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Integrated Practical Solutions

Report on Geotechnical Investigation

Proposed Mixed-Use Development
2-6 Cavil Avenue, Ashfield

Prepared for
Shayher Alliance Pty Ltd

Project 99573.00
November 2020

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Document History

Document details

Project No.	99573.00	Document No.	R.001.Rev1
Document title	Report on Geotechnical Investigation Proposed Mixed-Use Development		
Site address	2-6 Cavil Avenue, Ashfield		
Report prepared for	Shayher Alliance Pty Ltd		
File name	99573.00.R.001.Rev1		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Andrew McIntyre	Peter Oitmaa	5 May 2020
Revision 1	Andrew McIntyre	Peter Oitmaa	30 November 2020

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	-	Ken Liao, Shayher Alliance Pty Ltd Andy Chiu, Shayher Alliance The Trustee for Lin Family Ashfield Unit Trust
Revision 1	1	-	Ken Liao, Shayher Alliance Pty Ltd Andy Chiu, Shayher Alliance The Trustee for Lin Family Ashfield Unit Trust

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		30 November 2020
Reviewer		30 November 2020

bsi. ISO 9001 Quality Management
FS 604853

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666

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Report on Geotechnical Investigation
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1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed mixed-use development at 2 – 6 Cavil Avenue, Ashfield. The work was commissioned in an email dated 10 February 2020 by Andy Chiu of Shayher Alliance The Trustee for Lin Family Ashfield Unit Trust and was undertaken in accordance with Douglas Partners' proposal SYD200012.P.001.Rev1 dated 7 February 2020.

The proposed development includes the demolition of the existing structures and the construction of four residential towers up to 10 storeys high with a common two level basement carpark. The lowest proposed basement level (LB2) is at RL 14.1 m relative to the Australian Height Datum (AHD). Excavations to approximately 6 m to 10 m depth will be required to facilitate basement construction.

The investigation was carried out to provide information on subsurface conditions for design and planning purposes. The investigation included the drilling of six boreholes, laboratory testing of selected rock core and soil samples, engineering analysis and reporting. Details of the field and laboratory work are given in the report, together with comments on design and construction issues.

The scope for this investigation did not include a contamination assessment or waste classification assessment of soils for off-site disposal.

2. Site Description and Geology

The site of the proposed development is shown on Drawing 1 in Appendix B. The site covers an area of approximately 8,400 m^2 and is bounded by Cavil Avenue to the east, Thomas Street to the south, and Liverpool Road (Hume Highway) to the south-east. The northern and western site boundaries are shared with a number of brick dwellings ranging from 1 to 4 storeys high. Additionally, a rail corridor (associated with the Western Line) lies approximately 20 m to the north of the site.

At the time of the investigation, the site was occupied by two 4-storey commercial office buildings. The buildings were located centrally to the site, with the remainder of the area occupied by landscaping, parking and associated pavements. A two-level basement car park is also present on the site, the extent of which is shown on Drawing 1 in Appendix B. It is understood that the lowest finished floor level of the existing car park is approximately RL 16.8 m AHD. Structural details and condition of the existing basement retention system are unknown.

Ground surface levels generally range between RL 23 m and RL 24 m in the northern and eastern portions of the site, falling to approximately RL 19.6 m at the driveway ramp in the south-western corner of the site.

Reference to the Sydney 1:100,000 Geological Series Sheet indicates that the site is underlain by Ashfield Shale which typically comprises black to dark grey shale, siltstone and laminite (finely interbedded siltstone and fine grained sandstone). The geological mapping was confirmed by investigation which encountered residual clays over laminite and siltstone.

3. Field Work Methods

The field work for the current investigation included six boreholes (BH1 to BH6) which were drilled using truck and track-mounted geotechnical drilling rigs. The borehole locations are shown on Drawing 1 in Appendix B.

The boreholes were drilled through the fill and soils to depths of between 4.0 m and 6.88 m using solid flight augering and rotary washboring methods. Standard Penetration Tests (SPTs) were carried out at regular intervals within the soil strata, with samples taken for subsequent laboratory testing. The boreholes were then advanced to depths of between 10 m and 13 m using NMLC-sized diamond core drilling equipment to obtain 50 mm diameter continuous core samples of rock for identification and strength testing purposes.

The boreholes were logged and sampled by a geotechnical engineer. The rock cores recovered from the boreholes were photographed, then Point Load Strength Index (Is_{50}) tests were carried out on selected samples.

A groundwater monitoring well was installed in BH1 to allow for the future measurement of groundwater levels. Details of the well construction are provided on the borehole log.

The ground surface levels and coordinates of the borehole locations were obtained by use of a differential GPS (dGPS). Where poor sky view precluded the use of the dGPS (i.e. due to tree coverage), coordinates were obtained with reference to Nearmap.com.au imagery and surface levels were interpolated from spot levels on LTS Survey Drawing 50291-002DT dated 10 January 2019.

4. Field Work Results

Details of the subsurface conditions encountered during the investigation are given in the borehole logs in Appendix C, together with colour photographs of the rock core and notes defining classification methods and descriptive terms. The sequence of materials encountered within the boreholes, in increasing depth order, may be summarised as follows:

Surface Cover: Asphaltic concrete between 20 mm and 80 mm thick encountered at all locations, with the exception of brick pavers at BH4 and topsoil at BH5. The asphaltic concrete at BH3 was underlain by a concrete slab to 0.3 m depth, over a void approximately 100 mm thick;

Fill: Encountered at all locations to depths of between 0.4 m and 2 m, although deeper fill was encountered in BH3 to 3.8 m depth. The deeper fill profile encountered in BH3 is likely to be associated with backfill behind the existing basement retaining wall. The fill generally comprises a mix of sandy clay, gravelly sand and silty clay with inclusions of sandstone and igneous gravel. SPT N-values between 4 and 21 indicate the fill is variably compacted corresponding with a firm to very stiff cohesive soil;

Natural Clay: Natural stiff to hard clay and silty clay to depths of between 4.55 m and 6.9 m;

Laminite/ Siltstone: Very low to low strength siltstone becoming generally medium strength siltstone/laminite at depths of between 8.4 m and 11.1 m. The lower strength siltstone and laminite was generally fragmented to fractured, grading to fractured to slightly fractured for the medium strength rock.

Numerous decomposed zones/seams are present within the rock mass, together with joint sets dipping between 30 and 70 degrees. Disturbed bedding and sheared defects/zones were also observed in BH2, BH3, BH5 and BH6.

No free groundwater was observed during augering in the boreholes to depths of up to approximately 6.9 m. Groundwater was measured in the monitoring well in BH1 at a depth of 6.3 m (RL 13.3 m) on 15 April 2020, approximately 6 weeks day after installation and development.

5. Laboratory Testing

5.1 Aggressivity

Two soil samples were tested at an external laboratory to assess aggressivity (pH, chloride, sulphate and electrical conductivity) to buried concrete elements. The results are summarised in Table 1 and are provided in Appendix D. Further discussion of aggressivity is provided in Section 8.7.

Table 1: Summary of Laboratory Chemical Analysis

Bore	Depth (m)	Material	pH	Chloride (mg/kg)	Sulphate (mg/kg)	Electrical Conductivity (µS/cm)
BH2	3.75-4.20	Silty Clay	5.3	38	21	23
BH6	2.50-2.95	Silty Clay	5.6	29	10	10

5.2 Point Load Strength Index

Selected samples of the rock core were tested in the laboratory to determine the Point Load Strength Index (Is_{50}) values to assist with the rock strength classification. The results of the testing are shown on the borehole logs at the appropriate depth. The Is_{50} values for the rock ranged from 0.05 MPa to 2.3 MPa, indicating that the rock samples tested were of very low to high strength. The corresponding

Uniaxial Compressive Strength, based on an estimated Is_{50} to UCS multiplier of 20, is in the range of 1 – 52 MPa.

6. Geotechnical Model

Two geotechnical cross-sections (Section A-A' and B-B') are shown on Drawings 2 and 3 in Appendix B. The sections show interpreted geotechnical divisions of underlying soil and rock together with the current ground surface level/existing basement and proposed basement level.

It should be noted that the interpreted boundaries shown on the sections are accurate at the borehole locations only and layers shown diagrammatically on these drawings are based on inferred strata boundaries. Reference should be made to the borehole logs for more detailed information and descriptions of the soil and rock.

The rock encountered in the boreholes has been classified in accordance with the procedures given in Reference 1, which use a combination of rock strength and fracture spacing to divide the rock into five classes ranging from Class I (high strength with very few defects) to Class V (extremely low to very low strength and/or highly fractured). The interpreted depth and Reduced Level (RL) at the top of the various rock classes is shown in Table 2. In some cases, the rock classes of stronger rock have been downgraded due to the presence of significant defects and weak seams that will dominate the engineering behaviour of the rock mass.

Table 2: Summary of Depths (and Reduced Levels) to Top of Various Rock Strata

Bore	Surface RL (AHD)	Depth (RL) to top of Siltstone/Laminite Strata [m (m AHD)]		
		Class V	Class IV	Class III
BH1	19.6	4.55 (15.1)	7.57 (12.0)	8.41 (11.2)
BH2	22.2	6.2 (16.0)	7.15 (15.1)	9.25 (13.0)
BH3	22.9	6.88 (16.0)	8.57 (14.3)	11.2 (11.7)
BH4	23.9	6.01 (17.9)	6.89 (17.0)	10.7 (13.2)
BH5	24.0	6.47 (17.5)	8.91 (15.1)	11.1 (12.9)
BH6	23.1	6.03 (17.1)	6.93 (16.2)	11.0 (12.1)

Notes: - Rock classification is based on Reference 1;
- Reduced Levels (to AHD) for the top of the stratum are rounded to nearest 0.1m

7. Proposed Development

Based on architectural plans prepared by PTW Architects, it is understood that the proposed development will comprise the construction of four residential buildings between 7 and 10 storeys tall. The buildings share a common two level basement across the development footprint. A third basement level ('ground floor basement') is planned in the northern portion of the site, where the existing site levels are generally higher.

The lowest proposed basement level (LB2) is at RL 14.1 m AHD. Excavations to approximately 6 m to 10 m depth will be required to facilitate basement construction. Deeper, detailed excavations are likely to be required for lift pit over runs, footings and service trenches. Specific details of column working loads for the new building have not been provided.

Based on preliminary basement floor plans (ref: "B1 Floor – Double L Option"), it is understood that the basement excavation will be set back between 4 m and 8 m distance from the site boundaries. When the proposed and existing basement outlines are overlaid (refer to Drawing 1 in Appendix B), it appears that the proposed retaining wall will be constructed in front of the existing retaining wall in some portions of the site, in particular in the south-eastern corner of the site. The relative position of the proposed and existing retaining walls should be confirmed by the designer.

8. Comments

8.1 Considerations Relating to Rail and RMS Infrastructure

A rail corridor lies approximately 20 m north of the northern site boundary, and the edge of the closest track appears to be approximately 25 m from the site boundary. Based on available LiDAR data and site observations, it appears the existing site levels are approximately equal to the level of the tracks (~RL 23 m AHD). The proposed development is required to take the nearby rail corridor into consideration.

Developments near rail corridors fall under State Environmental Planning Policy Infrastructure (2007), which may trigger certain consent conditions during the Development Application process. Further details and guidance on interpreting the requirements of the Infrastructure SEPP (2007) are provided in the NSW Department of Planning document *"Development Near Rail Corridors and Busy Roads – Interim Guideline" (2008).*

Based on previous experience, it is likely that Sydney Trains may require geotechnical assessment of proposed footing and excavation plans where the development involves "penetration of the ground to a depth of at least 2 m below ground level of (existing) land" that is "within 25 m (measured horizontally) or a rail corridor" (ref: Infrastructure SEPP Clause 86). Penetration of the ground is broadly defined and may include excavations for piled foundations.

The extent of assessment and any monitoring requirements is subject to discussion and agreement from Sydney Trains once final details of the proposed development are known.

In relation to excavation/shoring along the Liverpool Road (Hume Highway) frontage, reference should also be made to the Roads and Maritime Services (RMS) Geotechnical Technical Direction (GTD) 2012/001 dated April 2012. This document outlines requirements for excavations adjacent to RMS infrastructure and outlines details for dilapidation surveys, instrumentation and monitoring during construction. Instrumentation (e.g. inclinometers) and monitoring is typically required where the excavation exceeds 3 m depth (for cantilevered shoring walls) or 6 m depth (for anchored or propped shoring walls). A geotechnical monitoring plan may be required by RMS prior to construction on the site.

8.2 Site Preparation and Excavation

8.2.1 Excavation Conditions

It is anticipated that excavation for the basement to about 6 m to 10 m depth will require the removal of mostly soil and very low to low strength siltstone/laminite. Excavation of soil and extremely low to low strength rock should be achievable using conventional earthmoving equipment, however the assistance of rock hammering or ripping will probably be required for effective removal of any medium to high strength ironstone bands within the weathered rock sequence.

Where encountered, excavation of medium strength (or better) rock may require heavy ripping, together with the use of hydraulic rock breakers and/or rock saws for effective removal of this material. The detailed excavation for footings, services and side walls within medium strength or stronger rock will generally require the use of a rotary rock saw or grinder, or hydraulic rock hammer. Rock saws are recommended close to neighbouring buildings to reduce disturbance.

8.2.2 Vibrations

During excavation, it will be necessary to use appropriate methods and equipment to keep ground vibrations near adjacent buildings and structures within acceptable limits. The level of acceptable vibration is dependent on various factors including the type of building structure (e.g. reinforced concrete, brick, etc.), its structural condition, the frequency range of vibrations produced by the construction equipment, the natural frequency of the building and the vibration transmitting medium.

Ground vibration can be strongly perceptible to humans at levels above 2.5 mm/s component peak particle velocity (PPVi). This is generally much lower than the vibration levels required to cause structural damage to buildings. The Australian Standard AS2670.2-1990 *"Evaluation of human exposure to whole-body vibrations – continuous and shock induced vibrations in buildings (1-80 Hz)"* indicates an acceptable day time limit of 8 mm/s PPVi for human comfort.

Based on the experience of DP and with reference to AS2670, it is suggested that a maximum PPVi of 8 mm/s (applicable at the foundation level of existing buildings) be adopted at this site for both architectural and human comfort considerations, although this vibration limit may need to be reduced if there are sensitive buildings or equipment in the area.

As the magnitude of vibration transmission is site specific, it is recommended that a vibration trial be undertaken at the commencement of rock excavation. The trial may indicate that smaller or different types of excavation equipment should be used for bulk (or detailed) excavation purposes.

8.2.3 Disposal of Excavated Material

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014). This includes filling and natural materials that may be removed from the site.

8.3 Excavation Support

Vertical excavations within the fill, soil and rock will require both temporary and permanent lateral support during and after excavation. Excavations in siltstone and laminite will also need to consider jointing and potential wedges that may be formed, although this is unlikely to govern design for the relatively shallow two level basement excavation.

It is likely that the existing basement slabs are providing lateral support to the existing retaining walls. During demolition, careful consideration will need to be made with respect to construction sequencing to ensure that the existing retaining walls continue to provide adequate support to the retained material until the new retaining walls become 'active'. In this regard, it may be necessary to undertake temporary anchoring/propping of the existing walls prior to removal of the slabs.

8.3.1 Batter Slopes and Vertical Rock Faces

Suggested temporary and permanent batter slopes for unsupported excavations up to a maximum depth of 4 m are shown in Table 3. If surcharge loads are applied near the crest of the slope then further specific geotechnical review and probably flatter batters or stabilisation using rock bolts or soil nails may be required.

Table 3: Recommended Batter Slopes for Exposed Material

Exposed Material	Maximum Temporary Batter Slope (H : V)	Maximum Permanent Batter Slope (H : V)
Fill and Clay	1 : 1	2 : 1**
Class V and IV Laminite/Siltstone	1 : 1	1.5 : 1*
Class III (or better) Laminite/Siltstone	1 : 1	1 : 1*

Note: * Subject to jointing assessment by experienced Geotechnical Engineer/Engineering Geologist

** Permanent batters in soil may need to be reduced to 3H: 1V to facilitate maintenance of grassed slopes, if required

8.3.2 Shoring Walls

Where batter slopes cannot be accommodated, shoring walls will be required to support the filling, soils and rock. Anchored soldier pile walls are often used to provide temporary retaining support to residual soils and weathered rock.

The soldier piles are usually spaced at approximately 2 m to 2.5 m centres, although more closely spaced piles may be required to reduce wall movements, or prevent collapse of infill materials, particularly where pavements, structures or services are located in close proximity to the excavation.

Shoring piles should be founded at least 1.0 m below the lowest excavation level (including detailed excavation) in order to provide lateral restraint at the base of the excavation and to avoid the risk of adversely inclined joints or wedges undermining the base of the piles. Suitably sized drilling rigs fitted with rock augers will be required to penetrate the medium strength (or stronger) rock.

For standard bored piles allowance should be made for pumping of water from the pile hole prior to pouring concrete, or the use of tremie pour techniques.

8.3.3 Earth Pressure Design

It is suggested that preliminary design of cantilevered shoring systems (or shoring with one row of anchors or propping) be based on a triangular earth pressure distribution using the earth pressure coefficients provided in Table 4.

Table 4: Recommended Design Parameters for Shoring Systems

Material	Unit Weight (kN/m^3)	Earth Pressure Coefficient		Effective Cohesion c' (kPa)	Effective Friction Angle (Degrees)
		Active (K_a)	At Rest (K_o)		
Fill and Clay	20	0.3	0.5	5	20
Class V and IV Laminite/Siltstone	21	0.2	0.3	10	25
Class III (or better) Laminite/Siltstone	22	10 kPa uniform	10 kPa uniform	20	25

'Active' earth pressure coefficient (K_a) values may be used for a wall where some wall movement is acceptable, and 'at rest' earth pressure (K_o) values should be used where the wall movement needs to be reduced (i.e. adjacent to existing structures or utilities). A uniform pressure of 10 kPa should be adopted for the support of medium strength or stronger laminite/siltstone (Class III) between soldier piles and/or anchors to account for minor joint wedges that may become mobilised.

Where multiple rows of anchors or propping are used it is suggested that preliminary design of shoring walls could be based a trapezoidal earth pressure distribution with a maximum pressure calculated based on 4H kPa where H is equal to the retained height of soil and extremely low to low strength rock. The maximum pressure should be increased to 6H where wall movement needs to be reduced. In each case the maximum pressure generally acts over the central 60% of the wall, reducing to zero at the top and base.

The design of temporary and permanent support will also need to consider the possibility that 45 degree joints in the siltstone and laminite will daylight near the base of the excavation leading to wedges of rock requiring support by the temporary and permanent retaining structures. As a guide, an anchor force equal to $4.2H^2$ kN per meter length of wall would be required for a continuous 45 degree joint daylighting at the toe of the excavation. This mechanism usually only governs shoring design for deeper excavations in stronger siltstone/laminite and is unlikely to be relevant for a two level basement in residual clay and very low to medium strength rock.

All surcharge loads should be allowed for in the shoring design including building footings, inclined slopes behind the wall, traffic and construction related activities.

Shoring walls should also be designed for full hydrostatic pressures unless drainage of the ground behind impermeable walls can be provided. Drainage could comprise 150 mm wide strip drains pinned to the face at 1 m to 2 m centres behind the shotcrete in-fill panels. The base of the strip drains should extend out from the shoring wall to allow any seepage to flow into a perimeter toe drain which is connected to the stormwater drainage system

8.3.4 Passive Resistance

Passive resistance for piles founded below the base of the bulk excavation (including allowance for services or footings) may be based on the ultimate passive restraint values provided in Table 5. These ultimate values will need to incorporate a factor of safety to limit the wall movement that is required to mobilise the full passive resistance. The top 0.5 m of the socket should be ignored due to possible disturbance (e.g. over-excavation) and tolerance effects. The passive restraint adopted in the design should not exceed the shear capacity of the pile.

Table 5: Passive Resistance Values

Foundation Stratum	Ultimate Passive Pressure (kPa)
Fill/Clay	N/A
Class V Laminite/Siltstone	500
Class IV Laminite/Siltstone	1000
Class III (or better) Laminite/Siltstone	2000

8.3.5 Ground Anchors

The design of temporary and permanent ground anchors for the support of excavations and/or shoring systems may be carried out on the basis of the maximum allowable bond stresses given in Table 6.

Table 6: Allowable Bond Stresses for Rock Anchor Design

Material Description	Maximum Allowable Bond Stress (kPa)	Maximum Ultimate Bond Stress (kPa)
Fill	N/A	N/A
Clay: Very Stiff to Hard	40	80
Class V Laminite/Siltstone	75	150
Class IV Laminite/Siltstone	100	200
Class III (or better) Laminite/Siltstone	200	400

The parameters given in Table 6 assume that the drilled holes are clean and adequately flushed. The anchors should be bonded behind a line drawn up at 45 degrees from the base of the shoring, and "lift-off" tests should be carried out to confirm the anchor capacities. It is suggested that ground anchors should be proof loaded to 125% of the design working load and locked-off at no higher than 80% of the working load.

It is anticipated that the building will support the basement excavation over the long term and therefore the ground anchors are expected to be temporary only. The use of permanent anchors would require careful attention to corrosion protection including full column grouting and the use of an internal corrugated sheathing over the full length of the anchor. A detailed specification would need to be prepared for the installation and stressing of permanent anchors.

8.4 Groundwater and Seepage

Groundwater was not encountered during auger drilling of the boreholes to shallow depths, although was measured at a depth of 6.3 m in BH1. It is expected that the measured water is associated with perched water within the clay and top of rock and not a permanent or regional groundwater table. Some seepage flows should be expected along the top of the rock and through fractures and joints in the rock, particularly following periods of wet weather.

During construction and in the long term, it is anticipated that seepage into the excavation should be readily controlled by perimeter and subfloor drainage connected to a "sump-and-pump" system. On this basis, a drained basement may be considered for this site.

Generally, water collected from dewatering operations should be suitable for disposal by pumping to stormwater drains subject to confirmation testing and approval from Council. Treatment by flocculating or other methods may be required prior to pumping.

Based on DPs experience, it is possible that seepage into the basement may give rise to precipitation of red brown iron oxide residue from the groundwater and therefore perimeter and subfloor drains should be designed for easy access to allow for inspection, maintenance and periodic cleaning.

8.5 Foundations

It is expected that bulk excavation to about RL 14 m will expose Class IV siltstone/laminite over most of the site for which pad footings may be suitable. However, in some areas (e.g. the south-eastern corner) Class V rock will be exposed at bulk excavation level so a reduced bearing capacity will apply.

Alternatively, bored piles could be used to reach a stronger (Class III) and more consistent founding stratum. The shoring piles could also be designed to carry building loads if required. Seepage should be expected within the open piles and therefore allowance for pumping to remove water or the use of tremie methods to place concrete should be considered. Relatively high seepage flows can sometimes occur at the rock/soil interface and within the fractured rock.

Recommended maximum pressures for the various rock strata are presented in Table 7. If piles are utilised, shaft adhesion values for uplift (tension) may be taken as being equal to 70% of the values for compression.

Table 7: Recommended Design Parameters for Foundation Design

Foundation Stratum	Maximum Allowable Pressure		Maximum Ultimate Pressure	
	End Bearing (kPa)	Shaft Adhesion (Compression) (kPa)	End Bearing (kPa)	Shaft Adhesion (Compression) (kPa)
Fill and Clay	N/A	N/A	N/A	N/A
Class V Laminite/Siltstone	700	70	1000	100
Class IV Laminite/Siltstone	1000	100	3000	150
Class III (or better) Laminite/Siltstone	3500	350	15,000	600

Foundations proportioned on the basis of the allowable bearing pressures in Table 7 would be expected to experience total settlements of less than 1% of the footing width / pile diameter under the applied working load, with differential settlements between adjacent columns expected to be less than half of this value.

All footings/piles should be inspected by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters.

8.6 Site Preparation and Engineered Fill

It is suggested that site preparation and engineered fill for lightly loaded pavements and/or raising of site levels should incorporate the following:

- Stripping of vegetation, organic topsoil and obvious unsuitable material;
- Rolling of the exposed subgrade with at least 8 passes of a vibrating smooth drum roller with a minimum static weight of 10 tonnes. The final pass (proof roll) of the subgrade should be

inspected by a geotechnical engineer to detect any soft or heaving areas. Any soft spots detected during proof rolling would generally need to be stripped to a stiff base or depth of approximately 0.5 m, subject to confirmation by a geotechnical engineer, and replaced with engineered filling;

- Engineered filling for replacing soft spots or raising site levels should be placed in layers of 300 mm maximum loose thickness and compacted to a dry density ratio of between 98% and 102% relative to Standard compaction with moisture contents strictly within 2% of Standard optimum moisture content (OMC). The density ratio should be increased to between 100% and 102% Standard compaction within 0.3 m of the finished surface. The existing fill and clayey soils/rock on site should generally be suitable for re-use as engineered filling provided it has a maximum particle size of 150 mm and moisture content within 2% of Standard OMC. Reuse of material should also consider the contamination status of the soil, which may require further assessment;
- Density testing of each layer of filling should be undertaken in accordance with AS 3798-2007 "Guidelines for Earthworks for Commercial and Residential Developments" to verify that specified density ratios have been achieved.

8.7 Aggressivity

Aggressivity to buried concrete and steel structures was assessed using the laboratory test results presented in Section 5.1. The exposure classification is assessed as being mildly aggressive to concrete structures and non-aggressive to steel structures in accordance with Australian Standard AS 2159 – 2009 *Piling – Design and Installation*.

8.8 Seismicity

In accordance with Australian Standard AS1170 – 2007 *"Structural Design Actions, Part 4: Earthquake Actions in Australia"*, a hazard factor (z) of 0.08 and a site subsoil Class C_e is considered appropriate for this site.

9. References

1. Pells, P.J., Mostyn, G. and Walker, B.F. *"Foundations on Sandstone and Shale in the Sydney Region".* Australian Geomechanics Journal, Vol. No. 33 Part 3, Dec. 1998.
2. Australian Standard AS2159 – 2009, 'Piling – Design and Installation', October 2010, Standards Australia

10. Limitations

Douglas Partners (DP) has prepared this report (or services) for this project at 2-6 Cavil Avenue, Ashfield in accordance with DP's proposal SYD2000012.P.001.Rev1 dated 7 February 2020 and acceptance received from Andy Chiu of Shayher Alliance The Trustee for Lin Family Ashfield Unit Trust dated 10 February 2020. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Shayher Alliance Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report .

Douglas Partners Pty Ltd

Appendix A

About This Report

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.

  Soil tends to stick together.

  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.

  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈LL' (i.e. near the liquid limit).
- 'Wet' or 'w >LL' (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

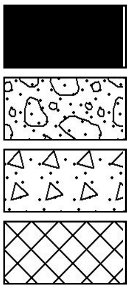
Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

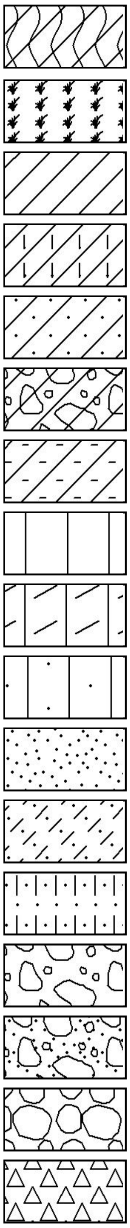
Graphic Symbols for Soil and Rock

General



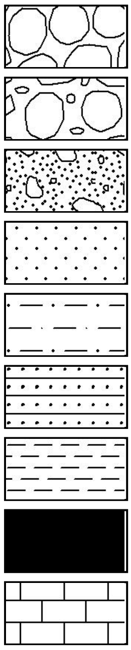
- Asphalt
- Road base
- Concrete
- Filling

Soils



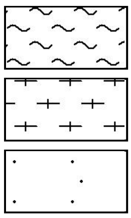
- Topsoil
- Peat
- Clay
- Silty clay
- Sandy clay
- Gravelly clay
- Shaly clay
- Silt
- Clayey silt
- Sandy silt
- Sand
- Clayey sand
- Silty sand
- Gravel
- Sandy gravel
- Cobbles, boulders
- Talus

Sedimentary Rocks



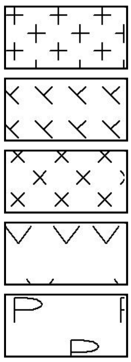
- Boulder conglomerate
- Conglomerate
- Conglomeratic sandstone
- Sandstone
- Siltstone
- Laminite
- Mudstone, claystone, shale
- Coal
- Limestone

Metamorphic Rocks



- Slate, phyllite, schist
- Gneiss
- Quartzite

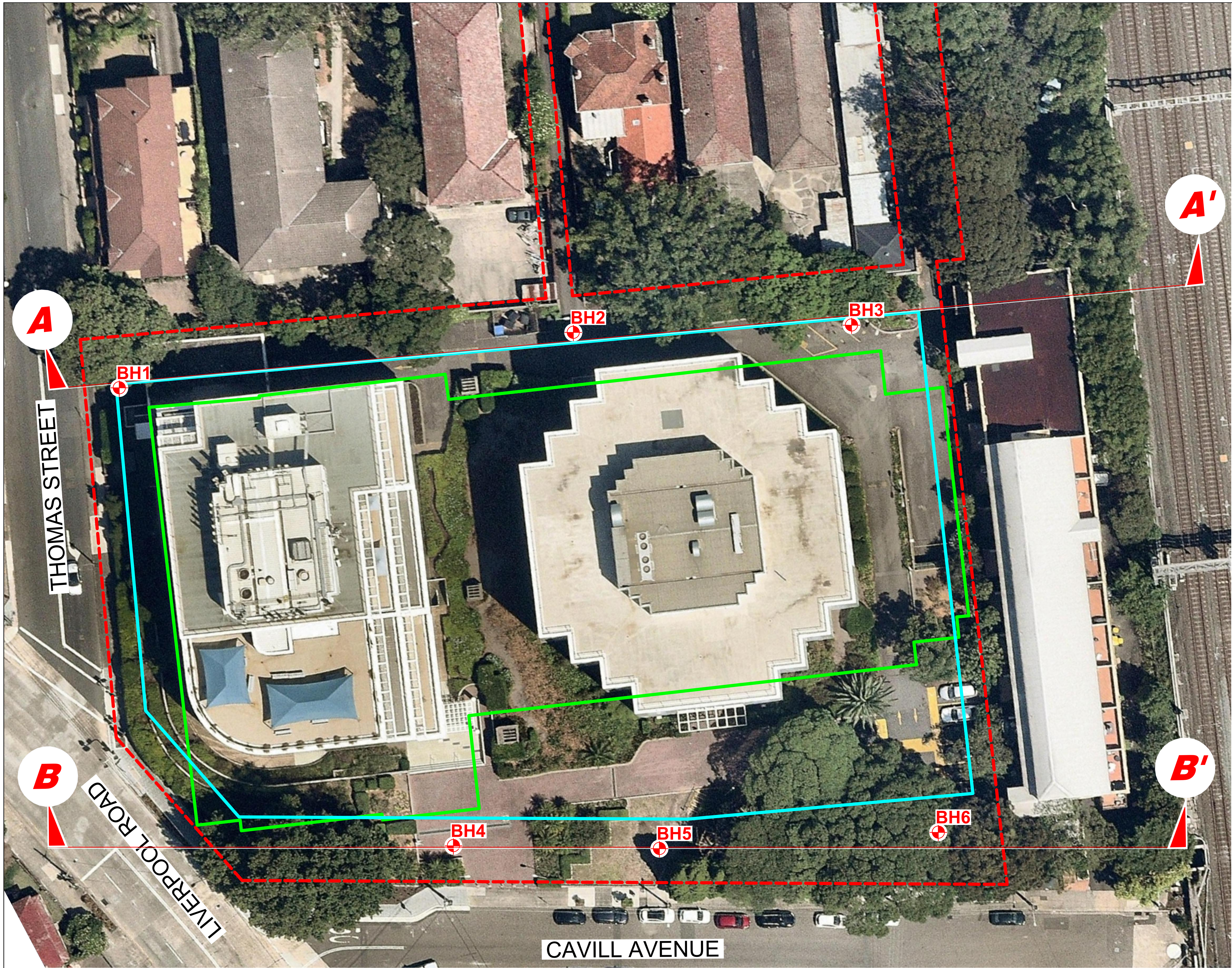
Igneous Rocks

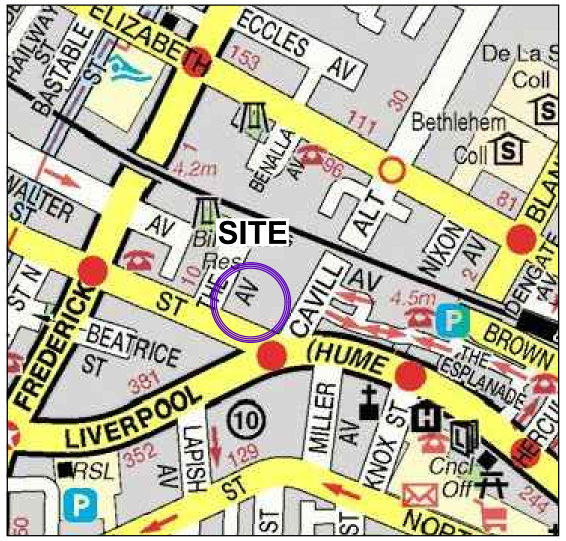


- Granite
- Dolerite, basalt, andesite
- Dacite, epidote
- Tuff, breccia
- Porphyry

Appendix B

Drawings





Locality Plan

LEGEND

- Approximate Borehole Location
- Outline of Existing Basement
- Outline of Proposed Basement
- Site Boundary
- A — A' Geotechnical Cross Section A-A'

0 5 10 15 20 30 40 50m

1:500 @ A3

NOTE:
1: Base image from Nearmap.com (Dated 21.1.2020)

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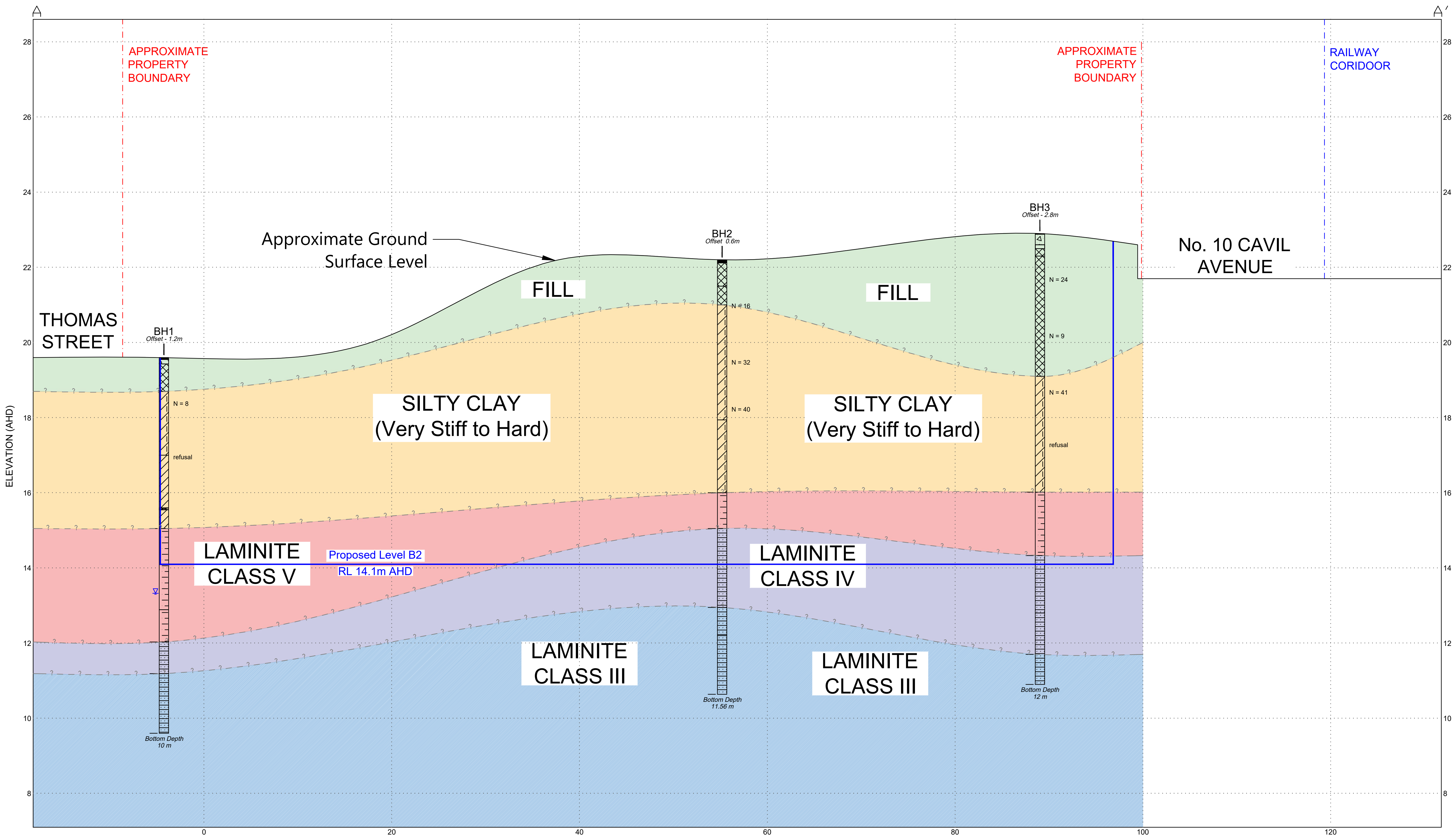
Geotechnics | Environment | Groundwater

CLIENT: Shayher Alliance Pty Ltd		TITLE: **Borehole Location Plan**	PROJECT No: 99573.00
OFFICE: Sydney	DRAWN BY: IT	**Proposed Mixed-Use Development**	DRAWING No: 1
SCALE: 1:500 @ A3	DATE: 30.11.2020	**2-6 Cavill Avenue, Ashfield**	REVISION: 1



LEGEND

Core Loss	Void	Siltstone
Asphaltic Concrete	Filling	Silty Clay
Clay	Laminite	
Concrete	Roadbase	

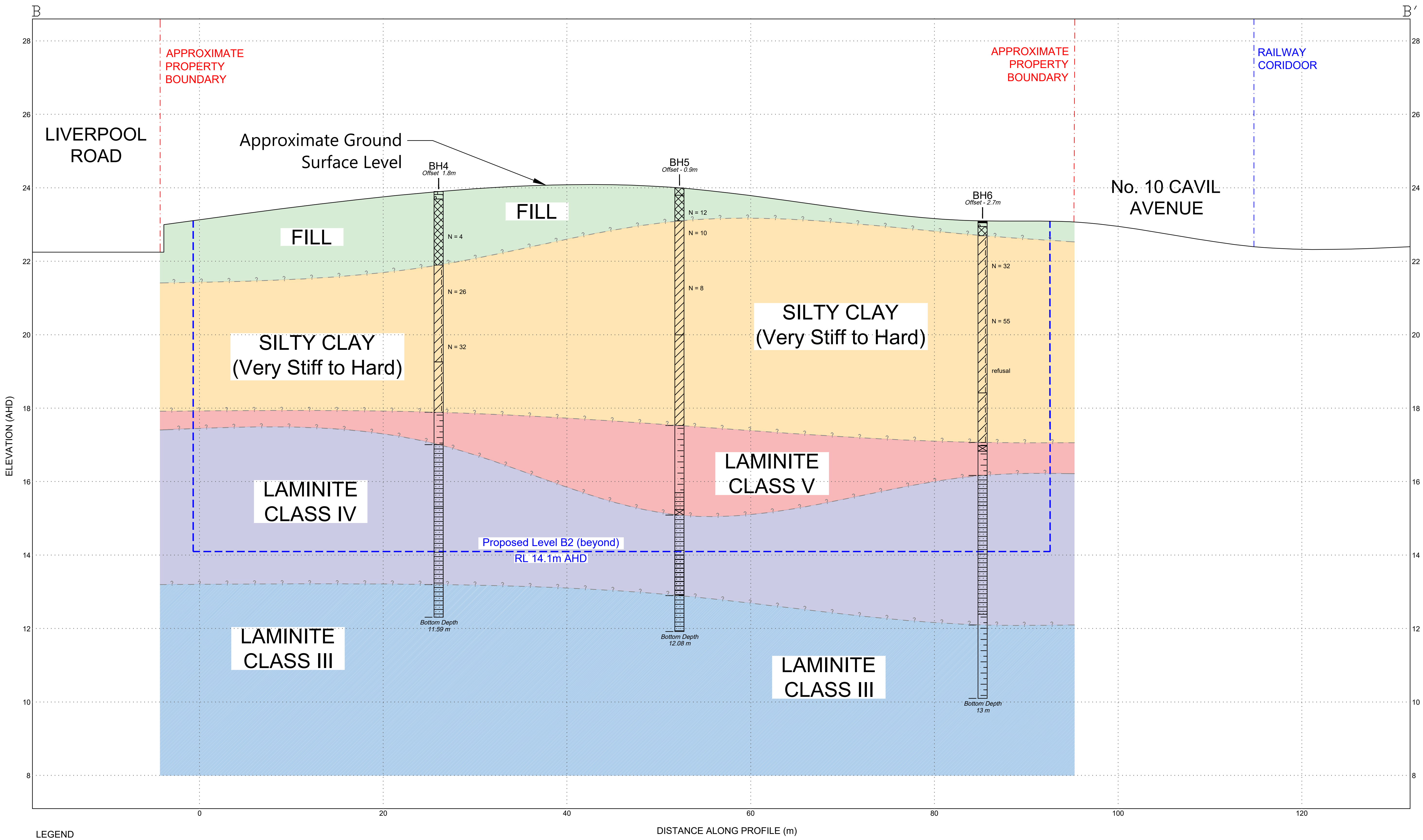
TESTS / OTHER
N - Standard penetration test value
Water level

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs included only and should be read in conjunction with detailed logs.

0 8
Horizontal Scale (metres)
Vertical Exaggeration = 4.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Shayher Alliance Pty Ltd	TITLE: Interpreted Geotechnical Cross-section A-A'	PROJECT No: 99573.00
OFFICE: Sydney / DRAWN BY: AH	Proposed Mixed-Use Development	DRAWING No: 2
SCALE: 1:400 (H) 1:100 (V) @ A3 / DATE: 30.11.2020	2-6 Cavil Avenue, Ashfield	REVISION: 1



LEGEND

- Core Loss
- Asphaltic Concrete
- Bricks
- Clay
- Filling
- Laminite
- Roadbase
- Siltstone
- Silty Clay

TESTS / OTHER

N - Standard penetration test value

- Water level

NOTES:

1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs included only and should be read in conjunction with detailed logs.

0 8

Horizontal Scale (metres)

Vertical Exaggeration = 4.0

Douglas Partners

Geotechnics / Environment / Groundwater

CLIENT: Shayher Alliance Pty Ltd		
OFFICE: Sydney	DRAWN BY: AH	
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 30.11.2020	

TITLE: Interpreted Geotechnical Cross-section B-B'
Proposed Mixed-Use Development
2-6 Cavil Avenue, Ashfield

PROJECT No:	99573.00
DRAWING No:	3
REVISION:	1

Appendix C

Results of Field Work

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 19.6 AHD
EASTING: 326230.4
NORTHING: 6248749.6
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 1 OF 1

Depth (m)	Description of Strata
0.05	ASPHALTIC CONCRETE: 50mm
0.17	FILL/ROADBASE
0.9	FILL/Sandy CLAY: low plasticity, brown, fine to medium sand, with fine to medium igneous gravel, w<PL, appears moderately compacted
2.6	Silty CLAY CL-CI: low to medium plasticity, pale grey and red-brown, trace fine to medium ironstone gravel, w<PL, stiff, residual
4.0	CLAY CI-CH: medium to high plasticity, pale grey, w<PL, very stiff to hard, residual
4.05	(core loss)
4.55	CLAY CI-CH: as above, with 40% iron indurated bands
6.71	SILTSTONE: grey and dark grey, very low strength, extremely weathered, fragmented to fractured, approximately 50% extremely weathered/decomposed seams, Ashfield Shale
7.57	SILTSTONE: dark grey, with 5% pale grey, fine grained sandstone laminations , very low strength, highly to moderately weathered, fractured, Ashfield Shale
8.41	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey, fine grained sandstone (30%), with iron indurated bands, low strength, slightly weathered, fractured, Ashfield Shale
10.0	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey, fine grained sandstone (30%), medium strength, fresh, slightly fractured, Ashfield Shale At 9.45m: tuffaceous bed, 50mm thick

Bore discontinued at 10.0m

Water: 15-04-20 (water level at approx. 6.3m)

Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault):

- Unless noted otherwise, defects are bedding partings dipping 0-10° that are planar, smooth with a clay coating or veneer
- 4m: CORE LOSS: 50mm
- 7.07m: Cs, 90mm
- 7.2m: Cs, 40mm
- 7.3m: Cs, 120mm
- 7.71m: J45°, pl, sm, cly vn
- 7.77m: Cs, 50mm
- 8.15m: J30°, pl, sm, cly vn
- 8.2-8.28m: J60°, un, ti, fe stn
- 8.32-8.4m: J70-90°, un, ro
- 8.4m: Cs, 10mm
- 8.72m: J30°, pl, sm, cln
- 8.81m: J30°, pl, sm, cln
- 8.82-9.03m: J80-90°, un, ro, cln
- 9.5m: Ds, 10mm

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
A			
A			
S			3,3,5 N = 8
S			12,25/150,HB refusal
C	96	0	
C	100	0	PL(A) = 0.05
C	100	55	PL(A) = 0.21 PL(A) = 0.2 PL(A) = 0.34
C	100	100	PL(A) = 0.46 PL(A) = 0.43 PL(A) = 0.86

RIG: Bobcat - target depth reached **DRILLER:** JE **LOGGED:** IT **CASING:** HW to 2.5m, HQ to 4.0m

TYPE OF BORING: Diatube to 0.17m, solid flight auger to 2.5m, washboring to 4.0m, NMLC coring to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Groundwater measured in monitoring well at 6.3m depth on 15/4/20.

REMARKS: Groundwater well installed: blank PVC 0.0-2.5m, screen PVC 2.5-10.0m, backfill 0.0-0.8m, bentonite 0.8-2.0m, gravel 2.0-10.0m, gatic cover at the surface. Coordinates obtained by dGPS. Surface level interpolated from LTS drawing 50291-002DT dated 10/1/19

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 1 PROJECT: 99573.00 February 2020

4.00 – 8.00 m

BORE: 1 PROJECT: 99573.00 February 2020

8.00 – 10.00 m

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 22.2 AHD
EASTING: 326251.8
NORTHING: 6248805.1
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 1 OF 2

Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
0.08	ASPHALTIC CONCRETE: 80mm		A			
0.7	FILL/Gravelly SAND: medium to coarse, grey, with fine to medium igneous gravel, dry, apparently in a dense condition		A			
1.2	FILL/Silty CLAY: medium plasticity, dark brown, with fine ironstone gravel, trace ash, w<PL, apparently in a stiff condition		A			
			S			5,7,9 N = 16
4.26	Silty CLAY CI-CH: medium to high plasticity, grey mottled red, trace fine subangular ironstone gravel, w<PL, very stiff to hard, residual		S			8,15,17 N = 32
		Unless noted otherwise, defects are bedding partings dipping 0-10° that are planar, smooth with a clay coating or veneer	S			9,15,25 N = 40
6.2	Silty CLAY CI-CH: medium to high plasticity, grey and red-brown, 40% iron indurated bands, hard, residual		C	100	0	
7.15	SILTSTONE: pale grey and red brown, very low to low strength, highly weathered, highly fractured, with 15% extremely weathered/ decomposed seams, Ashfield Shale	6.99m: Cs, 10mm	C	100	62	PL(A) = 0.15
9.25	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey fine grained sandstone (30%), medium strength, moderately to slightly weathered, fractured, Ashfield Shale	7.03m: Cs(x2), 10mm 7.09m: Ds, 20mm 7.11m: J45°, pl, ro, fe stn 7.12m: Cs, 30mm 7.15m: J60°, pl, ro, fe stn 7.35m: J30°, pl, ro, fe stn 8m: J45°, pl, he				PL(A) = 0.48 PL(A) = 0.4
	At 9.22m: tuffaceous bed, 30mm	9.05m: J60°, pl, fe co, he, sheared 9.12m: J60°, pl, fe co, he, sheared 9.2-9.24m: J70-80°, pl, fe, he	C	100	94	PL(A) = 0.35 PL(A) = 0.38
10.0	LAMINITE: description on page over					

RIG: Comacchio 305 **DRILLER:** CT **LOGGED:** AH **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.26m, NMLC coring to 11.56m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Coordinates obtained by dGPS. Surface level interpolated from LTS drawing 50291-002DT dated 10 January 19

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 22.2 AHD
EASTING: 326251.8
NORTHING: 6248805.1
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
12, 11	11	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey fine grained sandstone (30%), medium strength, fresh stained then fresh, slightly fractured, Ashfield Shale						10.34m: Ds, 10mm 10.61m: Ds, 10mm 10.81m: Ds, 10mm 10.87m: Ds, 10mm	C	100	94	PL(A) = 0.76 PL(A) = 2.3
10, 9, 8, 7, 6, 5, 4, 3	11.56, 12, 13, 14, 15, 16, 17, 18, 19	Bore discontinued at 11.56m - target depth reached										

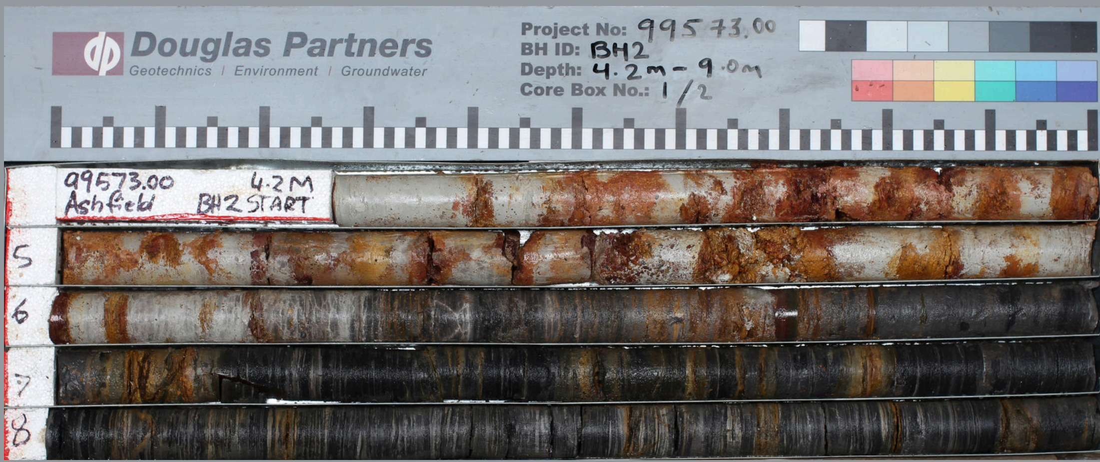
RIG: Comacchio 305 **DRILLER:** CT **LOGGED:** AH **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.26m, NMLC coring to 11.56m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates obtained by dGPS. Surface level interpolated from LTS drawing 50291-002DT dated 10 January 19

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

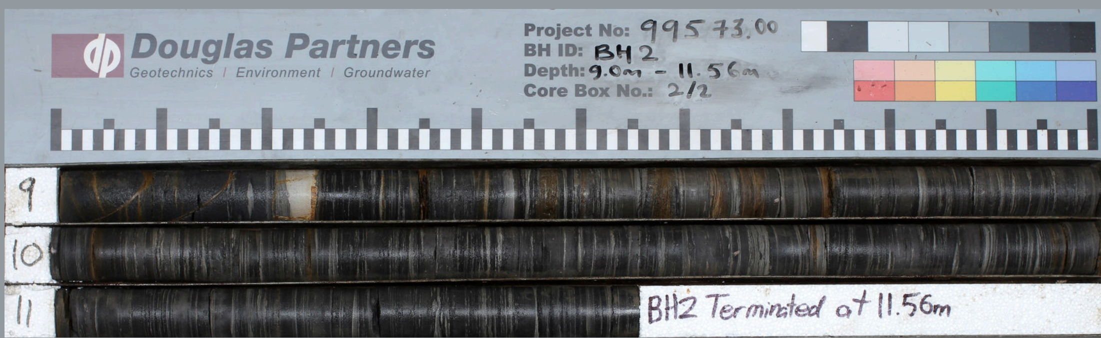
Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 2 PROJECT: 99573.00 February 2020



4.20 – 9.00 m

BORE: 2 PROJECT: 99573.00 February 2020



9.00 – 11.56 m

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 22.9 AHD
EASTING: 326268
NORTHING: 6248835
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 1 OF 2

Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
0.02	ASPHALTIC CONCRETE: 20mm					
0.3	CONCRETE: 280mm					
0.4	VOID: 100mm					
0.6	FILL/Silty CLAY: medium plasticity, brown, with sand and fine to medium ironstone and sandstone gravel, w<PL		A			
			A			
	FILL/Gravelly SAND: medium to coarse, orange and pale grey with medium to coarse sandstone gravel, dry, generally in a loose to medium dense condition		S			10,12,12 N = 24
			S			2,5,4 N = 9
3.8	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red-brown, with fine to medium subangular ironstone gravel, w<PL, hard, residual		S			14,18,23 N = 41
			S			18,27/100HB refusal
		Unless noted otherwise, defects are bedding partings dipping 0-10° that are planar, smooth with a clay coating or veneer				
6.88	SILTSTONE: dark grey and pale grey, with 10-15% fine grained sandstone laminations, very low to low strength, highly weathered, highly fractured, with 50% extremely weathered clay seams to 7.6m, Ashfield Shale	6.88m: Ds, 50mm 6.97m: Ds, 50mm 7.07-7.34m: Ds, 270mm 7.37-7.61m: Ds, 240mm 7.75m: Cs, 10mm 7.78m: Ds, 50mm 7.92m: Ds, 60mm 8.17-8.29m: Cs(x4), 10mm 8.33m: Ds, 30mm 8.52m: Ds, 50mm	C	100	0	PL(A) = 0.21
8.57	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey fine grained sandstone (30%), low strength with very low strength bands, moderately weathered, highly fractured to fractured, Ashfield Shale 9.6m to 10.6m: disturbed bedding, shear displacement along joints	8.85m: Cs, 10mm 9.13m: Cs, 30mm 9.6m: Ds, 30mm 9.68m: Ds, 20mm 9.79-10.09m: J80-90°,	C	100	45	PL(A) = 0.18 PL(A) = 0.22

RIG: Scout 4 **DRILLER:** RE **LOGGED:** AH **CASING:** HW to 5.5m, HQ to 6.88m
TYPE OF BORING: Solid flight auger to 4.0m, washboring to 6.88m, NMLC coring to 12.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates obtained from Nearmap.com.au. Surface level interpolated from LTS drawing 50291-002DT dated 10 January 19.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 22.9 AHD
EASTING: 326268
NORTHING: 6248835
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
12	10.1 – 11	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey fine grained sandstone (30%), medium strength, fresh, fractured, Ashfield Shale Below 11.2m: slightly fractured						ir, fe 10.09m: J45°, 5mm, sheared 10.56m: J35°, sheared 10.86m: Cs, 20mm 11.63-11.85m: J60-90°, ir-st, sm, cln 11.98m: J45°, cln	C	100	45	PL(A) = 0.56 PL(A) = 0.6 PL(A) = 1.2
11	12 12.0	Bore discontinued at 12.0m - target depth reached										
10	13											
9	14											
8	15											
7	16											
6	17											
5	18											
4	19											
3												

RIG: Scout 4 **DRILLER:** RE **LOGGED:** AH **CASING:** HW to 5.5m, HQ to 6.88m
TYPE OF BORING: Solid flight auger to 4.0m, washboring to 6.88m, NMLC coring to 12.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates obtained from Nearmap.com.au. Surface level interpolated from LTS drawing 50291-002DT dated 10 January 19.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 3 PROJECT: 99573.00 February 2020

6.88 – 11.00 m

BORE: 3 PROJECT: 99573.00 February 2020

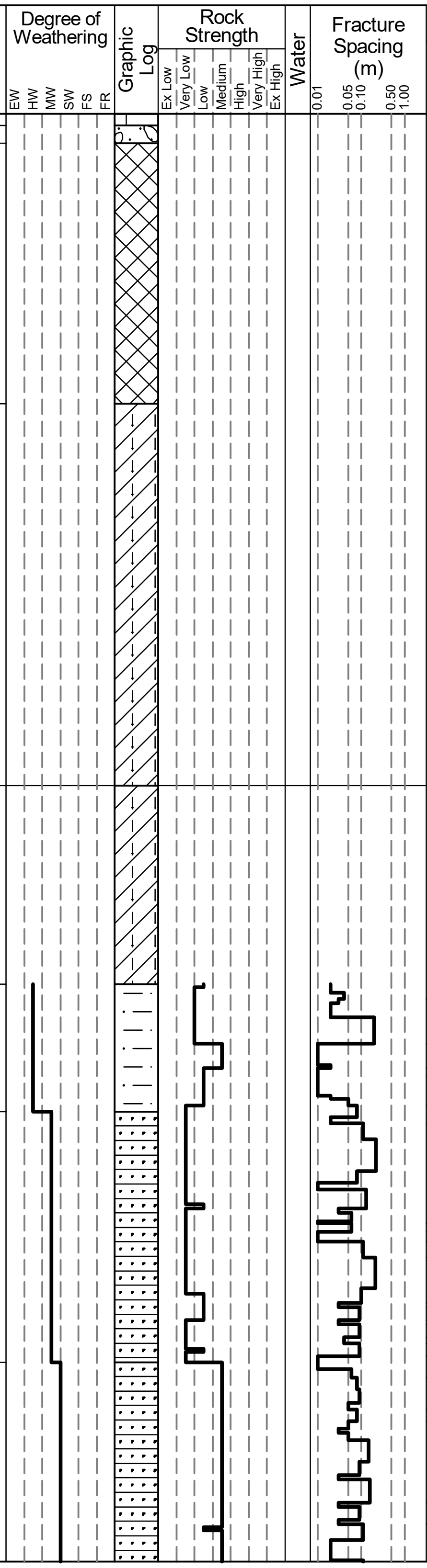
11.00 – 12.00 m

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 23.9 AHD
EASTING: 326301.8
NORTHING: 6248759.5
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 1 OF 2



Depth (m)	Description of Strata
0.08	BRICK PAVERS: 80mm
0.2	FILL/ROADBASE
	FILL/Clayey SAND: medium to coarse, orange-brown, trace fine to medium subrounded sandstone gravel, moist, generally in a loose condition Below 1.0m with medium to coarse subangular igneous gravel
2.0	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red-brown, trace fine to medium ironstone gravel, w<PL, very stiff to hard, residual
4.64	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red-brown, 20% iron indurated bands, w<PL, very stiff to hard, residual
6.01	SILTSTONE: dark grey and pale grey, very low to low strength, extremely to highly weathered, highly fractured to fractured, occasional iron-indurated bands, Ashfield Shale
6.89	LAMINITE: grey and dark grey siltstone (80%) interlaminated with fine grained sandstone (20%), very low to low strength, moderately weathered, fractured, Ashfield Shale
8.62	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey fine grained sandstone (30%), medium strength, moderately to slightly weathered, fractured, Ashfield Shale At 9.75m: tuffaceous bed, 50mm

RL: 23 (at ~0.9m), 22, 21, 20, 19, 18, 17, 16, 15, 14. Depth scale: 1–9 m.

Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)

Unless noted otherwise, defects are bedding partings dipping 0-10° that are planar, smooth with a clay coating or veneer

- 6.05m: J60-90°, st, ro, fe stn
- 6.11m: J70°, un, sm, cly vn
- 6.42m: Ds, 150mm
- 6.59m: Ds, 50mm
- 6.64m: Cs, 140mm
- 6.85m: Cs, 40mm
- 6.97m: Ds, 40mm
- 7.38m: DS, 50mm
- 7.56m: Ds, 10mm
- 7.66m: Ds, 30mm
- 7.72m: Ds, 60mm
- 7.79m: Cs, 40mm
- 7.9m: J60°, pl, sm, cly co, 3mm
- 8.21m: Cs, 30mm
- 8.24m: J70°, st, ro, fe stn
- 8.33m: Cs, 30mm
- 8.36m: J60°, pl, sm, cly vn
- 8.45m: J45°, pl, sm, cly vn
- 8.49m: Cs, 40mm
- 8.58-8.62m: Cs(x3), 10-20mm
- 8.73m: J20-60°, st, ro, fe

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
A			
A			
A			
S			3,2,2 N = 4
A			
S			6,13,13 N = 26
A			
S			12,15,17 N = 32
C	100	0	
C	100	25	PL(A) = 0.13 PL(A) = 0.41 PL(A) = 0.18
C	100	30	PL(A) = 0.39 PL(A) = 0.29

RIG: Comacchio 305 **DRILLER:** CT **LOGGED:** AH **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.64m, NMLC coring to 11.59m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates and surface level obtained by dGPS.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 23.9 AHD
EASTING: 326301.8
NORTHING: 6248759.5
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low – Ex High)	Water	Fracture Spacing (m) (0.01 0.05 0.10 0.50 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
13	11	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey fine grained sandstone (30%), medium strength, moderately to slightly weathered, fractured, Ashfield Shale *(continued)*						stn 8.95m: J45°, pl, fe co, 10mm, he 9.03m: J20-60° st, ro, fe, stn 9.59-9.71m: J45°(x3), pl, fe, cly 7mm 9.74m: Ds, 40mm 10.1m: Cs, 5mm 10.12m: J35°, pl, ro, fe stn 10.24m: J45°, pl, ro, fe stn 10.29m: Cs, 10mm 11.15m: J35°, 2mm	C	100	30	PL(A) = 0.57 PL(A) = 0.51 PL(A) = 0.93
12	11.59 12	Bore discontinued at 11.59m - target depth reached										
11	13											
10	14											
9	15											
8	16											
7	17											
6	18											
5	19											
4												

RIG: Comacchio 305 **DRILLER:** CT **LOGGED:** AH **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.64m, NMLC coring to 11.59m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates and surface level obtained by dGPS.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 4 PROJECT: 99573.00 February 2020

4.64 – 9.00 m

BORE: 4 PROJECT: 99573.00 February 2020

9.00 – 11.59 m

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 24.0 AHD
EASTING: 326314.3
NORTHING: 6248782.7
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 1 OF 2

Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
0.2	FILL/Sandy CLAY: low to medium plasticity, brown, with fine to medium igneous gravel, trace rootlets, grass and plastic, w<PL		A			
0.9	FILL/Silty CLAY: medium to high plasticity, brown, with fine to medium sandstone and ironstone gravel, w<PL, generally in a stiff condition		S			6,5,7 N = 12
	CLAY CI-CH: medium to high plasticity, orange-brown mottled pale grey, trace fine to medium ironstone gravel, w<PL, stiff, residual	Unless noted otherwise, defects are bedding partings dipping 0-10° that are planar, smooth with a clay coating or veneer	A			
			S			3,4,6 N = 10
			S			2,3,5 N = 8
4.0	CLAY CI-CH: medium to high plasticity, pale grey and orange-brown, with low to medium strength ironstone bands and very low strength siltstone bands, hard, extremely weathered siltstone		C	100	0	
			C	100	0	
6.47	SILTSTONE: dark grey siltstone, very low strength, extremely to highly weathered weathered, highly fractured, 50% extremely weathered/ decomposed seams, Ashfield Shale	6.67-6.7m: fg 6.85m: Ds, 150mm 7.02m: Ds, 90mm 7.13m: Ds, 40mm 7.27-7.31m: J60-70°, st, fe, ti 7.36m: Cs, 80mm 7.44-7.52m: fg 7.54m: Cs, 50mm 7.6m: Ds, 220mm 7.92m: Ds, 150mm 8.07-8.12m: fg 8.12m: Ds, 140mm	C	100	0	PL(A) = 0.08
8.3	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey, fine grained sandstone (30%), low strength, moderately then slightly weathered, highly fractured, Ashfield Shale	8.32-8.49m: J60-90°, st, ro, cly vn 8.49-8.56m: fg 8.56m: Cs, 20mm				PL(A) = 0.28
8.91		8.76m: CORE LOSS: 150mm 9.24-9.29m: J70°, pl, ro, cly vn 9.45-9.54m: J80-90°, st, ro, cly vn 9.54-9.82m: J70°, pl, ro,	C	88	35	PL(A) = 0.25 PL(A) = 0.21 PL(A) = 0.25
	At 9.84m: tuffaceous bed, 50mm					

RIG: Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** HW to 2.5m, HQ to 4.0m
TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.0m, NMLC coring to 12.08m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates and surface level obtained by dGPS.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 24.0 AHD
EASTING: 326314.3
NORTHING: 6248782.7
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
14		LAMINITE (continued)	fe stn 9.85m: Ds, 30mm 9.98m: Cs, 20mm 10.05-10.25m: fg 10.43m: J60°, un, ro, cly co, 3mm 10.58m: Cs, 100mm				PL(A) = 0.06
13	11			C	100	30	
	11.1	LAMINITE: dark grey siltstone (80%) interlaminated with pale grey, fine grained sandstone (20%), low then medium strength, fresh, fractured, Ashfield Shale	10.98m: Ds, 20mm 11.04m: Ds, 60mm 11.47m: J60°, pl, sm, cly vn, sheared 11.63-11.72m: J50-60° (x2), pl, sm cly, vn				PL(A) = 0.19 PL(A) = 0.18 PL(A) = 0.21 PL(A) = 0.33
12	12 12.08	Bore discontinued at 12.08m - target depth reached	12.04m: J30°, pl, sm, cly vn				
11	13						
10	14						
9	15						
8	16						
7	17						
6	18						
5	19						

Degree of Weathering: EW, HW, MW, SW, FS, FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

RIG: Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** HW to 2.5m, HQ to 4.0m
TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.0m, NMLC coring to 12.08m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates and surface level obtained by dGPS.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 5 PROJECT: 99573.00 February 2020

4.00 – 8.00 m

BORE: 5 PROJECT: 99573.00 February 2020

8.00 – 12.08 m

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 23.1 AHD
EASTING: 326328.6
NORTHING: 6248812.5
DIP/AZIMUTH: 90°/--

BORE No: BH6
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 1 OF 2

Discontinuities: B - Bedding, J - Joint, S - Shear, F - Fault

Depth (m)	Description of Strata	Discontinuities
0.05	ASPHALTIC CONCRETE: 50mm	
0.15	FILL/ROADBASE	
0.4	FILL/Gravelly SAND: fine to medium, grey, fine sub-angular igneous gravel, dry	
	Silty CLAY CH: high plasticity, orange mottled grey, trace fine, sub-angular ironstone gravel, w<PL, hard, residual Below 2.2m: pale grey mottled orange-brown, with iron indurated bands	Unless noted otherwise, defects are bedding partings dipping 0-10° that are planar, smooth with a clay coating or veneer
4.68	Silty CLAY CI-CH: medium to high plasticity, grey, w<PL, hard, residual	
6.03	SILTSTONE: grey-brown, very low strength, extremely to highly weathered, fractured, 50% clay seams, Ashfield Shale	6.12m: CORE LOSS: 150mm
6.27		6.71-6.93m: fg
6.93	LAMINITE: dark grey siltstone (70%) interlaminated with pale grey, fine grained sandstone (30%), medium strength, moderately weathered, fractured, Ashfield Shale	7.04-7.37m Ds (x4), 10 mm 7.45-7.51m: Cs, 60 mm 7.68m: J30°, pl, he
7.75	LAMINITE: grey and dark grey siltstone (80%) interlaminated with pale grey, fine grained sandstone (20%), low then very low strength, highly to moderately weathered, fractured, Ashfield Shale At 8.07m: tuffaceous bed, 60mm Below 9.0m: disturbed bedding, possible sheared zone	7.87m: Ds, 10 mm 8.04-8.13m: Cs, 90 mm 8.17-8.30m: Ds, 230 mm 8.49-8.59m: Ds, 100 mm 8.67m: Ds, 20 mm 8.75m: Ds, 50 mm 8.76m: J30°, pl, sm, cly vn 8.85m: Ds, 40 mm 8.95m: Ds, 30 mm 9.05m: Ds, 60 mm 9.2m: Ds, 50 mm 9.3-9.45m: Sz, 150 mm

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
A			
A			
A			
S			13,13,19 N = 32
A			
S			15,24,31 N = 55
S			30/150 refusal
C	100	0	
C	93	0	PL(A) = 0.53 PL(A) = 0.4 PL(A) = 0.2
C	100	0	PL(A) = 0.14 PL(A) = 0.07
C	100	21	

RIG: Scout 4 **DRILLER:** RE **LOGGED:** AH **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.68m, NMLC coring to 13.00m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates obtained by dGPS. Surface level interpolated from LTS drawing 50291-002DT dated 10 January 19.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Shayher Alliance Pty Ltd
PROJECT: Proposed Mixed-Use Development
LOCATION: 2-6 Cavil Avenue, Ashfield

SURFACE LEVEL: 23.1 AHD
EASTING: 326328.6
NORTHING: 6248812.5
DIP/AZIMUTH: 90°/--

BORE No: BH6
PROJECT No: 99573.00
DATE: 29/2/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
13		LAMINITE (continued)	9.46m: J75°, pl, sm, cly vn 9.5m: Ds, 50 mm 9.62-9.77m: Sz, 150 mm 9.83-9.93m: Sz, 100 mm				PL(A) = 0.05
12	10.71 / 11	SILTSTONE: dark grey, with 15% pale grey sandstone laminations, medium strength, slightly weathered, fractured, Ashfield Shale	10.0-10.22m: Sz, 220mm 10.55m: fg, 50mm 10.82m: Ds, 50 mm 10.89m: J20°, pl, sm, cln 10.95m: J75°, pl, sm, cln 11.04-11.95m: Cs(x6), 5 mm 11.08-11.10m: fg 11.12m: J45°, pl, sm, cln 11.37m: J80-90°(x2), un, sm, cln 11.42m: J30°, pl, sm, cln 11.75m: J30°, pl, sm, cln 12.1-12.43m: J30°(x3), pl, sm, cln 12.25-12.32m: J90°(x2), pl, sm, cln 12.42m: J30°, pl, sm, cly vn 12.72-12.77m: Cs(x2), 10 mm	C	100	21	PL(A) = 0.69 PL(A) = 0.63 PL(A) = 0.7
11	12						
10	13 13.0	Bore discontinued at 13.0m - target depth reached					
9	14						
8	15						
7	16						
6	17						
5	18						
4	19						

Degree of Weathering: EW, HW, MW, SW, FS, FR. Graphic Log. Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High. Water. Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00.

RIG: Scout 4 **DRILLER:** RE **LOGGED:** AH **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger to 2.5m, washboring to 4.68m, NMLC coring to 13.00m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Coordinates obtained by dGPS. Surface level interpolated from LTS drawing 50291-002DT dated 10 January 19.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 6 PROJECT: 99573.00 February 2020

4.68 – 9.00 m

BORE: 6 PROJECT: 99573.00 February 2020

9.00 – 13.00 m

Appendix D

Results of Laboratory Testing

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 237913

Client Details

Client	Douglas Partners Pty Ltd
Attention	Alexander Hanna
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**99573.00, Ashfield**
Number of Samples	2 Soil
Date samples received	02/03/2020
Date completed instructions received	02/03/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	09/03/2020
Date of Issue	06/03/2020

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Soil Aggressivity			
Our Reference	UNITS	237913-1	237913-2
Your Reference		BH2	BH6
Depth		3.75-4.20	2.5-2.95
Date Sampled		29/02/2020	29/02/2020
Type of sample		Soil	Soil
pH 1:5 soil:water	pH Units	5.3	5.6
Electrical Conductivity 1:5 soil:water	µS/cm	38	29
Chloride, Cl 1:5 soil:water	mg/kg	21	10
Sulphate, SO4 1:5 soil:water	mg/kg	23	10

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Soil Aggressivity					Duplicate					Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	110	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	115	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.