



Vera Vista – Geotechnical Investigation

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REVISION CONTROL

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1 INTRODUCTION

At the request of MAAS Group, Macquarie Geotechnical (MG) has carried out a Geotechnical Investigation for the proposed Vera Vista, Lithgow. It is proposed to construct a new housing estate with associated roads, drainage, buildings and retaining walls.

The objective of the investigation is to provide a geotechnical interpretive report.

The comments and opinions expressed in this report are based on the ground conditions encountered during the site work and on the results of tests carried out in the field and in the laboratory. There may, however, be special conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report.

2 SCOPE OF INVESTIGATION

Undertake a desk study of the site to confirm the likely geological conditions of the site and to develop a geological model for the site.

Undertake Dial Before You Dig (DBYD) Search. Service clearance was undertaken by a Telstra accredited service locator.

Mobilisation of two drill rigs, drilling, logging and sampling of thirteen (13) boreholes to a maximum depth of 10m below ground level. In-situ testing comprised of Standard Penetration Tests (SPT) at 1.5m intervals.

Samples were taken at regular intervals and at every change of strata to allow for laboratory testing and returned to our NATA accredited laboratory in Bathurst, NSW. Laboratory testing comprised the following:

- 8 No. Atterberg Limits with Linear Shrinkage.
- 7 No. California Bearing Ratio (4 day soak).
- 7 No. Maximum Dry Density (Moisture Relationship).
- 4 No. Aggressivity Suite (pH, Resistivity, Chloride, Sulphate).
- 9 No. Moisture Content.
- 5 No. PSD – Wash.
- 3 No. Emerson Class.
- 3 No. Permeability (Falling Head)
- 3 No. Pinhole Dispersion.

2.1 Site Description

The site is located on the southside of Magpie Hollow Road, approximately 4km southwest of Lithgow NSW, as shown in Figure 1 below. The site currently comprises mainly farmland with localised areas of plants and fauna.



Figure 1: Site Location

2.2 Desk Study

A desk study was undertaken using readily available geological and geotechnical information and included the following:

- Geological Map Sheet Sydney 1:250,000.
- ASRIS/CSIRO.
- Google Earth.
- NSW Department of Primary Industries – Groundwater Bore Data.

2.3 Regional Geology

Geoscience NSW Seamless Geology map sheet is shown in Figure 2 below:

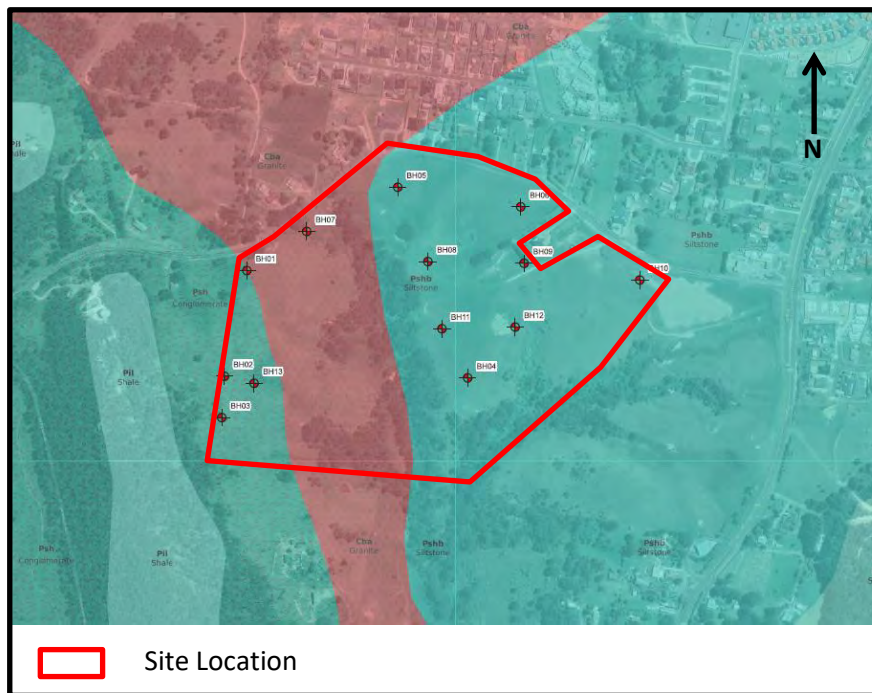


Figure 2: Geoscience NSW Seamless Geology overlay

With reference to Seamless Geological map the site is underlain by the following:

Table 1: Summary of Geology

Geological Symbol	Group	Lithology
Psh	Shoalhaven	Polymictic pebble paraconglomerate, fine-grained muddy lithic sandstone, sandy micaceous siltstone, minor shale, sporadic minor carbonate and evaporite; sandstone sporadically bioturbated, abundant fossil shell fragments, dropstones
Pshb	Berry Siltstone	Mid to dark grey siltstone, grades up sequence to very fine-grained sandstone, highly fossiliferous, sporadic dropped pebbles.
Cba	Bathurst Suite	Granites, monzogranite

2.3.1 Groundwater Bores

The groundwater data indicates the following ground conditions:

Table 2: Groundwater Data – GW115854

Depth (m)	Geological Strata
0.00 – 5.00	CLAY
5.00 – 150.00	GRANITE

2.3.2 Topography and Site Description

The summary of comments and observations from the site walkover survey carried out by Macquarie Geotechnical are described below. The site is lightly undulating with a slope direction to the east towards relatively steep catchment depressions in the centre of site, which the tributary forks confluence and run south. There is a sandstone/conglomerate outcrop to the west of the site identified by high elevation and dense trees, this has colluvial detrital material on its slopes which are permeable to groundwater from the slope, evidenced by a series of natural springs and soft spots draining to the catchment to the middle of the site. The eastern side is a stable outcrop of gravelly sandstone covered in residual soil, it is generally flat with a gentle slope to the east, steeper slopes are formed toward the tributary. The general elevation ranges from 975m AHD to 930m AHD.

2.4 Fieldwork

Fieldwork was undertaken between the 22nd March and 25th March 2022 by teams of Drillers and Engineering Geologists from our Bathurst and Sydney offices. The fieldwork was undertaken in accordance with Geotechnical proposal 22-417 dated 18th March 2022 and AS1726 Geotechnical Site Investigation.

2.4.1 Service Location

Macquarie Geotechnical obtained underground services and utility plans through 'Dial Before You Dig (DBYD)' services. A qualified services locator from MSG Locating Pty Ltd was present on site to locate services and utilities near the proposed works prior to commencement fieldwork.

2.4.2 GPS

All test locations were surveyed using a handheld GPS with co-ordinates recorded in MGA Zone 56 format and elevations in Australian Height Datum (AHD).

2.4.3 Boreholes

The boreholes were drilled at locations nominated by Maas Group and are summarised in Table 3.

A Commachio 305 was used to drill ten boreholes to depths of up to 10.00m utilising 115mm diameter solid flight augers. A Commachio 405 was used to drill three boreholes to depths of up to 10.00m utilising 200mm diameter solid flight augers and HQ3 wireline coring. In-situ testing comprised of Standard Penetration Tests (SPT) at 1.50m intervals.

Two boreholes were installed with 50mm monitoring wells and eleven boreholes were backfilled with arising's on completion.

Table 3: Borehole summary

Hole ID	Eastings	Northings	Depth (m)
BH01	231915.0	6288908.3	9.80
BH02	231875.2	6288719.0	10.00
BH03	231870.0	6288645.0	10.00
BH04	230766.5	6288641.8	10.20
BH05	232185.0	6289057.0	2.95
BH06	232405.0	6289022.0	3.00
BH07	232022.0	6288978.0	1.45
BH08	232239.0	6288924.0	3.00
BH09	232411.0	6288921.0	3.00
BH10	232618.0	6288891.0	3.00
BH11	232264.0	6288804.0	3.00
BH12	232395.0	6288807.0	1.60
BH13	231901.0	6288719.7	3.45

2.5 Sampling

The sampling was undertaken in general accordance with AS1289 1.2.1 and based on that defined in the proposal and considered the engineering requirements of the investigation and the nature of the materials encountered.

2.6 In Situ Testing

In-situ testing as specified by the client or our proposal was carried out in selected exploratory holes in accordance with the techniques outlined in the relevant Australian and Macquarie Geotechnical Quality procedures. The results are presented on the relevant exploratory hole logs in Appendix C.

2.6.1 Standard Penetration Testing

Standard Penetration Tests (SPT) were carried out in the boreholes with techniques outlined in AS1289 6.3.1 in order to determine the relative density and consistency of the strata encountered. The SPT “N” value (number of blows per 300mm penetration) or the blow count / penetration were recorded for each test.

2.6.2 Pocket Penetrometer Testing

Pocket Penetrometer (PP) testing was carried out on SPT split spoon samples.

2.7 Laboratory Testing

The samples were returned to Macquarie Geotechnical NATA accredited laboratory at Bathurst for further assessment and testing. A summary of the soil laboratory tests is provided in Table 4 below.

Table 4: Summary of Soil Laboratory Tests

Laboratory Test	Quantity (m)
AS1289 3.6.1 PSD – WASH	5
AS1289 3.1.1 Atterberg Limits	8
AS1289 2.1.1 Moisture Content	9
AS 1289 6.1.1 California Bearing Ratio (4 day soak)	7
AS1289 5.1.1 & 2.1.1 Dry Density and Moisture Relationship	7
APHA-SCP pH/SO ₄ /Cl/EC	4
AS 1289.3.8.3 Pinhole Dispersion	3
AS 1289 3.8.1 Determination of Emerson class number of a soil (Dispersion)	3
AS 1289 6.7.2 Falling Head Permeability	3

3 EXISTING SUBSURFACE CONDITIONS

The subsurface conditions encountered in the boreholes are presented in detail in the attached borehole logs (refer Appendix C). The subsurface conditions encountered in all boreholes are broadly summarised in Table 5 below.

3.1 Exploratory Hole Summary

Table 5: Summary of Boreholes

	BH01	BH02	BH03	BH04	BH05	BH06	BH07	BH08	BH09	BH10	BH11	BH12	BH13
Material Description	Depth (m)												
TOPSOIL	0.00-0.50	0.00-0.05	0.00-0.50	0.00-0.30	0.00-0.50	0.00-0.50	0.00-0.50	0.00-0.50	0.00-0.50	0.00-0.50	0.00-0.50	0.00-0.50	0.00-0.35
Sandy CLAY/Clayey SAND	0.50-5.50	0.05-10.00	-	0.30-4.17	0.50-1.00	0.50-3.00	0.50-1.10	0.50-3.00	0.50-1.20	-	0.50-3.00	0.50-1.60	0.35-3.45
CLAY	-	-	0.50-2.50	-	1.00-2.95	-	1.10-1.45	-	1.20-1.45	0.50-3.00	-	-	-
Gravelly SAND	5.50-8.76	-	2.50-4.50	-	-	-	-	-	-	-	-	-	-
Sandy CLAY	8.76-9.80	-	4.50-10.00	-	-	-	-	-	-	-	-	-	-
Sandy gravelly CLAY	-	-	-	4.17-4.50	-	-	-	-	1.45-3.00	-	-	-	-
CONGLOMERATE	-	-	-	4.50-7.60	-	-	-	-	-	-	-	-	-
GRANITE	-	-	-	7.60-10.20	-	-	-	-	-	-	-	-	-
Test Termination Depth (m)	9.80 (R)	10.00 (LOI)	10.00 (LOI)	10.20 (LOI)	2.95 (R)	3.00 (LOI)	1.45 (R)	3.00 (LOI)	3.00 (LOI)	3.00 (LOI)	3.00 (LOI)	1.60 (R)	3.45 (LOI)
Free Groundwater Observation (m)	4.00	6.00	4.50	NFGWO	NFGWO	2.50	NFGWO	NFGWO	NFGWO	NFGWO	NFGWO	NFGWO	NFGWO

Note: Please refer to borehole logs in Appendix C for detailed descriptions.

NFGWO – No Free Groundwater Observed.

R – Refusal. LOI – Limit of Investigation.

3.2 Groundwater

The comments on groundwater are based on the observations made at the time of the investigation. Groundwater was encountered in four boreholes at depths ranging from 1.30m to 6.00m.

During a site walkover, groundwater springs were also present across the site. The groundwater springs and seepages may be associated with flow through the colluvium at the base of the conglomerate outcrop at the west of the site.

Seasonal variation in groundwater may be encountered and shall be considered as part of the design process.

4 LABORATORY TEST RESULTS

The laboratory tests were carried out on the samples nominated by Macquarie Geotechnical. The summaries of test results are shown in Tables 6 to 9 below:

Table 6 : Laboratory Test Results – Classification Tests

Hole ID	Depth (m)	Sample Description*	Moisture Content (%)	Atterberg Limits			
				LL (%)	PL (%)	PI (%)	Linear Shrink (%)
BH02	2.00 – 2.50	Sandy CLAY trace gravel	-	40	18	22	8.5
BH04	2.00 – 2.50	Sandy CLAY with gravel	8.8	-	-	-	-
BH05	0.00 – 0.50	Sandy CLAY trace gravel (Topsoil)	18.7	U	U	NP	U
BH06	0.00 – 0.50	Silty Sandy CLAY trace gravel (Topsoil)	19.3	26	17	9	4.5
BH07	0.50 – 1.00	Sandy CLAY trace gravel trace cobbles	13.9	28	16	12	4.0
BH08	0.50 – 1.00	Sandy CLAY	26.5	69	21	48	10.0
BH09	0.00 – 0.50	Silty Sandy CLAY trace gravel (Topsoil)	16.3	27	19	8	5.5
BH11	0.00 – 0.50	Silty Sandy CLAY with gravel (Topsoil)	13.9	28	16	12	5.0
BH12	0.50 – 1.00	Sandy CLAY trace gravel	13.0	34	16	18	7.0

Note: LL – Liquid Limit; PL – Plastic Limit; PI – Plasticity Index; U – Unobtainable; NP – Non-Plastic.

*Visual description.

Table 7: Laboratory Test Results – California Bearing Ratio

Hole ID	Depth (m)	Sample Description (USCS)	California Bearing Ratio (CBR)			
			MDD (t/m ³)	OMC (%)	CBR (%)	CBR Swell (%)
BH05	0.00 – 0.50	Sandy CLAY trace gravel (Topsoil)*	1.87	13.5	8.0	-
BH06	0.00 – 0.50	Silty Sandy CLAY trace gravel (Topsoil)*	1.90	13.0	16.0	0.5
BH07	0.50 – 1.00	Sandy CLAY trace gravel trace cobbles*	1.90	12.5	25.0	0.0
BH08	0.50 – 1.00	Sandy CLAY*	1.67	25.0	6.0	0.0
BH09	0.00 – 0.50	Silty Sandy CLAY trace gravel (Topsoil)*	1.83	14.5	13.0	0.5
BH11	0.00 – 0.50	Silty Sandy CLAY with gravel (Topsoil)*	1.92	11.5	25.0	0.5
BH12	0.50 – 1.00	Sandy CLAY trace gravel*	1.98	12.5	30.0	0.6

Note: USCS – Unified Soil Classification System; MDD – Maximum Dry Density; OMC – Optimum Moisture Content.

*Visual description.

Table 8: Laboratory Test Results – Soil Chemical Properties

Hole ID	Depth (m)	Sample Description*	Soil Chemical Properties (SCP)			
			pH	SO ₄ (ppm)	Cl (ppm)	Electrical Conductivity (uS/cm)
BH01	1.45 – 2.00	Sandy CLAY trace gravel	5.1	68	36	32.2
BH02	1.50 – 2.00	Sandy CLAY trace gravel	5.1	62	27	24.6
BH03	1.00 – 1.45	Silty CLAY with sand	5.2	<10	26	25.6
BH04	0.50 – 1.00	Sandy CLAY trace silt	5.3	45	30	32.9

Note: * Visual description, SO₄ – Sulphate, Cl – Chloride.

Table 9: Laboratory Test Results – Permeability and Dispersion

Hole ID	Depth (m)	Sample Description (USCS)	Falling Head Permeability (m/sec)	Emerson Class Number	Pinhole Dispersion
BH01	0.50 – 1.00	Gravelly Silty CLAY*	-	-	ND2 Completely Erosion Resistant
BH01	1.00 – 1.45	Sandy CLAY trace gravel*	-	5	-
BH02	3.50 – 4.00	Silty Sandy CLAY*	-	-	D1 Highly Dispersive
BH03	0.20 – 1.00	CLAY trace sand*	-	3	-
BH03	1.80 – 2.50	Silty Sandy CLAY*	-	-	ND2 Completely Erosion Resistant
BH04	1.00 – 1.45	Sandy CLAY with gravel*	-	5	-
BH05	0.50 – 1.00	Sandy CLAY trace gravel trace cobbles*	1.0E-10	-	-
BH06	0.50 – 1.00	Sandy CLAY trace gravel trace cobbles*	6.0E-10	-	-
BH11	0.50 – 1.00	Sandy CLAY*	1.0E-9	-	-

Note: USCS – Unified Soil Classification System.

5 GEOTECHNICAL ASSESSMENT

5.1 Site Classification

The classification of a site involves a number of geotechnical factors such as depth of bedrock, the nature and extent of subsurface soils and any specific problems (slope stability, soft soils, filling, reactivity, etc).

In accordance with AS2870 2011 the proposed development site will have an anticipated surface movement (Y_s) of **20 – 30mm** and is classified as “**Class M**”.

An appropriate footing system should be designed in accordance with the above code to accommodate these anticipated movements. The possibility of additional movements, due to abnormal moisture variations, should be minimised by proper "site management" procedures.

It should be noted that this assessment is based on site conditions being represented by the natural soil profile. Any change in conditions noted during development, including cut or fill should be referred to Macquarie Geotechnical for appropriate inspection and assessment.

The above classifications, based on AS2870 which relates to construction of residential dwellings, is not technically correct for the type of structures proposed and therefore it is given as a guide only with respect to soil reactivity.

5.2 Foundations

The investigation indicates that the ground conditions generally comprised of alluvial and colluvial soils overlying residual and extremely weathered soils. Conglomerate bedrock was encountered at borehole BH04 at a depth of 4.5m below existing ground level.

5.2.1 Geotechnical Design Parameters

Based on our investigation, and our experience in this region, we recommend the following geotechnical design parameters:

Table 10: Estimated Geotechnical Engineering Parameters

Depth (m)	Soil Description	Unit Weight (KN/m ³)	Angle of Friction (degrees)		Cohesion (KPa)		Concrete to Soil Friction Angle δ (degrees)
			Drained ϕ'	Undrained ϕ	Drained c'	Undrained c_u	
Varying Depth	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Soft	18	17	0	0	12	13
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Firm	18	21	0	0	25	16
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Stiff	19	26	0	0	50	20
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Very Stiff	19	29	0	0	100	23
	Gravelly CLAY, Silty CLAY, Sandy CLAY - Hard	20	32	0	0	200	25
	Gravelly SAND - Medium Dense	18	30	30	0	-	23
	Gravelly SAND, Clayey SAND - Dense	19	36	36	0	-	29
	Gravelly SAND - Very Dense	20	40	40	0	-	32

Table 11: Bearing Pressure – Shallow Foundations

Depth (m)	Soil Description	Allowable Bearing Pressure (KPa)	Ultimate Bearing Pressure (KPa)	Modulus of Subgrade Reaction (MN/m ³)
Varying Depth	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Soft	20	60	2
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Firm	40	120	5
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Stiff	85	255	10
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Very Stiff	170	510	20
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Hard	340	1020	40
	Gravelly SAND - Medium Dense	100	300	12
	Gravelly SAND, Clayey SAND - Dense	300	900	36
	Gravelly SAND - Very Dense	500	1500	60

Note: Preliminary design parameters to be confirmed by a detailed design analysis.

Table 12: Pile Design Parameters

Depth (m)	Soil Description	Ultimate End Bearing Pressure (KPa)	Ultimate Shaft Adhesion (KPa)	*Modulus of Subgrade Reaction (MN/m ³) Ks	
				Vertical	Horizontal
Varying Depth	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Soft	-	4	4	8
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Firm	-	8	9	18
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Stiff	450	15	18	36
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Very Stiff	900	30	36	72
	Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Hard	1800	60	72	144
	Gravelly SAND - Medium Dense	650	8	26	52
	Gravelly SAND, Clayey SAND - Dense	1750	20	70	140
	Gravelly SAND - Very Dense	3000	35	120	240
	Conglomerate / Granite Bedrock (Very Low Strength)	3000	35	120	240

Note: Preliminary design parameters to be confirmed by a detailed design analysis.

Pile design parameters based on bored piles.

A bearing capacity factor N_c equal to 9 for clay can be used provided that the pile has been embedded at least to a depth of five diameters into the bearing stratum.

For bored piles formed in coarse soils it is assumed that the soil will be loosened as a result of the boring operations, even though it may initially be in a dense or medium dense state.

Ultimate end bearing resistance of bored piles founded in coarse soils is dependent on the pile depth.

5.2.2 Geotechnical Strength Reduction Factor (AS2159)

The geotechnical strength reduction factor for pile design is defined in the Piling Code. Selection of the geotechnical strength reduction factor (ϕ_g) is based on a series of individual risk ratings (IRR) which are weighted and lead to an average risk rating (ARR). The individual risk ratings and final value of (ϕ_g) depend on the following factors:

- Site: the type, quantity and quality of testing.
- Design: design methods and parameter selection.
- Installation: construction control and monitoring.
- Pile testing regime.
- Redundancy.

Without clear details about the pile type, design method, testing regime and other construction factors it is not possible to calculate the appropriate (ϕ_g) value. Assuming no pile testing, limited

specialist geotechnical supervision during construction, and the limited/basic investigation and testing, an ϕ_g value of 0.45 is considered appropriate.

Nevertheless, with geotechnical supervision and pile integrity testing ϕ_g value can be increased to 0.52.

5.3 Foundation Settlements

For both shallow and deep foundations bearing on the natural soils (alluvium, colluvium, residual and extremely weathered soils) and weathered bedrock (Conglomerate and Granite), total and differential settlements are expected to be less than 25mm provided that the allowable bearing capacities are not exceeded.

5.3.1 Aggressive Soils

We refer to Table 6.4.2 (c) Exposure Classification for Concrete Piles AS2159 – 2009 ‘Piling – Design and Installation’.

The soil condition is classified as 'Condition B'. The test results indicate low levels of sulfates (<10 to 68 ppm), Chlorides (26 to 36 ppm) and pH (5.1 to 5.3). Therefore the soil at this site is Mild. If groundwater is encountered then they would be classified as Moderate.

5.3.2 Earthquake Classification

The Australian Standard ‘Structural Design Actions – Earthquake Actions in Australia’ (AS 1170.4-2007) gives guidance on the design standards for earthquake loading. Based on the above Australian Standard and the results of the investigation, the following subsoil classification is recommended for design:

- Class Ce – Shallow Soil Site

5.3.3 Soil Dispersion

Based on the laboratory test results the soils were generally non-dispersive to some dispersion. However, dispersive soils were encountered at boreholes BH02 and BH03.

5.4 Retention Systems

The following design parameters are based on Rankine’s theory and assumes a retention system with a vertical back supporting a soil with a horizontal surface.

Table 13: Retention System Design Parameters

Material	Unit Weight (kN/m ³)	K _a	K _p	K _o	c' (kPa)
Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Soft	18	0.55	1.83	0.71	0
Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Firm	18	0.47	2.12	0.64	0
Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Stiff	19	0.39	2.56	0.56	0
Gravelly CLAY, Silty CLAY, Sandy CLAY, CLAY - Very Stiff	19	0.35	2.88	0.52	0
Gravelly CLAY, Silty CLAY, Sandy CLAY - Hard	20	0.31	3.25	0.47	0
Gravelly SAND - Medium Dense	18	0.33	3.00	0.50	0
Gravelly SAND, Clayey SAND - Dense	19	0.26	3.85	0.41	0
Gravelly SAND - Very Dense	20	0.22	4.60	0.36	0

Notes: K_a – coefficient of active earth pressure, K_p – coefficient of passive earth pressure,
K_o – coefficient of earth pressure at rest, c' – apparent cohesion of soil in terms of effective stress.

It is assumed that adequate drainage is provided to prevent the build up of water pressures behind the retention system and any surcharge loading is superimposed in the design calculations. Where temporary works retention system is required to be installed below the groundwater level, water pressures and any surcharge loading should be superimposed in the design calculations.

If any adjacent structures are located within the zone of influence of the excavations then the at-rest earth pressures should be used to limit the potential settlement and damage to adjacent structures. A condition survey of any adjacent structures including installation of settlement monitoring points should be undertaken prior to commencement of any excavation works.

6 EXCAVATION AND STABILITY

6.1 Soil

The soils at the site comprise predominately alluvial and colluvial soils overlying residual and extremely weathered soils. and should present no excavation difficulty. For temporary work conditions above groundwater level, benching or slope angles of 1V:1H is considered appropriate for the materials. For temporary work conditions below groundwater level excavation support will be required. For permanent conditions, slope angles of 1V:2H is considered appropriate.

6.2 Rock

Highly weathered Conglomerate and Granite bedrock was encountered at borehole BH04 commencing at a depth of 4.5m below existing ground level. Slope angles of 1V:1H and 1V:2H is considered appropriate for the highly weathered bedrock in the temporary and permanent conditions respectively.

For excavation of highly weathered rock a D10 dozer or similar is likely to be required to rip the bedrock. A hydraulic rock breaker may also be required at depth and to trim the face of the rock cutting.

6.3 Drainage

Drainage should be installed at the top of the cuttings to divert surface water runoff from above the cutting during rainfall events. It is also recommended that topsoil is placed on exposed cut soil surfaces and the area re-seeded with grass.

7 EARTHWORKS

7.1 Site Preparation

The following scope of work is required as a minimum to prepare the site prior to filling:

- Prior to construction and placement of any fill, the proposed areas should be stripped to remove all vegetation, topsoil, uncontrolled fill, organic, root affected or other potentially deleterious material.
- Boxed-out excavations should be drained permanently to allow any infiltration from subsequent fill to escape the excavation profile.
- Where the ground slopes at more than 1V:10H (6°), the ground profile should be benched in 300mm vertical steps to create near-level platforms for filling. The platforms should be graded with a cross fall no steeper than 2% downslope to allow drainage of any infiltration to the fill and to prevent pooling of subsurface moisture.
- Following stripping, the exposed subgrade materials should be proof rolled in the presence of a suitably qualified and experienced Geotechnical Engineer to identify any wet or excessively deflecting material.
- Proof rolling should involve compacting the site with an 8-ton roller, trimming the rolled surface to level and clean finish. Where there are areas indicating excessive deflection then these may require over-excavation and backfilling with an approved select material.

7.2 Re-use of Site Material

Careful extraction and stockpile management will be required to optimise the potential volume of site won materials. Where feasible, material should be trucked directly to the placement site to avoid double handling and associated time and cost implications.

Screening and blending of raw materials won from the soil and rock cuttings will be required to comply with Specification grading requirements for particular material types.

With the exception of the topsoil, the majority of the site won soil material from the cuttings is considered suitable for use as general fill material. If the material is proposed to be used as engineered fill within the permanent works then some blending of the material with coarser particle sizes may be required to comply with Specification grading requirements. Further testing of the excavated material would be required during construction to confirm specification and design acceptability requirements.

7.3 Bulk Earthworks

Subgrade preparation will generally only require removal of topsoil and compaction to 98% relative to standard compaction of the excavated subgrade material.

Slope angles of 1V:1H and 1V:2H is considered appropriate for compacted embankment fill materials in the temporary and permanent conditions respectively.

Site filling should be undertaken to the provisions of AS3798-2007: "Earthworks for Residential and Commercial Developments". Fill for support of structures or equipment should be placed to Level 1 inspection and testing requirements as per the standard.

7.4 Trafficability

The clay subgrades at the site have a low wet strength and poor subgrade strength. The site soils would be trafficable during dry periods. Some desiccation of exposed surfaces can be expected and large quantities of dust will be generated during dry periods under traffic. The soils will be soft and difficult to traverse following wet weather or inundation. Drying out of these soils could take several days or weeks before being able to accommodate construction traffic.

8 PAVEMENT DESIGN

8.1 Pavement Traffic

Based on 20 year design life with 2% growth rate, the estimated design traffic of 2.0×10^5 Equivalent Standard Axles (ESA's) has been adopted. Traffic data to be confirmed with council prior to construction.

8.2 Design Subgrade CBR

From the results of the testing undertaken, design CBR was determined following Austroads Guide to Pavement Technology Part 2 Pavement Structural Design. A design subgrade CBR value of 6.0% has been adopted for the design.

8.3 Pavement Design

The design pavement thicknesses have been determined using the above design subgrade CBR and Traffic Volumes.

Table 14: Pavement Design - Asphalt

Depth (m)	Descriptions
0.00 – 0.03	30mm AC Design by others
0.03 – 0.15	120 mm thick Base Course Unbound layer (reference to RMS DGB20 Base – Specification RMS 3051)
0.15 – 0.33	180 mm thick Subbase Unbound layer (reference to RMS DGS20/40 Subbase – Specification RMS 3051)
Subgrade	Design CBR = 6.0%

Table 15: Pavement Design - Concrete

Depth (m)	Descriptions
0.00 – 0.18	180mm thick concrete base
0.18 – 0.33	150 mm thick Subbase Unbound layer
Subgrade	Design CBR = 6.0%

Note: Preliminary design to be confirmed by a detailed design.

8.4 Pavement Material and Construction Requirements

The pavement base, sub-base and select materials should be compacted to a minimum dry density ratio of 102% relative to standard compaction at a moisture ratio of 60-90% of the optimum moisture content.

The subgrade (or proposed fill areas) should be stripped of all soft, organic or moisture affected materials and rolled and compacted to a minimum dry density ratio of 98% relative to standard compaction at a moisture ratio of 60-90% of the optimum moisture content. Prepared subgrade shall then be proof rolled to identify any soft spots to remedy it. General fill should be placed and compacted in maximum 250mm loose thickness layers and compacted to a minimum dry density ratio of 98% relative to standard compaction at a moisture ratio of 60-90% of the optimum moisture content.

9 CONCLUSION

The findings of our report were based on our fieldwork, in-situ testing, laboratory testing and technical assessment for this site.

We trust the foregoing is sufficient for your present purposes, and if you have any questions please contact the undersigned.



David Clarkson
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BEng MSc MIEAust



John Boyle
Geotechnical Manager
BSc (Hons) MEngSc (Geotechnical) Affil MIE Aust

Attached: Limitations of Geotechnical Site Investigation

References: Australian Standard 1726 – 2017 Geotechnical Site Investigations

LIMITATIONS OF GEOTECHNICAL SITE INVESTIGATION

Scope of Services

This report has been prepared for the Client in accordance with the Services Engagement Form (SEF), between the Client and Macquarie Geotechnical.

Reliance on Data

Macquarie Geotechnical has relied upon data and other information provided by the Client and other individuals. Macquarie Geotechnical has not verified the accuracy or completeness of the data, except as otherwise stated in the report. Recommendations in the report are based on the data.

Macquarie Geotechnical will not be liable in relation to incorrect recommendations should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

Geotechnical Investigation

Findings of Geotechnical Investigations are based extensively on judgment and experience. Geotechnical reports are prepared to meet the specific needs of individual clients. This report was prepared expressly for the Client and expressly for the Clients purposes.

This report is based on a subsurface investigation, which was designed for project-specific factors. Unless further geotechnical advice is obtained this report cannot be applied to an adjacent site nor can it be used when the nature of any proposed development is changed.

Limitations of Site investigation

As a result of the limited number of sub-surface excavations or boreholes there is the possibility that variations may occur between test locations. The investigation undertaken is an estimate of the general profile of the subsurface conditions. The data derived from the investigation and laboratory testing are extrapolated across the site to form a geological model. This geological model infers the subsurface conditions and their likely behavior with regard to the proposed development.

The actual conditions at the site might differ from those inferred to exist.

No subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

Time Dependence

This report is based on conditions, which existed at the time of subsurface exploration. Construction operations at or adjacent to the site, and natural events such as floods, or groundwater fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report.

Macquarie Geotechnical should be kept apprised of any such events, and should be consulted for further geotechnical advice if any changes are noted.

Avoid Misinterpretation

A geotechnical engineer or engineering geologist should be retained to work with other design professionals explaining relevant geotechnical findings and in reviewing the adequacy of their plans and specifications relative to geotechnical issues.

No part of this report should be separated from the Final Report.

Sub-surface Logs

Sub-surface logs are developed by geoscientific professionals based upon their interpretation of field logs and laboratory evaluation of field samples. These logs should not under any circumstances be redrawn for inclusion in any drawings.

Geotechnical Involvement During Construction

During construction, excavation frequently exposes subsurface conditions. Geotechnical consultants should be retained through the construction stage, to identify variations if they are exposed.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendations and should make their own enquiries and obtain independent advice in relation to such matters

Macquarie Geotechnical assumes no responsibility and will not be liable to any other person or organisations for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisations arising from matters dealt with or conclusions expressed in the report.

Other limitations

Macquarie Geotechnical will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Other Information

For further information reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, 1987.

Appendix A – Geotechnical Explanatory Notes

Geotechnical Explanatory Notes

Soil Description

In engineering terms soil includes every type of uncemented or partially cemented inorganic material found in the ground. In practice, if the material can be remoulded by hand in its field condition or in water it is described as a soil. The dominant soil constituent is given in capital letters, with secondary textures in lower case. The dominant feature is assessed from the Unified Soil Classification system and a soil symbol is used to define a soil layer as follows:

UNIFIED SOIL CLASSIFICATION

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

USC Symbol	Description
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
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty Soil

MOISTURE CONDITION

Dry – Cohesive soils are friable or powdery
Cohesionless soil grains are free-running

Moist – Soil feels cool, darkened in colour
Cohesive soils can be moulded
Cohesionless soil grains tend to adhere

Wet – Cohesive soils usually weakened
Free water forms on hands when handling

For cohesive soils the following codes may also be used:

MC>PL Moisture Content greater than the Plastic Limit.
MC~PL Moisture Content near the Plastic Limit.
MC<PL Moisture Content less than the Plastic Limit.

PLASTICITY

The potential for soil to undergo 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 (LL) is as follows:

Description of Plasticity	LL (%)
Low	<35
Medium	35 to 50
High	>50

COHESIVE SOILS – CONSISTENCY

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 assessed by the shear strength of the soil as observed visually, by the pocket penetrometer values and by resistance to deformation to hand moulding.

A Pocket Penetrometer may be used in the field or the laboratory to provide approximate assessment of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

Strength	Symbol	Pocket Penetrometer Reading (kPa)
Very Soft	VS	< 25
Soft	S	20 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very Stiff	VSt	200 to 400
Hard	H	> 400

COHESIONLESS SOILS – RELATIVE DENSITY

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silty and sandy material, and these are usually based on resistance to drilling penetration or the Standard Penetration Test (SPT) 'N' values. Other condition terms, such as friable, powdery or crumbly may also be used.

The Standard Penetration Test (SPT) is carried out in accordance with AS 1289, 6.3.1. For completed tests the number of blows required to drive the split spoon sampler 300 mm are recorded as the N value. For incomplete tests the number of blows and the penetration beyond the seating depth of 150 mm are recorded. If the 150 mm seating penetration is not achieved the number of blows to achieve the measured penetration is recorded. SPT correlations may be subject to corrections for overburden pressure and equipment type.

Term	Symbol	Density Index	N Value (blows/0.3 m)
Very Loose	VL	0 to 15	0 to 4
Loose	L	15 to 35	4 to 10
Medium Dense	MD	35 to 65	10 to 30
Dense	D	65 to 85	30 to 50
Very Dense	VD	>85	>50

COHESIONLESS SOILS PARTICLE SIZE DESCRIPTIVE TERMS

Name	Subdivision	Size
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 µm to 2.36 mm
	medium	200 µm to 600 µm
	fine	75 µm to 200 µm

Rock Description

The rock is described with strength and weathering symbols as shown below. Other features such as bedding and dip angle are given.

ROCK QUALITY

The fracture spacing is shown where applicable and the Rock Quality Designation (RQD) or Total Core Recovery (TCR) is given where:

$$\text{RQD (\%)} = \frac{\text{Sum of Axial lengths of core } > 100\text{mm long}}{\text{total length considered}}$$

$$\text{TCR (\%)} = \frac{\text{length of core recovered}}{\text{length of core run}}$$

ROCK STRENGTH

Rock strength is described using AS1726 and ISRM – Commission on Standardisation of Laboratory and Field Tests, "Suggested method of determining the Uniaxial Compressive Strength of Rock materials and the Point Load Index", as follows:

Term	Symbol	Point Load Index Is(50) (MPa)
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	>10

ROCK MATERIAL WEATHERING

Rock weathering is described using the following abbreviation and definitions used in AS1726:

Abbreviation	Term
RS	Residual soil
XW	Extremely weathered
DW	Distinctly weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
FR	Fresh

DEFECT SPACING/BEDDING THICKNESS

Measured at right angles to defects of same set or bedding.

Term	Defect Spacing	Bedding
Extremely closely spaced	<6 mm	Thinly Laminated
	6 to 20 mm	Laminated
Very closely spaced	20 to 60 mm	Very Thin
Closely spaced	0.06 to 0.2 m	Thin
Moderately widely spaced	0.2 to 0.6 m	Medium
Widely spaced	0.6 to 2 m	Thick
Very widely spaced	>2 m	Very Thick

DEFECT DESCRIPTION

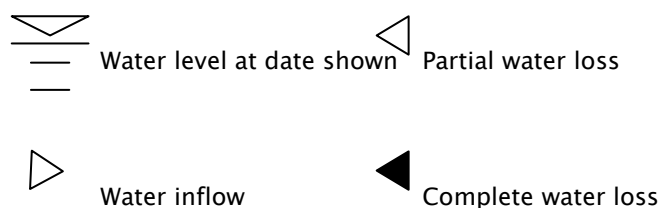
Type:	Description
B	Bedding
F	Fault
C	Cleavage
J	Joint
S	Shear Zone
D	Drill break

Planarity/Roughness:

Class	Description
I	rough or irregular, stepped
II	smooth, stepped
III	slickensided, stepped
IV	rough or irregular, undulating
V	smooth, undulating
VI	slickensided, undulating
VII	rough or irregular, planar
VIII	smooth, planar
IX	slickensided, planar

The inclination if defects are measured from perpendicular to the core axis.

WATER



Groundwater not observed: The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.

Groundwater not encountered: The borehole/test pit was dry soon after excavation, however groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

Graphic Symbols for Soils and Rocks

Typical symbols for soils and rocks are as follows. Combinations of these symbols may be used to indicate mixed materials such as clayey sand.

Soil Symbols

Main components

	CLAY - CL
	CLAY - CH
	SAND
	GRAVEL
	BOULDERS / COBBLES
	TOPSOIL
	SILT

Minor Components

	Clayey
	Silty
	Sandy
	Gravelly

Other

	FILL
	BITUMEN
	CONCRETE

Rock Symbols

Sedimentary Rocks

	SANDSTONE
	SILTSTONE
	CLAYSTONE, MUDSTONE
	SHALE
	LAMINITE
	ASPHALT
	LIMESTONE
	CONGLOMERATE

Igneous Rocks

	GRANITE
	BASALT
	UNDIFFERENTIATED IGNEOUS

Metamorphic Rocks

	SLATE, PHYLLITE, SCHIST
	GNEISS
	QUARTZITE

Engineering Classification of Shales and Sandstones in the Sydney Region – A Summary Guide

The Sydney Rock Class classification system is based on rock strength, defect spacing and allowable seams as set out below. All three factors must be satisfied.

CLASSIFICATION FOR SANDSTONE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>24	>600	<1.5
II	>12	>600	<3
III	>7	>200	<5
IV	>2	>60	<10
V	>1	N.A.	N.A.

CLASSIFICATION FOR SHALE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>16	>600	<2
II	>7	>200	<4
III	>2	>60	<8
IV	>1	>20	<25
V	>1	N.A.	N.A.

UNIAXIAL COMPRESSIVE STRENGTH (UCS)

For expedience in field/construction situations the uniaxial (unconfined) compressive strength of the rock is often inferred, or assessed using the point load strength index (Is_{50}) test (AS 4133.4.1 – 1993). For Sydney Basin sedimentary rocks the uniaxial compressive strength is typically about $20 \times (Is_{50})$ but the multiplier may range from about 10 to 30 depending on the rock type and characteristics. In the absence of UCS tests, the assigned Sydney Rock Class classification may therefore include rock strengths outside the nominated UCS range.

DEFECT SPACING

The terms relate to spacing of natural fractures in NMLC, NQ and HQ diamond drill cores and have the following definitions:

Defect Spacing (mm)	Terms Used to Describe Defect Spacing ¹
>2000	Very widely spaced
600 – 2000	Widely spaced
200 – 600	Moderately spaced
60 – 200	Closely spaced
20 – 60	Very closely spaced
<20	Extremely closely spaced

¹After ISO/CD14689 and ISRM.

ALLOWABLE SEAMS

Seams include clay, fragmented, highly weathered or similar zones, usually sub-parallel to the loaded surface. The limits suggested in the tables relate to a defined zone of influence. For pad footings, the zone of influence is defined as 1.5 times the least footing dimension. For socketed footings, the zone includes the length of the socket plus a further depth equal to the width of the footing. For tunnel or excavation assessment purposes the defects are assessed over a length of core of similar characteristics.

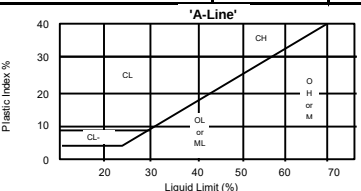
Source: Based on Pells et al (1978), as revised by Pells et al (1998).

Pells, P.J.N, Mostyn, G. and Walker, B.F. – Foundations on Sandstone and Shale in the Sydney Region. Australian Geomechanics Journal, No 33 Part 3, December 1998.

Summary of Soil Logging Procedures

Coarse Material: grain size - colour - particle shape - secondary components - minor constituents - moisture condition - relative density - origin - additional observations.

Fine Material: plasticity - colour - secondary components - minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Guide to the Description, Identification and Classification of Soils						
Major Divisions		SYMBOL	Typical Names			
> 200mm		BOULDERS				
60 to 200mm		COBBLES				
COARSE GRAINED SOILS	More than 65% by dry mass less than 63mm is greater than 0.075mm	GRAVEL	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.		
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.		
			GM	Silty gravels, gravel-sand-silt mixtures.		
			GC	Clayey gravels, gravel-sand-clay mixtures		
	More than 50% of coarse fraction of coarse fraction > 2.36mm	Gravelly Soils				
		SANDS	SW	Well-graded sands, gravelly sands, little or no fines.		
			SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.		
			SM	Silty sands, sand-silt mixtures.		
FINE GRAINED SOILS	More than 35% by dry mass less than 60mm is less than 0.075mm	Liquid Limit < 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.		
			OL	Organic silts and organic silty clays of low plasticity.		
		Liquid Limit > 50%	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.		
			CH	Inorganic clays of high plasticity, fat clays.		
			OH	Organic clays of medium to high plasticity, organic silts.		
		HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.	
				Grain sizes		
Gravel				Sand		
Coarse - 63 to 20mm				Coarse - 2.36 to 0.6mm		
Medium - 20 to 6 mm				Medium - 0.6 to 0.2mm		
Fine - 6 to 2.36mm				Fine - 0.2 to 0.075mm		

GEOLOGICAL ORIGIN:-

Fill - artificial soils / deposits

Alluvial - soils deposited by the action of water

Aeolian - soils deposited by the action of wind

Topsoil - soils supporting plant life containing significant organic content

Residual - soils derived from insitu weathering of parent rock.

Colluvial - transported debris usually unsorted, loose and deposited

Field Identification of Fine Grained Soils - Silt or Clay?

Dry Strength - Allow the soil to dry completely and then test its strength by breaking and crumbling between the fingers.

High dry strength - Clays; Very slight dry strength - Silts.

Toughness Test - the soil is rolled by hand into a thread about 3mm in diameter. The thread is then folded and re-rolled repeatedly until it has dried sufficiently to break into lumps. In this condition inorganic clays are fairly stiff and tough while inorganic silts produce a weak and often soft thread which may be difficult to form and readily breaks and crumbles.

Dilatancy Test - Add sufficient water to the soil, held in the palm of the hand, to make it soft but not sticky. Shake horizontally, striking vigorously against the other hand several times. Dilatancy is indicated by the appearance of a shiny film on the surface of the soil. If the soil is then squeezed or pressed with the fingers, the surface becomes dull as the soil stiffens and eventually crumbles. These reactions are pronounced only for predominantly silt size material. Plastic clays give no reaction.

Descriptive Terms for Material Portions			
COARSE GRAINED SOILS		FINE GRAINED SOILS	
% Fines	Term/Modifier	% Coarse	Term/Modifier
≤ 5	Omit, or use "trace"	≤ 15	Omit, or use "trace"
> 5, ≤ 12	"with clay/silt" as applicable	> 15, ≤ 30	"with sand/gravel" as applicable
> 12	Prefix soil as "silty/clayey"	> 30	Prefix as "sandy/gravelly"

Moisture Condition	
<i>for non-cohesive soils:</i>	
Dry -	runs freely through fingers.
Moist -	does not run freely but no free water visible on soil surface.
Wet -	free water visible on soil surface.
<i>for cohesive soils:</i>	
MC > PL	Moisture content estimated to be greater than the plastic limit.
MC ~ PL	Moisture content estimated to be approximately equal to the plastic limit. The soil can be moulded
MC < PL	Moisture content estimated to be less than the plastic limit. The soil is hard and friable, or powdery.

The plastic limit (PL) is defined as the moisture content (percentage) at which the soil crumbles when rolled into threads of 3mm dia.

Consistency - For Clays & Silts		
Description	UCS(kPa)	Field guide to consistency
Very soft	< 25	Exudes between the fingers when squeezed in hand
Soft	25 - 50	Can be moulded by light finger pressure
Firm	50 - 100	Can be moulded by strong finger pressure
Stiff	100 - 200	Cannot be moulded by fingers. Can be indented by thumb.
Very stiff	200 - 400	Can be indented by thumb nail
Hard	> 400	Can be indented with difficulty by thumb nail
Friable	-	Crumbles or powders when scraped by thumbnail

Relative Density for Gravels and Sands		
Description	SPT "N" Value	Density Index (ID) Range %
Very loose	0 - 4	< 15
Loose	4 - 10	15 - 35
Medium dense	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very dense	> 50	> 85

Summary of Rock Logging Procedures

Description order: constituents - rock name - grain size - colour - weathering - strength - minor constituents - additional observations.

- minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Definition - Sedimentary Rock	
Conglomerate	more than 50% of the rock consists of gravel (>2mm) sized fragments
Sandstone	more than 50% of the rock consists of sand (0.06 to 2mm) sized grains
Siltstone	more than 50% of the rock consists of silt sized granular particles and the rock is not laminated
Claystone	more than 50% of the rock consists of clay or mica material and the rock is not laminated
Shale	more than 50% of the rock consists of clay or silt sized particles and the rock is laminated

Weathering		
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a change in volume but the soil has not significantly transported.
Extremely Weathered	EW	Rock is weathered to such an extent that it has 'soil' properties; ie. it either disintegrates or can be remoulded, in water.
Distinctly Weathered	DW	Highly Weathered (HW) - Rock is wholly discoloured and rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals Moderately Weathered (MW) - The whole of the rock is discoloured, usually by iron staining and bleaching. Shows little or no change in rock strength.
Slightly Weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

Stratification			
thinly laminated	<6mm	medium bedded	0.2 - 0.6m
laminated	6 - 20mm	thickly bedded	0.6 - 2m
very thinly bedded	20 - 60mm	very thickly bedded	>2m
thinly bedded	60mm - 0.2m		

Discontinuities					
order of description: depth - type - orientation - spacing - roughness / planarity - thickness - coating					
	Type	Class	Roughness/Planarity	Class	Roughness/Planarity
B	Bedding	I	rough or irregular, stepped	VI	slickensided, undulating
F	Fault	II	smooth, stepped	VII	rough or irregular, planar
C	Cleavage	III	slickensided, stepped	VIII	smooth, planar
J	Joint	IV	rough or irregular, undulating	IX	slickensided, planar
S	Shear Zone	V	smooth, undulating		
D	Drill break				

Rock Strength			
Term		Is (50)	Field Guide
Very low	VL	0.03	Material crumbles under firm blows with sharp end of pick; can be peeled with knife. Pieces up to 30mm thick can be broken by finger pressure.
Low	L	0.1	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium	M	0.3	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.
High	H	1	A piece of core 150 mm long x 50 mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
Very High	VH	3	A piece of core 150 mm long x 50 mm dia. May be broken readily with hand held hammer. Cannot be scratched with pen knife.
Extremely High	EH	10	A piece of core 150 mm long x 50 mm dia. Is difficult to break with hand held hammer. Rings when struck with a hammer.

* - rock strength defined by point load strength (Is 50) in direction normal to bedding

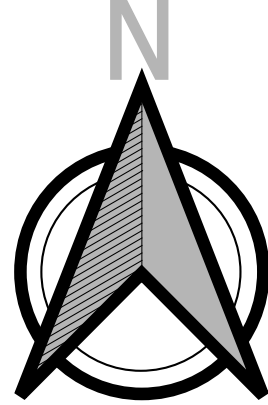
Degree of fracturing	
fragmented	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter
highly fractured	Core lengths are generally less than 20mm - 40mm with occasional fragments.
fractured	Core lengths are mainly 30mm - 100mm with occasional shorter and longer lengths
slightly fractured	Core lengths are generally 300mm - 1000mm with occasional longer sections and shorter sections of 100mm -- 300mm.
unbroken	The core does not contain any fracture.

- spacing of all types of natural fractures, but not artificial breaks, in cored bores.

The fracture spacing is shown where applicable and the Rock Quality Designation is given by:

$$RQD (\%) = \frac{\text{sum of unbroken core pieces 100 mm or longer}}{100}$$

Appendix B – Site Plan & Borehole Locations



Legend

 BOREHOLES

Google Hybrid Satellite

150.110 150.120

-33.510

MACQUARIE GEOTECH	Client: MAAS Group Holdings			0100200300400 Metres - Scale 1:5000	JOB NO	B21552
	Project: Vera Vista Sub-Division					
	3 Watt Drive, Bathurst NSW 2795 P: 02 6332 2011 F: 02 6334 4213 E: macgeo@macgeo.com.au	Location: Lithgow, NSW			Vertical to Horizontal Scale 1 : 1 Co-ordinate Reference System - EPSG: 4326 WGS: 84	Macquarie Geotechnical Ltd Geotechnical Investigation Locality Map
Drawn: CG		Checked: JB	Date: 29/04/2022	Drawing Number: B21552_Plan_Rev0		

Appendix C – Borehole Logs

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	23/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	231915.0 m E 6288908.3 m N MGA94 Zone 56	Checked By:	C.Green

Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	F Ferreiro

Drilling Information							Soil Description						Observations			
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
AD/T				1 D 0.00-0.50 m					CL	TOPSOIL Gravelly Sandy CLAY: low plasticity, yellow-brown mottled black; sand fine to coarse grained; gravel fine to medium subrounded to subangular.		S to F			TOPSOIL	
				1 D 0.50-1.00 m					CL	Sandy CLAY trace gravel: low plasticity, yellow-brown mottled black; sand fine to coarse grained; gravel fine subangular.		F			ALLUVIAL SOIL	
				1 SPT 1.00-1.45 m 5.9,12 N=21			1			1.00-2.00: colour tending to be red-brown mottled yellow-brown and grey		St to VSt			* 1.20: HP Samp =600 kPa	
				1 D 1.45-2.00 m			2			2.00-2.50: colour tending to be yellow-brown mottled grey, trace fine subangular gravel	M (-PL)					
				1 SPT 2.50-2.95 m 10,13,16 N=29			3		CL	Gravelly Sandy CLAY: low plasticity, yellow-brown mottled brown and grey; sand fine to coarse grained; gravel fine to medium subangular.				x	2.70: HP Samp =320 kPa	
				1 D 2.95-3.50 m					CL	Sandy CLAY: low plasticity, yellow-brown mottled grey; sand fine to coarse grained.		VSt				
				1 D 3.50-4.00 m			4			4.00-5.00: with fine subrounded to subangular gravel				x	4.20: HP Samp =240 kPa	
				1 SPT 4.00-4.45 m 4,4,4 N=8							M (<PL) to M (~PL)	F				
				1 D 4.45-5.00 m			5				M (>PL)					
				1 D 5.00-5.50 m												
			1 SPT 5.50-5.95 m 4,7,11 N=18				6		SP	Gravelly SAND with silt: fine to coarse grained, brown mottled dark grey and yellow-brown; gravel fine subrounded to subangular.						
			1 D 5.95-6.50 m									MD				
			1 D 6.50-7.00 m								W					
			1 SPT 7.00-7.45 m 8,13,19 N=32				7			7.45-8.00: trace coarse subrounded gravel						
			1 D 7.45-8.00 m									D				

Method	Penetration	Water	Samples and Tests	Moisture Condition	Consistency/Relative Density
AS - Auger Screwing RR - Rock Roller WB - Washbore	No resistance ranging to refusal	Level (Date) Inflow Partial Loss Complete Loss	U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	Core recovered (hatching indicates material) Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client: MAAS Group		Commenced: 23/03/2022	
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow		Completed: 23/03/2022	
Hole Location: Lithgow		Logged By: H.Wen	
Hole Position: 231915.0 m E 6288908.3 m N MGA94 Zone 56		Checked By: C.Green	

Drill Model and Mounting: Comacchio 305/Track	Inclination: -90°	RL Surface: No survey
Hole Diameter: 115 mm	Bearing:	Datum: AHD Operator: F Ferreiro

Drilling Information				Soil Description				Observations							
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T				1 D 8.00-8.50 m			9		SP	Gravelly SAND with silt: fine to coarse grained, brown mottled dark grey and yellow-brown; gravel fine subrounded to subangular. <i>(continued)</i>	W	MD to D		100	ALLUVIAL SOIL
				1 SPT 8.50-8.76 m 28,30/110mm N=30/110mm					CL	Sandy CLAY: low plasticity, grey-brown; sand fine to coarse grained.					
				1 D 8.76-9.50 m											
				1 D 9.50-9.80 m											
							10			Hole Terminated at 9.80 m target depth not met due to Tc bit refusal					9.80: TC bit refusal end of hole
							11								
							12								
							13								
							14								
							15								

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
 No resistance ranging to refusal

Support
C - Casing

Water
 Level (Date)
 Inflow
 Partial Loss
 Complete Loss

Samples and Tests
U(x) - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
pp - Pocket Penetrometer (UCS kPa)
x=size in mm

Classification Symbols and Soil Descriptions
AS1726:2017

Moisture Condition
D - Dry
M - Moist
W - Wet

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

Plastic Limit
w < PL
w = PL
w > PL
w = LL
w > LL

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	23/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	231915.0 m E 6288908.3 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH01 Depth Range: 1.00 - 1.45 m



BH01 Depth Range: 2.50 - 2.95 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	23/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	231915.0 m E 6288908.3 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH01 Depth Range: 4.00 - 4.45 m



BH01 Depth Range: 5.50 - 5.95 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	23/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	231915.0 m E 6288908.3 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH01 Depth Range: 7.00 - 7.45 m

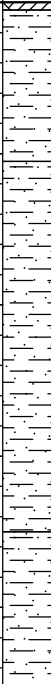


BH01 Depth Range: 8.50 - 8.76 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	22/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	231875.2 m E 6288719.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Hole Diameter:	115 mm	RL Surface:	No survey
		Bearing:	
		Datum:	AHD
		Operator:	I. Brest

Drilling Information								Soil Description						Observations		
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
AD/T			23/03/22	D00000 D 0.00-0.50 m					NA CL	TOPSOIL Sandy CLAY trace silt with sand: low plasticity, brown; sand fine to coarse grain; sand fine to medium grained; rootlets.	NA	NA			TOPSOIL	
				D00050 D 0.50-1.00 m						Sandy CLAY: low plasticity, grey mottled orange brown; sand fine to coarse grain.	M (>PL)	St		RESIDUAL SOIL Possibly COLLUVIAL SOIL		
				S00100 SPT 1.00-1.45 m 3.6,9 N=15					CL	Sandy CLAY trace gravel: low plasticity, red brown mottled grey; sand fine to coarse grain; gravel fine to medium; black organic material.				RESIDUAL SOIL		
				D00150 D 1.50-2.00 m									1.30: seepage			
				D00200 D 2.00-2.50 m												
				D00250 D 2.50-3.00 m						St to VSt						
				S00300 SPT 3.00-3.45 m 4.5,6 N=11					CL	Sandy CLAY: low plasticity, pale grey mottled pale red brown; sand fine to coarse grain.	M (~PL)			3.50: slow seepage		
				D00350 D 3.50-4.00 m												
				D00400 D 4.00-4.50 m						St						
				S00450 SPT 4.50-4.71 m 21,30/60mm N=30/60mm					CL	Sandy CLAY trace gravel: low plasticity, orange brown; sand fine to coarse grain; gravel fine to medium, sub angular to angular.						
22/03/22				D00500 D 5.00-5.50 m												
				D00550 D 5.50-6.00 m												
				D00600 D 6.00-6.50 m S00600 SPT 6.00-6.05 m 30/50mm					CL	Sandy CLAY with gravel: low plasticity, orange brown; sand fine to coarse grain; gravel fine, sub rounded, sub angular, angular.	M (>PL)	H				
				D00650 D 6.50-7.00 m D00700 D 7.00-7.50 m												
				S00750 SPT 7.50-7.70 m 21,30/50mm												

Method	Penetration	Water	Samples and Tests	Moisture Condition	Consistency/Relative Density
AS - Auger Screwing RR - Rock Roller WB - Washbore	No resistance ranging to refusal	Level (Date) Inflow Partial Loss Complete Loss	U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	Core recovered (hatching indicates material) Core loss		Classification Symbols and Soil Descriptions AS1726:2017		



Borehole No.

BH02

Page 2 of 5

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	22/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	231875.2 m E 6288719.0 m N MGA94 Zone 56	Checked By:	C.Green

Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	I. Brest

Drilling Information							Soil Description							Observations	
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T				N=30/50mm D00800 D 8.00-8.50 m			9		CL	Sandy CLAY with gravel: low plasticity, orange brown; sand fine to coarse grain; gravel fine, sub rounded, sub angular, angular. (continued)	M (>PL)	H			RESIDUAL SOIL
				D00850 D 8.50-9.00 m					CL	Sandy CLAY trace gravel: low plasticity, orange brown pale grey; sand fine to corse; gravel fine, sub round, sub angular to angular.					
				S00900 SPT 9.00-9.27 m 17,30/115mm N=30/115mm D00950 D 9.50-10.00 m			10			Hole Terminated at 10.00 m Target depth					
							11								
							12								
							13								
							14								
							15								

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration No resistance ranging to refusal	Water Level (Date) Inflow Partial Loss Complete Loss	Samples and Tests U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	Moisture Condition D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	 Core recovered (hatching indicates material) Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	22/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	231875.2 m E 6288719.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	I. Brest



BH02 Depth Range: 1.00 - 1.45 m

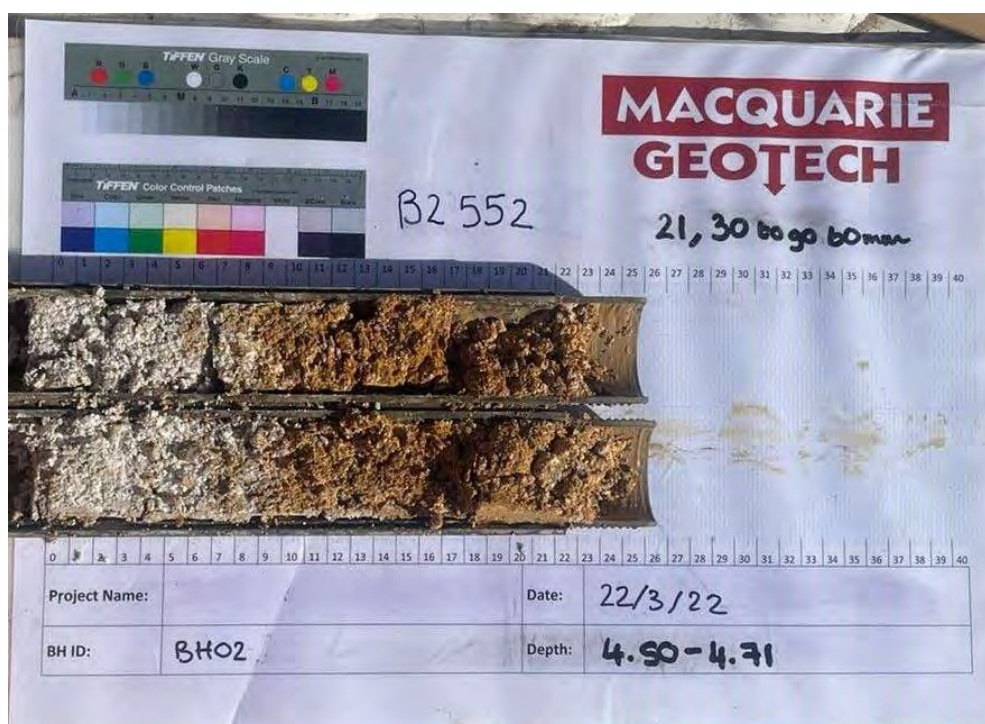


BH02 Depth Range: 3.00 - 3.45 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	22/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	231875.2 m E 6288719.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	I. Brest



BH02 Depth Range: 4.50 - 4.71 m



BH02 Depth Range: 6.00 - 6.05 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	22/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	231875.2 m E 6288719.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	I. Brest



BH02 Depth Range: 7.50 - 7.65 m



BH02 Depth Range: 9.00 - 9.26 m

Engineering Log - Borehole

Project No.: B21552

Client: MAAS Group	Commenced: 22/03/2022
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed: 23/03/2022
Hole Location: Lithgow	Logged By: H.Wen
Hole Position: 231870.0 m E 6288645.0 m N MGA94 Zone 56	Checked By: C.Green
Drill Model and Mounting: Comacchio 305/Track	Inclination: -90°
Hole Diameter: 115 mm	Bearing:
	RL Surface: No survey
	Datum: AHD
	Operator: F Ferreiro

Drilling Information							Soil Description						Observations					
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density					Structure and Additional Observations
													Pocket Penetrometer UCS (kPa)					
				1 D 0.00-0.50 m					CL	TOPSOIL Silty CLAY with sand: low plasticity, grey; sand fine to coarse grained; with rootlets.			100					TOPSOIL
				1 D 0.50-1.00 m					CL-CI	CLAY trace sand: low to medium plasticity, brown mottled grey; sand fine to coarse grained.	M (~PL)	S to F						COLLUVIAL SOIL
				1 SPT 1.00-1.45 m 3.5,7 N=12 1 UT 1.45-1.80 m			1		CL	Silty CLAY with sand: low plasticity, red-brown mottled brown and grey; sand fine to coarse grained.	M (<PL) to M (~PL)	St						1.15: HP Samp =560 kPa
				1 D 1.80-2.50 m			2		CL	Sandy Gravelly CLAY: low plasticity, grey-brown; gravel fine subrounded to subangular; sand fine to coarse grained.	M (<PL)	VSt to H						
				1 D 2.50-2.58 m SPT 2.50-2.58 m 30/75mm 1 D 2.58-4.00 m			3		SP	Gravelly SAND with silt with clay: fine to coarse grained, grey; gravel fine subrounded to angular. 2.80-4.50: colour tending to be grey-brown	D	VD						
				1 SPT 4.00-4.08 m 30/80mm 1 D 4.08-4.50 m 1 D 4.50-5.00 m 1 D 5.00-5.50 m			4		CL	Sandy CLAY: low plasticity, brown mottled grey; sand fine to coarse grained.								RESIDUAL SOIL
				1 SPT 5.50-5.67 m 40.20/15mm N=20/15mm 1 D 5.67-6.00 m 1 D 6.00-6.50 m 1 D 6.50-7.00 m			5			5.00-5.65: colour tending to be grey mottled brown, trace fine to medium angular gravel								5.60: HP Samp =220 kPa
				1 SPT 7.00-7.35 m 4.25.25/50mm N=50/200mm 1 D 7.35-8.00 m			6			5.65-7.00: with fine angular gravel	M (~PL) to M (>PL)	H						
							7			7.00-7.35: colour tending to be yellow-brown mottled grey, with fine to medium angular gravel								7.20: HP Samp >600 kPa
										7.35-8.00: colour tending to be grey mottled brown, trace fine to medium angular gravel								

Method	Penetration	Water	Samples and Tests	Moisture Condition	Consistency/Relative Density
AS - Auger Screwing RR - Rock Roller WB - Washbore	No resistance ranging to refusal	Level (Date) Inflow Partial Loss Complete Loss	U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	Core recovered (hatching indicates material) Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client: MAAS Group		Commenced: 22/03/2022	
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow		Completed: 23/03/2022	
Hole Location: Lithgow		Logged By: H.Wen	
Hole Position: 231870.0 m E 6288645.0 m N MGA94 Zone 56		Checked By: C.Green	
Drill Model and Mounting: Comacchio 305/Track		Inclination: -90°	
Hole Diameter: 115 mm		RL Surface: No survey	
		Datum: AHD	
		Operator: F Ferreiro	

Drilling Information				Soil Description				Observations							
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
				1 D 8.00-8.50 m					CL	Sandy CLAY: low plasticity, brown mottled grey; sand fine to coarse grained. <i>(continued)</i> 8.00-8.60: colour tending to be grey mottled brown, with fine angular gravel 8.60-9.50: trace fine angular gravel	M (~PL) to M (>PL)	H		100 200 300 400 500	RESIDUAL SOIL * 8.55: HP Samp >600 kPa
				1 SPT 8.50-8.60 m 30/100mm			9								
				1 D 8.60-9.50 m											
				1 D 9.50-10.00 m			10			9.50-10.00: with fine to medium angular gravel					
										Hole Terminated at 10.00 m Target depth					
							11								
							12								
							13								
							14								
							15								

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration  No resistance ranging to refusal	Water  Level (Date)  Inflow  Partial Loss  Complete Loss	Samples and Tests U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	Moisture Condition D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	 Core recovered (hatching indicates material)  Core loss	Classification Symbols and Soil Descriptions AS1726:2017			

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	231870.0 m E 6288645.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH03 Depth Range: 1.00 - 1.45 m



BH03 Depth Range: 2.50 - 2.58 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	231870.0 m E 6288645.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH03 Depth Range: 4.00 - 4.08 m



BH03 Depth Range: 5.50 - 5.67 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	22/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	231870.0 m E 6288645.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH03 Depth Range: 7.00 - 7.35 m



BH03 Depth Range: 8.50 - 8.60 m

Engineering Log - Borehole

Project No.: B21552

Client: MAAS Group		Commenced: 25/03/2022	
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow		Completed: 25/03/2022	
Hole Location: Lithgow		Logged By: M. Conner	
Hole Position: 230766.5 m E 6288641.8 m N MGA94 Zone 56		Checked By: C.Green	
Drill Model and Mounting: Comacchio GEO 405		Inclination: -90°	
Hole Diameter: 115 mm		RL Surface: No survey	
		Datum: AHD	
		Operator: I. Brest	

Drilling Information				Soil Description				Observations						
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T			Not Observed	D00000 D 0.00-0.50 m			1		CL	TOPSOIL Silty CLAY with sand: low plasticity, dark brown; sand fine to medium grained; rootlets.	NA	NA	100	TOPSOIL
				D00050 D 0.50-1.00 m					CL	Sandy CLAY trace silt: low plasticity, orange brown; sand fine to coarse.	F to St			RESIDUAL SOIL
				S00100 SPT 1.00-1.45 m 9.9,16 N=25 D00150 D 1.50-2.00 m					CI-CH	1.10-1.10: dark yellow Sandy CLAY with gravel: medium to high plasticity, pale brown, pale orange-brown; sand fine to coarse; gravel sub-round to sub-angular, fine to coarse grained. 1.25-1.25: pale yellow to orange brown 1.30-1.30: quartz	M (<PL)	VSt		1.10: dark yellow 1.25: pale yellow to orange brown 1.30: quartz
				D00200 D 2.00-2.50 m					SC	Clayey SAND with gravel: pale grey; clay low plasticity; gravel sub-round, sun-angular to angular, fine to coarse grained.	M	D		EXTREMELY WEATHERED MATERIAL
				S00250 SPT 2.50-2.74 m 23,30/90mm N=30/90mm D00300 D 3.00-3.50 m										
D00350 D 3.50-4.00 m	CL	Gravelly Sandy CLAY: low plasticity, white-dark grey, pale orange-brown; sand fine to coarse; gravel fine to coarse, sub-round, sub angular to angular.	M (<PL)	H										
				S00400 SPT 4.00-4.17 m 16,19/20mm N=19/20mm			5			Continued on cored borehole sheet				
							6							
							7							

Method

AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration

No resistance ranging to refusal

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests

U(x) - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
pp - Pocket Penetrometer (UCS kPa)
x=size in mm

Moisture Condition

D - Dry
M - Moist
W - Wet

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

Support

C - Casing

Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions

AS1726:2017

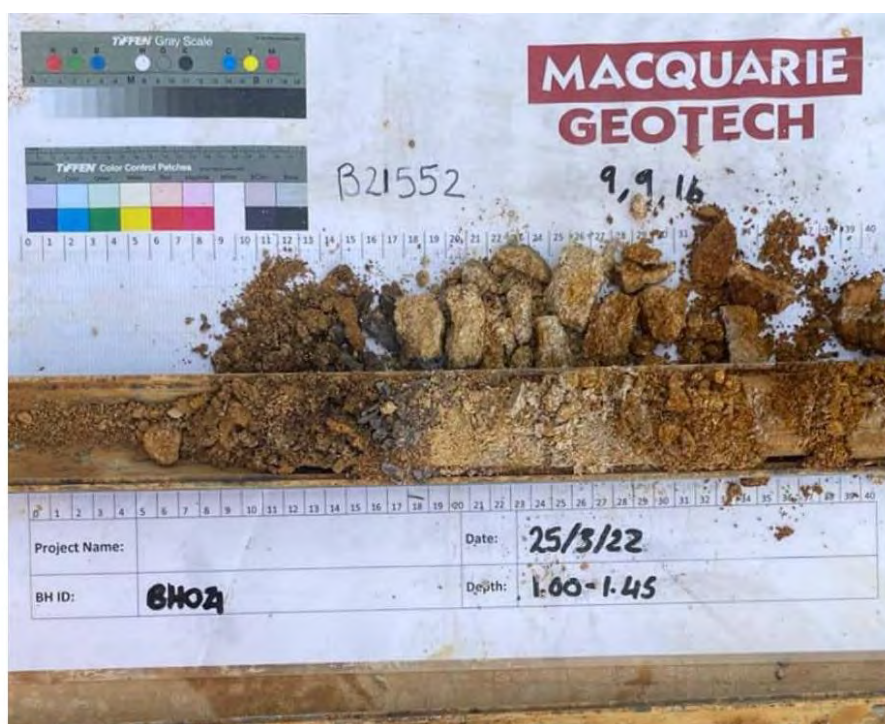
Plastic Limit

w < PL
w = PL
w > PL
w = LL
w > LL

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	230766.5 m E 6288641.8 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	I. Brest



BH04 Depth Range: 1.00 - 1.45 m

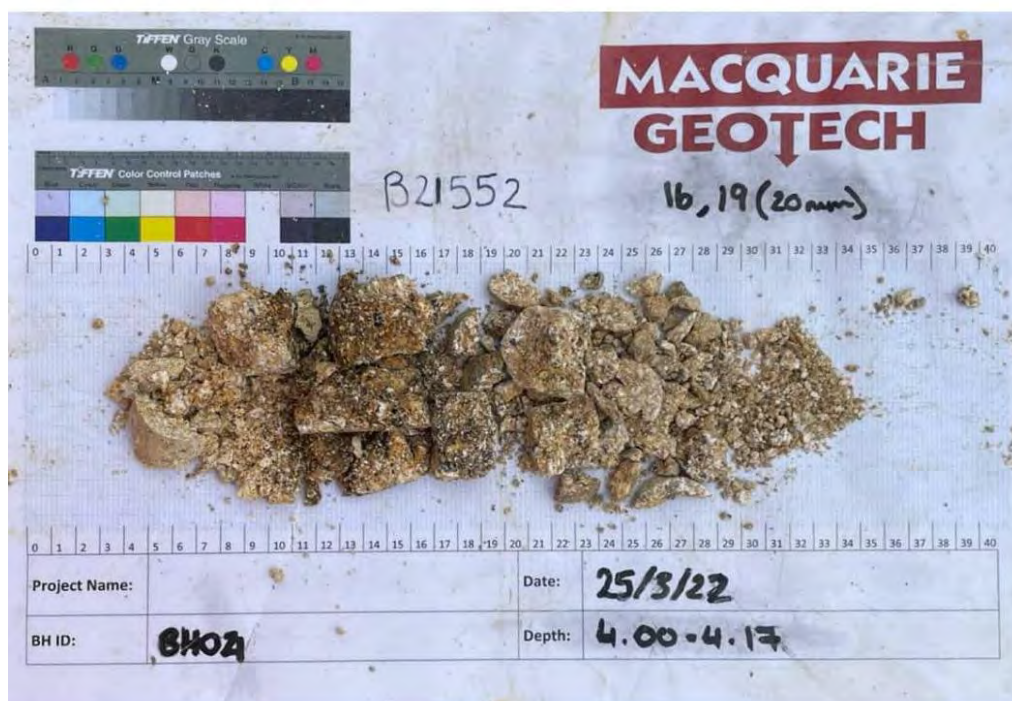


BH04 Depth Range: 2.50 - 2.74 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	230766.5 m E 6288641.8 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Hole Diameter:	115 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	I. Brest



BH04 Depth Range: 4.00 - 4.17 m

U(x) - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
pp - Pocket Penetrometer (UCS kPa)
x=size in mm

Engineering Log - Cored Borehole

Project No.: B21552

Client: MAAS Group		Commenced: 25/03/2022	
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow		Completed: 25/03/2022	
Hole Location: Lithgow		Logged By: M. Conner	
Hole Position: 230766.5 m E 6288641.8 m N MGA94 Zone 56		Checked By: C.Green	
Drill Model and Mounting: Comacchio GEO 405		Inclination: -90°	
Barrel Type and Length:		RL Surface: No survey	
		Datum: AHD	
		Operator: I. Brest	

Drilling Information				Rock Substance				Rock Mass Defects					
Method	Support	Water	TCR (%)	RQD (%)	RL (m)	Depth (m)	Graphic Log	Material Description rock type: grain characteristics, colour, structure, minor components	Weathering	Strength Is(50) ● - Axial ○ - Diametral	Defect Spacing (mm)	Visual	Defect Description thickness, type, inclination, planarity, roughness, coating/infilling
													Particular
						1							General
						2							
						3							
						4							
						5		Continued from non-cored borehole sheet					
			82	9.5		6		CONGLOMERATE: pale orange brown grey, massive.	HW				
			94	59		7		SP-SC Clayey Gravelly SAND: pale orange white; gravel fine to medium grained, sub-angular; clay low plasticity.	HW				
								CONGLOMERATE: pale orange brown white.					
								CLAY: low plasticity, orange brown.					
								CONGLOMERATE: orange brown white.					
			89	25				GRANITE: grey white orange brown.	HW				

Method

AS - Auger Screwing
WB- Washbore
HQ3 HQ3 Core Barrel
NQ3 NQ3 Core Barrel

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss

Core recovered (hatching indicates material)
Core loss

Weathering

FR - Fresh
SW - Slightly Weathered
DW - Distinctly Weathered
XW - Extremely Weathered
RS - Residual Soil

Support

T - Timbering

Strength
(indirect tensile strength)

VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Engineering Log - Cored Borehole

Project No.: B21552

Client: MAAS Group		Commenced: 25/03/2022	
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow		Completed: 25/03/2022	
Hole Location: Lithgow		Logged By: M. Conner	
Hole Position: 230766.5 m E 6288641.8 m N MGA94 Zone 56		Checked By: C.Green	
Drill Model and Mounting: Comacchio GEO 405		Inclination: -90°	
Barrel Type and Length:		RL Surface: No survey	
		Datum: AHD	
		Operator: I. Brest	

Drilling Information				Rock Substance				Rock Mass Defects						
Method	Support	Water	TCR (%)	RQD (%)	RL (m)	Depth (m)	Graphic Log	Material Description rock type: grain characteristics, colour, structure, minor components	Weathering	Strength Is(50) ● - Axial ○ - Diametral	Defect Spacing (mm)	Visual	Defect Description thickness, type, inclination, planarity, roughness, coating/infilling	
										Particular				General
HQ3	Not Observed	89	25	100	13	9	+	GRANITE: grey white orange brown.(continued)	HW	VL	30			
						10	+	GRANITE: orange brown grey.						
Hole Terminated at 10.20 m														
						11								
						12								
						13								
						14								
						15								

Method

AS - Auger Screwing
WB- Washbore
HQ3 HQ3 Core Barrel
NQ3 NQ3 Core Barrel

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss

Core recovered (hatching indicates material)
Core loss

Weathering

FR - Fresh
SW - Slightly Weathered
DW - Distinctly Weathered
XW - Extremely Weathered
RS - Residual Soil

Support

T - Timbering

Strength
(indirect tensile strength)

VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

All defects BP, 1deg, undulating unless otherwise noted.

Engineering Log - Cored Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	230766.5 m E 6288641.8 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Barrel Type and Length:		RL Surface:	No survey
		Bearing:	
		Datum:	AHD
		Operator:	I. Brest



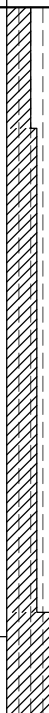
PointID : BH04 Depth Range: 4.50 - 10.20 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	24/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	24/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232185.0 m E 6289057.0 m N MGA94 Zone 56	Checked By:	C.Green

Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°	RL Surface:	No survey
Hole Diameter:	200 mm	Bearing:		Datum:	AHD
				Operator:	F Ferreiro

Drilling Information							Soil Description							Observations		
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
AD/T		Not Observed		1 B 0.00-0.50 m			1		CL	TOPSOIL Sandy CLAY trace gravel: low plasticity, dark grey; sand fine to coarse grained; gravel fine to medium subangular to angular; with rootlets.	M (~PL)	S to F		TOPSOIL		
				1 B 0.50-1.00 m					CL-CI	Sandy CLAY trace gravel trace cobbles: low to medium plasticity, yellow-brown mottled black; sand fine to coarse grained; gravel fine to coarse angular.				ALLUVIAL SOIL		
				1 B 1.00-1.45 m 1 SPT 1.00-1.45 m 4,8,8 N=16					CI	CLAY trace sand trace gravel: medium plasticity, yellow-brown mottled grey; sand fine to coarse grained; gravel fine angular.				✖ 1.30: HP Samp =580 kPa		
				1 B 1.45-2.00 m					CL	Sandy CLAY: low plasticity, grey mottled brown; sand fine to coarse grained.						
				1 B 2.00-2.50 m					CL	2.00-2.50: colour tending to be yellow-brown mottled grey						
				1 SPT 2.50-2.95 m 10,18,13 N=31			2		CL	2.70-2.80: with gravel, fine to coarse subangular to angular gravel	VSt to H			✖ 2.70: HP Samp =510 kPa		
						ML	2.70-2.80: with gravel, fine to coarse subangular to angular gravel									
							3			SILT with cobbles: low plasticity, pale grey.					2.95: Bulk auger stopped at 2.6m as blocked by cobbles	
							4			Hole Terminated at 2.95 m target depth not met due to Bulk auger with Tc bit Refusal on cobbles						

Method	Penetration	Water	Samples and Tests	Moisture Condition	Consistency/Relative Density
AS - Auger Screwing RR - Rock Roller WB - Washbore	No resistance ranging to refusal 	Level (Date) Inflow Partial Loss Complete Loss	U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	Core recovered (hatching indicates material) Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	24/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	24/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232185.0 m E 6289057.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH05 Depth Range: 1.00 - 1.45 m



BH05 Depth Range: 2.50 - 2.95 m

Engineering Log - Borehole

Project No.: B21552

Client: MAAS Group		Commenced: 25/03/2022	
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow		Completed: 25/03/2022	
Hole Location: Lithgow		Logged By: H.Wen	
Hole Position: 232405.0 m E 6289022.0 m N MGA94 Zone 56		Checked By: C.Green	

Drill Model and Mounting: Comacchio 305/Track	Inclination: -90°	RL Surface: No survey
Hole Diameter: 200 mm	Bearing:	Datum: AHD Operator: F Ferreiro

Drilling Information				Soil Description				Observations						
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T				1 B 0.00-0.50 m					CL	TOPSOIL Silty Sandy CLAY trace gravel: low plasticity, dark grey; sand fine to coarse grained; gravel fine subrounded to subangular; with rootlets.				TOPSOIL
				1 B 0.50-1.00 m					CL-CI	Sandy CLAY trace gravel trace cobbles: low to medium plasticity, yellow-brown mottled black; sand fine to coarse grained; gravel fine to coarse angular.		F		ALLUVIAL SOIL
				1 B 1.00-1.45 m 1 SPT 1.00-1.45 m 10,11,12 N=23 1 B 1.45-2.00 m			1			1.20-1.45: colour tending to be grey mottled yellow-brown and brown 1.45-2.00: with fine to coarse subrounded to subangular gravel	M (~PL)		x	1.20: HP Samp =440 kPa
				1 B 2.00-2.50 m			2							
				1 B 2.50-3.00 m 1 SPT 2.50-2.93 m 16,24,26/130mm N=50/280mm			3			2.50-3.00: colour tending to be yellow-brown mottled grey, with fine to medium subrounded to angular gravel	H		x	2.70: HP Samp =360 kPa
							4			Hole Terminated at 3.00 m Target depth				

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Support
C - Casing

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U(x) - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
pp - Pocket Penetrometer (UCS kPa)
x=size in mm

Classification Symbols and Soil Descriptions
AS1726:2017

Moisture Condition
D - Dry
M - Moist
W - Wet

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

Plastic Limit
w < PL
w = PL
w > PL
w = LL
w > LL

Core recovered (hatching indicates material)
Core loss

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232405.0 m E 6289022.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH06 Depth Range: 1.00 - 1.45 m



BH06 Depth Range: 2.50 - 2.93 m

Engineering Log - Borehole

Project No.: B21552

Client: MAAS Group		Commenced: 24/03/2022	
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow		Completed: 24/03/2022	
Hole Location: Lithgow		Logged By: H.Wen	
Hole Position: 232022.0 m E 6288978.0 m N MGA94 Zone 56		Checked By: C.Green	
Drill Model and Mounting: Comacchio 305/Track		Inclination: -90°	
Hole Diameter: 200 mm		RL Surface: No survey	
		Datum: AHD	
		Operator: F Ferreiro	

Drilling Information				Soil Description				Observations							
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T		Not Observed		1 B 0.00-0.50 m			1		CL	TOPSOIL Gravelly Sandy CLAY: low plasticity, yellow-brown; sand fine to coarse grained; gravel fine to coarse subrounded to subangular; with rootlets.	M (~PL)	S to F		100 200 300 400 500	TOPSOIL
				1 B 0.50-1.00 m					CL	Sandy CLAY trace gravel trace cobbles: low plasticity, grey; sand fine to coarse grained; gravel fine to coarse subrounded to subangular.				ALLUVIAL SOIL	
				1 SPT 1.00-1.45 m 3,4,4 N=8					CL	CLAY with sand trace gravel: low plasticity, yellow-brown mottled grey; sand fine to coarse grained; gravel fine to medium angular.	M (~PL) to M (>PL)	F	x	1.30: HP Samp =190 kPa	
							2			Hole Terminated at 1.45 m target depth not met due to Bulk auger with Tc bit Refusal					
							3								
							4								

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
 No resistance ranging to refusal

Support
C - Casing

Water
 Level (Date)
 Inflow
 Partial Loss
 Complete Loss

Samples and Tests
U(x) - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
pp - Pocket Penetrometer (UCS kPa)
x=size in mm

Classification Symbols and Soil Descriptions
AS1726:2017

Moisture Condition
D - Dry
M - Moist
W - Wet

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

Plastic Limit
w < PL
w = PL
w > PL
w = LL
w > LL

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	24/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	24/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232022.0 m E 6288978.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH07 Depth Range: 1.00 - 1.45 m

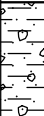
U(x) - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
pp - Pocket Penetrometer (UCS kPa)
x=size in mm

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	24/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	24/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232239.0 m E 6288924.0 m N MGA94 Zone 56	Checked By:	C.Green

Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°	RL Surface:	No survey
Hole Diameter:	200 mm	Bearing:		Datum:	AHD
				Operator:	F Ferreiro

Drilling Information							Soil Description							Observations		
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
AD/T			Not Observed	1 B 0.00-0.50 m			1		CL	TOPSOIL Gravelly Sandy CLAY: low plasticity, brown mottled red-brown; sand fine to coarse grained; gravel fine to medium subrounded to subangular; with rootlets.	M (~PL)	S to F			TOPSOIL	
				1 B 0.50-1.00 m					CL-CI	Sandy CLAY: low to medium plasticity, red-brown; sand fine to coarse grained.					ALLUVIAL SOIL	
				1 B 1.00-1.45 m						1.00-1.00: becoming low plasticity						
				1 SPT 1.00-1.45 m 4,4,6 N=10											1.30: HP Samp =280 kPa	
				1 B 1.45-2.00 m												
				1 B 2.00-2.50 m			2									
				1 B 2.50-3.00 m												
				1 SPT 2.50-2.95 m 1,2,5 N=7			3			Hole Terminated at 3.00 m Target depth						2.70: HP Samp =380 kPa
							4									

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration  No resistance ranging to refusal	Water  Level (Date)  Inflow  Partial Loss  Complete Loss	Samples and Tests U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	Moisture Condition D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	 Core recovered (hatching indicates material)  Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	24/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	24/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232239.0 m E 6288924.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH08 Depth Range: 1.00 - 1.45 m



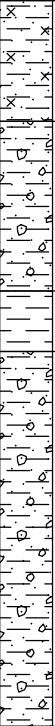
BH08 Depth Range: 2.50 - 2.95 m

Engineering Log - Borehole

Project No.: B21552

Client: MAAS Group	Commenced: 24/03/2022
Project Name: MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed: 24/03/2022
Hole Location: Lithgow	Logged By: H.Wen
Hole Position: 232411.0 m E 6288921.0 m N MGA94 Zone 56	Checked By: C.Green

Drill Model and Mounting: Comacchio 305/Track	Inclination: -90°	RL Surface: No survey
Hole Diameter: 200 mm	Bearing:	Datum: AHD Operator: F Ferreiro

Drilling Information							Soil Description						Observations				
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations		
AD/T			Not Observed	1 B 0.00-0.50 m			1		CL	TOPSOIL Silty Sandy CLAY trace gravel: low plasticity, dark grey mottled brown; sand fine to coarse grained; gravel fine subangular; with rootlets.	M (~PL)	S to F			TOPSOIL		
				1 B 0.50-1.00 m					CL-CI	Gravelly Sandy CLAY: low to medium plasticity, yellow-brown; sand fine to coarse grained; gravel fine subrounded to subangular.					ALLUVIAL SOIL		
				1 B 1.00-1.45 m					CL-CI	CLAY with sand trace gravel: low to medium plasticity, grey mottled brown; sand fine to coarse grained; gravel fine to medium subrounded to subangular.					1.10: HP Samp =420 kPa		
				1 SPT 1.00-1.45 m 4,8,11 N=19												CL	Gravelly Sandy CLAY: low plasticity, yellow-brown; sand fine to coarse grained; gravel fine to medium subrounded to subangular.
				1 B 1.45-2.00 m													
1 B 2.00-2.50 m	2	M (<PL) to M (~PL)	VSt														
1 B 2.50-3.00 m	M (~PL)					H		2.65: HP Samp =410 kPa									
1 SPT 2.50-2.95 m 14,19,24 N=43			Hole Terminated at 3.00 m Target depth														
							4										

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration  No resistance ranging to refusal	Water  Level (Date)  Inflow  Partial Loss  Complete Loss	Samples and Tests U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	Moisture Condition D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	 Core recovered (hatching indicates material)  Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	24/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	24/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232411.0 m E 6288921.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH09 Depth Range: 1.00 - 1.45 m



BH09 Depth Range: 2.50 - 2.95 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232618.0 m E 6288891.0 m N MGA94 Zone 56	Checked By:	C.Green

Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	200 mm	Bearing:		Datum:	AHD	Operator:	F Ferreiro

Drilling Information							Soil Description						Observations	
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T		Not Observed		1 B 0.00-0.50 m					CL	TOPSOIL Silty CLAY with sand trace gravel: low plasticity, dark grey; sand fine to coarse grained; gravel fine subrounded to subangular; with rootlets.		S to F		TOPSOIL
				1 B 0.50-1.00 m					CL-CI	CLAY with sand with gravel: low to medium plasticity, yellow-brown; sand fine to coarse grained; gravel fine to medium subrounded to subangular.				ALLUVIAL SOIL
				1 B 1.00-1.45 m 1 SPT 1.00-1.45 m 4,6,6 N=12 1 B 1.45-2.00 m			1		CI	CLAY trace gravel: medium plasticity, grey mottled red-brown; gravel fine to medium subrounded.	M (~PL)	St		1.30: HP Samp =400 kPa
				1 B 2.00-2.50 m					CI	CLAY with sand with gravel: medium plasticity, grey-brown mottled red-brown; sand fine to coarse grained; gravel fine to coarse subrounded to angular.				St to VSt
				1 B 2.50-3.00 m 1 SPT 2.50-2.87 m 25,30,20/65mm N=50/215mm			3		ML	SILT with sand with gravel: low plasticity, grey mottled red-brown; sand fine to coarse grained; gravel fine to medium subangular to angular.	M (<PL) to M (~PL)	H		ALLUVIAL SOIL possibly EXTREMELY WEATHERED MATERIAL 2.70: HP Samp =260 kPa
									Hole Terminated at 3.00 m Target depth					
							4							

Method	Penetration	Water	Samples and Tests	Moisture Condition	Consistency/Relative Density
AS - Auger Screwing RR - Rock Roller WB - Washbore	No resistance ranging to refusal	Level (Date) Inflow Partial Loss Complete Loss	U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	Core recovered (hatching indicates material) Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232618.0 m E 6288891.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH10 Depth Range: 1.00 - 1.45 m



BH10 Depth Range: 2.50 - 2.87 m

MG 4.02 LIB MAINBRANCH GLB Log MG BOREHOLE EXCL, DCP MG 4.02 GPJ <<DrawingFile>> 02/06/2022 11:59 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: DGD-T-P 4.01 2 dpl 3.04 2018-07-02 Pj: DGD-T-P 4.00 6 2017-11-25

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232264.0 m E 6288804.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH11 Depth Range: 1.00 - 1.45 m



BH11 Depth Range: 2.50 - 2.95 m

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232395.0 m E 6288807.0 m N MGA94 Zone 56	Checked By:	C.Green

Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	200 mm	Bearing:		Datum:	AHD	Operator:	F Ferreiro

Drilling Information							Soil Description							Observations		
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency	Relative Density	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
AD/T		Not Observed		1 B 0.00-0.50 m			1		CL	TOPSOIL Gravelly Sandy CLAY: low plasticity, dark grey; sand fine to coarse grained; gravel fine to coarse subrounded to angular; with rootlets.	M (~PL)	F			TOPSOIL	
				1 B 0.50-1.00 m					CL-CI	Sandy CLAY trace gravel: low to medium plasticity, yellow-brown; sand fine to coarse grained; gravel fine to medium subrounded to subangular.		F to St			ALLUVIAL SOIL	
				1 B 1.00-1.45 m 1 SPT 1.00-1.45 m 5,6,13 N=19 1 B 1.45-1.60 m						1.05-1.40: colour tending to be yellow-brown mottled brown and grey, trace fine to medium gravel		VSt			x	1.25: HP Samp =460 kPa
							2			Hole Terminated at 1.60 m target depth not met due to Bulk auger with Tc bit Refusal						
							3									
							4									

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration No resistance ranging to refusal	Water Level (Date) Inflow Partial Loss Complete Loss	Samples and Tests U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	Moisture Condition D - Dry M - Moist W - Wet Plastic Limit w < PL w = PL w > PL w = LL w > LL	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
Support C - Casing	 Core recovered (hatching indicates material) Core loss		Classification Symbols and Soil Descriptions AS1726:2017		

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	25/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	25/03/2022
Hole Location:	Lithgow	Logged By:	H.Wen
Hole Position:	232395.0 m E 6288807.0 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio 305/Track	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	F Ferreiro



BH12 Depth Range: 1.00 - 1.45 m

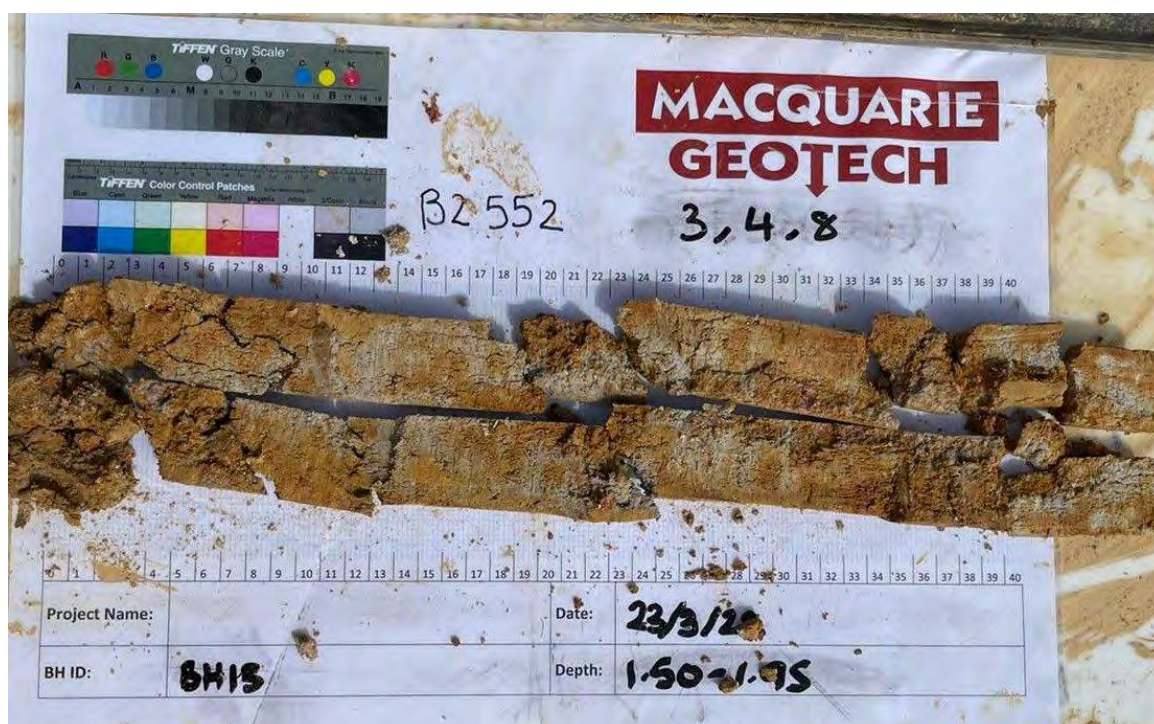
U(x) - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
pp - Pocket Penetrometer (UCS kPa)
x=size in mm

<u>Method</u>	<u>Penetration</u>	<u>Water</u>	<u>Samples and Tests</u>	<u>Moisture Condition</u>	<u>Consistency/Relative Density</u>
AS - Auger Screwing		 Level (Date)  Inflow  Partial Loss  Complete Loss	U(x) - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test pp - Pocket Penetrometer (UCS kPa) x=size in mm	D - Dry M - Moist W - Wet	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
RR - Rock Roller					
WB- Washbore					
<u>Support</u>			<u>Classification Symbols</u> <u>and Soil Descriptions</u> AS1726:2017	<u>Plastic Limit</u>	
C - Casing				w < PL w = PL w > PL w = LL w > LL	
	Core recovered (hatching indicates material) Core loss				

Engineering Log - Borehole

Project No.: B21552

Client:	MAAS Group	Commenced:	23/03/2022
Project Name:	MAAS Group-Vera Vista-Geotechnical Drilling - Lithgow	Completed:	23/03/2002
Hole Location:	Lithgow	Logged By:	M. Conner
Hole Position:	231901.0 m E 6288719.7 m N MGA94 Zone 56	Checked By:	C.Green
Drill Model and Mounting:	Comacchio GEO 405	Inclination:	-90°
Hole Diameter:	200 mm	Bearing:	
		RL Surface:	No survey
		Datum:	AHD
		Operator:	I. Brest



BH13 Depth Range: 1.00 - 1.45 m



BH13 Depth Range: 3.00 - 3.45 m

Appendix D – Laboratory Test Results

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329B
Date Sampled: 23/03/2022
Dates Tested: 31/03/2022 - 12/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH01, Depth: 1.0-1.45

MACQUARIE GEOTECH

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
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Email: bmorris@macgeo.com.au



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Approved Signatory: Brad Morris
Operations Manager
NATA Accredited Laboratory Number: 14874

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	5		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (°C)	15		

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329F
Date Sampled: 22/03/2022
Dates Tested: 31/03/2022 - 07/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH02, Depth: 2.5-3.0m

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A handwritten signature in black ink, appearing to read 'Brad Morris'.

Approved Signatory: Brad Morris
Operations Manager
NATA Accredited Laboratory Number: 14874

Particle Size Distribution (AS1289 3.6.1)					
Sieve	Passed %	Passing Limits		Retained %	Retained Limits
75 mm	100			0	
63 mm	100			0	
53 mm	100			0	
37.5 mm	100			0	
26.5 mm	100			0	
19 mm	100			0	
13.2 mm	100			0	
9.5 mm	100			0	
6.7 mm	100			0	
4.75 mm	99			1	
2.36 mm	98			2	
1.18 mm	94			4	
0.6 mm	87			7	
0.425 mm	84			3	
0.3 mm	81			3	
0.15 mm	76			5	
0.075 mm	66			10	

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329G
Date Sampled: 22/03/2022
Dates Tested: 31/03/2022 - 07/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH02, Depth: 2.0-2.5m

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Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	40		
Plastic Limit (%)	18		
Plasticity Index (%)	22		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	8.5		
Cracking Crumbling Curling	None		

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329J
Date Sampled: 23/03/2022
Dates Tested: 31/03/2022 - 12/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH03, Depth: 0.2-1.0m

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Operations Manager
NATA Accredited Laboratory Number: 14874

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	3		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (°C)	15		

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329K
Date Sampled: 23/03/2022
Dates Tested: 31/03/2022 - 21/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH03, Depth: 2.58-4.0m

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Operations Manager
NATA Accredited Laboratory Number: 14874

Particle Size Distribution (AS1289 3.6.1)					
Sieve	Passed %	Passing Limits		Retained %	Retained Limits
75 mm	100			0	
63 mm	100			0	
53 mm	100			0	
37.5 mm	100			0	
26.5 mm	100			0	
19 mm	100			0	
13.2 mm	100			0	
9.5 mm	100			0	
6.7 mm	100			0	
4.75 mm	98			2	
2.36 mm	89			9	
1.18 mm	76			14	
0.6 mm	57			19	
0.425 mm	52			5	
0.3 mm	48			4	
0.15 mm	40			7	
0.075 mm	34			6	

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329L
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 07/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH04, Depth: 1.5-2.0m

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Approved Signatory: Brad Morris
Operations Manager
NATA Accredited Laboratory Number: 14874

Particle Size Distribution (AS1289 3.6.1)					
Sieve	Passed %	Passing Limits		Retained %	Retained Limits
75 mm	100			0	
63 mm	100			0	
53 mm	100			0	
37.5 mm	100			0	
26.5 mm	100			0	
19 mm	100			0	
13.2 mm	100			0	
9.5 mm	98			2	
6.7 mm	97			1	
4.75 mm	96			1	
2.36 mm	93			3	
1.18 mm	79			14	
0.6 mm	45			35	
0.425 mm	39			6	
0.3 mm	35			3	
0.15 mm	31			5	
0.075 mm	28			3	

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329M
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 12/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH04, Depth: 1.0-1.45m

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NATA Accredited Laboratory Number: 14874

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	5		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (°C)	15		

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329N
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 06/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH04 , Depth: 2.0-2.5m

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.8

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329P
Date Sampled: 23/03/2022
Dates Tested: 31/03/2022 - 21/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH13, Depth: 1.0-1.5m

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NATA Accredited Laboratory Number: 14874

Particle Size Distribution (AS1289 3.6.1)					
Sieve	Passed %	Passing Limits		Retained %	Retained Limits
75 mm	100			0	
63 mm	100			0	
53 mm	100			0	
37.5 mm	100			0	
26.5 mm	100			0	
19 mm	100			0	
13.2 mm	99			1	
9.5 mm	99			0	
6.7 mm	99			0	
4.75 mm	99			0	
2.36 mm	98			1	
1.18 mm	92			6	
0.6 mm	79			13	
0.425 mm	73			6	
0.3 mm	69			5	
0.15 mm	63			5	
0.075 mm	55			8	

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329Q
Date Sampled: 24/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH05 , Depth: 0.0-0.5m

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 NATA Accredited Laboratory Number: 14874

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	8		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Technician Assessment		
Maximum Dry Density (t/m ³)	1.87		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Moisture Content at Placement (%)	13.7		
Moisture Content Top 30mm (%)	14.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	175.3		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	Not Obtainable		
Plastic Limit (%)	Not Obtainable		
Plasticity Index (%)	Non Plastic		
Linear Shrinkage (%) - Unobtainable			

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			
Linear Shrinkage (%) - Unobtainable			

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.7

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329R
Date Sampled: 24/03/2022
Dates Tested: 31/03/2022 - 03/05/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH05, Depth: 0.5-1.0m

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Operations Manager

NATA Accredited Laboratory Number: 14874

Falling Head Permeability (AS 1289 6.7.2 & 2.1.1)		Min	Max
Coefficient of Permeability (m/sec)	1×10^{-10}		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.96		
Optimum Moisture Content (%)	12.0		
Field Moisture Content (%)	7.9		
Sieve for Oversize (mm)	19		
Oversize Material (%)	2.3		
Placement Moisture Content (%)	11.9		
Laboratory Density Ratio (%)	97.8		
Laboratory Moisture Ratio (%)	98.1		
Surcharges and Pressure Applied	-		

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329S
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH06 , Depth: 0.0-0.5m

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California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	16		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Technician Assessment		
Maximum Dry Density (t/m ³)	1.90		
Optimum Moisture Content (%)	13.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m ³)	1.89		
Field Moisture Content (%)	9.2		
Moisture Content at Placement (%)	12.8		
Moisture Content Top 30mm (%)	13.9		
Moisture Content Rest of Sample (%)	13.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	27.6		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	26		
Plastic Limit (%)	17		
Plasticity Index (%)	9		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	4.5		
Cracking Crumbling Curling	Cracking		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	19.3

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329T
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 03/05/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH06, Depth: 0.5-1.0m

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Falling Head Permeability (AS 1289 6.7.2 & 2.1.1)		Min	Max
Coefficient of Permeability (m/sec)	6×10^{-10}		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.83		
Optimum Moisture Content (%)	15.5		
Field Moisture Content (%)	10.3		
Sieve for Oversize (mm)	19		
Oversize Material (%)	2.8		
Placement Moisture Content (%)	15.9		
Laboratory Density Ratio (%)	97.4		
Laboratory Moisture Ratio (%)	101.2		
Surcharges and Pressure Applied	-		

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329U
Date Sampled: 23/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH07 , Depth: 0.5-1.0m

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California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	25		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Technician Assessment		
Maximum Dry Density (t/m ³)	1.90		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	98.0		
Dry Density after Soaking (t/m ³)	1.90		
Field Moisture Content (%)	14.5		
Moisture Content at Placement (%)	12.2		
Moisture Content Top 30mm (%)	14.7		
Moisture Content Rest of Sample (%)	13.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	26.2		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	28		
Plastic Limit (%)	16		
Plasticity Index (%)	12		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	4.0		
Cracking Crumbling Curling	Cracking		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	13.9

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329V
Date Sampled: 24/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH08 , Depth: 0.5-1.0m

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California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	6		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Technician Assessment		
Maximum Dry Density (t/m ³)	1.67		
Optimum Moisture Content (%)	25.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m ³)	1.66		
Field Moisture Content (%)	25.6		
Moisture Content at Placement (%)	25.3		
Moisture Content Top 30mm (%)	26.2		
Moisture Content Rest of Sample (%)	26.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	186.6		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	69		
Plastic Limit (%)	21		
Plasticity Index (%)	48		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	10.0		
Cracking Crumbling Curling	Cracking		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	26.5

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329W
Date Sampled: 24/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH09 , Depth: 0.0-0.5m

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California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	13		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Technician Assessment		
Maximum Dry Density (t/m ³)	1.83		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m ³)	1.82		
Field Moisture Content (%)	16.3		
Moisture Content at Placement (%)	14.5		
Moisture Content Top 30mm (%)	17.6		
Moisture Content Rest of Sample (%)	16.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	187.6		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	27		
Plastic Limit (%)	19		
Plasticity Index (%)	8		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	5.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	16.3

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329X
Date Sampled: 23/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH10 , Depth: 0.5-1.0m

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Particle Size Distribution (AS1289 3.6.1)					
Sieve	Passed %	Passing Limits	Retained %	Retained Limits	
75 mm	100		0		
63 mm	100		0		
53 mm	100		0		
37.5 mm	99		1		
26.5 mm	97		2		
19 mm	96		1		
13.2 mm	95		2		
9.5 mm	94		1		
6.7 mm	93		1		
4.75 mm	92		1		
2.36 mm	91		2		
1.18 mm	89		2		
0.6 mm	87		2		
0.425 mm	86		1		
0.3 mm	84		1		
0.15 mm	77		7		
0.075 mm	70		7		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)			Min	Max
CBR taken at	2.5 mm			
CBR %	9			
Method of Compactive Effort	Standard			
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1			
Method used to Determine Plasticity	Technician Assessment			
Maximum Dry Density (t/m ³)	1.71			
Optimum Moisture Content (%)	20.0			
Laboratory Density Ratio (%)	99.5			
Laboratory Moisture Ratio (%)	100.5			
Dry Density after Soaking (t/m ³)	1.68			
Field Moisture Content (%)	22.2			
Moisture Content at Placement (%)	19.9			
Moisture Content Top 30mm (%)	24.9			
Moisture Content Rest of Sample (%)	22.3			
Mass Surcharge (kg)	4.5			
Soaking Period (days)	4			
Curing Hours	51.2			
Swell (%)	1.5			
Oversize Material (mm)	19			
Oversize Material Included	Excluded			
Oversize Material (%)	3.1			

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	54		
Plastic Limit (%)	19		
Plasticity Index (%)	35		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	11.0		
Cracking Crumbling Curling	Cracking		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	22.3

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329Y
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH11 , Depth: 0.0-0.5m

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California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	25		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Technician Assessment		
Maximum Dry Density (t/m ³)	1.92		
Optimum Moisture Content (%)	11.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m ³)	1.92		
Field Moisture Content (%)	13.8		
Moisture Content at Placement (%)	11.4		
Moisture Content Top 30mm (%)	14.3		
Moisture Content Rest of Sample (%)	12.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	187.7		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	1.7		

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	28		
Plastic Limit (%)	16		
Plasticity Index (%)	12		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	5.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	13.9

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329Z
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 12/05/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH11, Depth: 0.5-1.0m

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Falling Head Permeability (AS 1289 6.7.2 & 2.1.1)		Min	Max
Coefficient of Permeability (m/sec)	1x10 ⁻⁹		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m ³)	1.75		
Optimum Moisture Content (%)	16.5		
Field Moisture Content (%)	10.4		
Sieve for Oversize (mm)	19		
Oversize Material (%)	0.0		
Placement Moisture Content (%)	16.6		
Laboratory Density Ratio (%)	97.7		
Laboratory Moisture Ratio (%)	100.4		
Surcharges and Pressure Applied	-		

Material Test Report

Report Number: B21552-1
Issue Number: 1
Date Issued: 12/05/2022
Client: MAAS Group Properties
 20L Sheraton Road, Dubbo NSW 2830
Contact: Brad Draper
Project Number: B21552
Project Name: Vera Vista
Work Request: 329
Sample Number: BTH-329AA
Date Sampled: 25/03/2022
Dates Tested: 31/03/2022 - 26/04/2022
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: BH12 , Depth: 0.5-1.0m

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California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	30		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Technician Assessment		
Maximum Dry Density (t/m ³)	1.98		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m ³)	1.97		
Field Moisture Content (%)	12.9		
Moisture Content at Placement (%)	12.6		
Moisture Content Top 30mm (%)	13.7		
Moisture Content Rest of Sample (%)	13.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	26.3		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	1.7		

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	34		
Plastic Limit (%)	16		
Plasticity Index (%)	18		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	7.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	13.0

SOIL CHEMICAL PROPERTIES REPORT

Client	Maas Group Properties	Source	BH01, Depth: 1.45-2.0m
Address	20L Sheraton Road, Dubbo, NSW 2830	Sample Description	Sandy CLAY trace gravel
Project	Vera Vista	Report #	BTH-329C-SCP
Job #	B21552	Lab #	BTH-329C

Test Procedure

- ☒ APHA 4500 H+B pH
- ☒ APHA 4500 SO4 2-B Sulphate
- ☒ APHA 4500 Cl-B Chloride
- ☒ APHA 2510 & 2520-E Electrical Conductivity
- ☐ AS 1012.20.1 Chloride and sulphate
- ☐ AS1289 4.2.1 Sulfate content of natural soil and groundwater
- ☐ AS1289 4.3.1 pH value of a soil - Electrometric method
- ☐ AS 1289 4.4.1 Electrical resistivity of a soil - Method for sands and granular material
- ☐ RMS T123 pH value of a soil - Electrometric method
- ☐ RMS T185 Resistivity of sands and granular road construction materials
- ☐ RMS T200 Chloride content of roadbase
- ☐ RMS T1010 Chlorides in soil
- ☐ RMS T1011 Sulphates in soil
- ☐ BS1377(1990 pt.3) Water soluble sulphate content
- ☐ TAI B117* Sulphides Present (*Not covered by NATA accreditation)
- ☐ In-house* Resistivity calculated from Electrical Conductivity (*Not covered by NATA accreditation)

Sampling

Sampled by Macquarie Geotechnical Staff in accordance with AS1289 1.1

Date Sampled

23/03/2022

Preparation

Prepared in accordance with the test method

Dates Tested

20/04/2022

APHA 4500 H+B	pH	5.1
APHA 2510 & 2520-B	Electrical Conductivity ($\mu\text{S}/\text{cm}$)	32.2
APHA 4500 Cl-B	Chloride ion content (ppm)	36
	Chloride ion content (% w/w)	0.004
APHA 4500 SO4 2-B	Sulphate content (ppm)	68
	Sulphate content (% w/w)	0.007
	Mean Resistivity $\Omega\cdot\text{m}$	-
	(Resistivity) Density ratio (R_D)	-
	(Resistivity) Density index (I_D)	-
	Sulphides Present	-
	Sulphur Peroxide (% w/w)	-
	Resistivity (ohm m)	-

Notes



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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Brad Morris

12/05/2022

Date:



Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

SOIL CHEMICAL PROPERTIES REPORT

Client	Maas Group Properties	Source	BH02, Depth: 1.5-2.0m
Address	20L Sheraton Road, Dubbo, NSW 2830	Sample Description	Sandy CLAY trace Gravel
Project	Vera Vista	Report #	BTH-329E-SCP
Job #	B21552	Lab #	BTH-329E

Test Procedure	☒ APHA 4500 H+B	pH
	☒ APHA 4500 SO4 2-B	Sulphate
	☒ APHA 4500 Cl-B	Chloride
	☒ APHA 2510 & 2520-E	Electrical Conductivity
	☐ AS 1012.20.1	Chloride and sulphate
	☐ AS1289 4.2.1	Sulfate content of natural soil and groundwater
	☐ AS1289 4.3.1	pH value of a soil - Electrometric method
	☐ AS 1289 4.4.1	Electrical resistivity of a soil - Method for sands and granular material
	☐ RMS T123	pH value of a soil - Electrometric method
	☐ RMS T185	Resistivity of sands and granular road construction materials
	☐ RMS T200	Chloride content of roadbase
	☐ RMS T1010	Chlorides in soil
	☐ RMS T1011	Sulphates in soil
	☐ BS1377(1990 pt.3)	Water soluble sulphate content
	☐ TAI B117*	Sulphides Present (*Not covered by NATA accreditation)
	☐ In-house*	Resistivity calculated from Electrical Conductivity (*Not covered by NATA accreditation)

Sampling	Sampled by Macquarie Geotechnical Staff in accordance with AS1289 1.1	Date Sampled	23/03/2022
Preparation	Prepared in accordance with the test method	Dates Tested	20/04/2022

APHA 4500 H+B	pH	5.1
APHA 2510 & 2520-B	Electrical Conductivity ($\mu\text{S}/\text{cm}$)	24.6
APHA 4500 Cl-B	Chloride ion content (ppm)	27
	Chloride ion content (% w/w)	0.003
APHA 4500 SO4 2-B	Sulphate content (ppm)	62
	Sulphate content (% w/w)	0.006
	Mean Resistivity $\Omega\cdot\text{m}$	-
	(Resistivity) Density ratio (R_D)	-
	(Resistivity) Density index (I_D)	-
	Sulphides Present	-
	Sulphur Peroxide (% w/w)	-
	Resistivity (ohm m)	-

Notes



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3 Watt Drive
Bathurst NSW 2795

SOIL CHEMICAL PROPERTIES REPORT

Client	Maas Group Properties	Source	BH03, Depth: 1.0-1.45m
Address	20L Sheraton Road, Dubbo, NSW 2830	Sample Description	Silty CLAY with sand
Project	Vera Vista	Report #	BTH-329H-SCP
Job #	B21552	Lab #	BTH-329H

Test Procedure

- ☒ APHA 4500 H+B pH
- ☒ APHA 4500 SO4 2-B Sulphate
- ☒ APHA 4500 Cl-B Chloride
- ☒ APHA 2510 & 2520-E Electrical Conductivity
- ☐ AS 1012.20.1 Chloride and sulphate
- ☐ AS1289 4.2.1 Sulfate content of natural soil and groundwater
- ☐ AS1289 4.3.1 pH value of a soil - Electrometric method
- ☐ AS 1289 4.4.1 Electrical resistivity of a soil - Method for sands and granular material
- ☐ RMS T123 pH value of a soil - Electrometric method
- ☐ RMS T185 Resistivity of sands and granular road construction materials
- ☐ RMS T200 Chloride content of roadbase
- ☐ RMS T1010 Chlorides in soil
- ☐ RMS T1011 Sulphates in soil
- ☐ BS1377(1990 pt.3) Water soluble sulphate content
- ☐ TAI B117* Sulphides Present (*Not covered by NATA accreditation)
- ☐ In-house* Resistivity calculated from Electrical Conductivity (*Not covered by NATA accreditation)

Sampling

Sampled by Macquarie Geotechnical Staff in accordance with AS1289 1.1

Date Sampled

23/03/2022

Preparation

Prepared in accordance with the test method

Dates Tested

20/04/2022

APHA 4500 H+B	pH	5.2
APHA 2510 & 2520-B	Electrical Conductivity ($\mu\text{S}/\text{cm}$)	25.6
APHA 4500 Cl-B	Chloride ion content (ppm)	26
	Chloride ion content (% w/w)	0.003
APHA 4500 SO4 2-B	Sulphate content (ppm)	< 10
	Sulphate content (% w/w)	< 0.001
	Mean Resistivity $\Omega\cdot\text{m}$	-
	(Resistivity) Density ratio (R_D)	-
	(Resistivity) Density index (I_D)	-
	Sulphides Present	-
	Sulphur Peroxide (% w/w)	-
	Resistivity (ohm m)	-

Notes



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Macquarie Geotechnical
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SOIL CHEMICAL PROPERTIES REPORT

Client	Maas Group Properties	Source	BH04, Depth: 0.5-1.0m
Address	20L Sheraton Road, Dubbo, NSW 2830	Sample Description	Sandy CLAY trace silt
Project	Vera Vista	Report #	BTH-3290-SCP
Job #	B21552	Lab #	BTH-3290

Test Procedure

- ☒ APHA 4500 H+B pH
- ☒ APHA 4500 SO4 2-B Sulphate
- ☒ APHA 4500 Cl-B Chloride
- ☒ APHA 2510 & 2520-E Electrical Conductivity
- ☐ AS 1012.20.1 Chloride and sulphate
- ☐ AS1289 4.2.1 Sulfate content of natural soil and groundwater
- ☐ AS1289 4.3.1 pH value of a soil - Electrometric method
- ☐ AS 1289 4.4.1 Electrical resistivity of a soil - Method for sands and granular material
- ☐ RMS T123 pH value of a soil - Electrometric method
- ☐ RMS T185 Resistivity of sands and granular road construction materials
- ☐ RMS T200 Chloride content of roadbase
- ☐ RMS T1010 Chlorides in soil
- ☐ RMS T1011 Sulphates in soil
- ☐ BS1377(1990 pt.3) Water soluble sulphate content
- ☐ TAI B117* Sulphides Present (*Not covered by NATA accreditation)
- ☐ In-house* Resistivity calculated from Electrical Conductivity (*Not covered by NATA accreditation)

Sampling

Sampled by Macquarie Geotechnical Staff in accordance with AS1289 1.1

Date Sampled

23/03/2022

Preparation

Prepared in accordance with the test method

Dates Tested

20/04/2022

APHA 4500 H+B	pH	5.3
APHA 2510 & 2520-B	Electrical Conductivity ($\mu\text{S}/\text{cm}$)	32.9
APHA 4500 Cl-B	Chloride ion content (ppm)	30
	Chloride ion content (% w/w)	0.003
APHA 4500 SO4 2-B	Sulphate content (ppm)	45
	Sulphate content (% w/w)	0.004
	Mean Resistivity $\Omega\cdot\text{m}$	-
	(Resistivity) Density ratio (R_D)	-
	(Resistivity) Density index (I_D)	-
	Sulphides Present	-
	Sulphur Peroxide (% w/w)	-
	Resistivity (ohm m)	-

Notes



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12/05/2022

Date:



Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

PINHOLE DISPERSION REPORT

Client	MAAS Group Properties	Source	BH01 0.50-1.0m
Address	20L Sheraton Road Dubbo NSW 2830	Sample Description	Gravelly Silty CLAY
Project	Vera Vista	Report No.	S76242-PH
Job No.	S21583-1	Sample No.	S76242 (BTH-329A)

Test Procedure	☒ AS1289 3.8.3 Soil classification tests - Dispersion - Determination of pinhole dispersion classification of a soil	Date Sampled	23/03/2022
Sampling	Sampled by Client - results apply to the sample as received	Date Tested	4/05/2022
Preparation	Prepared in accordance with the test method		

Pinhole Dispersion Results	
Pinhole Dispersion Classification	ND2 Completely Erosion Resistant
Flow rate (ml/s)	2.500
Natural Moisture Content (%)	24.8
Moisture Content Before Testing (%)	16.7
Time Required to Mature Sample (Curing time in hours)	24 Hrs
Density Before Testing (Dry Density t/m ³)	1.535
Method of Moisture Determination for Remoulding	Plastic Limit
Source of Water	Distilled - Laboratory
Hole Reformed at 50mm Head (Yes / No)	No
Comments	
-	

Notes



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Authorised Signatory:

Chris Lloyd

6/05/2022

Date:



Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

PINHOLE DISPERSION REPORT

Client	MAAS Group Properties	Source	BH02 3.50-4.0m
Address	20L Sheraton Road, Dubbo NSW 2830	Sample Description	Silty Sandy CLAY
Project	Vera Vista	Report No.	S76243-PH
Job No.	S21583-1	Sample No.	S76243 (BTH-329D)

Test Procedure	☒ AS1289 3.8.3 Soil classification tests - Dispersion - Determination of pinhole dispersion classification of a soil	Date Sampled	23/03/2022
Sampling	Sampled by Client - results apply to the sample as received	Date Tested	5/05/2022
Preparation	Prepared in accordance with the test method		

Pinhole Dispersion Results	
Pinhole Dispersion Classification	D1 Highly Dispersive
Flow rate (ml/s)	0.983
Natural Moisture Content (%)	15.0
Moisture Content Before Testing (%)	12.7
Time Required to Mature Sample (Curing time in hours)	24 Hrs
Density Before Testing (Dry Density t/m ³)	1.717
Method of Moisture Determination for Remoulding	Plastic Limit
Source of Water	Distilled - Laboratory
Hole Reformed at 50mm Head (Yes / No)	No
Comments	
-	

Notes



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Authorised Signatory:

Chris Lloyd

6/05/2022

Date:



Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

PINHOLE DISPERSION REPORT

Client	MAAS Group Properties	Source	BH03 1.80-2.50m
Address	20L Sheraton Road, Dubbo NSW 2830	Sample Description	Silty Sandy CLAY
Project	Vera Vista	Report No.	S76244-PH
Job No.	S21583-1	Sample No.	S76244 (BTH-329I)

Test Procedure	☒ AS1289 3.8.3 Soil classification tests - Dispersion - Determination of pinhole dispersion classification of a soil	Date Sampled	23/03/2022
Sampling	Sampled by Client - results apply to the sample as received	Date Tested	5/05/2022
Preparation	Prepared in accordance with the test method		

Pinhole Dispersion Results	
Pinhole Dispersion Classification	ND2 Completely Erosion Resistant
Flow rate (ml/s)	3.177
Natural Moisture Content (%)	7.3
Moisture Content Before Testing (%)	13.0
Time Required to Mature Sample (Curing time in hours)	24 Hrs
Density Before Testing (Dry Density t/m ³)	1.825
Method of Moisture Determination for Remoulding	Plastic Limit
Source of Water	Distilled - Laboratory
Hole Reformed at 50mm Head (Yes / No)	No
Comments	
-	

Notes



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