to dry	12, 27, 11
				137.65	0.70		CH	Silty CLAY, stiff to very stiff, high plasticity, dark brown mottled grey, W=Wp, trace gravel	7, 7, 6
1.0				137.35	1.00			End BH03 at 1.00 m. No Groundwater Encountered.	
2.0									
3.0									
4.0									
5.0									
6.0									

DCP (Blows per 100 mm): 0, 8, 16, 24

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES:

LOG ID: BH04

SHEET : 1 OF 1

Client:	Urban Land Developments	**Contractor:**	Construction Scienes	**Easting:**	279725.732
Project:	Hopetoun Park residential development	**Drilling Rig:**	Truck mounted drill rig	**Northing:**	5825552.333
Location:	Hopetoun Park North	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020 MGA Zone 55
Job No.:	V2211	**Logged By:**	NDS	**Surface RL:**	137.40 m AHD
Date:	10/01/2023	**Checked By:**	BB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	DCP (Blows per 100 mm)
0.0				137.38	0.02		GW	FILL: 20 mm asphalt	
				137.10	0.30			FILL: Sandy GRAVEL, dense, fine to coarse grained, pale brown, moist to dry, trace cobbles	
	SSA						SP	FILL: Gravelly SAND, medium dense to dense, fine to coarse grained, brown, moist to dry	29, 45, 19, 13
				136.70	0.70				
			D (0.8-0.9m)				CH	Silty CLAY, friable, high plasticity, dark brown mottled red, W<Wp, trace gravel	4, 5
				136.45	0.95				
1.0								End BH04 at 0.95 m. No Groundwater Encountered.	
2.0									
3.0									
4.0									
5.0									
6.0									

DCP scale: 0, 8, 16, 24

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES:

LOG ID: BH05

SHEET : 1 OF 1

Client:	Urban Land Developments	**Contractor:**	Construction Scienes	**Easting:**	279714.55
Project:	Hopetoun Park residential development	**Drilling Rig:**	Truck mounted drill rig	**Northing:**	5825460.499
Location:	Hopetoun Park North	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020 MGA Zone 55
Job No.:	V2211	**Logged By:**	NDS	**Surface RL:**	136.15 m AHD
Date:	10/01/2023	**Checked By:**	BB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	DCP (Blows per 100 mm)
0.0	SSA	NO GROUNDWATER ENCOUNTERED		136.13	0.02		GW	FILL: 20 mm asphalt FILL: Sandy GRAVEL, dense, fine to coarse grained, pale brown, moist to dry, trace cobbles	
				135.80	0.35		SP	FILL: Gravelly SAND, medium dense to dense, fine to coarse grained, brown, moist to dry	13 28 24 10
				135.45	0.70		CH	Silty CLAY, friable, high plasticity, brown mottled red-pale grey, W<Wp, trace gravel	7 8
1.0			B (0.7-1.5m)	134.65	1.50			End BH05 at 1.50 m. No Groundwater Encountered.	
2.0									
3.0									
4.0									
5.0									
6.0									

DCP scale: 0, 8, 16, 24

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES:

LOG ID: BH06

SHEET : 1 OF 1

Client:	Urban Land Developments	**Contractor:**	Construction Scienes	**Easting:**	279702.025
Project:	Hopetoun Park residential development	**Drilling Rig:**	Truck mounted drill rig	**Northing:**	5825362.309
Location:	Hopetoun Park North	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020 MGA Zone 55
Job No.:	V2211	**Logged By:**	NDS	**Surface RL:**	134.22 m AHD
Date:	10/01/2023	**Checked By:**	BB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	DCP (Blows per 100 mm)
0.0				134.20	0.02		GW	FILL: 20 mm asphalt FILL: Sandy GRAVEL, dense, fine to coarse grained, pale brown, moist to dry, trace cobbles	50
	SSA			133.72	0.50		SP	FILL: Gravelly SAND, medium dense to dense, fine to coarse grained, brown, moist to dry	30 28 Refusal
				133.37	0.85		CH	Silty CLAY, friable, high plasticity, dark brown mottled red, W<Wp, trace gravel	
1.0				133.22	1.00			End BH06 at 1.00 m. No Groundwater Encountered.	
2.0									
3.0									
4.0									
5.0									
6.0									

DCP: 0 | 8 | 16 | 24

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES:

LOG ID: BH07

SHEET : 1 OF 1

Client:	Urban Land Developments	**Contractor:**	Construction Scienes	**Easting:**	279687.806
Project:	Hopetoun Park residential development	**Drilling Rig:**	Truck mounted drill rig	**Northing:**	5825250.339
Location:	Hopetoun Park North	**Position:**	Refer Figure 1	**Co-ord. Datum:**	GDA2020 MGA Zone 55
Job No.:	V2211	**Logged By:**	NDS	**Surface RL:**	131.95 m AHD
Date:	10/01/2023	**Checked By:**	BB		

DEPTH (m)	DRILLING METHOD	WATER	SAMPLES AND TESTS	REDUCED LEVEL	DEPTH	GRAPHIC LOG	UCS SYMBOL	DESCRIPTION (Soil type, consistency/density, plasticity/particle size, colour, moisture condition, secondary components)	DCP (Blows per 100 mm)
0.0	SSA			131.93	0.02		GW	FILL: 20 mm asphalt FILL: Sandy GRAVEL, dense, fine to coarse grained, pale brown, moist to dry, trace cobbles	0 8 16 24
			B (0.4-0.6m)	131.50	0.45		SP	FILL: Gravelly SAND, medium dense to dense, fine to coarse grained, brown, moist to dry	50 Refusal
1.0			D (1.1-1.3m)	131.25	0.70		CH	Silty CLAY, friable, high plasticity, dark brown-brown mottled red, W<Wp, trace gravel Becoming pale grey-brown from 1.0 m	
				130.55	1.40			End BH07 at 1.40 m. No Groundwater Encountered.	
2.0									
3.0									
4.0									
5.0									
6.0									

Refer to Figure 1A & 1B for a summary of descriptive terms and symbols.
Descriptions are based on visual and tactile assessment unless laboratory test results are available.

NOTES:

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

MOISTURE CONTENT REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/328468-2
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	21/02/2023 Page 1 of 1

Test Procedures:	AS1289.2.1.1

Sample Number	14874/S/1009086	14874/S/1009087	14874/S/1009088	14874/S/1009089
ID / Client ID	-	-	-	-
Lot Number	-	-	-	-
Date / Time Sampled	11/01/2023	11/01/2023	11/01/2023	11/01/2023
Sampling Method	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3
Sampled By	Georgi Valkanov	Georgi Valkanov	Georgi Valkanov	Georgi Valkanov
Tested By	Daniel Boyd	Daniel Boyd	Daniel Boyd	Daniel Boyd
Date Tested	9/02/2023	9/02/2023	9/02/2023	9/02/2023
Material Source	Onsite	Onsite	Onsite	Onsite
Material Type	Insitu	Insitu	Insitu	Insitu
Borehole No.	BH01	BH05	BH07	BH03
Depth	0.65 - 0.9	0.7 - 1.5	0.4 - 0.6	0.3 - 0.5
Moisture Content (%)	**12.6**	**19.0**	**2.9**	**3.3**

Sample Number				
ID / Client ID				
Lot Number				
Date / Time Sampled				
Sampling Method				
Sampled By				
Tested By				
Date Tested				
Material Source				
Material Type				
Borehole No.				
Depth (m)				
Moisture Content (%)				

Remarks	Re-Issued Report Replaces Report No 14874/R/328468-1 (reason:).,

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W20Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

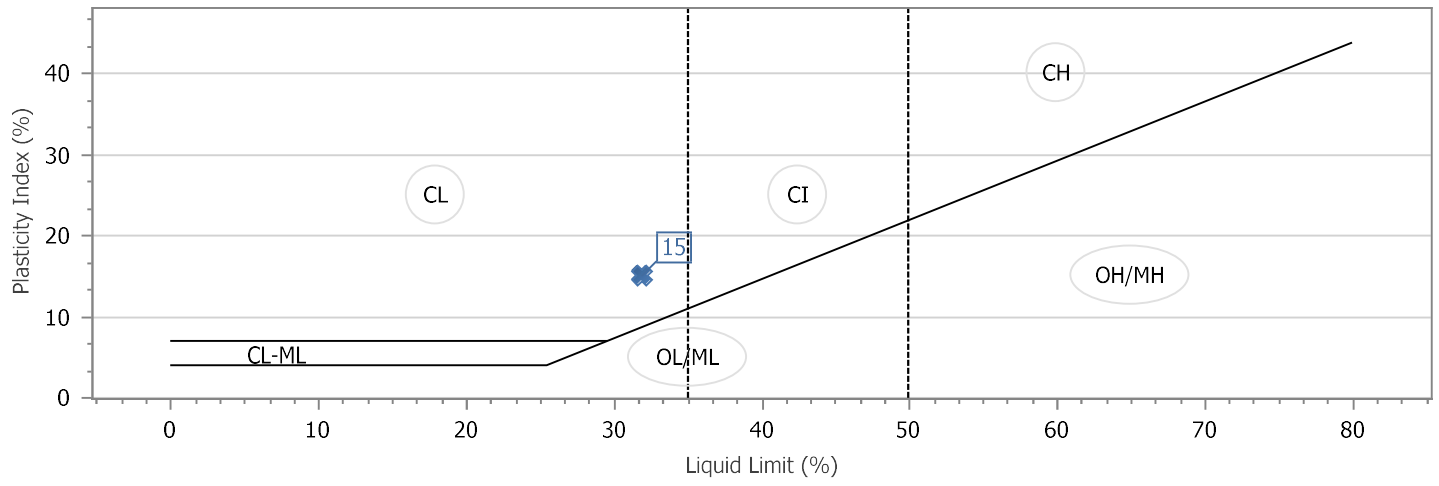
ATTERBERG LIMITS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329031-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 1 of 4

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	14874/S/1009086	Sample Location	
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Borehole No.	BH01
Date Sampled	11/01/2023	Depth (m)	0.65 - 0.9
Sampled By	Georgi Valkanov		
Date Tested	1/02/2023		
Drying / Prep Method	Oven Dried / Dry Sieved	Material Source	Onsite
LL Water Type	Potable	Material Type	Insitu
LL Device Type	Cassagrande	Prep Mat > 53mm (%)	-
Material Description	insitu		

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**32**	
Plastic Limit (%)		**17**	
Plasticity Index (%)		**15**	
Linear Shrinkage (%)		**7.5**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.7mm / Cracking		

Atterberg Limits 'A-Line' Graph



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W11Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

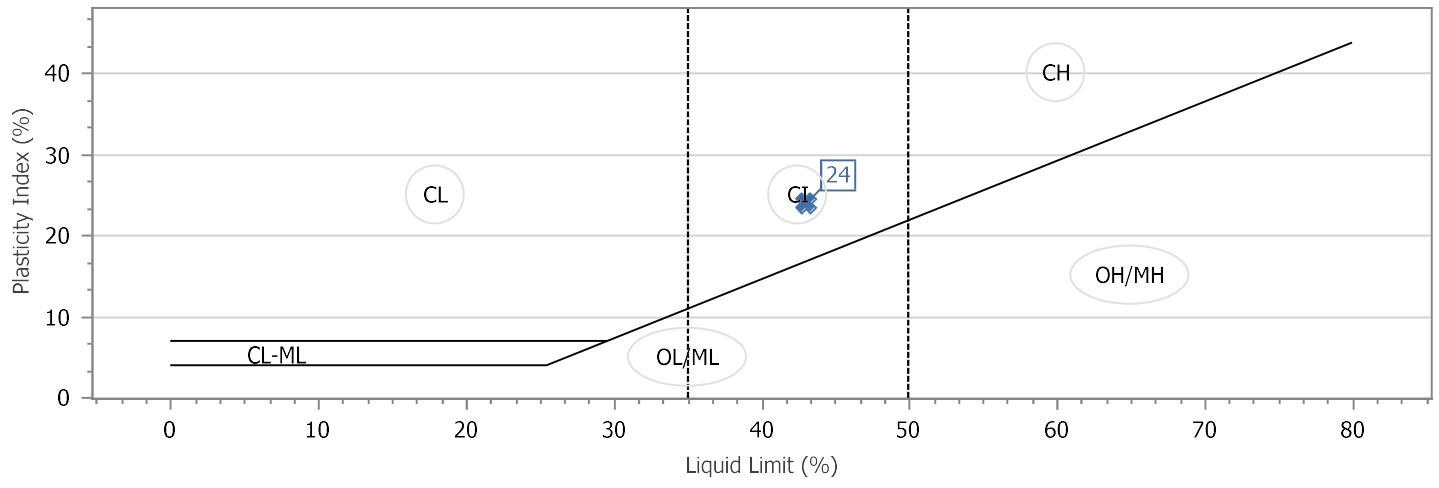
ATTERBERG LIMITS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329031-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 2 of 4

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	14874/S/1009087	Sample Location	
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Borehole No.	BH05
Date Sampled	11/01/2023	Depth (m)	0.7 - 1.5
Sampled By	Georgi Valkanov		
Date Tested	31/01/2023		
Drying / Prep Method	Oven Dried / Dry Sieved	Material Source	Onsite
LL Water Type	Potable	Material Type	Insitu
LL Device Type	Cassagrande	Prep Mat > 53mm (%)	-
Material Description	Insitu		

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**43**	
Plastic Limit (%)		**19**	
Plasticity Index (%)		**24**	
Linear Shrinkage (%)		**9.5**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.6mm / Cracking		

Atterberg Limits 'A-Line' Graph



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W11Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

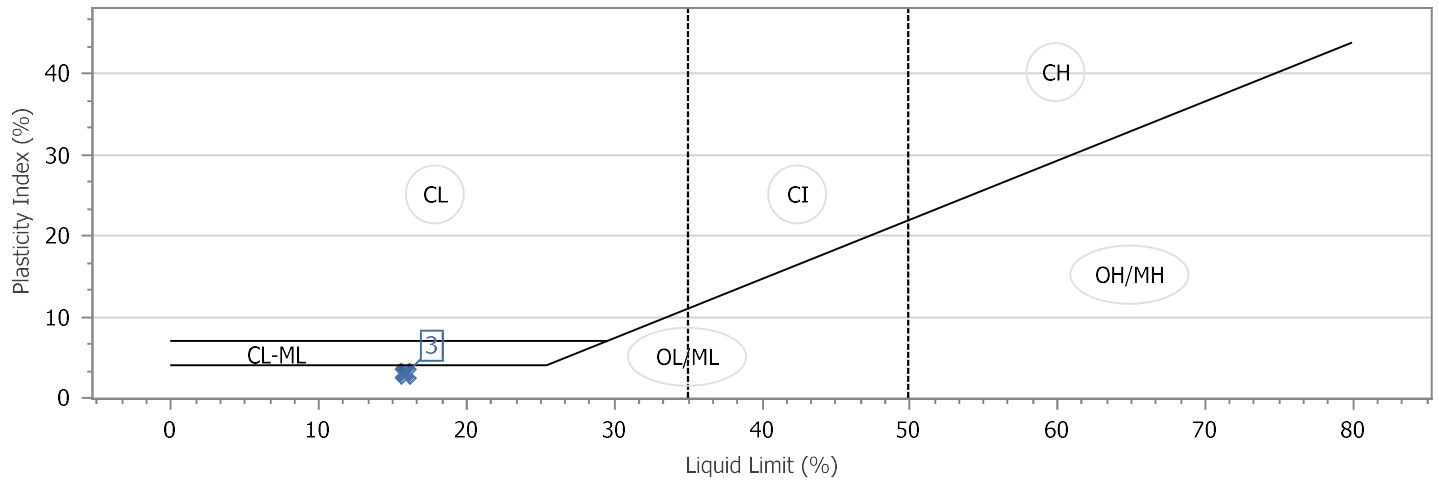
ATTERBERG LIMITS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329031-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 3 of 4

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	14874/S/1009088	Sample Location	
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Borehole No.	BH07
Date Sampled	11/01/2023	Depth (m)	0.4 - 0.6
Sampled By	Georgi Valkanov		
Date Tested	1/02/2023		
Drying / Prep Method	Oven Dried / Dry Sieved	Material Source	Onsite
LL Water Type	Potable	Material Type	Insitu
LL Device Type	Cassagrande	Prep Mat > 53mm (%)	-
Material Description	Insitu		

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**16**	
Plastic Limit (%)		**13**	
Plasticity Index (%)		**3**	
Linear Shrinkage (%)		**1.5**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.4mm / Cracking		

Atterberg Limits 'A-Line' Graph



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W11Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

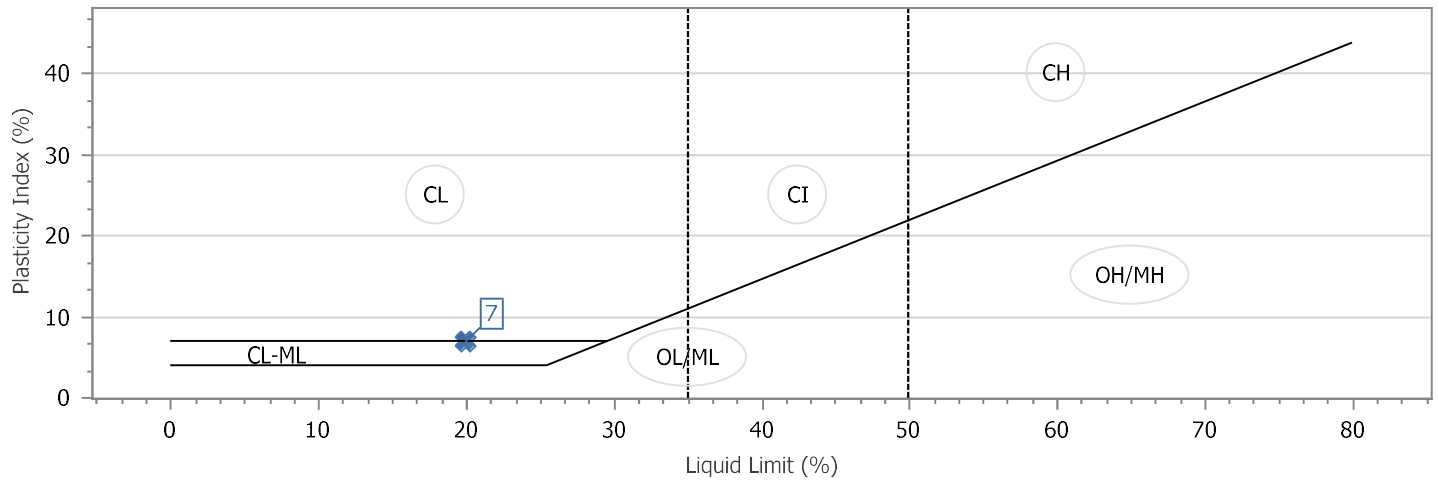
ATTERBERG LIMITS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329031-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 4 of 4

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	14874/S/1009089	Sample Location	
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Borehole No.	BH03
Date Sampled	11/01/2023	Depth (m)	0.3 - 0.5
Sampled By	Georgi Valkanov		
Date Tested	2/02/2023		
Drying / Prep Method	Oven Dried / Dry Sieved	Material Source	Onsite
LL Water Type	Potable	Material Type	Insitu
LL Device Type	Cassagrande	Prep Mat > 53mm (%)	-
Material Description	Insitu		

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**20**	
Plastic Limit (%)		**13**	
Plasticity Index (%)		**7**	
Linear Shrinkage (%)		**3.0**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 250.3mm / None		

Atterberg Limits 'A-Line' Graph



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W11Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

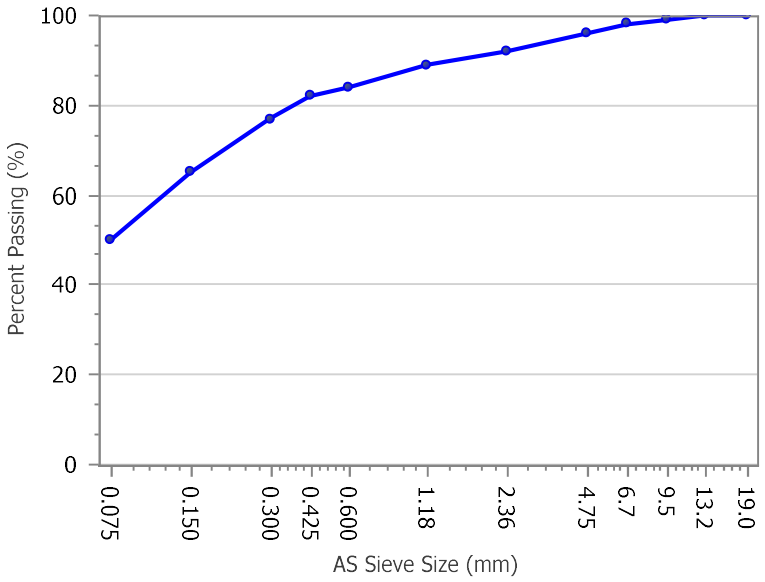
QUALITY OF MATERIALS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329032-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 1 of 4

Test Procedures	AS1289.3.6.1, AS1289.3.1.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	14874/S/1009086	Borehole No.	BH01
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.65 - 0.9
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	25/01/2023	Material Source	Onsite
PSD Preparation		Material Type	Insitu
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	insitu		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
19.0		**100**	
13.2		**100**	
9.5		**99**	
6.7		**98**	
4.75		**96**	
2.36		**92**	
1.18		**89**	
0.600		**84**	
0.425		**82**	
0.300		**77**	
0.150		**65**	
0.075		**50**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**32**		0.075/0.425 Fines Ratio		**0.61**	
Plastic Limit (%)		**17**		PI x 0.425 Ratio (%)		**1222.5**	
Plastic Index (%)		**15**		LS x 0.425 Ratio (%)		**611.2**	
Linear Shrinkage (%)		**7.5**		Linear Shrinkage Defects	Cracking		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W85Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

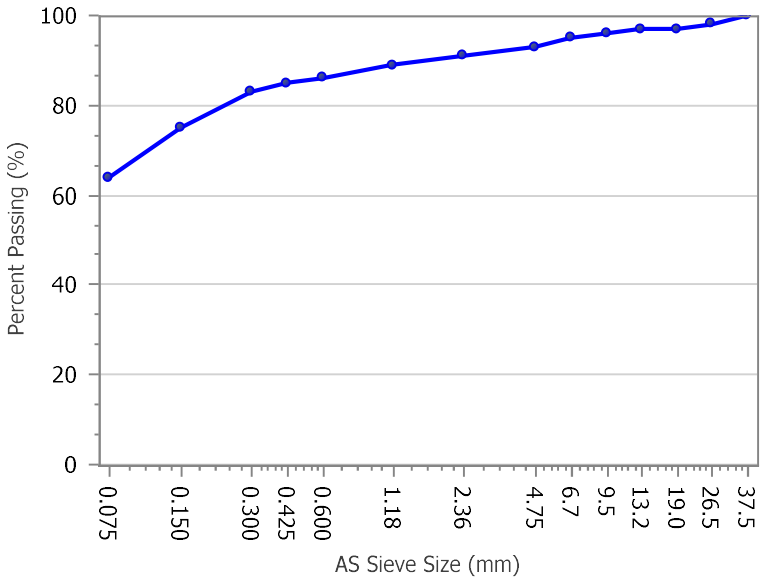
QUALITY OF MATERIALS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329032-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 2 of 4

Test Procedures	AS1289.3.6.1, AS1289.3.1.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	14874/S/1009087	Borehole No.	BH05
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.7 - 1.5
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	25/01/2023	Material Source	Onsite
PSD Preparation		Material Type	Insitu
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Insitu		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
37.5		**100**	
26.5		**98**	
19.0		**97**	
13.2		**97**	
9.5		**96**	
6.7		**95**	
4.75		**93**	
2.36		**91**	
1.18		**89**	
0.600		**86**	
0.425		**85**	
0.300		**83**	
0.150		**75**	
0.075		**64**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**43**		0.075/0.425 Fines Ratio		**0.76**	
Plastic Limit (%)		**19**		PI x 0.425 Ratio (%)		**2028.2**	
Plastic Index (%)		**24**		LS x 0.425 Ratio (%)		**802.8**	
Linear Shrinkage (%)		**9.5**		Linear Shrinkage Defects	Cracking		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W85Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

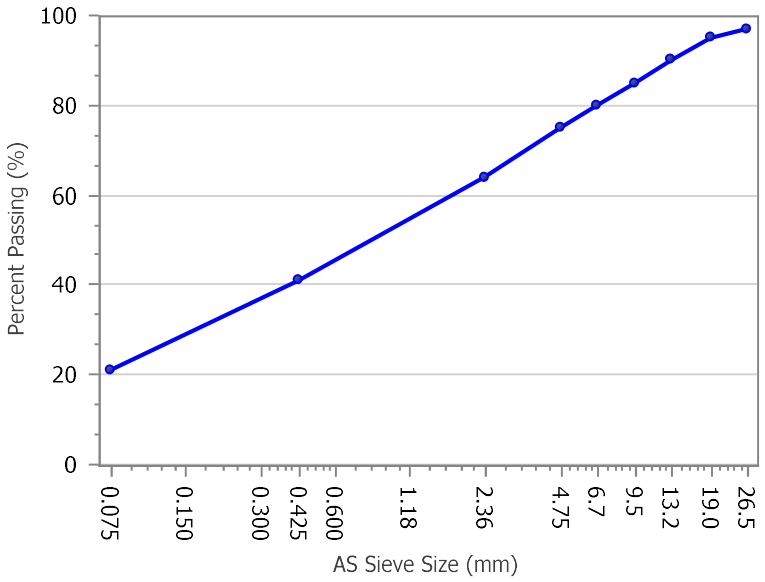
QUALITY OF MATERIALS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329032-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 3 of 4

Test Procedures	AS1289.3.6.1, AS1289.3.1.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	14874/S/1009088	Borehole No.	BH07
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.4 - 0.6
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	25/01/2023	Material Source	Onsite
PSD Preparation		Material Type	Insitu
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Insitu		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
26.5		**97**	
19.0		**95**	
13.2		**90**	
9.5		**85**	
6.7		**80**	
4.75		**75**	
2.36		**64**	
0.425		**41**	
0.075		**21**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**16**		0.075/0.425 Fines Ratio		**0.52**	
Plastic Limit (%)		**13**		PI x 0.425 Ratio (%)		**122.5**	
Plastic Index (%)		**3**		LS x 0.425 Ratio (%)		**61.2**	
Linear Shrinkage (%)		**1.5**		Linear Shrinkage Defects	Cracking		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W85Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

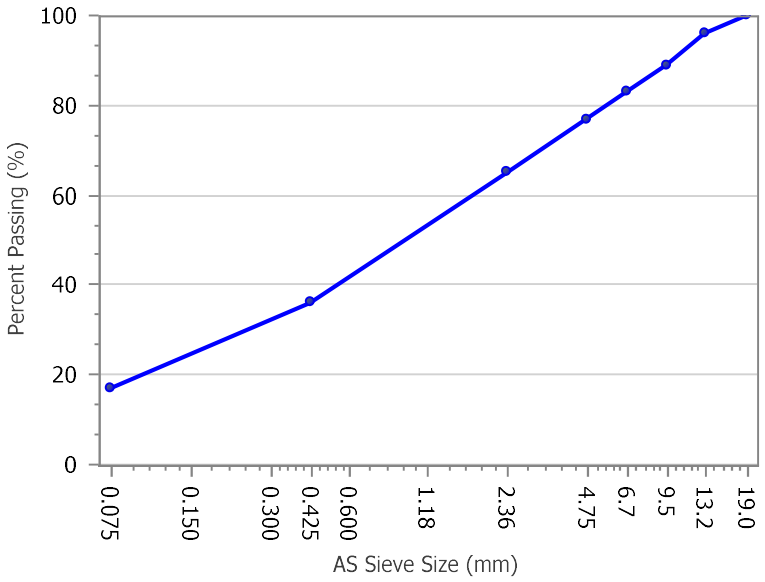
QUALITY OF MATERIALS REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329032-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 4 of 4

Test Procedures	AS1289.3.6.1, AS1289.3.1.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	14874/S/1009089	Borehole No.	BH03
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.3 - 0.5
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	24/01/2023	Material Source	Onsite
PSD Preparation		Material Type	Insitu
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Insitu		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
19.0		**100**	
13.2		**96**	
9.5		**89**	
6.7		**83**	
4.75		**77**	
2.36		**65**	
0.425		**36**	
0.075		**17**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**20**		0.075/0.425 Fines Ratio		**0.47**	
Plastic Limit (%)		**13**		PI x 0.425 Ratio (%)		**249.2**	
Plastic Index (%)		**7**		LS x 0.425 Ratio (%)		**106.8**	
Linear Shrinkage (%)		**3.0**		Linear Shrinkage Defects	None		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W85Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

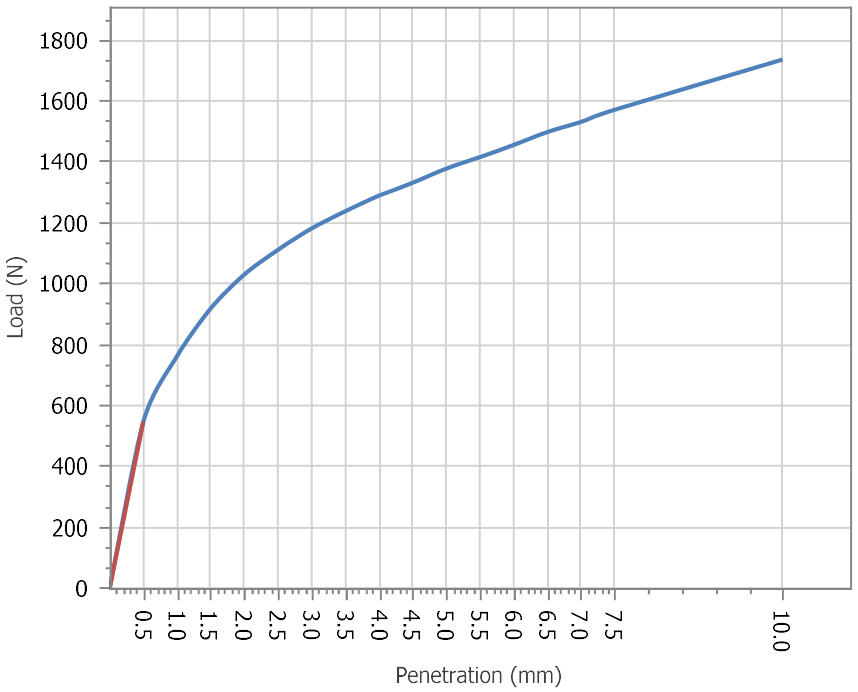
CALIFORNIA BEARING RATIO REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329034-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 1 of 4

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	14874/S/1009086	Borehole No.	BH01
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.65 - 0.9
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	3/02/2023	Prep Material > 53mm (%)	-
Material Source	Onsite	Material Limit Start	-
Material Type	Insitu	Material Limit End	-
Client Reference	-	Compactive Effort	Standard
Material Description	insitu		

Maximum Dry Density (t/m³):	1.82
Optimum Moisture Content (%):	14.5
Field Moisture Content (%):	-
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	98
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.79
Placement Dry Density Ratio (%):	98.0
Placement Moisture Content (%):	14.5
Placement Moisture Ratio (%):	99.5
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	4.5
Dry Density After Soak (t/m³):	1.77
Total Curing Time (hrs)	333
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	19.2
Moisture (remainder) After Soak (%)	17.9
CBR Swell (%):	1.0
Minimum CBR Specification (%):	-
CBR Value @ 2.5mm (%):	**8**

CBR PENETRATION PLOT



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W2ASRep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

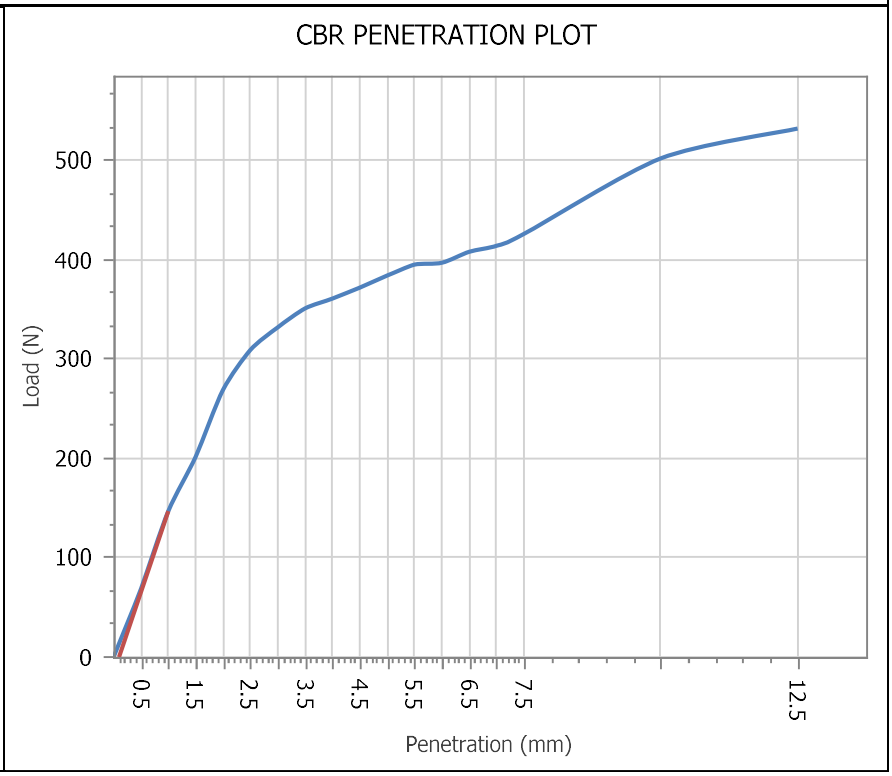
Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

CALIFORNIA BEARING RATIO REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329034-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 2 of 4

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	14874/S/1009087	Borehole No.	BH05
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.7 - 1.5
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	24/01/2023	Prep Material > 53mm (%)	-
Material Source	Onsite	Material Limit Start	-
Material Type	Insitu	Material Limit End	-
Client Reference	-	Compactive Effort	Standard
Material Description	Insitu		

Maximum Dry Density (t/m³):	1.67
Optimum Moisture Content (%):	21.0
Field Moisture Content (%):	-
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	98
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.64
Placement Dry Density Ratio (%):	97.5
Placement Moisture Content (%):	20.9
Placement Moisture Ratio (%):	99.5
Test Condition / Soaking Period:	Unsoaked
CBR Surcharge (kg)	4.5
Dry Density After Soak (t/m³):	1.60
Total Curing Time (hrs)	216
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	26.3
Moisture (remainder) After Soak (%)	23.2
CBR Swell (%):	2.0
Minimum CBR Specification (%):	-
CBR Value @ 2.5mm (%):	**2.5**



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W2ASRep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

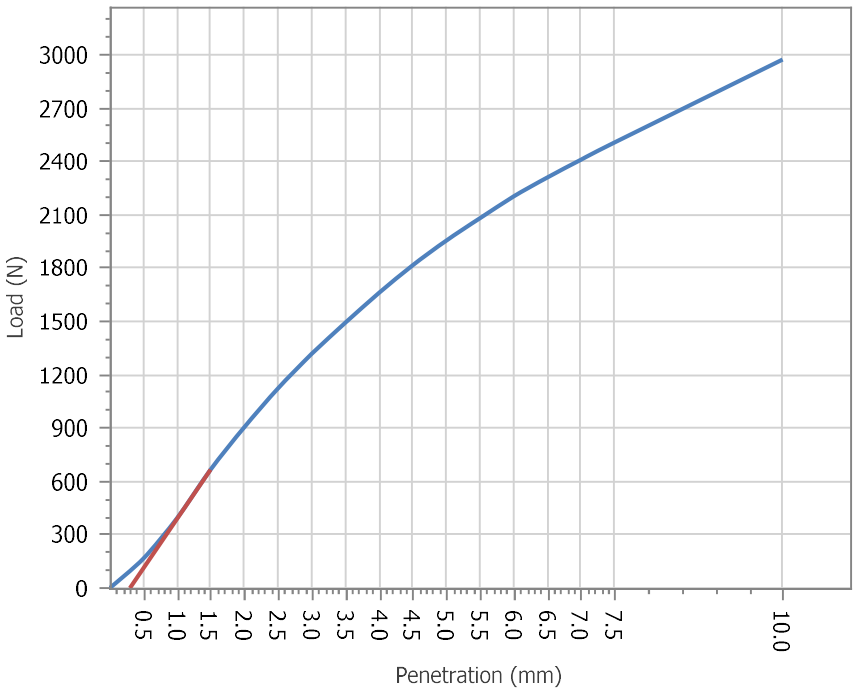
CALIFORNIA BEARING RATIO REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329034-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 3 of 4

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	14874/S/1009088	Borehole No.	BH07
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.4 - 0.6
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	27/01/2023	Prep Material > 53mm (%)	-
Material Source	Onsite	Material Limit Start	-
Material Type	Insitu	Material Limit End	-
Client Reference	-	Compactive Effort	Standard
Material Description	Insitu		

Maximum Dry Density (t/m³):	2.06
Optimum Moisture Content (%):	6.5
Field Moisture Content (%):	-
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	98
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	2.02
Placement Dry Density Ratio (%):	98.5
Placement Moisture Content (%):	6.5
Placement Moisture Ratio (%):	98.5
Test Condition / Soaking Period:	Unsoaked
CBR Surcharge (kg)	4.5
Dry Density After Soak (t/m³):	2.02
Total Curing Time (hrs)	168
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	8.6
Moisture (remainder) After Soak (%)	7.8
CBR Swell (%):	0.5
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**10**

CBR PENETRATION PLOT



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W2ASRep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
60 - 64 Vella Drive,
Sunshine West VIC 3020

Laboratory: **Melbourne Laboratory**
Phone: 03 9364 9301
Fax: 03 9338 3255
Email: Melbourne@constructionsciences.net

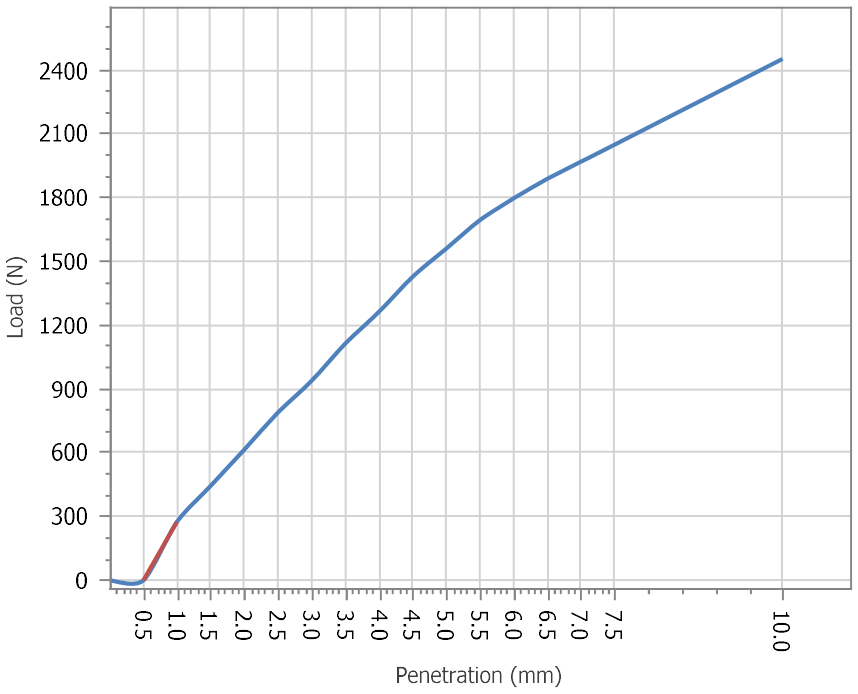
CALIFORNIA BEARING RATIO REPORT

Client:	Black Geotechnical Pty Ltd	Report Number:	14874/R/329034-1
Client Address:	258 Hyde Street, YARRAVILLE	Project Number:	14874/P/2677
Project:	Hopetoun Park Drilling Works	Lot Number:	
Location:	Hopetoun Park	Internal Test Request:	14874/T/146763
Supplied To:	n/a	Client Reference/s:	Pavement Dippings
Area Description:		Report Date / Page:	13/02/2023 Page 4 of 4

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	14874/S/1009089	Borehole No.	BH03
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth (m)	0.3 - 0.5
Date Sampled	11/01/2023		
Sampled By	Georgi Valkanov		
Date Tested	4/02/2023	Prep Material > 53mm (%)	-
Material Source	Onsite	Material Limit Start	-
Material Type	Insitu	Material Limit End	-
Client Reference	-	Compactive Effort	Standard
Material Description	Insitu		

Maximum Dry Density (t/m³):	2.10
Optimum Moisture Content (%):	6.0
Field Moisture Content (%):	-
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	98
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	2.06
Placement Dry Density Ratio (%):	98.0
Placement Moisture Content (%):	5.9
Placement Moisture Ratio (%):	96.5
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	4.5
Dry Density After Soak (t/m³):	2.04
Total Curing Time (hrs)	357
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	26.4
Moisture (remainder) After Soak (%)	19.6
CBR Swell (%):	0.5
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**9**

CBR PENETRATION PLOT



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 14874

Approved Signatory: Daniel Boyd
Form ID: W2ASRep Rev 3