REPORT TO

PYMBLE LADIES COLLEGE

ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED SECONDARY INNOVATION PRECINCT AND CAMPUS COMMONS

AT

AVON ROAD, PYMBLE, NSW

Date: 24 March 2025
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JKGeotechnics
www.jkgeotechnics.com.au

T: +61 2 9888 5000
JK Geotechnics Pty Ltd
ABN 17 003 550 801

Report prepared by:

Thomas Clent
Associate | Engineering Geologist

Report reviewed by:

Paul Stubbs
Principal | Geotechnical Engineer

For and on behalf of
JK GEOTECHNICS
PO BOX 976
NORTH RYDE BC NSW 1670

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Dynamic Cone Penetration Test Results Sheet (s)

Figure 1: Site Location Plan

Figure 2a: Borehole Location Plan

Figure 2b: Borehole Location Plan

Vibration Emission Design Goals

Report Explanation Notes

1 INTRODUCTION

JK Geotechnics has been commissioned by Pymble Ladies' College (the College) to prepare this geotechnical report in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs) and in support of the preparation of an Environmental Impact Statement (EIS) and State Significant Development Application for the proposed Secondary Innovation Precinct (SIP) and Campus Commons (SSD- 79146716) to the Department of Planning, Housing and Infrastructure (DPHI).

This report has been prepared with reference to architectural plans prepared by 3XN and dated March 2025. We have also been provided with Landscape architect plans by T.C.L (Ref:S2407, Revision 1, dated 14 March 2025)

Project SEAR SSD 79146716	Documentation
12. Ground and Water Conditions	
▪ • Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity and acid sulfate soils. ▪ Provide a Surface and Groundwater Impact Assessment that assesses potential impacts on: o surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses. o groundwater resources in accordance with the *Groundwater Guidelines*	Geotechnical Assessment Surface and Groundwater Impact Assessment Salinity Management Plan and/or Acid Sulfate Soils Management Plan

This report addresses the '*Geotechnical Assessment*' component of the above SEARS table. The investigation was commissioned by Pymble Ladies College and carried out in accordance with our proposals (Ref: P56132YCrev2) dated 30 September 2024 and (Ref: P70420YC) dated 22 October 2024

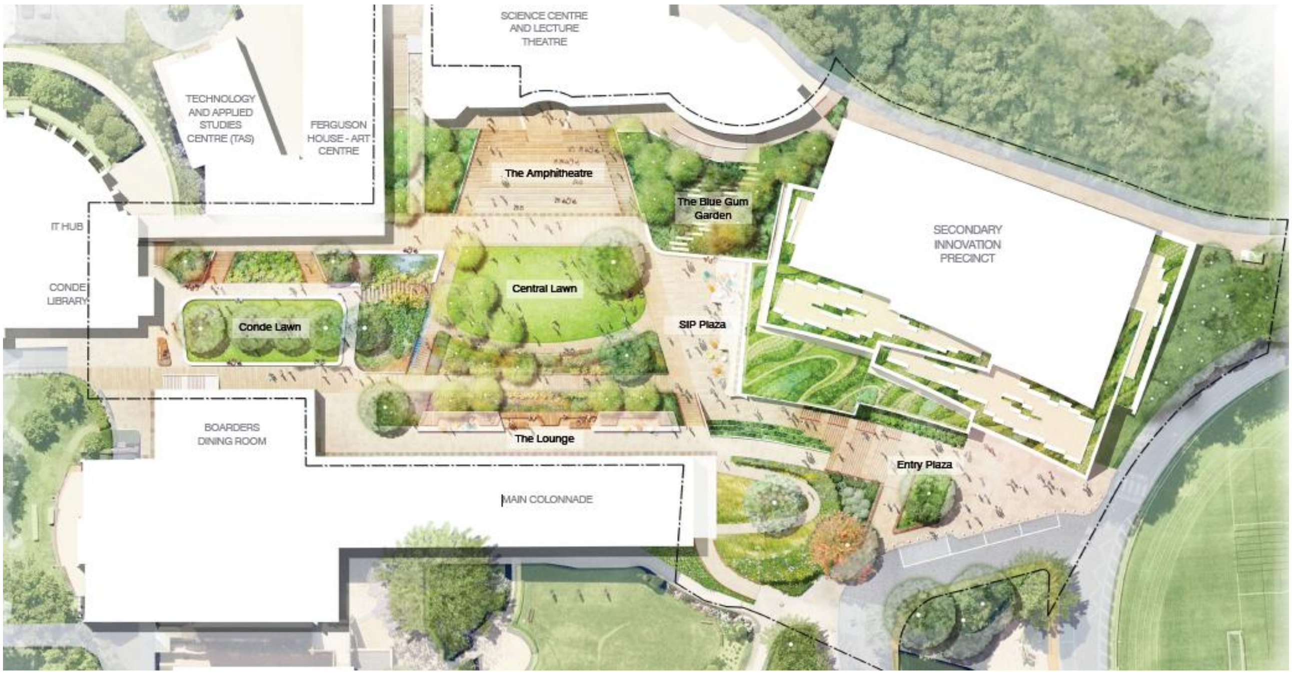
1.1 Description of Site and Locality

The site is located at 20 Avon Road, Pymble, within the Ku-Ring-Gai Local Government Area (LGA). The site comprises multiple parcels of land and is legally described as:

- Lot 1 Deposited Plan 69541
- Lots 11- 17 Deposited Plan 7131

The site and proposed work areas are identified in the figures below.

Source: Urbis



Source: TCL

Key features of the site are as follows:

- The site accommodates the existing Pymble Ladies' College which accommodates Kindergarten to Year 12 students.

- Vehicular access to the College is provided via separate ingress and egress driveways on the northern and western sections of Avon Road.
- Pedestrian access is provided through multiple gates along Avon Road.
- The project area that is subject to this SSDA is located at the entrance to the College west of the oval.
- The project area slopes down from south to north with a fall from RL 124.50 at the southern corner to RL 116 at the north west corner.

Key features of the locality:

The development context surrounding the site is a leafy suburban environment, predominantly made up of detached residential properties set within expansive gardens and along avenues lined with mature trees. Recent developments of moderate-scale residential apartment buildings occur closer to the railway corridor. Two storey commercial establishments are located near to Pymble train station, specifically along the Pacific Highway and on the northern flank of the railway line.

- The site is located approximately 19km north west of the Sydney Central Business District.
- The College is situated approximately 200m from Pymble train station, situated on Pacific Highway and Pymble town centre.

The immediately surrounding locality is described as follows:

- **North:** Avon Road and Pacific Highway (approximately 400m).
- **East:** Residential uses, accommodating a mixture of dwelling houses and residential flat buildings.
- **South:** Avondale Golf Course.
- **West:** Avon Road, beyond which is a residential area characterised by detached dwelling houses.

1.2 Project Description

The project comprises demolition of several existing buildings and the construction of the Secondary Innovation Precinct, associated landscaping and Campus Commons at the Pymble Ladies College. The SIP is a five-storey building that will consolidate STEM based learning opportunities within the College.

1.2.1 Detailed Description

The proposal seeks development approval for the Secondary Innovation Precinct (SIP) and Campus Commons at Pymble Ladies' College. The development comprises:

- Demolition of the existing Isabel Harrison, Dorothy Knox, John Vicars and Robert Vicars Buildings.
- Tree removal.
- Excavation of the basement level.
- Construction of the new five storey SIP building of RL 146.98m and including:
  - General Learning Spaces.
  - STEM teaching spaces.
  - Senior student facilities.

  - Function spaces.
  - Food and beverage facilities.
  - Associated amenities.
  - Storage and building services.
- 1 loading space within the basement (for service vehicles) accessible from the existing rear vehicle service road.
- Minor kerb realignment of the existing access road to the east of the SIP.
- Landscaping on the outdoor terraces and surrounding the building.
- The project also includes the Campus Commons, a significant garden lawn and amphitheatre connecting the SIP precinct to the rest of the campus.

1.3 Proposed Construction

Proposed Basement - Secondary School Innovation Precinct

We understand that the existing 'Isabel McKinney Harrison Library' building will be demolished, and a new senior school building constructed into the existing hillside. The proposed building will have four above ground levels over Lower Ground and Partial Basement level with finished floor levels of RL121.1m and 116.1m, respectively. Due to the sloping nature of the site and the proposed stepped basement profile we expect excavations to a maximum depth of about 5m.

Proposed Construction - Campus Commons

We understand the proposed Campus Commons to comprise the demolition of the existing 'Dorothy Knox Building' and existing common area then completion of landscaping works. We understand the proposed landscaping works to comprise various retaining walls, benches, steps and pavements. Planter beds and lawn areas are also proposed. The drawings show finished pavement levels ranging from about RL118m to RL123m which are similar to the existing site surface levels. As such, we have assumed only minor excavation are required for site levelling purposes and for footings.

The purpose of the investigations was to obtain geotechnical information on the subsurface conditions as a basis for comments and recommendations on site preparation, earthworks, batters, excavation, retention, groundwater considerations, footing design and pavements.

2 INVESTIGATION PROCEDURE

2.4 Secondary School Innovation Precinct Investigations

Initially JK Geotechnics carried out a geotechnical investigation of the site on 12 and 13 April 2022 which comprised the drilling of four boreholes (BH1 to BH4) using diamond coring techniques. Groundwater monitoring wells were installed within boreholes (BH1, BH2 and BH4). The borehole logs are attached to this report.

An additional geotechnical investigation was completed between 9 and 11 October 2024, and comprised the drilling of four boreholes (BH101 to BH104). The boreholes were initially advanced using spiral auger techniques with an attached tungsten carbide (TC) bit. Once competent bedrock was encountered the boreholes were extended to depths ranging from 6.1m to 18.08m using diamond coring techniques with water flush.

The borehole locations, as shown on Figure 2a, were set out by tape measurements from existing surface features as close as possible to the locations nominated by Arup (structural engineers). The approximate surface levels on the borehole logs were interpolated from spot heights shown on the supplied survey plans by LTS Lockley (Ref: 15263 001DT, Sheets 4 and 9, Rev. L, dated 5/10/21). The datum of the levels is Australian Height datum (AHD).

The apparent compaction of the fill and the strength of the residual soils was assessed from Standard Penetration Test (SPT) 'N' values, augmented by hand penetrometer test results on cohesive samples recovered by the SPT split tube sampler. Within the augered portions of the boreholes, the strength of the underlying weathered bedrock was assessed from observation of the resistance to penetration of the Tungsten Carbide (TC) bit attached to the augers, together with inspection of the recovered rock chip samples. The strength of the cored siltstone and sandstone was assessed from inspection of the recovered core and subsequent laboratory Point Load Strength Index ($I_{S(50)}$) test results. The point load strength index test results are summarised in the attached Table A and on the cored borehole logs.

Groundwater observations were made in the boreholes during and on completion of auger drilling. The use of water for core drilling limited further meaningful measurements of groundwater levels. Groundwater monitoring wells were installed in BH101, BH102 and BH103 on completion and a return visit was made to the site on 23 October 2024 to record the groundwater levels. No longer term monitoring of groundwater levels was carried out.

Our Geotechnical Engineer, Mr Alex Moran, set out the borehole locations, nominated the sampling and testing locations, and prepared logs of the strata encountered. The borehole logs, including colour photographs of the recovered core, are attached to this report together with a set of explanatory notes, which describe the investigation techniques, and their limitations, and define the logging terms and symbols used.

2.5 Campus Commons Investigation

The fieldwork for the investigation was carried out on the 2 November 2024 and due to limited site access the investigation was carried out using hand augers and Dynamic Cone Penetration (DCP) tests, all of which is portable and hand operated. The investigation comprised the following;

- The drilling of six hand augered boreholes (BH201 to BH206) to refusal depths ranging from 0.97m to 1.6m.

- Eight Dynamic Cone Penetration (DCP) tests (DCP201 to DCP208) completed adjacent to the boreholes and at three additional locations to refusal depths ranging from 1.22m to 2.1m.

The boreholes were drilled to identify the soils present. The DCP tests were completed to assess the apparent compaction of the fill, the strength/relative density of the natural soils and to probe the depth to the surface of the underlying siltstone bedrock. It should be noted that while the depth of refusal of the DCP test is typically considered to represent the depth to the underlying bedrock, it is possible that premature refusal may occur on inclusions in the fill or harder layers within the soils.

The test locations, as shown on the attached Figure 2b, were set out by taped measurements from existing surface features. The approximate surface levels as shown on the borehole logs and DCP test results, were estimated by interpolation between spot levels shown on the supplied survey plan (unreferenced). We have assumed the datum of the levels is Australian Height Datum (AHD).

Groundwater observations were made during and on completion of the drilling of each borehole. No longer term groundwater monitoring was carried out.

Our engineering geologist, Mr Keagen Rousseau was on site full time during the fieldwork and set out the test locations, nominated the sampling and testing, prepared the borehole logs and recorded the DCP test results. The borehole logs and DCP test results are attached to this report, together with our Report Explanation Notes which describe the investigation techniques and their limitations and define the logging terms and symbols used.

3 RESULTS OF INVESTIGATION

3.6 Geotechnical Site Description

3.6.2 Secondary Innovation Precinct

The site is located within the north-western portion of the school grounds of Pymble Ladies College, which is situated on the upper reaches of a hill within undulating topography. The site is generally positioned over the existing footprint of the 'Isabel McKinney Harrison Library' and its immediate surrounds.

The site slopes and steps down to the north and north-east, having an elevation relief of about 9m between the access road along the high (south-east) side and the low (north-west) side. Ground levels fall via a series of steep embankments and brick retaining walls. The existing Isabel McKinney Harrison Library comprises a one and two storey split level building, which was assessed to be in good external condition based on a cursory inspection. Surrounding the lower portion of the building is a brick paved courtyard area, which was also in good condition. This paved courtyard is supported by an embankment that slopes down to the north-west at about 22° to 26°. Below this embankment the slope reduces, above the adjoining access road which sits on another filled grass covered embankment with slopes of around 25° This lower access road contains longitudinal cracks, with widths of about 2mm to 3mm, which extended approximately parallel to the slope below the road. The cracks may indicate instability of the slope.

Along the south-eastern side of the building is a 1.5m high brick retaining wall that supports a grassed lawn and sloping garden beds. The retaining structure is in good condition, with no signs of rotation, bulging or cracking. Above these garden areas is the higher access road, with the asphaltic concrete (AC) surfacing in good condition based on a cursory inspection.

Medium to large sized trees, as well as dense shrubbery, was observed within the majority of the site outside of the building area. Paved pathways and densely vegetated gardens extend along the south-west and north-east sides of the site, respectively.

To the north of the site is an embankment that slopes at about 40° to 45°down to the west, with localised steeper undulations. The embankment is densely vegetated and has a total height of about 4m to 5m. The embankment continues to the north adjacent to the main school oval.

Further to the south-west and west of the site are two and three storey brick buildings that step down the hillside similarly to the building within the subject site. The buildings appeared to be in good external condition based on a cursory inspection.

3.6.3 Campus Commons

For the purpose of this site description, the 'site' shall be regarded as the existing common area between the 'Dorothy Knox House', and 'Main Colonnade', and also on the south-western side of the 'Robert Vicars Building'. This description should be read in conjunction with attached Figure 2b.

The site is located within the north-eastern portion of the school grounds of Pymble Ladies College, which is situated on the upper reaches of a north-west facing hillside. The site slopes and steps down to the north and north-west, having an elevation relief of about 3m between the upper southern-western area and the lower north-eastern area, stepping down through a series of steps and retained garden beds.

The existing common area is mostly covered with brick pavers and concrete paved surfaces, with raised garden beds supported by low height brick and concrete retaining walls. The brick retaining walls range from 0.7m to 1.2m in height. The various steps throughout the common area are of brick and concrete construction. Within the north-eastern half of the site the ground level drops to a lower-level tile surfaced courtyard surrounded by wooden benches. Some of the planter beds contain small to medium sized trees The paved surfaces and retaining walls all appear to be in good condition, based on a cursory inspection.

Dorothy Knox House is a three-storey brick building located centrally within the proposed works area which abuts the north-eastern portion of the existing common area. The lower ground floor level of the building appears to be at a similar level to the northern part of the common area. Where observed, the elevated surface levels of the courtyard adjacent to the south-eastern half of the building are supported by brick retaining walls (maximum height about 1.1m). On the south-western side of the building are covered

walkways. Metal stairwells provide access from the lower ground floor at the northern corner to the upper levels. The building appears to be in good external condition, based on a cursory inspection.
Main Collonade is a three-storey brick building which abuts the south-eastern portion of the common area. The lower ground floor level of the building is similar to the adjacent concrete pavements of the common area. The north-eastern end of the building adjoins the south-eastern end of the Dorothy Knox House. The building appears to be in good external condition, based on a cursory inspection.

Robert Vicars Building is a two-storey building of brick construction which trends approximately south-east to north-west through the centre of the common area. The lower ground floor level of the building is similar to the northern part of the common area. On the eastern side of the building are covered walkways extending from each of the upper floor levels. A set of metal stairwells provide access from the lower ground floor level to the upper floor levels at the western corner. The building appears to be in good external condition, based on a cursory inspection.

3.7 Subsurface Conditions

Reference to the Penrith 1:100,000 Geological Series Sheet indicates that the site is located within an area mapped to be underlain by the Ashfield Shale.

3.7.1 Secondary School Innovation Precinct

Pavements

Pavers with a thickness of 40mm overlying concrete with thicknesses ranging from 100mm to 250mm were encountered in BH2 to BH4. In BH3 and BH4 a sand blinding layer was encountered between the pavers and the concrete. At the surface of BH103 a concrete pavement with a thickness of 140mm was encountered. BH101, BH102 and BH104 encountered asphaltic concrete (AC) with thicknesses ranging from 20mm to 40mm. Concrete was encountered below the AC within BH102 and BH104 and had thicknesses of 180mm and 160mm, respectively.

Fill

Fill was encountered in all boreholes to depths ranging from 0.4m to 2.3m. The fill predominantly comprised silty clay, with varying proportions of gravel. The gravel component within the fill comprised igneous, siltstone and ironstone gravel. Based on the SPT ‘N’ values, the fill was assessed to be poorly or moderately compacted with some localised well compacted bands.

Residual Silty Clay

Residual silty clay assessed to mostly be of medium to high plasticity and of very stiff to hard strength extended to the underlying siltstone bedrock.

Weathered Sandstone and Siltstone

Weathered siltstone bedrock was encountered at depths ranging from 0.9m to 4.2m, with the level of the surface of the rock falling down towards the north from about RL121.8m in BH1 to about RL111m in BH102.

The siltstone was initially assessed to be extremely weathered to highly weathered and of hard (soil strength) to very low strength. Within the cored portions of the boreholes, the weathering and strength improved with depth to generally moderately or slightly weathered and of low to medium or medium to high strength below depths ranging from 5.2m (~RL110.8m) to 10.7m (or ~RL115.1m).

In BH3, BH4 and BH103 interbedded siltstone/sandstone, laminite and sandstone were encountered below the siltstone profile. The cored rock in BH3 and BH4 was of higher strength and contained fewer defects that the rock cored in BH1 and BH2. In BH102 and BH104, slightly weathered or fresh sandstone bedrock was encountered below the siltstone profile. The sandstone bedrock was assessed to be generally of medium to high strength.

Defects within the cored bedrock comprised extremely weathered seams of generally less than 110mm, sub horizontal bedding partings, and joints inclined at up to 90°. Significant core loss zones were also noted within BH1, BH101 and BH104 which are indicative of extremely weathered bands.

The following table summarises the rock levels and the rock classification in the cored boreholes in accordance with Classification of Sandstone and Shales in the Sydney Region: Forty Year Review by Pells et al 2019.

Borehole	**Approx. Surface RL (m) AHD**	**Depth (m)/ RL (mAHD) Class V**	**Depth (m)/ RL (mAHD) Class IV**	**Depth (m)/RL (mAHD) Class III or better**
BH1	125.8	4/121.8	9.3/116.4	10.6/115.2
BH2	120.5	3.5/117	6.7/113.8	-
BH3	120.3	7/113.3	-	7.5/112.8
BH4	120.4	4.4/116	7.1/113.3	8.8/111.6
BH101	125.5	4/121.5	5.4/120.1	10.6/114.9
BH102	119.6	5/114.6	-	8.6/110.9
BH103	120.3	6/114.3	6.4/113.9	9/111.3
BH104	116.0	2.8/113.2	3.1/112.9	5/111

Groundwater

Groundwater seepage was not encountered during auger drilling of the boreholes, which were dry on completion of auger drilling. Once coring is commenced water is introduced which obscures the true groundwater level. The groundwater within the monitoring wells allowed to stabilise over several weeks and return visits were made to measure the groundwater levels with the results tabulated below;

Results of Groundwater Monitoring

Borehole	Date	Surface RL (mAHD)	Depth to Groundwater	Groundwater RL (mAHD)
1	5/5/22	125.8	2.3	123.2
2	5/5/22	120.5	0.0	120.5
4	5/5/22	120.4	3.45	116.9
101	5/5/22	125.5	-	-
102	5/5/22	119.6	3	116.6
103	5/5/22	120.3	2.09	118.2

104	5/5/22	116.0	2.14	113.8

3.7.2 Campus Commons

All boreholes encountered fill to depths ranging from 0.5m to 0.8m. With exception of BH202, the fill initially comprised silty sand to depths ranging from 0.1m to 0.4m and then silty clay. In BH2 silty clay fill was encountered directly below the Aspahltic Concrete (AC) surface. The fill contained varying fractions of slag, ash, ironstone gravel and root fibres. Based on DCP tests, the fill was assessed to be poorly to moderately compacted.

Residual silty clay was encountered within all boreholes and was assessed to be of medium to high plasticity and of stiff to very stiff strength. The boreholes refused within the clays at depths ranging from 0.97m to 1.53m.

The DCP tests refused at depths ranging from 1.5m (DCP202) to 2.1m (DCP207), but since these tests do not provide sample recovery the nature of the material that caused refusal cannot be confirmed. Refusal may have occurred on the surface of the underlying siltstone, but it may also have occurred on ironstone layers within the residual silty clay. We note that we have previously drilled boreholes to the north-east of the site for the proposed secondary school building and weathered siltstone was encountered at depths ranging from 0.9m to 4.2m.

Groundwater was not encountered during or on completion of drilling of the boreholes.

Reference should be made to the borehole logs, DCP test results for detailed descriptions of the subsurface conditions encountered.

3.8 Laboratory Test Results

The point load strength index test results showed reasonably good correlation with our field assessment of rock strength. The Unconfined Compressive Strength (UCS) of the rock core, estimated from the point load strength index test results, generally ranged from 1MPa to 36MPa with some locally higher results of up to 60MPa.

The pH values on samples of the fill, residual silty clay and weathered sandstone ranged from 4.7 to 6.0, indicating acidic soil conditions. The sulphate contents ranged from 20mg/kg to 57mg/kg, the chloride contents ranging from <10mg/kg to 38mg/kg, and the resistivity ranged from 16,000ohm.cm to 51,000ohm.cm. Based on these results, the fill would be classified as 'non-aggressive' and the residual soil and bedrock would be classified as 'mild' exposure classification for concrete piles in accordance with Table 6.4.2(C) of AS2159-2009 'Piling – Design and Installation'. The fill, residual soil and bedrock samples would all classify as 'non-aggressive' exposure classification for steel piles in accordance with Table 6.5.2(C) of AS2159-2009.

4 COMMENTS AND RECOMMENDATIONS

4.1 Secondary School Innovation Precinct

4.1.1 Excavation and Groundwater

Due to the sloping nature of the site and the proposed stepped profile of the lower levels, excavations to a maximum depth of about 5m will be required to achieve the proposed Lower Ground Floor and Partial Basement level. Excavation to such depths is expected to encounter concrete, clayey fill, residual soils and weathered siltstone bedrock.

Excavation of the soils and upper rock of up to very low strength should be achievable using conventional excavation equipment, such as the buckets of hydraulic excavators. Some ripping of higher strength bands may be necessary if they are encountered within the weaker rock.

Excavation of bedrock of low strength or higher strength will require assistance with rock excavation equipment and is likely to be required for a limited depth along the south-eastern side of the site. Such equipment may comprise hydraulic rock hammers, ripping hooks, rotary grinders or rock saws. Hydraulic rock hammers must be used with care due to the risk of damage to the neighbouring school buildings and accessways. If hydraulic rock hammers are to be used the vibrations transmitted to the nearby buildings should be quantitatively monitored at least at the start of rock hammer operation to confirm that the transmitted vibrations are within acceptable limits. If during the initial monitoring the transmitted vibrations are close to acceptable limits full time monitoring may then be warranted. Reference should be made to the attached Vibration Emission Design Goals sheet for acceptable limits of transmitted vibrations. Where the transmitted vibrations are excessive it would be necessary to change to alternative excavation equipment, such as a smaller rock hammer, ripping hooks, rotary grinders or rock saws.

No groundwater seepage was encountered during auger drilling of the boreholes, but groundwater was measured within the monitoring wells between RL123.2m and RL113.8m, which is likely intersect the proposed lower ground floor level of RL121.1 and also the partial basement with a finished floor level of RL116m. The measured groundwater levels fall towards the north-west and given sites position on the slope we expect these groundwater levels represent ephemeral flow across the soil/rock interface and through joints within the rock. Therefore, we expect seepage to occur into the excavation and this would tend to occur along the soil/rock interface and through joints and bedding partings within the rock, particularly during and following rainfall and that initial flows will diminish with time. Any such seepage that does occur should be able to be controlled during construction using gravity drainage and conventional sump and pump techniques. In the long term, drainage should be provided behind all retaining walls and below the lowest floor slab. The completed excavation should be inspected by the hydraulic consultant to confirm that the designed drainage system is adequate for the actual seepage flows.

4.1.2 Retention

Given the sloping nature of the site, the depth of residual soils and variably weathered siltstone bedrock, we anticipate that temporary batters will not be suitable for this site and a full depth retention system will need to be installed prior to the start of bulk excavation. However, on the north-western side of the excavation sufficient space may exist for temporary batters depending on final levels and setbacks.

Temporary batter slopes through the clayey fill, residual silty clays and weathered siltstone may be excavated no steeper than 1 Vertical (V) in 1 Horizontal (H) for heights to 3.5m, above which a bench at least 1m wide should be added at mid-height. Such batters should remain stable in the short term provided all surcharge loads, including construction loads, are kept well clear of the crest of the batters. Permanent batters should be no steeper than 1V:2H, but flatter batters of the order of 1V:3H may be preferred to allow access for maintenance of vegetation. All permanent batters should be covered with topsoil and planted with a deep-rooted runner grass, or other suitable coverings, to reduce erosion. All stormwater runoff should be directed away from all temporary and permanent batters to also reduce erosion.

Permanent retaining walls constructed at the base of the batters may be designed as cantilevered walls based on a triangular earth pressure distribution using an active earth pressure coefficient, K_a, of 0.33 and a bulk unit weight of $21kN/m^3$. Where walls are restrained from some lateral movements, such as by other structural elements in front of the wall, or where movements are to be kept low, an 'at rest' earth pressure coefficient, K_0, of 0.6 should be used.

Where insufficient space is available or where excavations are deeper than about 3.5m (which we expect for most of the excavation), full depth retention systems will be required. Such retention systems may comprise soldier pile retaining walls with shotcrete infill panels, provided clayey soils are encountered that can stand vertically between the piles to allow placement of shotcrete. If poorly compacted fill is encountered in some areas, particularly if it is sandy, the soils may not stand to allow placement of shotcrete and closely spaced piles or even contiguous piles may be required. Contiguous pile walls would also be required of the excavations extend close to existing buildings, in order to limit wall deflections.

If walls retain more than about 3m additional lateral support in the form of external anchors or internal props will be required and these must be installed progressively as each restraining point is uncovered. The presence of any buried services and nearby building levels outside of the basement excavation must also be considered in assessing the feasibility of external anchors.

Propped or anchored retaining walls may be provisionally designed based on a trapezoidal earth pressure distribution of magnitude 6H kPa (where H is the retained height in metres) where some resulting ground movements are tolerable and existing structures are located beyond a horizontal distance of 2H from the wall. Where movements are to be kept low and structures are located within a horizontal distance of 2H from the wall, a trapezoidal earth pressure distribution of 8H kPa should be used. These lateral pressures should be held constant for the central 50% of the pressure distribution.

Passive resistance of retaining walls embedded in residual soil or extremely weathered siltstone can be calculated using a passive earth pressure coefficient, $K_{P,}$ of 3.0. Where walls are embedded in siltstone bedrock of very low strength or above, an allowable lateral bearing pressure of 200kPa may be adopted. As the strains to generate passive earth pressure are relatively large, a factor of safety of at least 2 should be applied and passive earth pressure should be neglected where rock sockets are used

The above coefficients and lateral pressures assume horizontal backfill surfaces and where inclined backfill is proposed the coefficients/pressures would need to be increased or the inclined backfill taken as a surcharge load. All surcharge loads must be allowed for in the design, plus full hydrostatic pressures unless measures are undertaken to provide complete and permanent drainage behind the wall.

Anchors should have their bond formed within rock of at least low strength, with the bond formed beyond a line drawn up at 45° from the base of the excavation. Preliminary design of anchors may be based on an allowable bond stress of 200kPa for rock of low strength. All anchors should be proof loaded to at least 1.3 times the design working load before locking off at about 80% of the working load. Lift-off tests should be carried out on at least 10% of the anchors 24 to 48 hours following locking off to confirm that the anchors are holding their load. Anchors are generally carried out on a design and construct basis so that failure of the anchors to hold their test load does not become a contractual issue.

Where batters are used, the space between the batters and the permanent retaining walls will need to be carefully backfilled to reduce future settlement of the backfill. Only light compaction equipment should be used for compaction behind retaining walls so that excessive lateral pressures are not placed on the walls. This will require the backfill to be placed in thin layers, say 100mm loose thickness, appropriate to the compaction equipment being used. The excavated clay and siltstone will be difficult to properly compact within the limited space available behind the walls and consideration should be given to the use of more readily compactable materials, such as ripped or crushed rock or gravel. The compaction specification for the backfill will depend on whether paving or structures are to be supported on the fill. If the fill is to support paved areas it should be compacted to a density of at least 98% of Standard Maximum Dry Density (SMDD) for granular fill materials, but if it is only to support landscaped areas a lower compaction specification, say 95% of SMDD, may be appropriate, provided the risk of future settlement and maintenance can be accepted. If clay fill is to be used a greater control of fill compaction and moisture control will be required and further geotechnical advice on the use of such material should be obtained. An alternative for backfill would also be to use a uniform granular material, such as blue metal or crushed concrete, surrounded in a geofabric, with a capping layer of clay to reduce infiltration behind the wall.

4.1.3 Footings

We expect variable bedrock conditions to be exposed at the likely bulk excavation levels of RL121.1m and RL116m. At the borehole locations extremely weathered rock or very low strength rock is expected, but in the deepest excavation areas rock of low to medium strength siltstone may be encountered. All footings should be founded within the weathered rock to provide uniform support and reduce the risk of differential settlement. Where rock is exposed or is at depths of less than about 1m, pad or strip footings may be used.

Where the depth of rock is more than about 1m bored piles will be more practical to found within the better-quality rock.

Where the above ground portions of the building extend outside the basement or lower ground floor level footprint these structures will also need to be supported on piles founded within the underlying weathered bedrock. In addition, the piles would need to be founded at sufficient depth as not to surcharge the basement shoring walls. In this case piles should be founded below a line drawn upwards at 1V:1H from the bulk excavation level.

The following table provides bearing pressures for both serviceability and limit state design in accordance with Classification of Sandstone and Shales in the Sydney Region: Forty Year Review by Pells et al 2019.

Rock Class	**Serviceability**		**Limit State Design**		
	Allowable Bearing Pressure (MPa)	**Allowable Shaft Adhesion (kPa)**	**Ultimate End Bearing (MPa)**	**Ultimate Shaft Adhesion (kPa)**	**Elastic Modulus (MPa)**
V	0.8	80	>3	100	75
IV	1	100	>3	150	150
III	3.5	350	20	600	600

Where piles extend below the bulk excavation level or below a line drawn upwards from the base of the excavation at 1V:1H the above shaft adhesions may be adopted. The pile sockets must be satisfactorily cleaned and roughened to Roughness R2 or rougher. The designer must note that the allowable bearing pressure provided above are based on serviceability criteria of settlements at the footing base/pile toe of less than or equal to 1% of the footing width/pile diameter. Consequently, differently sized footings will experience greater or lesser settlements.

For ultimate values, settlements in excess of 5% of the footing width/pile diameters can be expected. If limit state design is to be adopted, then ultimate end bearing values with an appropriate geotechnical reduction factor calculated in accordance with the methodology presented in AS2159-2009 must be adopted. For piles subjected to uplift loads it is recommended that designs be checked for ‘cone pullout’ of rock and interaction effects.

With regards to earthquake actions, we consider that the site will have a Hazard Design factor of 0.8 and a Site Subsoil Class of Ce in accordance with AS1170.4-2007 Structural design actions Part 4: Earthquake actions in Australia

At least the initial stages of footing excavation or pile drilling should be inspected by a geotechnical engineer to ascertain that the recommended foundation has been reached and to check initial assumptions about foundation conditions and possible variations that may occur between borehole locations.

4.1.4 Lower Ground Floor Slab

The subgrade at bulk excavation level will comprise variably weathered siltstone bedrock. The completed excavation should be inspected by a geotechnical engineer to assess the subgrade quality and where extremely weathered siltstone is exposed at design subgrade level; the geotechnical engineer may require proof rolling of the subgrade to check for weak areas. Any weak areas detected should be treated as recommended by the geotechnical engineer.

If residual soil is exposed, the following subgrade preparation should be carried out;

- Proof rolling of the exposed subgrade using a smooth drum roller with a minimum dead weight of 5 tonnes. A minimum of eight passes should be completed with the final pass completed in the presence of a geotechnical engineer.
- The purpose of the proof rolling is to identify any soft spots or heaving materials and to increase the density of the near surface soils.
- Where soft or heaving areas are identified they must be excavated down to a sound base and replaced with engineered fill. It should be noted that the high water table means that the clay subgrade may be substantially affected and that over excavation and replacement of water softened areas with granular fill maybe necessary.
- Engineered fill must be free from all organic or otherwise deleterious materials. Clean ripped sandstone bedrock may be used as engineered fill. The material should be placed in loose layer thicknesses of no greater than about 100mm, although depending on the compaction equipment used, layer thicknesses may be varied provided the compaction specification outlined below is achieved. Maximum particle sizes should be limited to no greater than 75mm. Engineered fill must be compacted to between 98% and 102% of Standard Maximum Dry Density (SMDD) and within +/- 2% of Standard Optimum Moisture Content (SOMC).
- Earthworks testing should be completed at a frequency of 1 test/50m^2/2 layers. Where movement sensitive structures are to be supported on the engineered fill, Level 1 earthworks testing in accordance with AS3798-2007 should be completed. The Geotechnical Inspection and Testing Authority (GITA) should be engaged directly by the end client and not the earthworks contractor. The guidelines set out in AS3798 should be adopted for this site.

Slabs on grade should be designed with a subbase layer of at least 100mm thickness of crushed rock to TfNSW QA specification 3051 unbound base material (or other approved good quality and durable fine crushed rock), which is compacted to at least 100% of SMDD. This subbase layer will provide a separation between the siltstone subgrade and the slab and provide a uniform base for the slab. As recommended above, drainage will need to be provided below the basement slab and this can be achieved by constructing the subbase layer using free draining gravel to form a drainage blanket which should be placed over a geotextile to avoid “pumping” of fines. Alternatively, a closely spaced grid of subsoil drains could be constructed below the slab. The drainage will need to be connected to a permanent fail-safe pump out system, which is fitted with automatic level controls to avoid flooding.

If pavements extend over both siltstone bedrock and soils a movement joint should be incorporated in the pavement design at the interface between the bedrock and soil. Similarly, all slabs should be isolated from structural elements such as walls and columns such that they can more differentially.

4.1.5 Further Work

As detailed above, we believe that the following further geotechnical work will be required:

- Vibration monitoring during percussive excavation.
- Inspection of shoring piles
- Proof loading of any anchors to at least 1.3 times the working load.
- Inspection of all footings by the geotechnical engineer to confirm that the design bearing pressures are achieved.
- Where bearing pressures of 3,500kPa are adopted, spoon tests will be required in a third of all footing excavations evenly spread across the site.
- Further advice on subgrade improvement, if considered necessary.
- Witnessing of proof rolling of the subgrade by an experience geotechnical engineer or geotechnician and the placement and insitu testing of engineered fill, where necessary.

4.2 Campus Commons

4.2.1 Site Preparation and Earthworks

Any shallow excavations will encounter sandy or clayey fill and residual clay soils. Such material should be able to be excavated using conventional excavation equipment such as the buckets of hydraulic excavators. Fill was encountered to depths ranging from 0.5m to 0.8m and is not considered suitable for support of pavements or where fill is to be placed. The fill including any root affected soils should preferably be fully stripped prior to placement of any fill or construction of paving. However, if only pavers or other minor surface coverings are proposed that can be easily repaired by removal and filling of depressions, then the existing fill may be left in place provided any root affected soils are removed and the area is proof rolled to improve the surface compaction. Where trees or tree stumps are located within the pavement areas these should be removed and the holes filled using engineered fill. We note that pavement performance is likely to be affected by shrink-swell movements, exacerbated by the proximity of trees.

Following stripping, the exposed subgrade should be proof rolled with at least 7 passes of a minimum 8 tonne dead weight, smooth drum, vibratory roller. The final pass of the proof rolling should be carried out without vibration and in the presence of a geotechnical engineer to detect any weak subgrade areas.

Any weak or unstable areas detected during proof rolling should be locally excavated to a sound base and the excavated material replaced with controlled, engineered fill, or as directed by the geotechnical engineer during proof rolling. Following treatment of weak areas, engineered fill should be placed in thin layers as recommended in section 4.2 below.

4.2.2 Engineered Fill and Compaction Control

Engineered fill should preferably comprise well graded granular materials, such as ripped or crushed sandstone, free of deleterious substances and having a maximum particle size not exceeding 75mm. Such fill should be compacted in horizontal layers of not greater than 200mm loose thickness, to a density of at least 98% of Standard Maximum Dry Density (SMDD). For backfilling confined excavations such as service trenches, a similar compaction to engineered fill should be adhered to, but if light compaction equipment is used then the layer thickness should be limited to 100mm loose thickness.

The excavated fill may be reused as engineered fill, provided they are free of deleterious material and particles in excess of 75mm in size. If material is to be imported to site we recommend that the use of clay fill be avoided and preferably granular fill be used. If the site won clay fill is to be used it must be compacted in maximum 200mm loose thickness layers to a density strictly between 98% and 102% of SMDD and at moisture contents within 2% of Standard Optimum Moisture Content (SOMC).

Density tests should be regularly carried out on the fill to confirm the above specifications are achieved. The frequency of density testing should be at least one test per layer per 500m^2 or three tests per visit, whichever requires the most tests.

4.2.3 Batters and Retaining Walls

The following recommendations are for batters or retaining walls of no more than 3m in height.

If temporary batters are required to allow for construction of retaining walls, then they should be no steeper than 1 Vertical in 1 Horizontal (1V:1H) through the clayey fill and underlying residual silty clays. Given the nature of the upper sandy fill profile, some 'sand bagging' may be required to temporarily retain this material. Such batters should remain stable in the short term, provided all surcharge loads, including construction loads, are kept well clear of the crest of the batters. Cut batters should not encroach any closer than a distance equal to twice the height from the crest of the batter to the footing of the building (unless the building is supported on piles to rock)

If permanent batters are required, they should be no steeper than 1 Vertical in 3 Horizontal (1V:3H). All batters should be protected from erosion by the placement of topsoil and planting of a deep-rooted runner grass, or other suitable surface protection.

If walls are retaining more than about 3m, additional lateral support of the walls may be required. The following parameters may be used for preliminary design of low height retaining walls of less than 3m height;

- Free-standing cantilever walls which support areas where movement is of little concern (i.e. landscape walls) may be designed using a triangular lateral earth pressure distribution and an 'active' earth pressure coefficient, K_a, of 0.35, assuming a horizontal retained surface.

- Where movements are to be kept low, or walls are restricted from some lateral movement such as by other structural elements in front of the wall, an 'at rest' earth pressure coefficient, K_0, of 0.6 should be used, assuming a horizontal retained surface.
- A bulk unit weight of 20kN/m^3 should be adopted for the retained soil.
- All surcharge loads affecting the walls (e.g. sloping backfill, traffic loads, construction loads, stockpiles, etc) should be taken into account in the wall design using the appropriate earth pressure coefficient from above. Appropriate hydrostatic pressures should also be added to the above pressures.
- Where the walls are designed as drained, measures must be taken to provide permanent and effective drainage of the ground behind the walls. The subsoil drains should incorporate a non-woven geotextile fabric (e.g. Bidim A34) to act as a filter against subsoil erosion.
- Lateral toe restraint may be achieved by passive resistance of the soil profile in front of the wall using a triangular lateral earth pressure distribution and a 'passive' earth pressure coefficient, K_P, of 3.0 for the soil profile and extremely weathered shale. We note that significant movement is required in order to mobilise the full passive pressure of a soil, and therefore a factor of safety of at least 2 should be adopted to reduce such movements. Any localised excavations in front of the wall should be taken into account in the embedment design

4.2.4 Footings

The fill encountered within the boreholes is considered uncontrolled fill and is not suitable for support of footing loads. Consequently, we recommend that all footings be uniformly founded within the underlying residual silty clay of at least very stiff strength. Footings founded on very stiff residual silty clays may be designed for a maximum allowable bearing pressure of 100kPa. If any more substantial structures are proposed they could be supported on piled footings comprising bored piles that are founded in weathered siltstone bedrock of at least very low strength and designed for an allowable bearing pressure of 700kPa.

Our nearby soil classification testing (Atterberg Limits and Linear Shrinkage tests) on the residual clays for the nearby Junior and Prep School Administration Building indicate the residual silty clay soils are typically of high plasticity. As such, footings must also be designed to take into account the shrink/swell movements of the clays. We expect shrink/swell movements similar to Class H1 site in accordance with AS2870-2011.

Excavations for pad/strip or bored pier footings should be visually inspected by a geotechnical engineer to confirm that a suitable founding material has been encountered.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the detailed design and construction phases of the project. In the event that any of the detailed design or construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

A waste classification is required for any soil and/or bedrock excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM), General Solid, Restricted Solid or Hazardous Waste. Analysis can take up to seven to ten working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) could be expected. We strongly recommend that this requirement is addressed prior to the commencement of excavation on site.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

TABLE A
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Pymble Ladies College	**Ref No:**	34901BC
Project:	Proposed Senior School Building	**Report:**	A
Location:	Avon Road, PYMBLE, NSW	**Report Date:**	19/04/22
		Page 1 of 1	

BOREHOLE NUMBER	DEPTH (m)	IS (50) (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
1	7.46 - 7.48	0.3	6	A
	7.77 - 7.79	0.04	1	A
	8.20 - 8.22	0.2	4	A
	8.47 - 8.51	0.05	1	A
	9.45 - 9.48	0.5	10	A
	9.89 - 9.92	0.3	6	A
	10.21 - 10.23	0.06	1	A
	10.77 - 10.80	1.4	28	A
	11.30 - 11.33	1.2	24	A
	11.72 - 11.75	0.7	14	A
	12.22 - 12.25	1.3	26	A
	12.77 - 12.80	1.3	26	A
	13.07 - 13.09	1	20	A
2	5.32 - 5.34	0.02	<1	A
	5.97 - 5.99	0.03	1	A
	6.48 - 6.50	0.02	<1	A
	6.73 - 6.76	0.2	4	A
	7.06 - 7.09	0.3	6	A
	7.49 - 7.52	0.7	14	A
3	7.39 - 7.43	1	20	A
	7.94 - 7.98	0.9	18	A
	8.24 - 8.27	0.8	16	A
	8.72 - 8.76	0.8	16	A
	9.22 - 9.26	1.1	22	A
	9.81 - 9.84	1.4	28	A

NOTES

1. In the above table, testing was completed in test direction A for the axial direction, D for the diametral direction, B for the block test and L for the lump test.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RMS T223.
4. For reporting purposes, the IS(50) has been rounded to the nearest 0.1MPa, or to one significant figure if less than 0.1MPa.
5. The estimated Unconfined Compressive Strength was calculated from the Point Load Strength Index based on the correlation provided in AS1726:2017 'Geotechnical Site Investigations' and rounded off to the nearest whole number: U.C.S. = 20 IS(50).

TABLE A
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Pymble Ladies College	**Ref No:**	34901BC
Project:	Proposed Senior School Building	**Report:**	A
Location:	Avon Road, PYMBLE, NSW	**Report Date:**	19/04/22

BOREHOLE NUMBER	DEPTH (m)	IS (50) (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
3	10.14 - 10.18	1.6	32	A
4	7.39 - 7.43	0.7	14	A
	7.92 - 7.95	0.7	14	A
	8.10 - 8.13	0.2	4	A
	8.83 - 8.86	0.7	14	A
	9.08 - 9.11	0.9	18	A
	9.55 - 9.58	1.3	26	A
	10.10 - 10.13	1.1	22	A
	10.31 - 10.35	1.5	30	A

NOTE: SEE PAGE 1

TABLE A
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Pymble Ladies College	**Ref No:**	34901BC
Project:	Proposed Senior School Building	**Report:**	A
Location:	Pymble Ladies College, Avon Road, Pymble, NSW	**Report Date:**	14/10/24

BOREHOLE NUMBER	DEPTH (m)	$I_{S\ (50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
101	5.76 - 5.78	0.08	2	A
	6.27 - 6.30	0.05	1	A
	6.58 - 6.61	0.2	4	A
	7.28 - 7.30	0.3	6	A
	7.73 - 7.77	0.2	4	A
	8.52 - 8.55	0.04	1	A
	8.93 - 8.96	0.4	8	A
	9.41 - 9.44	0.06	1	A
	10.60 - 10.64	1	20	A
	11.22 - 11.24	1	20	A
	11.66 - 11.70	2.1	42	A
102	8.78 - 8.81	0.7	14	A
	9.09 - 9.12	1	20	A
	9.83 - 9.86	1.8	36	A
	10.08 - 10.11	2.5	50	A
	10.51 - 10.55	1.2	24	A
	11.07 - 11.10	3	60	A
	11.69 - 11.72	1.8	36	A
	12.38 - 12.41	0.9	18	A
	12.82 - 12.86	0.8	16	A
	13.18 - 13.23	0.9	18	A
	13.64 - 13.67	0.9	18	A
	14.12 - 14.17	2.1	42	A
	14.74 - 14.78	0.8	16	A
	15.21 - 15.25	1	20	A

NOTE: SEE PAGE 2

TABLE A
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Pymble Ladies College

Ref No: 34901BC

Project: Proposed Senior School Building

Report: A

Location: Pymble Ladies College, Avon Road, Pymble, NSW

Report Date: 14/10/24

Page 2 of 2

BOREHOLE NUMBER	DEPTH (m)	$I_{S\ (50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
102	15.76 - 15.80	0.6	12	A
	16.30 - 16.34	1.1	22	A
	16.69 - 16.73	1.3	26	A
	17.16 - 17.19	0.7	14	A
	17.50 - 17.53	1	20	A
	17.86 - 17.90	1	20	A
	18.04 - 18.07	1.1	22	A
103	7.85 - 7.87	0.2	4	A
	8.58 - 8.61	0.9	18	A
	8.79 - 8.82	0.1	2	A
	9.24 - 9.26	0.5	10	A
	9.52 - 9.55	1.6	32	A
	9.90 - 9.93	1	20	A
	10.03 - 10.05	1.4	28	A
104	3.80 - 3.83	1	20	A
	4.20 - 4.22	0.8	16	A
	4.68 - 4.71	0.7	14	A
	5.20 - 5.24	0.7	14	A
	5.51 - 5.55	1.6	32	A
	5.83 - 5.84	0.7	14	A
	6.06 - 6.08	0.6	12	A

NOTES

1. In the above table, testing was completed in test direction A for the axial direction, D for the diametral direction, B for the block test and L for the lump test.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RMS T223.
4. For reporting purposes, the $I_{S(50)}$ has been rounded to the nearest 0.1MPa, or to one significant figure if less than 0.1MPa.
5. The estimated Unconfined Compressive Strength was calculated from the Point Load Strength Index based on the correlation provided in AS1726:2017 'Geotechnical Site Investigations' and rounded off to the nearest whole number: U.C.S. = 20 $I_{S(50)}$.

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 293610

Client Details

Client	JK Geotechnics
Attention	Ben Sheppard
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**34901BC, Pymble**
Number of Samples	3 Soil
Date samples received	19/04/2022
Date completed instructions received	19/04/2022

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.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	27/04/2022
Date of Issue	27/04/2022

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil				
Our Reference		293610-1	293610-2	293610-3
Your Reference	UNITS	BH1	BH3	BH4
Depth		1.5-1.8	4.5-4.95	3-3.3
Date Sampled		12/04/2022	12/04/2022	12/04/2022
Type of sample		Soil	Soil	Soil
Date prepared	-	26/04/2022	26/04/2022	26/04/2022
Date analysed	-	26/04/2022	26/04/2022	26/04/2022
pH 1:5 soil:water	pH Units	6.0	5.3	4.7
Chloride, Cl 1:5 soil:water	mg/kg	<10	21	38
Sulphate, SO4 1:5 soil:water	mg/kg	20	57	40
Resistivity in soil*	ohm m	510	170	160

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 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
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.

Client Reference: 34901BC, Pymble

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			26/04/2022	1	26/04/2022	26/04/2022		26/04/2022	[NT]
Date analysed	-			26/04/2022	1	26/04/2022	26/04/2022		26/04/2022	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	6.0	6.0	0	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	[NT]		105	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	20	[NT]		92	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	1	510	520	2	[NT]	[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.

Report Comments

pH/EC

Samples were out of the recommended holding time for this analysis.

JKGeotechnics

BOREHOLE LOG

Borehole No.
1
1 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Method:** SPIRAL AUGER **R.L. Surface:** ~125.8 m
Date: 12/4/22 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** B.S./T.C.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Silty clay topsoil, medium plasticity, brown, with fine to medium grained sand, trace of fine grained igneous and ironstone gravel, and root fibres.	w>PL			GRASS COVER APPEARS MODERATELY COMPACTED
				■	N = 8 4,3,5	125	1			FILL: Gravelly silty clay, low to medium plasticity, red brown and brown, fine to coarse grained igneous and siltstone gravel, trace of fine grained sand and gravel lenses.			190 270 300	
				■	N = 4 4,2,2	124								APPEARS POORLY COMPACTED TOO GRAVELLY FOR HP TESTING
							2		CI-CH	Silty CLAY: medium to high plasticity, orange brown mottled grey, with fine to medium grained ironstone gravel.	w~PL	VSt	310 310	RESIDUAL
ON 5/5/22						123	3		CH	Silty CLAY: high plasticity, grey mottled red brown, trace of fine grained ironstone gravel.				
				■	N = 13 6,5,8							Hd	590 580 580	
						122				as above, but trace of extremely weathered siltstone bands.				
				■		121	4 5		-	SILTSTONE: dark grey and brown, with extremely weathered bands and iron indurated bands.	HW	VL		ASHFIELD SHALE VERY LOW 'TC' BIT RESISTANCE WITH LOW BANDS
						120 119	6			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 13.16m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 13.16m TO 10.16m. CASING 10.16m TO 0m. 2mm SAND FILTER PACK 13.16m TO 10.10m. BENTONITE SEAL 10.10m TO 8.0m. BACKFILLED WITH CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.

CORED BOREHOLE LOG

Borehole No.
1
2 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC | **Core Size:** NMLC | **R.L. Surface:** ~125.8 m
Date: 12/4/22 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK305 | **Bearing:** N/A | **Logged/Checked By:** B.S./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL -0.1, L -0.3, M -1, H -3, VH -10, EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	General	Formation
					START CORING AT 5.80m							
		120	6		NO CORE 0.92m							
		119	7		SILTSTONE: grey, laminations at 0-5°.	HW	VL			(6.72-7.07m) Rock is fragmented numerous Be, 0°, P, R, Clay Ct, and J, 60-90°, P, R, Cn (7.07m) XWS, 0°, 120 mm.t		Ashfield Shale
		118	8		SILTSTONE: dark grey and brown, with iron indurated bands, laminations at 0-5°.			0.30 0.040 0.20		(7.19m) Cr, 0°, 8 mm.t (7.21m) Be, 0°, P, R, Fe Sn (7.23m) XWS, 0°, 34 mm.t (7.29m) Cr, 0°, 29 mm.t (7.38m) XWS, 0°, 14 mm.t (7.47m) Be, 0°, P, R, Clay Ct (7.53m) Cr, 0°, 7 mm.t (7.57m) Cr, 0°, 6 mm.t (7.63m) J, 30 - 70°, Un, R, Fe Sn (7.64m) Be, 0°, P, R, Fe Sn (7.71m) J x 3, 30 - 40°, P, R, Fe Sn (7.77m) XWS, 0°, 4 mm.t (7.79m) XWS, 0°, 15 mm.t (7.87m) J, 40°, Un, R, XW FILLED, 10 mm.t (8.00m) XWS, 0°, 19 mm.t (8.12m) Be, 0°, P, R, Fe Sn		
					Extremely Weathered siltstone: silty CLAY, medium plasticity, grey and dark grey, with fragmented very low strength bands.	XW	Hd	0.050	600 200 60 20	(8.21m) Be, 0°, P, R, Fe Sn (8.24m) J, 75°, Un, R, Clay FILLED, 9 mm.t (8.31m) HP: >600 kPa (8.38m) HP: >600 kPa		
100% RETURN		117	9		NO CORE 0.75m							
		116	10		SILTSTONE: dark grey, laminations at 0-5°.	MW	L - M	0.50 0.30		(9.36-10.17m) Rock is highly fractured Be, 0 - 5°, P, R, Fe Sn/Cn, and J, 10-70°, P/Un, ,Sn, Fe, Sn and Cr, 0°, 0-10mm.t		Ashfield Shale
							VL	0.060		(10.15m) J, 85°, Un, R, Clay Vn (10.19m) Cr, 0°, 17 mm.t (10.25m) Be, 0°, P, R, Clay Vn (10.26m) Cr, 0°, 17 mm.t (10.36m) Cr, 0°, 110 mm.t (10.51m) XWS, 0°, 14 mm.t (10.55m) Cr, 0°, 84 mm.t		
		115 114	11			SW	M - H	1.4 1.2 0.70	600 200 60 20	(10.68m) Be, 0°, Un, S, Cn, numerous (10.80m) J, 40 - 90°, Ir, S, Ct (11.15m) Be, 0°, P, Fe Sn (11.22m) J, 25°, Un, R, Clay Vn (11.25m) J, 25°, P, S, Clay Ct (11.39m) J, 15°, P, S, Cn (11.46m) J, 25°, P, S, Clay Ct (11.50m) Ji, 30°, P		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

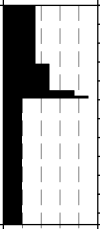
JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
1
3 / 3

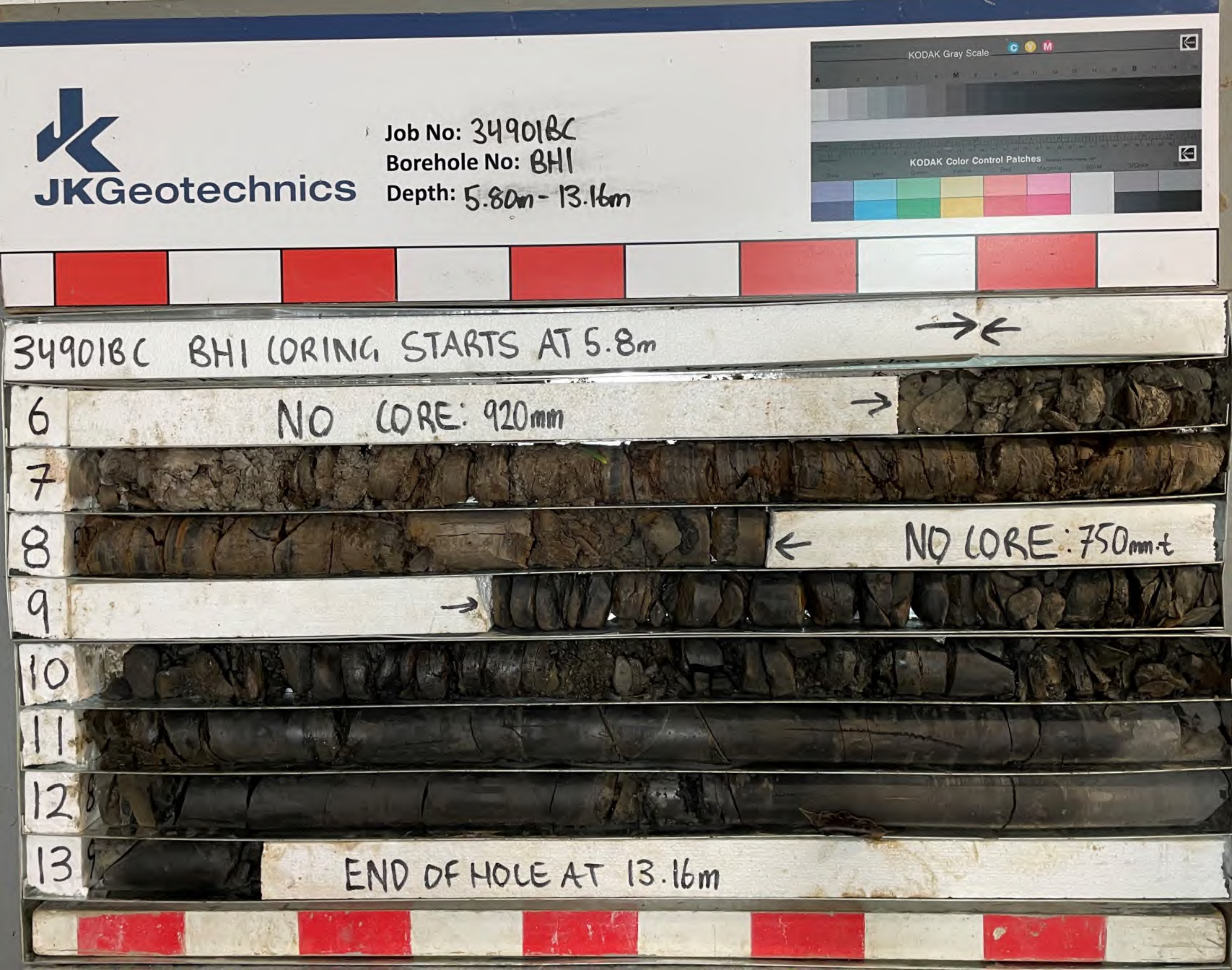
Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Core Size: NMLC
R.L. Surface: ~125.8 m
Date: 12/4/22
Inclination: VERTICAL
Datum: AHD
Plant Type: JK305
Bearing: N/A
Logged/Checked By: B.S./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL 0.1, L 0.3, M 1, H 3, VH 10, EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific General	Formation
100% RETURN		113	13		SILTSTONE: dark grey, laminations at 0-5°. *(continued)*	SW	M - H	1.3 1.3 1.0		(11.98m) J, 90°, Un, S, Cn (12.31m) J, 34°, P, S, Cn (12.48m) J, 30°, Un, R, Clay FILLED, 4 mm.t (12.49m) XWS, 0°, 55 mm.t (13.01m) J, 40°, P, S, Cn (13.14m) XWS, 5°, 20 mm.t	Ashfield Shale
		112 111 110 109 108 107	14 15 16 17 18		END OF BOREHOLE AT 13.16 m				600 200 60 20		

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 34901BC PYMBLE.GPJ <<DrawingFile>> 19/05/2022 17:13 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 34901BC
Borehole No: BH1
Depth: 5.80m - 13.16m
KODAK Gray Scale
KODAK Color Control Patches
34901BC BH1 CORING STARTS AT 5.8m
6
NO CORE: 920mm
7
8
NO CORE: 750mm.t
9
10
11
12
13
END OF HOLE AT 13.16m

JKGeotechnics

BOREHOLE LOG

Borehole No.
2
1 / 2

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Method: SPIRAL AUGER
R.L. Surface: ~120.5 m
Date: 13/4/22
Datum: AHD
Plant Type: JK305
Logged/Checked By: B.S./T.C.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
ON 5/5/22 DRY ON COMPLETION OF AUGERING									-	PAVERS: 400mm.t				7mm DIA. REINFORCEMENT, 100mm TOP COVER
									-	CONCRETE: 200mm.t				
										FILL: Silty clay, low plasticity, brown, with fine to coarse grained ironstone and siltstone gravel, trace of fine grained sand.	w>PL			
					N = 16 5,6,10	120			CH	Silty CLAY: high plasticity, grey, trace of iron indurated bands.	w>PL	VSt	370 340 340	RESIDUAL
					N=SPT 8/ 20mm REFUSAL	119	1		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey, trace of iron indurated bands.	XW	Hd		ASHFIELD SHALE VERY LOW 'TC' BIT RESISTANCE
						117	3			SILTSTONE: dark grey and brown, trace of iron indurated bands and extremely weathered bands.	HW	VL		VERY LOW RESISTANCE WITH LOW BANDS
						116				REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 7.53m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 7.53m TO 4.53m. CASING 4.53m TO 0m. 2mm SAND FILTER PACK 7.53m TO 3.9m. BENTONITE SEAL 3.9m TO 1.5m. BACKFILLED WITH CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.

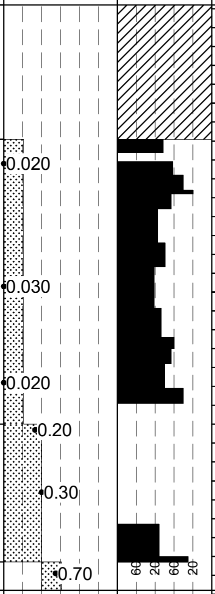
CORED BOREHOLE LOG

Borehole No.
2

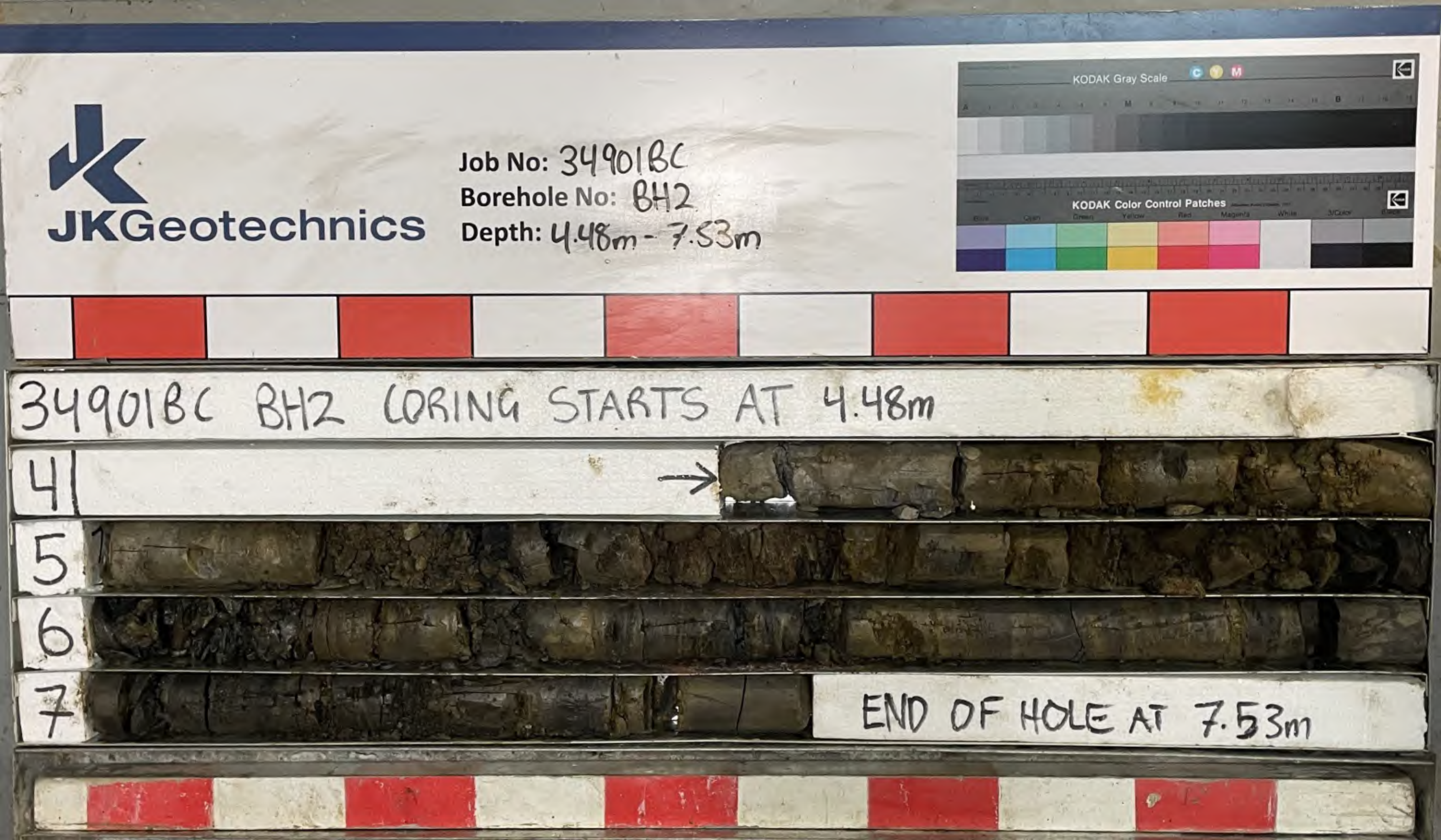
Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Core Size:** NMLC **R.L. Surface:** ~120.5 m
Date: 13/4/22 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK305 **Bearing:** N/A **Logged/Checked By:** B.S./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL -0.1 L -0.3 M -1 H -3 VH -10 EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific General	Formation
					START CORING AT 4.48m						
100% RETURN		116	5		Extremely Weathered siltstone: silty CLAY, medium plasticity, grey and dark grey, with occasional very low strength bands.	XW	Hd			(4.95m) HP: 470 kPa (5.12m) HP: >600 kPa (5.19m) Cr, 0°, 150 mm.t	Ashfield Shale
		115 114	6		SILTSTONE: dark grey and brown, distinctly bedded at 0-5°, with occasional iron indurated bands.	HW	VL	0.020 0.030 0.020		(5.31m) HP: >600 kPa (5.38m) XWS, 0°, 37 mm.t (5.42m) Be, 0°, P, R, Fe Sn (5.46m) J, 70°, Un, R, Fe Sn (5.48m) Be, 0°, P, R, Fe Sn (5.56m) XWS, 0°, 110 mm.t (5.77-5.96m) Rock is fragmented, numerous J and Cr, (indistinguishable) (6.00-6.17m) Rock is fragmented, numerous J and Cr, (indistinguishable) (6.24m) XWS, 0°, 64 mm.t (6.30m) Cr, 0°, 50 mm.t (6.38m) XWS, 0°, 75 mm.t (6.51m) XWS, 0°, 17 mm.t (6.55m) XWS, 0°, 44 mm.t (6.59m) XWS, 0°, 50 mm.t	
			7				VL - L	0.20 0.30		(6.86m) XWS, 0°, 8 mm.t (7.05m) XWS, 0°, 9 mm.t (7.17m) XWS, 0°, 13 mm.t (7.23m) XWS, 0°, 24 mm.t (7.40m) XWS, 0°, 10 mm.t (7.43m) Be, 0°, P, R, Clay Ct	
		113					M	0.70			
		112 111 110	8 9 10		END OF BOREHOLE AT 7.58 m						



FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS



Job No: 34901BC
Borehole No: BH2
Depth: 4.48m - 7.53m

34901BC BH2 CORING STARTS AT 4.48m

END OF HOLE AT 7.53m

JKGeotechnics

BOREHOLE LOG

Borehole No.
3
1 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Method:** SPIRAL AUGER **R.L. Surface:** ~120.3 m
Date: 12/4/22 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** B.S./T.C.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING									-	PAVERS: 40mm.t	M			
						120			-	FILL: Sand, fine to medium grained, yellow brown.				
									-	CONCRETE: 250mm.t	w<PL			APPEARS MODERATELY COMPACTED
				■ ■	N = 12 5,6,6 N = 10 5,7,8	119	1			FILL: Silty clay, low to medium plasticity, brown, red brown and grey, with fine to coarse grained ironstone and siltstone gravel, trace of ash.			550 410 470 470 310 270	
						118	2		CH	Silty CLAY: high plasticity, grey and orange brown, trace of fine grained ironstone gravel, and root fibres.	w~PL	Hd	550 470 550	RESIDUAL
				■	N = 20 11,10,10	117	3 4			Silty CLAY: high plasticity, red brown mottled grey, trace of iron indurated bands.			570 600 540	
				■ ■	N = 24 7,11,13	116 115 114	5 6		-	Extremely weathered siltstone: silty CLAY, medium plasticity, grey, trace of iron indurated bands.	XW	Hd	>600 >600 >600	ASHFIELD SHALE VERY LOW 'TC' BIT RESISTANCE
				■						as above, but with very low strength bands.				

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 34901BC PYMBLE.GPJ <<DrawingFile>> 19/05/2022 17:14 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

JKGeotechnics

BOREHOLE LOG

Borehole No.
3
2 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Method: SPIRAL AUGER
R.L. Surface: ~120.3 m
Date: 12/4/22
Datum: AHD
Plant Type: JK305
Logged/Checked By: B.S./T.C.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
								▥	-	SILTSTONE: dark grey and brown, with extremely weathered iron indurated bands.	HW	VL - L		LOW RESISTANCE
						113				REFER TO CORED BOREHOLE LOG				
							8							
						112								
							9							
						111								
							10							
						110								
							11							
						109								
							12							
						108								
							13							
						107								

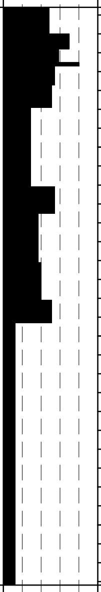
CORED BOREHOLE LOG

Borehole No.
3
3 / 3

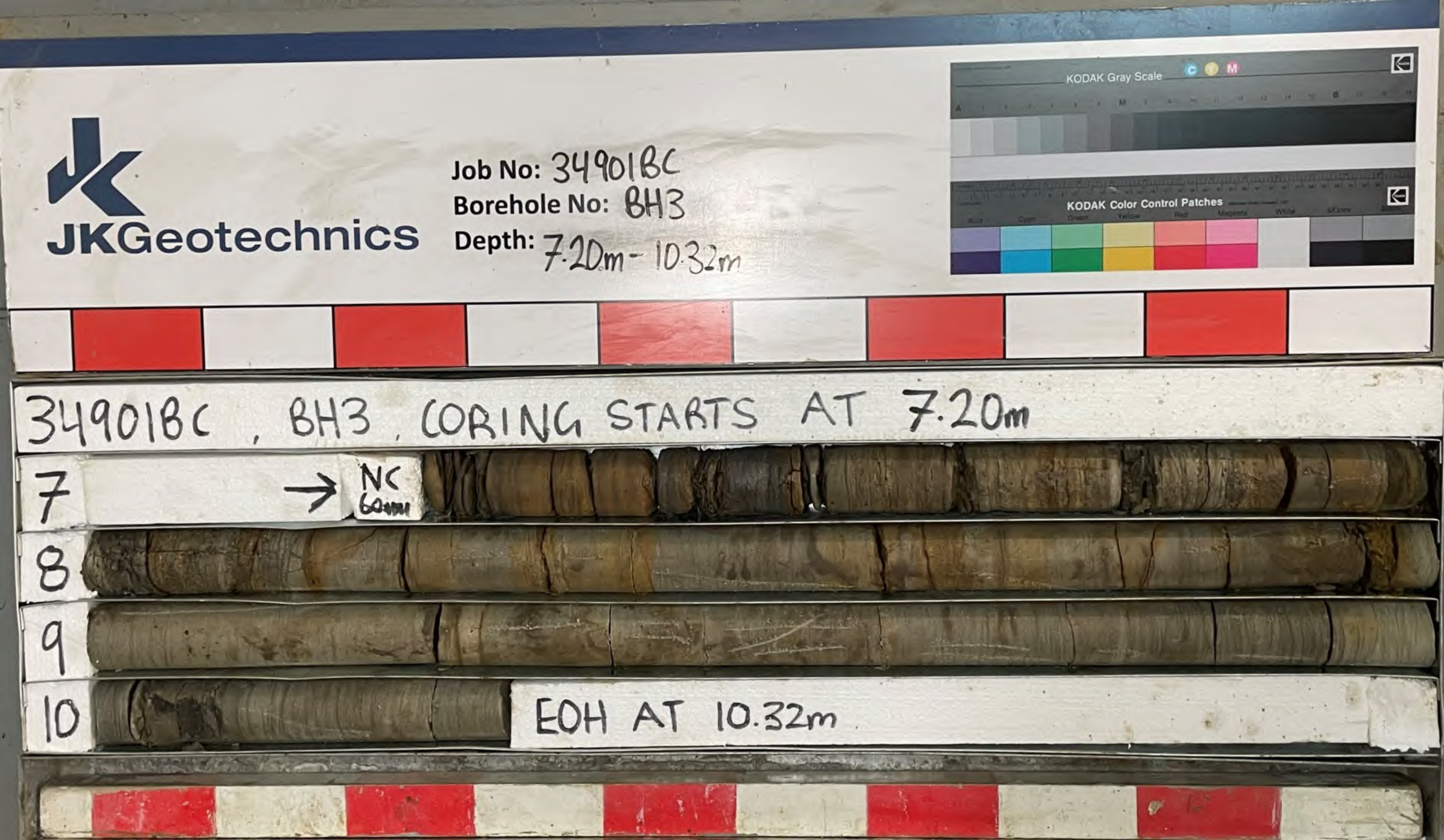
Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC	**Core Size:** NMLC	**R.L. Surface:** ~120.3 m
Date: 12/4/22	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK305	**Bearing:** N/A	**Logged/Checked By:** B.S./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL-0.1 L-0.3 M-1 H-3 VH-10 EH	DEFECT DETAILS: SPACING (mm) 600 200 60 20	DEFECT DETAILS: DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
					START CORING AT 7.20m						
100% RETURN		113	8		NO CORE 0.06m Interbedded SANDSTONE(80%): fine grained, orange brown, and SILTSTONE(20%): dark grey and grey, distinctly bedded at 0-5°.	MW	M - H	1.0 0.90		(7.26-7.33m) Rock is fragmented, numerous, Be, 0°, P, R, Fe, Sn and J, 0-90°, P, R, Fe, Sn (7.40m) Be, 0°, P, R, Fe Sn (7.48m) Cr, 0°, 13 mm.t (7.67m) Be, 0°, P, R, Clay FILLED, 4 mm.t (7.79m) XWS, 0°, 24 mm.t	Ashfield Shale
		112			SANDSTONE: fine grained, grey and brown, distinctly bedded at 0-10°, with occasional iron indurated bands.	SW		0.80 0.80		(8.21m) Ji, 40°, P (8.35m) Be, 0°, P, R, Clay Ct (8.61m) Be, 0°, P, R, Fe Sn (8.81m) Ji, 20°, Un, Cn (8.93m) XWS, 0°, 32 mm.t	Hawkesbury Sandstone
		111	9 10		SANDSTONE: fine grained, grey, with dark grey laminae, distinctly bedded at 0-10°.			1.1 1.4 1.6		(10.04m) XWS, 0°, 60 mm.t	
		110			END OF BOREHOLE AT 10.32 m				600 200 60 20		
		109	11								
		108	12								
		107	13						600 200 60 20		



FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS



JKGeotechnics

Job No: 34901BC

Borehole No: BH3

Depth: 7.20m - 10.32m

34901BC , BH3 , CORING STARTS AT 7.20m

7 → NC 60mm

8

9

10 EOH AT 10.32m

BOREHOLE LOG

Borehole No.
4
1 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Method: SPIRAL AUGER
R.L. Surface: ~120.4 m
Date: 13/4/22
Datum: AHD
Plant Type: JK305
Logged/Checked By: B.S./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING									-	PAVERS: 40mm.t	M			
									-	FILL: Sand, medium to coarse grained, yellow brown.	w<PL			
						120			-	CONCRETE: 100mm.t				6mm DIA. REINFORCEMENT, 50mm TOP COVER
				■	N = 10 4,5,5		1			FILL: Silty clay, medium plasticity, brown, trace of fine grained sand, fine to coarse grained igneous and ironstone gravel, and ash.			>600 >600 >600	APPEARS MODERATELY COMPACTED
				■	N = 8 7,5,3	119	2			FILL: Silty clay, medium to high plasticity, red brown and brown, trace of fine grained ironstone gravel and ash.			>600 >600 >600	
						118			CH	Silty CLAY: high plasticity, red brown and grey, trace of fine to medium grained ironstone gravel.	w~PL	Hd		RESIDUAL
ON 5/5/22 ▽				■	N = 19 7,7,12		3			as above, but grey mottled red brown.			>600 >600 >600	
						117 116	4		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey mottled red brown, trace of iron indurated bands.	XW	Hd	>600 >600 >600	ASHFIELD SHALE VERY LOW 'TC' BIT RESISTANCE
					N=SPT 4/ 10mm REFUSAL	115 114	5 6			as above, but with medium strength iron indurated bands				VERY LOW RESISTANCE WITH LOW BANDS
														VERY LOW TO LOW BANDED RESISTANCE

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BOREHOLE LOG

Borehole No.
4
2 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Method:** SPIRAL AUGER **R.L. Surface:** ~120.4 m
Date: 13/4/22 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** B.S./T.C.

Groundwater Record	SAMPLES ES	 U50	 DB	 DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SILTSTONE: as above	XW	Hd		
				■					-	SANDSTONE: fine grained, orange brown and brown, with extremely weathered iron indurated bands and very low strength siltstone bands.	HW	L		LOW RESISTANCE
						113				REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 7.3m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 7.3m TO 4.3m. CASING 4.3m TO 0m. 2mm SAND FILTER PACK 7.3m TO 4.0m. BENTONITE SEAL 4.0m TO 2.1m. BACKFILLED WITH CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							8							
						112								
							9							
						111								
							10							
						110								
							11							
						109								
							12							
						108								
							13							
						107								

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CORED BOREHOLE LOG

Borehole No.
4
3 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Core Size: NMLC
R.L. Surface: ~120.4 m
Date: 13/4/22
Inclination: VERTICAL
Datum: AHD
Plant Type: JK305
Bearing: N/A
Logged/Checked By: B.S./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL -0.1, L -0.3, M -1, H -3, VH -10, EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific General	Formation
					START CORING AT 7.30m						
100% RETURN		113 112	8 9		SANDSTONE: fine grained, grey and brown, distinctly bedded at 0-10°, with iron indurated bands.	HW - MW SW	L - M M - H	0.70 0.70 0.20 0.70 0.90		(7.35m) Be, 0°, P, R, Fe Sn (7.46m) J, 20°, Un, R, Fe Sn (7.47m) Cr, 0°, 9 mm.t (7.52m) Cr, 0°, 8 mm.t (7.55m) Be, 0°, Un, R, Fe Sn (7.56m) Cr, 0°, 11 mm.t (7.70m) XWS, 0°, 22 mm.t (7.85m) Be, 0°, P, R, Clay FILLED, 4 mm.t (8.14m) Jh, 80°, Fe Healed (8.20m) J, 60 - 75°, P, R, Fe Sn (8.38m) Be, 0°, P, R, Fe Sn (8.57m) J, 55°, P, R, Fe Sn (8.62m) XWS, 0°, 34 mm.t (8.78m) XWS, 0°, 7 mm.t	Hawkesbury Sandstone
		111			as above, but grey, with dark grey laminae.	FR				(9.34m) Be, 0°, P, R, FILLED, 20 mm.t, XW	
					LAMINITE: Sandstone(50%), fine grained, grey, interlaminated with Siltstone(50%), dark grey, distinctly bedded at 0-5°.			1.3		(9.71m) J, 55°, P, R, Fe Sn (9.80m) Ji, 90°, Un	
			10		SANDSTONE: fine grained, grey, distinctly bedded at 0-5°, with dark grey laminae.			1.1 1.5		(9.98m) XWS, 0°, 20 mm.t (10.26m) XWS, 0°, 12 mm.t	
		110 109 108 107	11 12 13		END OF BOREHOLE AT 10.36 m				600 200 60 20		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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Job No: 34901BC

Borehole No: BH4

Depth: 7.30m - 10.36m

JKGeotechnics

BOREHOLE LOG

Borehole No.
101
1 / 2

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Method:** SPIRAL AUGER **R.L. Surface:** ~125.5 m
Date: 9/10/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** A.M./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING									-	ASPHALTIC CONCRETE: 40mm.t	D			ASPHALT SURFACE
				■						FILL: Gravel, fine to medium grained, igneous.	w~PL			APPEARS WELL COMPACTED
				■	N = 19 7,10,9	125				FILL: Silty clay, medium to high plasticity, orange brown, with fine to medium grained igneous gravel.				
							1			FILL: Gravel, fine to medium grained, siltstone.	D			
				■	N = 12 4,6,6	124				FILL: Silty clay, medium to high plasticity, grey brown, trace of ash.	w<PL			
						123	2		CH	Silty CLAY: high plasticity, orange brown, trace of fine grained ironstone gravel.	w~PL	Hd	>600 >600 580	RESIDUAL
				■	N > 27 14,21,6/ 50mm REFUSAL	122	3		-	Extremely Weathered siltstone: silty CLAY, medium to high plasticity, orange brown and grey, with bands of very low strength siltstone and iron indurated bands.	XW	Hd	>600 >600 >600	ASHFIELD SHALE
				■		121	4 5			SILTSTONE: dark grey and brown, with occasional iron indurated bands.	DW	VL - L		VERY LOW TO LOW 'TC' BIT RESISTANCE GROUNDWATER MONITORING WELL INSTALLED TO 4.0m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 4.0m TO 1.0m. CASING 1.0m TO 0.1m. 2mm SAND FILTER PACK 4.0m TO 1.0m. BENTONITE SEAL 1.0m TO 0.1m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
				■		120				SILTSTONE: dark grey and brown.		L - M		LOW TO MODERATE RESISTANCE
						119	6			REFER TO CORED BOREHOLE LOG				

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CORED BOREHOLE LOG

Borehole No.
101
2 / 2

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Core Size:** NMLC **R.L. Surface:** ~125.5 m
Date: 9/10/24 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK330 **Bearing:** N/A **Logged/Checked By:** A.M./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL 0.1, L 0.3, M 1, H 3, VH 10, EH	DEFECT DETAILS: SPACING (mm) 600 200 60 20	DEFECT DETAILS: DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	General	Formation
		120			START CORING AT 5.72m							
100% RETURN		119	6		SILTSTONE: dark grey and brown, laminations bedded at 0-5°, with iron indurated bands.	HW	VL - L	0.080 0.050 0.20		(5.85m) Cr, 0°, 30 mm.t (5.90m) Cr, 0°, 20 mm.t (5.94m) CS, 0°, 20 mm.t (6.02m) J, 20°, P, R, Cn (6.04m) Cr, 0°, 40 mm.t (6.09m) J, 30°, P, S, Fe Sn (6.11m) Cr, 0°, 40 mm.t (6.15m) CS, 0°, 20 mm.t (6.20m) Cr, 0°, 20 mm.t (6.26m) J, 20°, P, S, Fe Sn (6.30m) Be, 0°, P, S, Fe Sn (6.32m) XWS, 0°, 40 mm.t (6.54m) Cr, 0°, 30 mm.t (6.59m) J, 20°, P, R, Fe Sn (6.60m) Ji, 30°, St (6.61m) Ji, 40°, St (6.63m) CS, 0°, 40 mm.t		Ashfield Shale
					NO CORE 0.18m							
		118	7 8		as above, but without iron indurated bands.	HW	L - M	0.30 0.20		(6.84m) XWS, 0°, 60 mm.t (6.93m) J, 30°, P (7.00m) Cr, 0°, 100 mm.t (7.12m) J, 70°, P, R, Fe Sn (7.22m) Cr, 0°, 30 mm.t (7.28m) J, 40°, P, S, Cn (7.29m) Cr, 0°, 20 mm.t (7.35m) Cr, 0°, 40 mm.t (7.42m) J, 70°, P, R, Fe Sn (7.46m) J, 30°, P, R, Fe Sn (7.50m) Ji, 50°, P (7.51m) Be, 0°, P, R, Fe Sn (7.61m) J, 30°, P, R, Fe Sn (7.65m) J, 70°, P, R, Cn (7.70m) J, 70°, P, R, Fe Sn (7.84m) J, 20°, P, R, Fe Sn (7.86m) CS, 0°, 20 mm.t (8.06m) J, 60°, P, R, Fe Sn (8.10m) Cr, 0°, 100 mm.t		Ashfield Shale
					NO CORE 0.10m							
		117 116	9 10		SILTSTONE: dark grey and brown, laminations bedded at 0-5°.	HW	VL - L	0.040 0.40 0.060		(8.35m) Cr, 0°, 20 mm.t (8.38m) J, 70°, P, R, Cn (8.40m) Cr, 0°, 60 mm.t (8.57m) Cr, 0°, 30 mm.t (8.66m) Cr, 0°, 30 mm.t (8.73m) Cr, 0°, 40 mm.t (8.89m) Cr, 0°, 40 mm.t (9.09m) Cr, 0°, 100 mm.t	(9.39-10.58m) Rock is extremely fractured, with Be 0-5°, P, R, Fe, Sn and J ~50°, P, R, Fe, Sn	Ashfield Shale
					NO CORE 0.16m							
		115			SILTSTONE: dark grey and brown, laminations bedded at 0-5°.	HW	VL					Ashfield Shale
		114	11		SILTSTONE: dark grey, laminations bedded at 0°.	SW	M - H	1.0 1.0 2.1		(10.60m) Ji, 30°, P (10.75m) J, 50°, P, S, Cn (11.12m) Cr, 0°, 10 mm.t (11.34m) CS, 0°, 20 mm.t (11.37m) J, 50°, P, S, Cn (11.46m) Be, 0°, P, S, Cn		
					END OF BOREHOLE AT 11.85 m							

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

Job No: 34901BC
Borehole No: BH101
Depth: 5.72m to 11.85m

34901BC BH101 START CORING AT 5.72m

END OF BOREHOLE AT 11.85m

BOREHOLE LOG

Borehole No.
102
1 / 4

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Method: SPIRAL AUGER
R.L. Surface: ~119.6 m
Date: 10/10/24
Datum: AHD
Plant Type: JK330
Logged/Checked By: A.M./T.C.

Groundwater Record	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING			ASPHALTIC CONCRETE: 20mm.t				
			CONCRETE: 180mm.t				3mm DIA. REINFORCEMENT, 140mm TOP COVER
		-	FILL: Gravel, fine to medium grained, igneous, grey brown, with fine to medium grained sandstone gravel, trace of clay.	M			APPEARS MODERATELY COMPACTED
	N = 11 3,4,7 N = 8 3,3,5		FILL: Silty clay, high plasticity, grey and brown, with fine to medium grained igneous gravel, trace of fine grained siltstone gravel, slag and root fibres.	w>PL		280 210 200	
		CI-CH	Silty CLAY: medium to high plasticity, grey and orange brown, trace of fine grained ironstone gravel.	w>PL	St	250 230 200	RESIDUAL
ON 23/10/24	N=SPT 8/ 100mm REFUSAL N > 13 14,13/ 100mm REFUSAL	-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey and orange brown, with iron indurated bands, trace of fine to medium grained ironstone gravel.	XW	Hd	>600 >600 >600	ASHFIELD SHALE TOO FRIABLE FOR HP TESTING
			as above, but with bands of very low strength siltstone.				
			Extremely Weathered siltstone: silty CLAY, medium plasticity, with bands of very low strength sandstone and siltstone.				BANDS OF VERY LOW RESISTANCE

SAMPLES: ES, U50, DB, DS

RL (m AHD): 119, 118, 117, 116, 115, 114, 113

Depth (m): 1, 2, 3, 4, 5, 6

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BOREHOLE LOG

Borehole No.
102
2 / 4

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Method:** SPIRAL AUGER **R.L. Surface:** ~119.6 m
Date: 10/10/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** A.M./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						112 111	8		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, with bands of very low strength sandstone and siltstone. *(continued)*	XW	Hd F - Hd	70 80 90 80 80 90	SOIL RESISTANCE HP TESTING ON REMOULDED SAMPLE
										SANDSTONE: fine to medium grained, grey.	DW	M		HAWKESBURY SANDSTONE MODERATE TO HIGH 'TC' BIT RESISTANCE
						110 109 108 107 106	9 10 11 12 13			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 18.08m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 18.08m TO 4.0m. CASING 4.0m TO 0.1m. 2mm SAND FILTER PACK 18.08m TO 4.5m. BENTONITE SEAL 4.5m TO 4.0m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.

CORED BOREHOLE LOG

Borehole No.
102
3 / 4

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Core Size: NMLC
R.L. Surface: ~119.6 m
Date: 10/10/24
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: A.M./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL -0.1 L -0.3 M -1 H -3 VH -10 EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	General	Formation
		111			START CORING AT 8.64m							
100% RETURN		110 109 108	9 10 11 12		SANDSTONE: fine to medium grained, grey, with dark grey laminations, bedded at 0-5°.	FR	M - H	0.70 1.0 1.8 2.5 1.2 3.0 1.8		(8.67m) CS, 0°, 10 mm.t (9.54m) CS, 0°, 20 mm.t (10.20m) J, 75°, P (10.43m) Be, 0°, P, R, Clay Vn (10.81m) Be, 0°, P, S, Cn (11.23m) Be, 0°, P, R, Clay Vn		Hawkesbury Sandstone
90% RETURN		107 106 105	13 14					0.90 0.80 0.90 0.90 2.1 0.80		(12.54m) Be, 0°, P, R, Cn		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

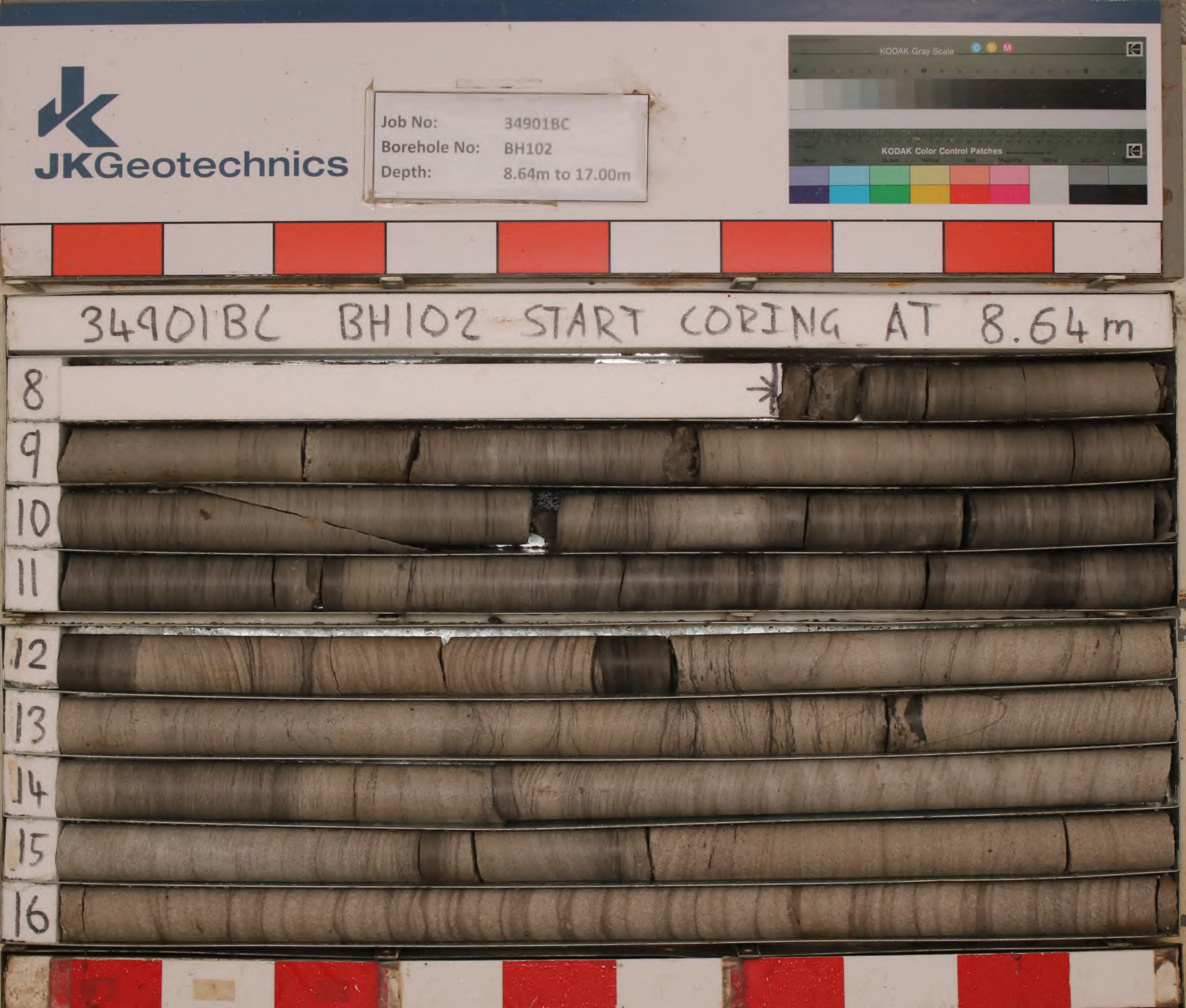
Borehole No.
102
4 / 4

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Core Size: NMLC
R.L. Surface: ~119.6 m
Date: 10/10/24
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: A.M./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL 0.1, L 0.3, M 1, H 3, VH 10, EH	DEFECT DETAILS SPACING (mm) 600, 200, 60, 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
90% RETURN		104 103 102	16 17 18		SANDSTONE: fine to medium grained, grey, with dark grey laminations, bedded at 0-10°.	FR	M - H	1.0 0.60 1.1 1.3 0.70 1.0 1.0 1.1		(15.51m) Be, 0°, P, R, Sand Ct	Hawkesbury Sandstone
		101 100 99 98	19 20 21		END OF BOREHOLE AT 18.08 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS



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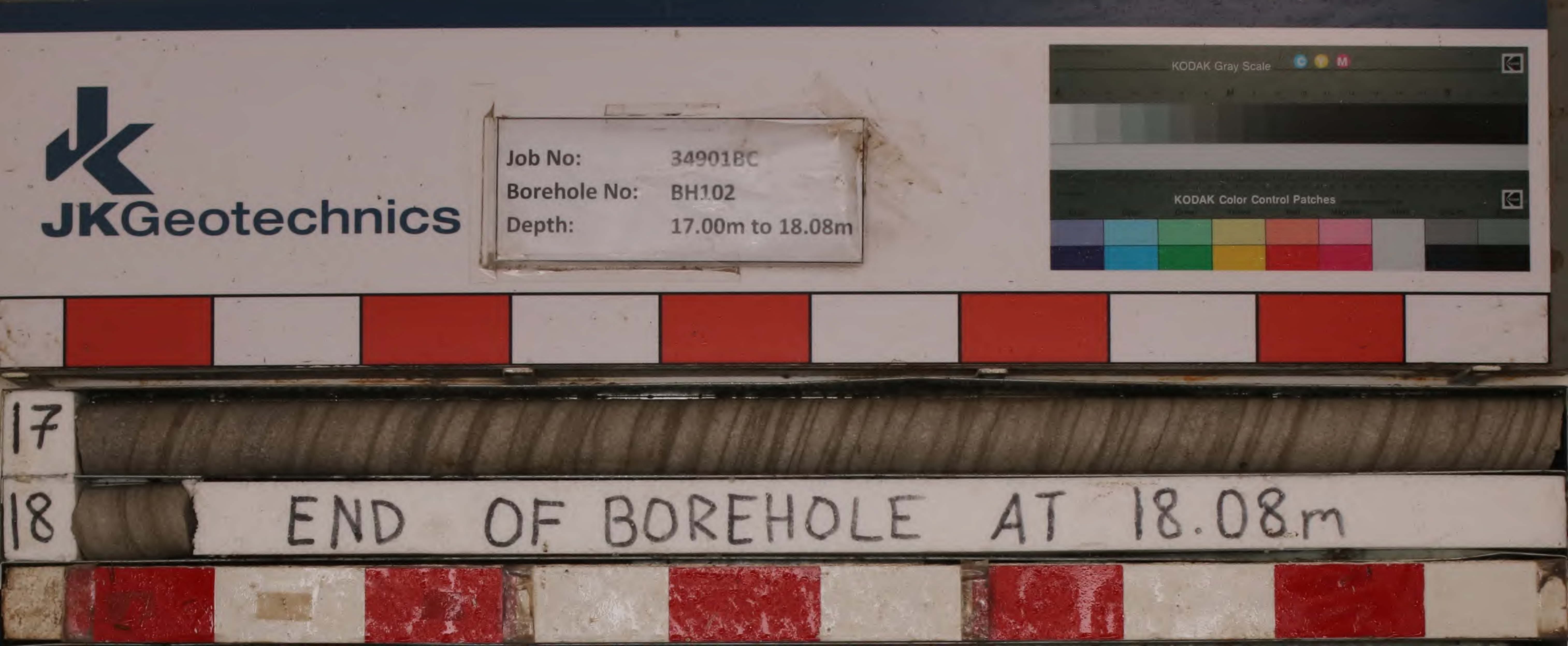
Job No: 34901BC
Borehole No: BH102
Depth: 8.64m to 17.00m

34901BC BH102 START CORING AT 8.64m



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Job No: 34901BC
Borehole No: BH102
Depth: 17.00m to 18.08m

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BOREHOLE LOG

Borehole No.
103
1 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Method:** SPIRAL AUGER **R.L. Surface:** ~120.3 m
Date: 10/10/24 TO 11/10/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** A.M./T.C.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										CONCRETE: 140mm.t				5mm DIA. REINFORCEMENT, 80mm TOP COVER
				■		120			-	FILL: Silty clay, medium plasticity, grey, with fine to medium grained sand, fine to medium grained igneous gravel, and ash, trace of brick fragments and root fibres.	w>PL M			APPEARS MODERATELY COMPACTED
				■	N = 15 4,7,8				CH	FILL: Silty sand, fine to medium grained, brown, trace of clay.	w>PL	Hd	>600 >600 >600	RESIDUAL
							1			Silty CLAY: high plasticity, orange brown and grey, with iron indurated bands, trace of fine to medium grained ironstone gravel, and root fibres.				
						119								
				■	N > 23 8,12,11/ 100mm REFUSAL						w<PL		>600 >600 >600	
ON 23/10/24 ▽							2							
						118								
									-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey and orange brown, with iron indurated bands.	XW	Hd		ASHFIELD SHALE
				■	N > 19 11,19/ 150mm REFUSAL		3						>600 >600 >600	BANDS OF VERY LOW RESISTANCE
						117								
							4							
						116								
				■	N > 5 11,5/ 50mm REFUSAL								>600 >600 >600	
							5							
						115								
				■			6			SILTSTONE: dark grey and brown, with extremely weathered bands and iron indurated bands.	DW	VL - L		LOW RESISTANCE, WITH BANDS OF VERY LOW RESISTANCE
						114								
										as above, but without extremely weathered bands.		L		LOW RESISTANCE

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BOREHOLE LOG

Borehole No.
103
2 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Method: SPIRAL AUGER
R.L. Surface: ~120.3 m
Date: 10/10/24 TO 11/10/24
Datum: AHD
Plant Type: JK330
Logged/Checked By: A.M./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									-	SILTSTONE: dark grey and brown, with iron indurated bands.	DW	L		
						113				REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 6.0m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 6.0m TO 3.0m. CASING 3.0m TO 0.1m. 2mm SAND FILTER PACK 6.0m TO 1.5m. BENTONITE SEAL 1.5m TO 0.1m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							8							
						112								
							9							
						111								
							10							
						110								
							11							
						109								
							12							
						108								
							13							
						107								

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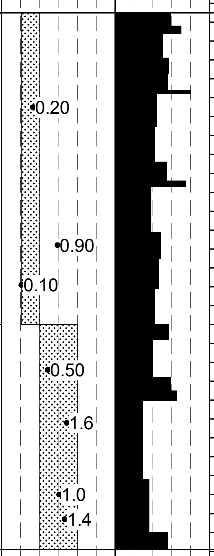
CORED BOREHOLE LOG

Borehole No.
103
3 / 3

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Core Size: NMLC
R.L. Surface: ~120.3 m
Date: 10/10/24 TO 11/10/24
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: A.M./T.C.



Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	General	Formation
					START CORING AT 7.22m						
90% RETURN		113			NO CORE 0.13m						
					SILTSTONE: dark grey, with iron indurated bands, laminations at 0-5°.	SW	L		(7.42m) Ji, 70°, P (7.46m) J, 75°, P, R, Fe Sn (7.59m) XWS, 0°, 50 mm.t (7.67m) J, 75°, P, R, Fe Sn (7.76m) Be, 0°, P, R, Fe Sn (7.78m) J, 80°, P, R, Fe Sn		Ashfield Shale
		112 111	8 9 10		SANDSTONE: fine to medium grained, grey, bedded at 0-10°, with iron indurated bands.		L M - H	0.20 0.90 0.10 0.50 1.6 1.0 1.4	(7.95m) Be, 0°, P, R, Fe Sn (8.14m) J, 75°, St, R, Cn (8.24m) Be, 0°, P, R, Fe Sn (8.27m) CS, 0°, 20 mm.t (8.51m) Be, 0°, P, R, Fe Sn (8.65m) Be, 0°, P, R, Fe Sn (8.81m) Cr, 0°, 10 mm.t (9.00m) J, 70°, P, R, Fe Sn (9.08m) Jh, 70°, P (9.28m) Be, 0°, P, R, Fe Sn (9.35m) J, 70°, P, R, Cn (9.40m) Ji, 70°, P (9.82m) Be, 0°, P, R, Cn (10.10m) J, 80°, P, R, Cn		Hawkesbury Sandstone
		110 109 108 107	11 12 13		END OF BOREHOLE AT 10.19 m						

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 34901BC PYMBLE.GPJ <<DrawingFile>> 13/11/2024 13:07 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

Job No: 34901BC
Borehole No: BH103
Depth: 7.22m to 10.19m

34901BC BH103 START CORING AT 7.22m

7 NO CORE 0.13m

8

9

10 END OF BOREHOLE AT 10.19m

BOREHOLE LOG

Borehole No.
104
1 / 2

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC **Method:** SPIRAL AUGER **R.L. Surface:** ~116.0 m
Date: 11/10/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** A.M./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING									-	ASPHALTIC CONCRETE: 20mm.t				NO REINFORCEMENT OBSERVED
									-	CONCRETE: 160mm.t				
										FILL: Silty gravelly clay, medium plasticity, brown, fine to coarse grained igneous gravel, trace of fine to medium grained sand, and root fibres.	w>PL			APPEARS MODERATELY COMPACTED
				■	N = 13 4,5,8	115	1			FILL: Silty clay, medium plasticity, brown, with fine to medium grained sands, trace of fine grained igneous and siltstone gravel, ash and root fibres.	w<PL		400 500 600	
ON 23/10/24				■	N = 16 6,7,9	114	2		CI-CH	Silty CLAY: medium to high plasticity, red brown and grey, trace of fine to medium grained ironstone gravel, and root fibres.	w<PL	Hd	>600 >600 >600	RESIDUAL
				■	N=SPT 6/ 50mm REFUSAL	113	3		-	SILTSTONE: light grey, with extremely weathered bands.	DW	VL - L		ASHFIELD SHALE VERY LOW TO LOW 'TC' BIT RESISTANCE
										SANDSTONE: fine to medium grained, light grey. REFER TO CORED BOREHOLE LOG		M		HAWKESBURY SANDSTONE MODERATE TO HIGH RESISTANCE
						112	4							
						111	5							
						110	6							

CORED BOREHOLE LOG

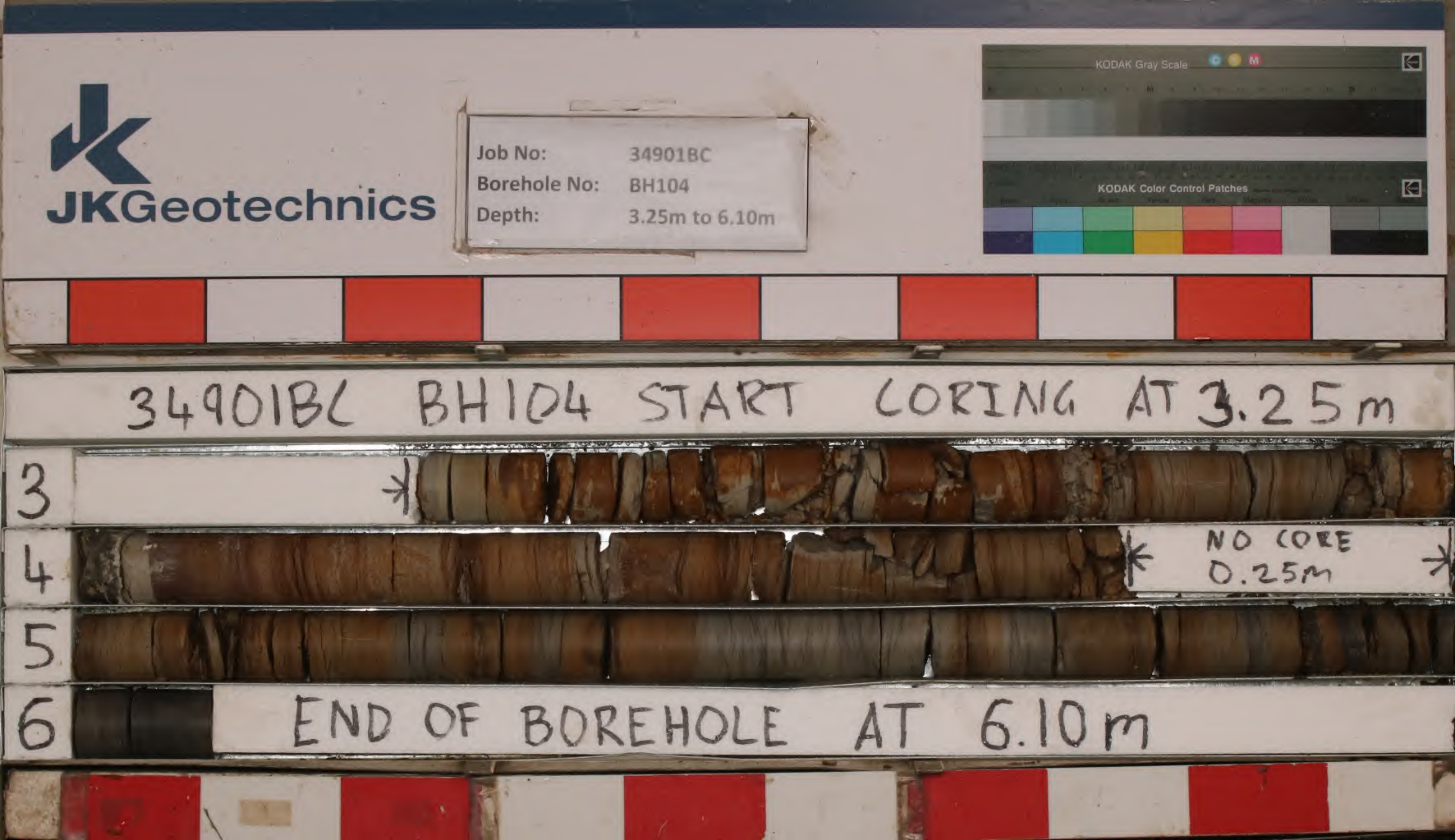
Borehole No.
104
2 / 2

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED SENIOR SCHOOL BUILDING
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 34901BC
Core Size: NMLC
R.L. Surface: ~116.0 m
Date: 11/10/24
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: A.M./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL 0.1 L 0.3 M 1 H 3 VH 10 EH	SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	General	Formation
					START CORING AT 3.25m							
90% RETURN		112	4		SANDSTONE: fine to medium grained, grey and orange brown, with occasional iron indurated bands, bedded at 0-5°.	MW SW	M	1.0 0.80 0.70		(3.34m) Be, 0°, P, R, Fe Sn (3.45m) Cr, 0°, 10 mm.t (3.53m) J, 50°, P, R, Cn (3.60m) J, 90°, P, R, Cn (3.71m) Cr, 0°, 50 mm.t (3.93m) Be, 0°, P, R, Clay Vn (3.95m) Be, 0°, P, R, Clay Vn (3.99m) CS, 0°, 40 mm.t (4.55m) J, 80°, St, R, Cn		Hawkesbury Sandstone
					NO CORE 0.25m							
		111	5		SANDSTONE: fine to medium grained, grey and orange brown, with occasional iron indurated bands, bedded at 0-5°.	SW	M - H	0.70 1.6 0.70		(5.08m) Be, 0°, P, R, Fe Sn (5.12m) Be, 0°, P, R, Fe Sn (5.38m) Be, 0°, P, R, Fe Sn (5.78m) Be, 0°, P, R, Fe Sn (5.88m) Be, 0°, P, R, Fe Sn		Hawkesbury Sandstone
		110	6		SILTSTONE: dark grey, with occasional iron indurated bands, laminations at 0-5°, with fine grained sandstone bands.			0.60				
					END OF BOREHOLE AT 6.10 m				600 200 60 20			
		109	7									
		108	8									
		107	9						600 200 60 20			

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS



JKGeotechnics

Job No: 34901BC
Borehole No: BH104
Depth: 3.25m to 6.10m

34901BC BH104 START CORING AT 3.25m

NO CORE 0.25m

END OF BOREHOLE AT 6.10m

JKGeotechnics

BOREHOLE LOG

Borehole No.
201
1/1

Client: PYMBLE LADIES COLLEGE

Project: PROPOSED CAMPUS COMMON WORKS

Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 37134YC **Method:** HAND AUGER **R.L. Surface:** ≈ 120.9m

Date: 2/11/24 **Datum:** AHD

Plant Type: - **Logged/Checked by:** K.R./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	-				REFER TO DCP TEST RESULTS SHEET	0	▦		FILL: Silty sand, fine to medium grained, dark brown, with roots and root fibres.	D			APPEARS POORLY TO MODERATELY COMPACTED
				■			▦		FILL: Silty clay, high plasticity, brown and orange brown, trace of root fibres.	w<PL		290 340 350	
				■		0.5	▨	CL-CI	Silty CLAY: low to medium plasticity, light brown and orange brown.	w>PL	St	170 180 170	RESIDUAL
				■		1 1.5	▨	CI-CH	Silty CLAY: medium to high plasticity, light grey mottled red brown.	w≈PL	VSt	270 310 280	
						2 2.5 3 3.5			END OF BOREHOLE AT 1.6m				HAND AUGER REFUSAL IN VERY STIFF CLAY

JKGeotechnics

BOREHOLE LOG

Borehole No.
202
1/1

Client: PYMBLE LADIES COLLEGE

Project: PROPOSED CAMPUS COMMON WORKS

Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 37134YC

Method: HAND AUGER

R.L. Surface: ≈ 122.4m

Date: 2/11/24

Datum: AHD

Plant Type: -

Logged/Checked by: K.R./T.C.

Groundwater Record	SAMPLES				Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES	U50	DB	DS									
DRY ON COMPLETION					REFER TO DCP TEST RESULTS SHEET	0	■		ASPHALTIC CONCRETE: 350mm.t				10mm DIA REINFORCEMENT, 250mm TOP COVER
				■		0.5	▨	CL-CI	Silty clay, low to medium plasticity, brown.	w≈PL	St	310 300 340	RESIDUAL
				■		1	▨	CI-CH	Silty CLAY: medium to high plasticity, red brown mottled light brown.			180 200 180	
				■			▨		Silty CLAY: medium to high plasticity, grey mottled light brown.	w<PL	VSt	290 260 280	
						1.5 2 2.5 3 3.5			END OF BOREHOLE AT 1.24m				HAND AUGER REFUSAL IN VERY STIFF CLAY

JKGeotechnics

BOREHOLE LOG

Borehole No.
203
1/1

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED CAMPUS COMMON WORKS
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 37134YC
Method: HAND AUGER
R.L. Surface: ≈ 121.0m
Date: 2/11/24
Datum: AHD
Plant Type: -
Logged/Checked by: K.R./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0	■		ASPHALTIC CONCRETE: 100mm.t				NO REINFORCEMENT OBSERVED
				■			▨	-	FILL: Silty sand, fine to medium grained, brown, trace of cemented friables.	W			
							▨		FILL: Silty clay, low to medium plasticity, dark brown, trace of fine to medium grained sand, slag and ash.	w>PL		30 40 30	APPEARS POORLY COMPACTED
				■		0.5 1	▨	CI-CH	Silty CLAY: medium to high plasticity, light brown mottled red brown, trace of fine to medium grained ironstone gravel, and ash.	w>PL	VSt	250 280 240	RESIDUAL
				■			▨		Silty CLAY: medium to high plasticity, light brown mottled red brown and grey, trace of fine to medium grained ironstone gravel, and root fibres.	w≈PL		330 360 310	
						1.5 2 2.5 3 3.5			END OF BOREHOLE AT 1.32m				HAND AUGER REFUSAL IN VERY STIFF CLAY

JKGeotechnics

BOREHOLE LOG

Borehole No.
204
1/1

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED CAMPUS COMMON WORKS
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 37134YC **Method:** HAND AUGER **R.L. Surface:** ≈ 120.6m
Date: 2/11/24 **Datum:** AHD
Plant Type: - **Logged/Checked by:** K.R./T.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION					REFER TO DCP TEST RESULTS SHEET	0	■		ASPHALTIC CONCRETE: 100mm.t				
							▨	-	FILL: Silty sandy gravel, fine to medium grained, dark grey siltstone, fine to medium grained sand.	W			APPEARS POORLY COMPACTED
				■		0.5	▨		FILL: Silty clay, low to medium plasticity, brown, light brown and grey, trace of fine to medium grained ironstone gravel, and ash.	w>PL		140 150 120	
				■			▨	CI	Silty CLAY: medium to high plasticity, light brown mottled grey, trace of fine to medium grained ironstone gravel.	w>PL	St	160 160 180	RESIDUAL
				■			▨		as above, but also mottled red brown, with fine to medium grained ironstone gravel.	w≈PL	(VSt)	330 300 300	
						1			END OF BOREHOLE AT 0.97m				HAND AUGER REFUSAL IN VERY STIFF CLAY
						1.5							
						2							
						2.5							
						3							
						3.5							

JKGeotechnics

BOREHOLE LOG

Borehole No.
205
1/1

Client: PYMBLE LADIES COLLEGE

Project: PROPOSED CAMPUS COMMON WORKS

Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 37134YC **Method:** HAND AUGER **R.L. Surface:** ≈ 122.4m

Date: 2/11/24 **Datum:** AHD

Plant Type: - **Logged/Checked by:** K.R./T.C.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	-				REFER TO DCP TEST RESULTS SHEET	0	■		ASPHALTIC CONCRETE: 100mm.t				NO REINFORCEMENT OBSERVED
							▩	-	FILL: Silty sand, fine to medium grained, dark brown and grey, with fine to medium grained igneous gravel, trace of roots and root fibres.	W			APPEARS POORLY TO MODERATELY COMPACTED
				■		0.5	▩		FILL: Silty clay, medium to high plasticity, brown and orange brown, trace of ash.	w<PL		270 290 290	
				■		1	▨	CI	Silty CLAY: medium to high plasticity, light brown mottled orange brown and grey.	w≈PL	VSt	270 320 310	RESIDUAL
						1.5 2 2.5 3 3.5			END OF BOREHOLE AT 1.48m				HAND AUGER REFUSAL IN VERY STIFF RESIDUAL SOILS

BOREHOLE LOG

Borehole No.
206
1/1

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED CAMPUS COMMON WORKS
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No.: 37134YC
Method: HAND AUGER
R.L. Surface: ≈ 123.7m
Date: 2/11/24
Datum: AHD
Plant Type: -
Logged/Checked by: K.R./T.C.

Groundwater Record	SAMPLES				Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES	U50	DB	DS									
DRY ON COMPLETION					REFER TO DCP TEST RESULTS SHEET	0			FILL: Silty sand, fine to medium grained, dark brown, with root fibres.	W			APPEARS POORLY TO MODERATELY COMPACTED
				■		0.5			FILL: Silty clay, low to medium plasticity, brown and dark brown, trace of root fibres.	w>PL		130 110 120	
				■		1		CI	Silty CLAY: medium to high plasticity, light brown mottled orange brown.	w≈PL	VSt	280 260 250	RESIDUAL
				■		1.5			as above, but orange brown mottled grey.	w<PL		330 340 360	
						2 2.5 3 3.5			END OF BOREHOLE AT 1.53m				HAND AUGER REFUSAL IN VERY STIFF CLAY

JKGeotechnics

DYNAMIC CONE PENETRATION TEST RESULTS

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED CAMPUS COMMON WORKS
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No. 37134YC
Date: 2-11-24
Tested By: K.R.
Hammer Weight & Drop: 9kg/510mm
Rod Diameter: 16mm
Point Diameter: 20mm

Test Location	**201**	**202**	**203**	**204**	**205**	**206**	**207**
Surface RL	≈120.9m	≈122.4m	≈121.0m	≈120.6m	≈122.4m	≈123.4m	≈122.4m
Depth (mm)	Number of Blows per 100mm Penetration						
0 - 100	4	CONCRETE	CONCRETE	CONCRETE	CONCRETE	1	CONCRETE
100 - 200	4	↓	1	1	2	2	5
200 - 300	2	↓	2	2	1	1	5
300 - 400	4	4/50mm	1	2	1	3	6
400 - 500	5	7	1	1	3	4	3
500 - 600	7	8	4	3	6	6	3
600 - 700	6	4	6	4	10	5	4
700 - 800	8	3	7	4	11	5	3
800 - 900	10	3	9	6	11	8	6
900 - 1000	11	5	8	12	14	11	7
1000 - 1100	13	7	11	18	13	10	11
1100 - 1200	12	14	13	27	14	10	10
1200 - 1300	11	20	15	10/20mm	12	14	9
1300 - 1400	11	23	17	REFUSAL	11	13	9
1400 - 1500	13	27	19		16	17	10
1500 - 1600	14	END	21		18	18	14
1600 - 1700	17		24		22	20	15
1700 - 1800	23		25		21	21	18
1800 - 1900	22		END		26	24	24
1900 - 2000	27				END	32	27
2000 - 2100	32					END	28
2100 - 2200	END						END
2200 - 2300							
2300 - 2400							
2400 - 2500							
2500 - 2600							
2600 - 2700							
2700 - 2800							
2800 - 2900							
2900 - 3000							

Remarks:
1. The procedure used for this test is described in AS1289.6.3.2-1997 (R2013)
2. Usually 8 blows per 20mm is taken as refusal
3. Datum of levels is AHD

JKGeotechnics

DYNAMIC CONE PENETRATION TEST RESULTS

Client: PYMBLE LADIES COLLEGE
Project: PROPOSED CAMPUS COMMON WORKS
Location: PYMBLE LADIES COLLEGE, AVON ROAD, PYMBLE, NSW

Job No. 37134YC
Date: 2-11-24
Tested By: K.R.
Hammer Weight & Drop: 9kg/510mm
Rod Diameter: 16mm
Point Diameter: 20mm

Test Location	**208**						
Surface RL	≈122.2m						
Depth (mm)	Number of Blows per 100mm Penetration						
0 - 100	1						
100 - 200	1						
200 - 300	↓						
300 - 400	2						
400 - 500	3						
500 - 600	6						
600 - 700	5						
700 - 800	4						
800 - 900	7						
900 - 1000	10						
1000 - 1100	13						
1100 - 1200	11						
1200 - 1300	11						
1300 - 1400	11						
1400 - 1500	15						
1500 - 1600	19						
1600 - 1700	24						
1700 - 1800	22						
1800 - 1900	25						
1900 - 2000	END						
2000 - 2100							
2100 - 2200							
2200 - 2300							
2300 - 2400							
2400 - 2500							
2500 - 2600							
2600 - 2700							
2700 - 2800							
2800 - 2900							
2900 - 3000							

Remarks:
1. The procedure used for this test is described in AS1289.6.3.2-1997 (R2013)
2. Usually 8 blows per 20mm is taken as refusal
3. Datum of levels is AHD

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the JK Geotechnics report.

Title:
SITE LOCATION PLAN

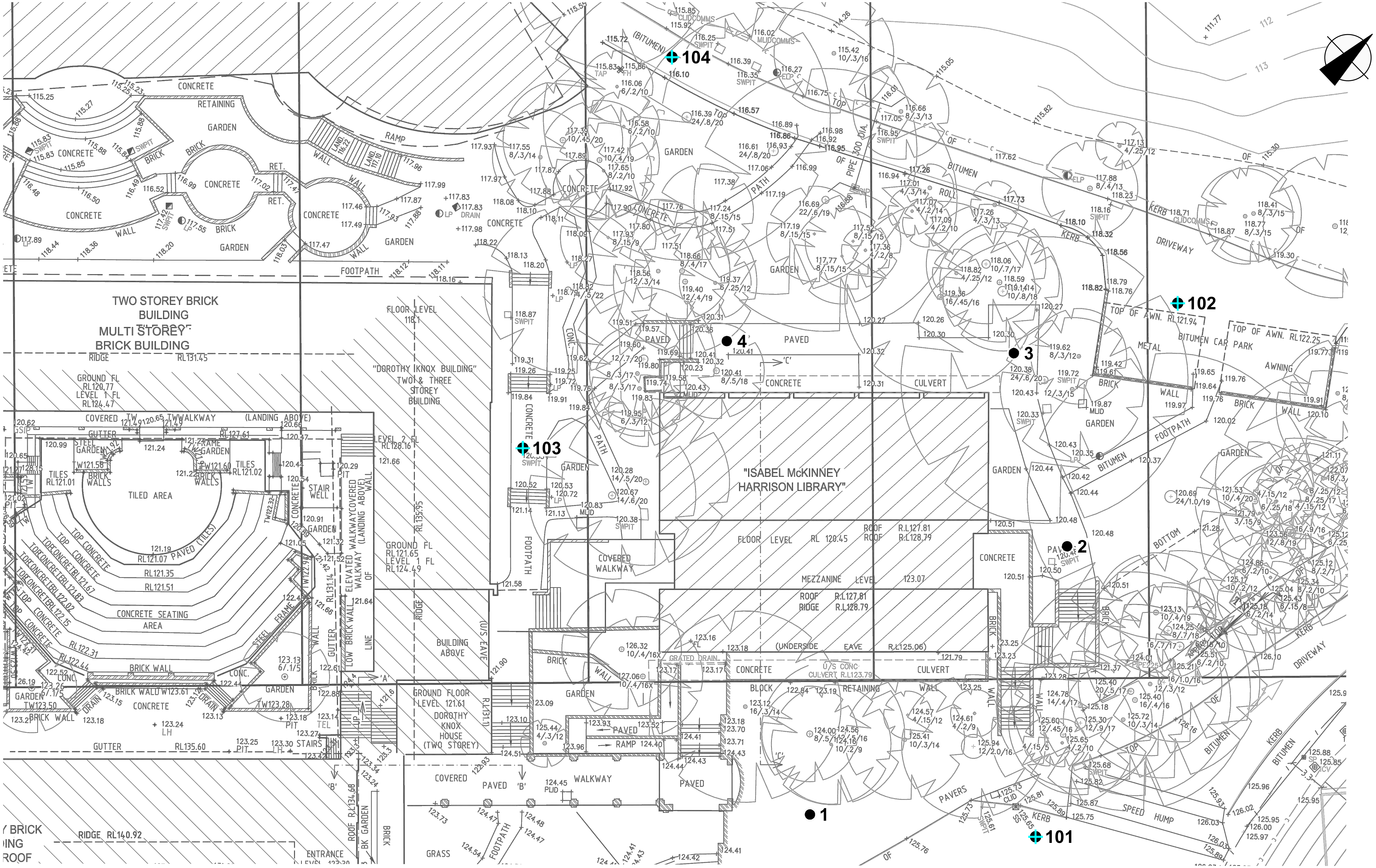
Location: AVON ROAD, PYMBLE, NSW

Report No: 34901SCrptRev2

Figure No: 1

JKGeotechnics

PLOT DATE: 28/02/2025 9:36:54 AM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\34000'S\34901BC PYMBLE\CAD\34901SCRPTREV2.DWG



LEGEND

- ● BOREHOLE
- ⊕ BOREHOLE AND GROUNDWATER MONITORING WELL

0 3 6 9 12 15

SCALE 1:300 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title:
BOREHOLE LOCATION PLAN

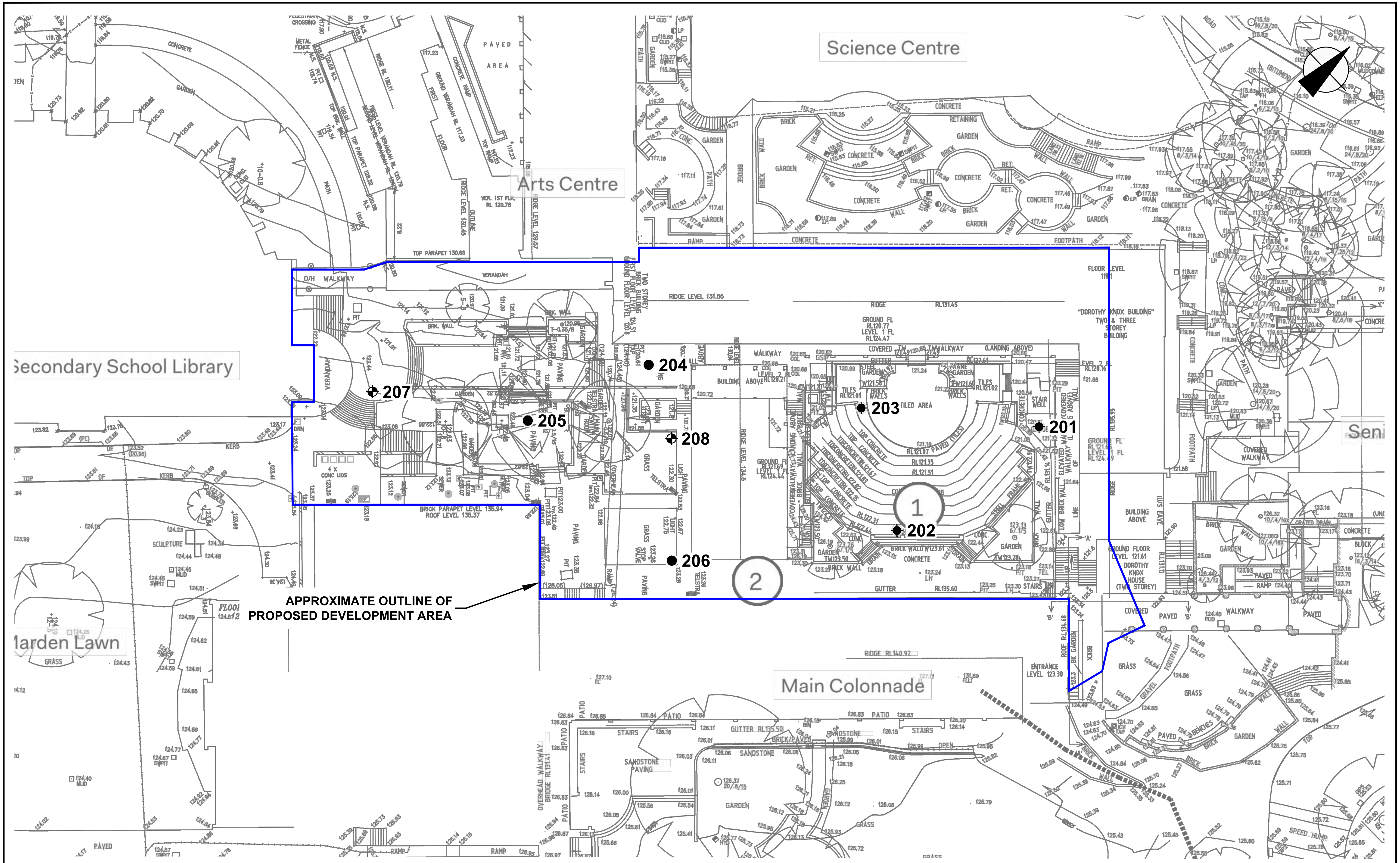
Location: AVON ROAD, PYMBLE, NSW

Report No: 34901SCrptRev2

Figure No: 2a

JKGeotechnics

PLOT DATE: 28/02/2025 9:37:06 AM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\34000'S\34901BC PYMBLE\CAD\34901SCRPTREV2.DWG



LEGEND

● BOREHOLE

⨁ BOREHOLE AND DCP TEST

⊕ DCP TEST

0 4 8 12 16 20

SCALE 1:400 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title:
INVESTIGATION LOCATION PLAN

Location:
AVON ROAD, PYMBLE, NSW

Report No: 34901SCrptRev2

Figure No: 2b

JKGeotechnics

PLOT DATE: 28/02/2025 1:22:12 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\34000'S\34901BC PYMBLE\CAD\34901SCRPTREV2.DWG

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) is referred to as 'laminite'.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shrink-swell behaviour, strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm 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 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

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

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing (CPT) and Interpretation: The cone penetrometer is sometimes referred to as a Dutch Cone. The test is described in Australian Standard 1289.6.5.1–1999 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Static Cone Penetration Resistance of a Soil – Field Test using a Mechanical and Electrical Cone or Friction-Cone Penetrometer'*.

In the tests, a 35mm or 44mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm or 165mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck. The CPT does not provide soil sample recovery.

As penetration occurs (at a rate of approximately 20mm per second), the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa. There are two scales presented for the cone resistance. The lower scale has a range of 0 to 5MPa and the main scale has a range of 0 to 50MPa. For cone resistance values less than 5MPa, the plot will appear on both scales.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between CPT and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of CPT values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

There are limitations when using the CPT in that it may not penetrate obstructions within any fill, thick layers of hard clay and very dense sand, gravel and weathered bedrock. Normally a 'dummy' cone is pushed through fill to protect the equipment. No information is recorded by the 'dummy' probe.

Flat Dilatometer Test: The flat dilatometer (DMT), also known as the Marchetti Dilometer comprises a stainless steel blade having a flat, circular steel membrane mounted flush on one side.

The blade is connected to a control unit at ground surface by a pneumatic-electrical tube running through the insertion rods. A gas tank, connected to the control unit by a pneumatic cable, supplies the gas pressure required to expand the membrane. The control unit is equipped with a pressure regulator, pressure gauges, an audio-visual signal and vent valves.

The blade is advanced into the ground using our CPT rig or one of our drilling rigs, and can be driven into the ground using an SPT hammer. As soon as the blade is in place, the membrane is inflated, and the pressure required to lift the membrane (approximately 0.1mm) is recorded. The pressure then required to lift the centre of the membrane by an additional 1mm is recorded. The membrane is then deflated before pushing to the next depth increment, usually 200mm down. The pressure readings are corrected for membrane stiffness.

The DMT is used to measure material index (I_D), horizontal stress index (K_D), and dilatometer modulus (E_D). Using established correlations, the DMT results can also be used to assess the 'at rest' earth pressure coefficient (K_o), over-consolidation ratio (OCR), undrained shear strength (C_u), friction angle (ϕ), coefficient of consolidation (C_h), coefficient of permeability (K_h), unit weight (γ), and vertical drained constrained modulus (M).

The seismic dilatometer (SDMT) is the combination of the DMT with an add-on seismic module for the measurement of shear wave velocity (V_s). Using established correlations, the SDMT results can also be used to assess the small strain modulus (G_o).

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod with a 20mm diameter cone end with a 9kg hammer dropping 510mm. The test is described in Australian Standard 1289.6.3.2–1997 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – 9kg Dynamic Cone Penetrometer Test'*.

The results are used to assess the relative compaction of fill, the relative density of granular soils, and the strength of cohesive soils. Using established correlations, the DCP test results can also be used to assess California Bearing Ratio (CBR).

Refusal of the DCP can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Vane Shear Test: The vane shear test is used to measure the undrained shear strength (C_u) of typically very soft to firm fine grained cohesive soils. The vane shear is normally performed in the bottom of a borehole, but can be completed from surface level, the bottom and sides of test pits, and on recovered undisturbed tube samples (when using a hand vane).

The vane comprises four rectangular blades arranged in the form of a cross on the end of a thin rod, which is coupled to the bottom of a drill rod string when used in a borehole. The size of the vane is dependent on the strength of the fine grained cohesive soils; that is, larger vanes are normally used for very low strength soils. For borehole testing, the size of the vane can be limited by the size of the casing that is used.

For testing inside a borehole, a device is used at the top of the casing, which suspends the vane and rods so that they do not sink under self-weight into the 'soft' soils beyond the depth at which the test is to be carried out. A calibrated torque head is used to rotate the rods and vane and to measure the resistance of the vane to rotation.

With the vane in position, torque is applied to cause rotation of the vane at a constant rate. A rate of 6° per minute is the common rotation rate. Rotation is continued until the soil is sheared and the maximum torque has been recorded. This value is then used to calculate the undrained shear strength. The vane is then rotated rapidly a number of times and the operation repeated until a constant torque reading is obtained. This torque value is used to calculate the remoulded shear strength. Where appropriate, friction on the vane rods is measured and taken into account in the shear strength calculation.

LOGS

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

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it 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 and may not be the same at the time of construction.
- 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 be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to 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 perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soils for Engineering Purposes'* or appropriate NSW Government Roads & Maritime Services (RMS) test methods. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.
- Details of the development that the Company could not reasonably be expected to anticipate.

If these occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

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, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Where information obtained from this investigation 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. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. Licence to use the documents may be revoked without notice if the Client is in breach of any obligation to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a joint design review which involves an experienced geotechnical engineer/engineering geologist.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

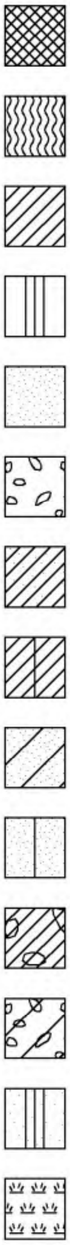
i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types and appropriate footing or pile founding depths, or

iii) full time engineering presence on site.

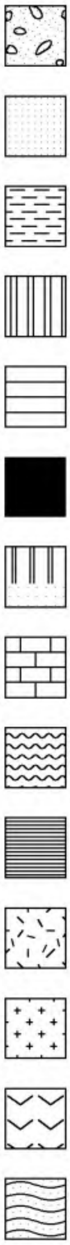
SYMBOL LEGENDS

SOIL



- FILL
- TOPSOIL
- CLAY (CL, CI, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CI, CH)
- SILTY CLAY (CL, CI, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CI, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML, MH)
- PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK



- CONGLOMERATE
- SANDSTONE
- SHALE/MUDSTONE
- SILTSTONE
- CLAYSTONE
- COAL
- LAMINITE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

OTHER MATERIALS

- BRICKS OR PAVERS
- CONCRETE
- ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

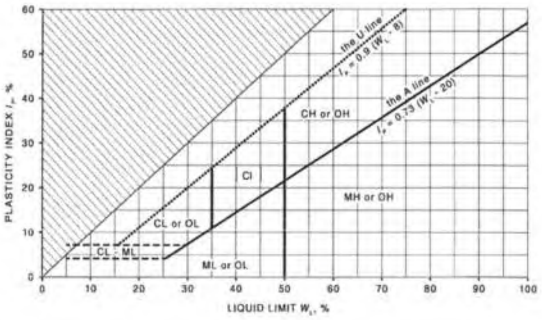
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

<table>
<tr><th>Log Column</th><th>Symbol</th><th colspan="3">Definition</th></tr>
<tr><td>Groundwater Record</td><td>▼</td><td colspan="3">Standing water level. Time delay following completion of drilling/excavation may be shown.</td></tr>
<tr><td></td><td>—C—</td><td colspan="3">Extent of borehole/test pit collapse shortly after drilling/excavation.</td></tr>
<tr><td></td><td>▶—</td><td colspan="3">Groundwater seepage into borehole or test pit noted during drilling or excavation.</td></tr>
<tr><td>Samples</td><td>ES</td><td colspan="3">Sample taken over depth indicated, for environmental analysis.</td></tr>
<tr><td></td><td>U50</td><td colspan="3">Undisturbed 50mm diameter tube sample taken over depth indicated.</td></tr>
<tr><td></td><td>DB</td><td colspan="3">Bulk disturbed sample taken over depth indicated.</td></tr>
<tr><td></td><td>DS</td><td colspan="3">Small disturbed bag sample taken over depth indicated.</td></tr>
<tr><td></td><td>ASB</td><td colspan="3">Soil sample taken over depth indicated, for asbestos analysis.</td></tr>
<tr><td></td><td>ASS</td><td colspan="3">Soil sample taken over depth indicated, for acid sulfate soil analysis.</td></tr>
<tr><td></td><td>SAL</td><td colspan="3">Soil sample taken over depth indicated, for salinity analysis.</td></tr>
<tr><td>Field Tests</td><td>N = 17
4, 7, 10</td><td colspan="3">Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. ‘Refusal’ refers to apparent hammer refusal within the corresponding 150mm depth increment.</td></tr>
<tr><td></td><td>N_c = 5
7
3R</td><td colspan="3">Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. ‘R’ refers to apparent hammer refusal within the corresponding 150mm depth increment.</td></tr>
<tr><td></td><td>VNS = 25</td><td colspan="3">Vane shear reading in kPa of undrained shear strength.</td></tr>
<tr><td></td><td>PID = 100</td><td colspan="3">Photoionisation detector reading in ppm (soil sample headspace test).</td></tr>
<tr><td>Moisture Condition
(Fine Grained Soils)</td><td>w > PL</td><td colspan="3">Moisture content estimated to be greater than plastic limit.</td></tr>
<tr><td></td><td>w ≈ PL</td><td colspan="3">Moisture content estimated to be approximately equal to plastic limit.</td></tr>
<tr><td></td><td>w < PL</td><td colspan="3">Moisture content estimated to be less than plastic limit.</td></tr>
<tr><td></td><td>w ≈ LL</td><td colspan="3">Moisture content estimated to be near liquid limit.</td></tr>
<tr><td></td><td>w > LL</td><td colspan="3">Moisture content estimated to be wet of liquid limit.</td></tr>
<tr><td>(Coarse Grained Soils)</td><td>D</td><td colspan="3">DRY – runs freely through fingers.</td></tr>
<tr><td></td><td>M</td><td colspan="3">MOIST – does not run freely but no free water visible on soil surface.</td></tr>
<tr><td></td><td>W</td><td colspan="3">WET – free water visible on soil surface.</td></tr>
<tr><td>Strength (Consistency)
Cohesive Soils</td><td>VS</td><td colspan="3">VERY SOFT – unconfined compressive strength ≤ 25kPa.</td></tr>
<tr><td></td><td>S</td><td colspan="3">SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.</td></tr>
<tr><td></td><td>F</td><td colspan="3">FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.</td></tr>
<tr><td></td><td>St</td><td colspan="3">STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.</td></tr>
<tr><td></td><td>VSt</td><td colspan="3">VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.</td></tr>
<tr><td></td><td>Hd</td><td colspan="3">HARD – unconfined compressive strength > 400kPa.</td></tr>
<tr><td></td><td>Fr</td><td colspan="3">FRIABLE – strength not attainable, soil crumbles.</td></tr>
<tr><td></td><td>( )</td><td colspan="3">Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.</td></tr>
<tr><td>Density Index/
Relative Density
(Cohesionless Soils)</td><td></td><td></td><td>Density Index (I_D) Range (%)</td><td>SPT ‘N’ Value Range (Blows/300mm)</td></tr>
<tr><td></td><td>VL</td><td>VERY LOOSE</td><td>≤ 15</td><td>0 – 4</td></tr>
<tr><td></td><td>L</td><td>LOOSE</td><td>> 15 and ≤ 35</td><td>4 – 10</td></tr>
<tr><td></td><td>MD</td><td>MEDIUM DENSE</td><td>> 35 and ≤ 65</td><td>10 – 30</td></tr>
<tr><td></td><td>D</td><td>DENSE</td><td>> 65 and ≤ 85</td><td>30 – 50</td></tr>
<tr><td></td><td>VD</td><td>VERY DENSE</td><td>> 85</td><td>> 50</td></tr>
<tr><td></td><td>( )</td><td colspan="3">Bracketed symbol indicates estimated density based on ease of drilling or other assessment.</td></tr>
<tr><td>Hand Penetrometer Readings</td><td>300
250</td><td colspan="3">Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.</td></tr>
</table>

Log Column	Symbol	Definition
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as:
		RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock.
		EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock.
		ALLUVIAL – soil deposited by creeks and rivers.
		ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents.
		MARINE – soil deposited in a marine environment.
		AEOLIAN – soil carried and deposited by wind.
		COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits.
		LITTORAL – beach deposited soil.

Classification of Material Weathering

Term		Abbreviation		Definition
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	Distinctly Weathered (Note 1)	HW	DW	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		Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'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 weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

			Guide to Strength	
Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Abbreviations Used in Defect Description

Cored Borehole Log Column		**Symbol Abbreviation**	**Description**
Point Load Strength Index		• 0.6	Axial point load strength index test result (MPa)
		x 0.6	Diametral point load strength index test result (MPa)
Defect Details	– Type	Be	Parting – bedding or cleavage
		CS	Clay seam
		Cr	Crushed/sheared seam or zone
		J	Joint
		Jh	Healed joint
		Ji	Incipient joint
		XWS	Extremely weathered seam
	– Orientation	Degrees	Defect orientation is measured relative to normal to the core axis (ie. relative to the horizontal for a vertical borehole)
	– Shape	P	Planar
		C	Curved
		Un	Undulating
		St	Stepped
		Ir	Irregular
	– Roughness	Vr	Very rough
		R	Rough
		S	Smooth
		Po	Polished
		Sl	Slickensided
	– Infill Material	Ca	Calcite
		Cb	Carbonaceous
		Clay	Clay
		Fe	Iron
		Qz	Quartz
		Py	Pyrite
	– Coatings	Cn	Clean
		Sn	Stained – no visible coating, surface is discoloured
		Vn	Veneer – visible, too thin to measure, may be patchy
		Ct	Coating ≤ 1mm thick
		Filled	Coating > 1mm thick
	– Thickness	mm.t	Defect thickness measured in millimetres

VIBRATION EMISSION DESIGN GOALS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structure.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity in mm/s			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (eg. buildings that are under a preservation order).	3	3 to 8	8 to 10	8

Note: For frequencies above 100Hz, the higher values in the 50Hz to 100Hz column should be used.