REPORT

TO
WOOLACOTTS

ON
GEOTECHNICAL INVESTIGATION

FOR
PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL

AT
THE HERMITAGE WAY, GLEDSWOOD HILLS NSW

31 May 2017
Ref: 29990SrptRev1

JK Geotechnics
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For and on behalf of
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1 INTRODUCTION

This report presents the results of a geotechnical investigation for proposed Gledswood Hills Public School at The Hermitage Way, Gledswood Hills NSW. The investigation was commissioned by Mr Kevin Christesen of Woolacotts Consulting Engineers by email, dated 21 April 2017. The commission was on the basis of our proposal, Ref: P42335S Rev1, dated 24 April 2017.

We understand from the provided project brief by Woolacotts Consulting Engineers and accompanying drawings prepared by Perumal Pedavoli (Ref. 3198 Dwg Nos. AS_04_001, AS_04_002, AS_04_003, AS_04_004 and AD_01_003), that the proposed development will comprise the following:

- Construction of one and two storey buildings over the western and southern portion of the site.
- One on grade car park within the north western portion of the site.
- Site regrading and general earthworks

We have assumed that typical structural loads for this type of development apply.

The purpose of the investigation was to obtain geotechnical information on subsurface conditions as a basis for comments and recommendations on issues including site classification, foundation systems, retention and pavement design.

We were also commissioned to carry out a Preliminary Environmental Site Screening. This work was carried out by Environmental Investigation Services (EIS) in conjunction with the geotechnical investigations. Reference should be made to the EIS report, (Ref: E29990K) for further details.

2 INVESTIGATION PROCEDURE

Prior to commencement of the fieldwork a 'Dial Before You Dig' (DBYD) search was undertaken and the borehole locations were electromagnetically scanned by a specialist sub-contractor for buried services.

The fieldwork was carried out between 8 and 10 May 2017 and comprised the drilling of ten boreholes (BH1 to BH10) to depths between 4.23m and 5.69m below existing grade using spiral

auger techniques with our track mounted JK305 drill rig. Five boreholes (BH1, BH2, BH3, BH4 and BH7) were then extended to total depths ranging from 7.07m to 10.17m by diamond coring techniques using an NMLC core barrel with water flush.

The borehole locations, are shown on the attached Figure 2, and these were set out by taped measurements from existing surface features shown on the supplied survey plans by Frankham Engineering Surveys (Ref: 217046, dated 22 March 2017) . The approximate surface levels, as shown on the borehole logs, were estimated by interpolation between spot levels and contours shown on the survey plans. The datum of the levels is Australian Height datum (AHD).

The strengths of the subsurface soils were assessed from Standard Penetration Test (SPT) 'N' values, augmented by hand penetrometer test results on cohesive samples returned by the SPT split tube sampler. Within the augered portions of the boreholes, the strength of the underlying shale was assessed by observation of the drilling resistance of the Tungsten Carbide (TC) bit attached to the augers, together with examination of the recovered rock chips and subsequent correlation with laboratory moisture content test results.

Where the bedrock was core drilled, the recovered core was returned to our NATA registered laboratory (Soil Test Services) for photographing and Point Load Strength Index (Is_{50}) testing. Using established correlations the Unconfined Compressive Strength (UCS) of the bedrock was then inferred from the Is_{50} results. The Point Load Strength index test results are summarised in the attached STS Table B and are plotted on the cored borehole logs. Colour photographs of the rock core are provided with the borehole logs.

Groundwater observations were made during drilling, after completion of the boreholes and approximately three weeks after completion. Slotted PVC standpipes were installed in BH2, BH3 and BH7 to allow further groundwater level monitoring during the fieldwork period.

The fieldwork was completed in the full time presence of our geotechnical engineer who set out the boreholes, nominated sampling and testing locations and prepared logs of the strata encountered. The borehole logs, which include field test results and groundwater observations, are attached to this report together with colour photographs of the rock core and our Report Explanation Notes, which describe the investigation techniques, and their limitations, and define the logging terms and symbols used.

Selected samples were returned to Soil Test Services Pty Ltd (STS) and Envirolab Services Pty Ltd, both NATA accredited laboratories to determine moisture contents, Atterberg limits, linear shrinkage, four day soaked CBR, point load strength index, pH, sulphate content, chloride content and resistivity. The results of the testing are summarised in the STS Tables A, B and C and Envirolab report No. 167096. Samples were also collected from the boreholes for testing as part of the environmental site screening by EIS.

3 RESULTS OF INVESTIGATION

3.1 Site Description

The site is located within undulating topography and slopes down to the east at approximately 5°. The site is approximately 140m wide (east west) and 180m long (north south).

At the time of fieldwork, the site was mainly undeveloped grassed farmland and bound to the east and west by roads that were still under construction and to the south by a road called Hermitage Way which was largely complete. Some earthworks associated with the roadworks extended into the site along the western, southern and eastern boundaries where some grading, clearing and filling appeared to have taken place.

To the west of the site beyond the roadway earthworks was ongoing related to the general infrastructure and development of the area. To the east of the site beyond the incomplete road was a detention basin. Bounding the site to the north was further undeveloped farmland.

3.2 Subsurface Conditions

The 1:100,000 series geological map of Wollongong indicates that the site is underlain by Bringelly Shale of the Wianamatta group. In summary, the boreholes disclosed a subsurface profile of varying depths of fill, overlying residual silty clays and then weathered shale bedrock at variable depths. A summary of the subsurface conditions is presented below and a graphical borehole summary is presented in Figure 3, but for more detailed descriptions of the conditions encountered at specific locations, reference should be made to the borehole logs.

Fill

Fill comprising silty clays was encountered from the surface of each borehole and extended to depths ranging from 0.3m to 2.0m below existing surface levels. Inclusions of roots, root fibres,

sand, shale, sandstone and igneous gravel, and concrete and tile fragments were present within the fill.

Residual Silty Clay

Residual silty clays were encountered in all boreholes underlying the fill. They were assessed to be of medium to high plasticity and stiff to hard strength and extended down to the top of the underlying weathered bedrock. The thickness of residual clay ranged from 1.1m to 3.1m.

Weathered Shale

Weathered bedrock was encountered in all boreholes at depths ranging from 1.4m to 5.1m below existing surface levels and extended to the borehole termination depths.

The depth of weathering varied substantially between boreholes with the deeper poorer quality shale present at boreholes BH1, BH3 and BH7. Within BH1, BH3 and BH7, large portions of extremely weathered and extremely low strength shale were encountered which extended down to termination depths.

Groundwater

Groundwater monitoring wells were installed in BH2, BH3 and BH7 upon the completion of drilling. No groundwater seepage was observed during auger drilling. Groundwater was measured in BH2, BH3 and BH7 at 2 days, 1 days and 3 hours respectively after the completion of drilling at depths of 3.0m, 2.3m and 3.2m. We expect those groundwater levels are a result of the water injected into the boreholes during core drilling and the time it took without dissipating is indicative of the low permeability of the substrata. Groundwater was measured again in BH2, BH3 and BH7 at approximately 3 weeks after fieldwork at depths of 5.5m, 4.6m and 8.9m.

3.3 Laboratory Test Results

The results of the moisture content tests carried out on recovered rock cuttings correlated well with our field assessment of bedrock strength. The point load strength index test results also correlated well with the field logging strength assessments, showing the shale to have highly variable Unconfined Compressive Strengths between <1MPa and 24MPa. Reference should be made to the attached Table C for specific test results.

The Atterberg Limits and linear shrinkage test result confirmed the samples tested were of medium to high plasticity and will therefore have a high potential for shrink-swell movements with

changes in moisture content. Reference should be made to the attached Table A for specific test results.

The four day soaked CBR tests carried out on samples of residual silty clay resulted in values of ranging from 1.5% to 2.5% when compacted to 98% of Standard Maximum Dry Density (SMDD) and surcharged with 4.5kg. Reference should be made to the attached Table B for specific test results.

The results of the pH, sulphate, chloride and resistivity tests are summarised in the table below.

Borehole	Depth (m)	Sample Type	pH	Sulphates SO_4 (ppm)	Chlorides Cl (ppm)	Resistivity ohm.cm
BH1	0.5-0.7	Clay Fill	8.5	70	110	2,900
BH6	0.5-0.95	Residual Clay	5.9	62	380	2,600
BH8	4-4.5	Shale Bedrock	5.7	210	330	2,200

The above results indicate that the soils and weathered shale would have an exposure classification of 'Non-Aggressive' when assessed in accordance with the criteria for concrete piling exposure classification given in Table 6.4.2 (C) of AS2159-2009 "Piling Design and Installation". Any concrete exposed to these conditions (e.g. Piles) should have a characteristic concrete strength and cover as recommended in Table 6.4.3 of the standard.

The above results indicate that the soils and weathered shale would have an exposure classification of 'Non Aggressive' when assessed in accordance with the criteria for steel piling exposure classification given in Table 6.5.2 (C) of AS2159-2009. Any steel exposed to these conditions should have a uniform corrosion allowance as recommended in Table 6.5.3.

4 COMMENTS AND RECOMMENDATIONS

4.1 Summary of Principal Geotechnical Findings and Issues and Further Work

The boreholes encountered a variable subsurface profile of fill of variable compaction and varying thickness (up to 2.0m), underlain by residual silty clays that grade into shale bedrock at moderate depths in the range of 1.1m to 5.1m.

Based on the above known subsurface conditions, the following are considered to be principal geotechnical issues for prospective development of typical one to two storey school buildings, associated structures and pavements:

1. The presence of fill of varying thicknesses and compaction, results in a site classification of Class P in accordance with AS2870-2011. Although this classification would not be applicable to any building larger than the residential buildings specified in the standard, it is useful to indicate potential problems at the site. Variations in fill quality/nature should be anticipated.
2. No documentation has been provided to indicate that the fill is controlled, engineered fill. Based upon the variable SPT 'N' values the fill is judged to be in a state of variable compaction and is unsuitable as a bearing stratum or support subgrade for building footings and floor slabs or any other structures that are sensitive to differential foundation movements and/or are have moderate to heavy loads. Instead, structures should be supported on footings bearing on the bedrock which is found at shallow to moderate depths. To support structures on the fill, the fill would have to be excavated and replaced with engineered, controlled fill.
3. The fill comprises materials which may be environmentally sensitive. Reference should be made to the EIS Environmental Report Ref: E29990Krpt. Classification would be required in order to allow the material to be exported from the site in accordance with the NSW DEC (formerly EPA) guidelines as inert, solid, industrial, or hazardous waste.
4. The clay and clay fill soils at the site have very low CBR values and will form a poor subgrade for pavements.

4.2 Earthworks

4.2.1 Excavation

Excavation of the fill and residual soils, as well as the extremely weathered shale will be readily achievable using the buckets of conventional hydraulic excavators. If very low and low strength shale is to be excavated, it will be able to be ripped using a Dozer (say D7 size) with ripping tyne or by using a ripping tyne fitted to a large hydraulic excavator. From the concept designs indicated to us to date it seems unlikely there will be any substantial rock excavation.

We recommend that only excavation contractors with appropriate insurances and experience on similar projects be used. Excavation contractors should be provided with a copy of this geotechnical report, including the borehole logs and point load strength test results, so that they can make their own assessment of suitable excavation equipment.

W e consider that the groundwater table is unlikely to be encountered in the excavations unless they are of substantial depth. However, groundwater seepage will occur through defects within the rock and at the soil/rock interface and will likely be more significant during and immediately following wet weather. During construction we expect that if groundwater seepage occurs, it will be able to be controlled by conventional sump and pump techniques if gravity drainage is not possible.

4.2.2 Excavation Batters

Where space permits, temporary batter slopes will likely be feasible for most of the perimeter of the proposed excavations. Temporary batters through the residual clays and all bedrock up to and including low strength should be battered at not steeper than 1 Vertical (V) in 1 Horizontal (H). Where such batters would be higher than 3m a berm should be incorporated in the profile at mid-height. At the toe of such batters some seepage may occur and it may be necessary to flatten batters or to provide some other local toe support, where there is a risk of instability.

Permanent batters should be no steeper than 2H:1V and protected by vegetation or hard surfacing. Flatter batters of at least 3H:IV are strongly recommended to allow maintenance of vegetation etc. It is very difficult to establish topsoil and vegetation on slopes as steep as 2H:1V

Surcharge loads, including construction loads, must be kept well clear of the crest of temporary batters (at least 2H from the crest, where H is the vertical height of the batter slope in metres). Temporary batter slopes are contingent on the batter slopes being inspected by a geotechnical engineer at not greater than 1.5m depth intervals.

Where temporary batters are formed to allow construction of retaining walls, consideration needs to be given to the type of backfill to be used against permanent basement and/or lower ground floor walls. Uncompacted backfill placed up against walls will result in large settlements which can have adverse effects on structures, paving or landscaping supported above. Compaction of the clay soils and weathered shale will be very difficult in confined spaces with light equipment and therefore the backfill placed against the permanent retaining walls should preferably comprise a uniform durable granular material which is surrounded in a geotextile fabric. There are cost implications of excavating and disposing of the additional soil from the batters, and importing large amounts of material to backfill the permanent basement walls. It may be preferable to install a shoring system around the perimeter of excavations to avoid the excavation of the material in

the batters and replacement with higher quality material. Further details are provided in the sub-section entitled Engineered Fill below.

4.2.3 Excavation Retention

Where temporary batters cannot be accommodated within the site boundaries or temporary batter slopes are not preferred then we recommend that a properly designed shoring system installed prior to bulk excavation be constructed. Given the subsurface conditions encountered, we consider that soldier pile walls with shotcrete infill panels are suitable for this site.

Bored piles would be suitable for the shoring system and would preferably be socketed at least 1.0m below the bulk excavation level, including allowances for nearby footing and service excavations. Greater embedment may be required for lateral stability of the shoring system.

The following characteristic parameters may be adopted for anchored shoring wall design. The parameters outlined below are on the assumption that a soldier pile wall is constructed and that inspection of the faces between soldier piles is completed by a geotechnical engineer at not greater than 1.5m depth intervals to check for significant adverse conditions.

- Where minor movements of the shoring wall are tolerable, we recommend a trapezoidal lateral earth pressure distribution of 5H (where H is the height of soil and all rock up to and including low strength). The pressure should be uniform across the trapezoid which extends over the central 50% of the wall height.
- Where adjoining structures or movement sensitive services are within a horizontal distance of 2H from the shoring wall we recommend that the magnitude of the rectangular lateral earth pressure be increased to 8H to reduce the risk of adverse deflections.
- All surcharge loads affecting the walls (e.g. nearby footings, construction loads and traffic etc) are additional to the earth pressure recommendations above and should be included in the design.
- The retaining walls should be designed as drained and measures taken to provide permanent and effective drainage of the ground behind the walls.

4.2.4 Other Retaining Walls

Retaining walls may be required to support low height cuts and/or fills. The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the design of such retention systems including cantilevered soldier pile shoring type walls.

- For free-standing cantilever walls located in areas where movement is of little concern (ie. where grassed or garden areas are being retained), adopt a triangular lateral earth pressure distribution and an "active" earth pressure coefficient (K_a) of 0.35 for the soil profile and weathered shale, assuming a horizontal backfill surface.
- For free-standing cantilever walls located in areas where movement is of concern (ie. where the walls are supporting proposed on-grade floor slabs and external pavements), adopt a triangular lateral earth pressure distribution and an "at rest" earth pressure coefficient (K_0) of 0.55 for the retained profile, assuming a horizontal backfill surface.
- For retaining walls incorporated into and supported by the proposed new buildings, adopt the above K_0 value, assuming a horizontal backfill surface.
- A bulk unit weight of 20kN/m^3 should be adopted for the soil profile and 23kN/m^3 for weathered shale.
- Any surcharge affecting the walls (eg. construction traffic, pavement and ground floor slab loads, compaction stresses during backfilling, etc.) should be allowed in the design using the appropriate above earth pressure coefficients.
- The retaining walls should be designed as permanently drained. Subsurface drains should incorporate a non-woven geotextile filter fabric such as Bidim A34 to control subsoil erosion.
- The passive lateral toe resistance for retaining walls founded in natural clay of at least stiff strength may be estimated using a "passive" earth pressure coefficient (K_p) of 3.0 (but with a Factor of Safety of at least 2.0 to limit deformations), assuming horizontal ground in front of the wall. The upper 0.3m below bulk excavation level should be ignored in the design to cater for excavation tolerances.
- Following retaining wall construction and backfilling, we recommend that a dish drain be provided immediately uphill of the walls to intercept surface water run-off. The discharge from such drains should be piped to the stormwater system.

4.2.5 Subgrade Preparation

The proposed development will require the possible removal of existing trees (including their root balls), stripping of grass, topsoil and root-affected soil, and any poorly compacted, deleterious or

contaminated existing fill. Stripped topsoil and root affected soils should be stockpiled separately as they are not suitable for reuse as engineered fill. They may be reused at a later stage for landscaping purposes. The site can then be excavated down to design subgrade level using hydraulic excavators and dozers.

Following stripping and excavation, we recommend that the subgrade be inspected by a geotechnical engineer and any poor quality material removed. If the fill is to support structures then all existing fill should be removed. Some fill may be suitable for replacement as engineered fill, if it is appropriately moisture conditioned. The surface should then be proof rolled with at least eight passes of a static smooth drum roller (at least 8 tonnes deadweight). The final two passes of proof rolling should be carried out under the direction of an experienced geotechnical engineer for the detection of unstable or soft areas.

Subgrade heaving should be expected in areas where the clayey subgrade may have become "saturated" or there are areas of poorly compacted fill. Heaving areas should be locally removed to a stable base and replaced with engineered fill, or further advice could be sought. If soil softening occurs after prolonged periods of rainfall, then the subgrade should be over-excavated to below the depth of moisture softening and replaced with engineered fill. Engineered fill should also be used where site levels need to be raised. If the clayey subgrade exhibits shrinkage cracking, then the surface should be watered and rolled until the shrinkage cracks are no longer evident.

4.2.6 Engineered Fill

The excavated clayey fill and natural clay will require strict quality control if they are to be reused as engineered fill, due to their reactive potential and moisture sensitivity. The excavated clayey soils must be free of organic matter and free of particle sizes greater than 75mm prior to reuse as engineered fill. The clayey soils may require moisture conditioning (ie. "wetting up") prior to re-use in order to satisfy the compaction specifications set out below, but this a seasonal issue and the reverse may also occur.

Engineered fill comprising the excavated clayey soils should be compacted in maximum 200mm loose layers using a minimum 8 tonne (static) roller to a density strictly between 98% and 102% of SMDD and at a moisture content within 2% of SOMC.

Materials preferred for use as good quality select fill below pavements and slabs-on-grade are well graded granular materials, such as ripped or crushed sandstone, free of organic matter and

free of particle sizes greater than 75mm. The select engineered fill should be compacted in maximum 200mm loose layers using a minimum 10 tonne static roller to a minimum density of 98% of SMDD.

4.3 Footings

The proposed buildings can be either uniformly supported on high level footings penetrating the existing fill and founded in the natural clays or an engineered fill or alternatively uniformly supported on piled footings founded in the underlying shale bedrock.

4.3.1 High Level Footings

High level pad and strip footings must penetrate any existing proof rolled fill and may be founded in natural clay of at least very stiff strength in which case they can be tentatively designed for a maximum allowable bearing pressure of 150kPa. In areas where there is existing uncontrolled fill more than 500mm in depth we do not recommend high level footings unless the fill is replaced as engineered fill. Alternatively footings can be uniformly founded on engineered fill where the applied bearing pressure should be limited to 100kPa.

Based on the laboratory test results, the subgrade clays in their natural profile are considered to be moderately to highly reactive (Class H1) with changes in moisture content. Where the cracked zone is removed by excavation or where engineered clay fill is present, the reactivity will increase and rather than the surface movements of 40mm to 45mm for the natural condition, movements will tend towards the 60mm to 70mm range.

All high level footing excavations should be cleaned out of loose debris, inspected by a geotechnical engineer and poured without delay. If delays in pouring are envisaged, then we recommend that a concrete blinding layer be poured to reduce deterioration due to weathering. Design detailing for reactive day sites is further described in AS2870-2011.

4.3.2 Piled Footings

The proposed buildings can be supported on piled footings founded in shale bedrock. Based on the results of the investigation, conventional bored piles are expected to be appropriate though seepage may affect construction in some cases. Steel screw (helix) piles could be considered for lighter loads bearing upon Class 5 shale at the first contact where allowable bearing pressures would be limited to 700kPa as we would expect them to encounter difficulties penetrating the

weathered bedrock. Similarly bored piles with a nominal socket of 0.3m into extremely weathered shale may be designed for 700 kPa allowable bearing pressure

Conventional bored piles socketed at least 0.3m into very low to low strength or stronger shale (Class 4) bedrock may be designed for a maximum allowable end bearing pressure of 1000kPa. Shale of higher quality than this was not found within the depth of investigation.

Sockets formed below the minimum 0.3m length requirement may be designed for maximum allowable shaft adhesion values of 70kPa in Class 5 shale or 100kPa in Class 4, on condition that the pile shaft is suitably roughened using a grooving tool fitted to the side of the auger. The provided bearing pressures are based upon a serviceability criteria of deflections at the pile toe of less than 1% of the pile diameter. Shaft adhesion values should be reduced by 50% for uplift loading conditions.

Bored pile holes should be cleaned out, inspected and tremie poured on the same day as drilling. The initial stages of bored piling should be inspected by a geotechnical engineer to confirm that a satisfactory bearing stratum has been achieved.

4.4 Ground Floor Slabs and Pavements

Slab-on-grade construction for the proposed buildings are considered feasible provided the subgrade is prepared as discussed in Section 4.2. The slabs-on-grade should be constructed independent of the building footings and walls (ie. designed as “floating” slabs) to permit relative movement.

Based on the laboratory test results we recommend that the design of pavements and concrete slabs be based on a CBR of 1.5%. This is a very low value and for pavements subject to heavy vehicle traffic there will need to a 300mm thick capping layer of material with a CBR of at least 10%. This can either be a product such as crushed/ripped sandstone or lime stabilisation of the in-situ clays. Ripped shale is not generally suitable as it breaks down to a material with a CBR below 10%.

Building slabs-on-grade and light duty concrete pavements should be supported on at least a 100mm thick sub-base of good quality fine crushed rock such as RTA Specification 3051 unbound base (eg. DGB20) or similar quality, and compacted to a minimum density of 100% of SMDD. The sub-base material will provide a more uniform slab support and would reduce

"pumping" of subgrade "fines" at joints. Slab joints should be designed to resist shear forces but not bending moments by providing dowelled or keyed joints.

Subsoil drains should be provided along the upslope perimeter of all proposed new external pavement areas, with invert levels at least 200mm below subgrade level. The drainage trench should be excavated with a uniform longitudinal fall to appropriate discharge points so as to reduce the risk of water ponding. The subgrade should be graded to promote water flow towards the subsoil drains. Discharge from the subsoil drains should be piped to the stormwater system.

5 SALINITY

The site is located in an area where soil and groundwater salinity may occur. Salinity can affect the longevity and appearance of structures as well as causing adverse horticultural and hydrogeological effects. The local council has guidelines relating to salinity issues which should be checked for relevance to this project.

6 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. As an example, special treatment of soft spots may be required as a result of their discovery during proof-rolling, etc. In the event that any of the 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.

The long term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

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 will need to be assigned to any soil excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), General Solid, Restricted Solid or Hazardous Waste. Analysis takes seven to 10 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) should be expected. We strongly recommend that this issue 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.

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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE A
MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client: JK Geotechnics
Project: Proposed Gledswood Hills Public School
Location: Hermitage Way, Gledswood Hills, NSW

Ref No: 29990S
Report: A
Report Date: 24/05/2017
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AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	DEPTH m	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	LINEAR SHRINKAGE %
1	4.10-4.50	9.2				
2	4.00-4.50	9.4				
3	0.50-0.95	13.2	46	19	27	13.0
3	2.70-3.00	14.3				
4	0.50-0.95	18.6	58	23	35	16.0
4	3.80-4.00	8.1				
5	0.50-0.95	20.0	46	20	26	13.0
5	2.50-3.00	12.2				
5	4.00-4.50	9.6				
6	2.50-3.00	11.3				
6	4.00-4.50	6.8				
7	3.00-3.45	22.8	54	22	32	15.0
7	5.50-6.00	8.8				
9	4.00-4.50	8.5				
10	2.50-3.00	6.1				

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 15/5/17

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TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: JK Geotechnics
Project: Proposed Gledswood Hills Public School
Location: Hermitage Way, Gledswood Hills, NSW

Ref No: 29990S
Report: B
Report Date: 24/05/2017
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BOREHOLE NUMBER		6	9	10
DEPTH (m)		0.50 - 1.50	0.50 - 1.50	0.50 - 1.50
Surcharge (kg)		4.5	4.5	4.5
Maximum Dry Density (t/m^3)		1.50 STD	1.49 STD	1.70 STD
Optimum Moisture Content (%)		24.0	24.2	18.6
Moulded Dry Density (t/m^3)		1.47	1.46	1.67
Sample Density Ratio (%)		98	98	98
Sample Moisture Ratio (%)		100	99	98
Moisture Contents				
Insitu (%)		25.2	31.0	14.2
Moulded (%)		23.9	24.0	18.3
After soaking and				
After Test, Top 30mm(%)		32.6	40.2	28.3
Remaining Depth (%)		27.0	31.1	21.7
Material Retained on 19mm Sieve (%)		0	0	0
Swell (%)		4.0	4.5	3.5
C.B.R. value:	@2.5mm penetration	2.5	1.5	1.5

NOTES:

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods :
  - (a) Soaked C.B.R. : AS 1289 6.1.1
  - (b) Standard Compaction : AS 1289 5.1.1
  - (c) Moisture Content : AS 1289 2.1.1
- Date of receipt of sample:15/5/17

NATA Accredited Laboratory Number:1327

Authorised Signature / Date
(A. Tatikonda) 24/5/17

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, BC 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	JK Geotechnics	**Ref No:**	29990S
Project:	Proposed Gledswood Hills Public School	**Report:**	C
Location:	Hermitage Way, Gledswood Hills, NSW	**Report Date:**	16/05/2017
		Page 1 of 1	

BOREHOLE NUMBER	DEPTH m	$I_{S\,(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
1	5.91-5.94	0.6	12
	6.37-6.39	0.9	18
	6.71-6.73	0.7	14
	7.48-7.50	0.4	8
	7.79-7.82	0.2	4
2	5.49-5.52	0.2	4
	5.92-5.94	0.3	6
	6.76-6.79	0.2	4
	7.04-7.07	0.1	2
	7.59-7.62	0.4	8
	7.92-7.95	0.2	4
	8.07-8.09	0.2	4
3	4.36-4.39	0.3	6
	4.49-4.52	0.6	12
4	4.48-4.50	0.5	10
	4.85-4.87	1.2	24
	5.36-5.39	0.4	8
	5.86-5.89	0.6	12
	6.26-6.29	0.4	8
	6.80-6.82	0.3	6
	7.08-7.10	0.2	4
7	7.54-7.57	0.3	6
	7.67-7.69	0.4	8
	8.78-8.81	0.5	10

NOTES:

1. In the above table testing was completed in the Axial direction.
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 by the following approximate relationship and rounded off to the nearest whole number :
   U.C.S. = 20 $I_{S\,(50)}$

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 167096

Client:
JK Geotechnics
PO Box 976
North Ryde BC
NSW 1670

Attention: Kapil Singh

Sample log in details:

Your Reference:	**29990S, Gledswood Hills**		
No. of samples:	3 Soils		
Date samples received / completed instructions received	15/05/17	/	15/05/17

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: / Issue Date:	22/05/17	/	18/05/17
Date of Preliminary Report:	Not Issued		

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025 - Testing **Tests not covered by NATA are denoted with *.**

Results Approved By:

David Springer
General Manager

Misc Inorg - Soil				
Our Reference:	UNITS	167096-1	167096-2	167096-3
Your Reference	----------	BH1	BH6	BH8
	-			
Depth	----------	0.5-0.7	0.5-0.95	4.0-4.5
Date Sampled		10/05/2017	10/05/2017	10/05/2017
Type of sample		Soil	Soil	Soil
Date prepared	-	17/05/2017	17/05/2017	17/05/2017
Date analysed	-	17/05/2017	17/05/2017	17/05/2017
pH 1:5 soil:water	pH Units	8.5	5.9	5.7
Chloride, Cl 1:5 soil:water	mg/kg	110	380	330
Sulphate, SO4 1:5 soil:water	mg/kg	70	62	210
Resistivity in soil*	ohm cm	2,900	2,600	2,200

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-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
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.

QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			17/05/2017	[NT]	[NT]	LCS-W1	17/05/2017
Date analysed	-			17/05/2017	[NT]	[NT]	LCS-W1	17/05/2017
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-W1	102%
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	LCS-W1	88%
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	LCS-W1	102%
Resistivity in soil*	ohm cm	1	Inorg-002	<1.0	[NT]	[NT]	[NR]	[NR]

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

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.

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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-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.

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 1
1 / 2

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~120.2 m
Date: 9/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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						120				FILL: Silty clay, medium plasticity, brown mottled grey, with concrete fragments.	MC<PL			APPEARS WELL COMPACTED
					N > 5 5,5/ 50mm REFUSAL		1							
ON COMPLETION OF CORING					N = 8 4,4,4	119								
							2		CL-CH	SILTY CLAY: medium to high plasticity, orange brown mottled light grey.	MC~PL	VSt		RESIDUAL
					N = 15 5,6,9	118	3			as above, but light grey.			300 370 320	
						117								
							4			SHALE: grey, with iron indurated bands and XW seams.	XW - DW	EL - VL		VERY LOW 'TC' BIT RESISTANCE
						116								
							5			SHALE: grey and brown, with iron indurated bands.	DW	VL - L		LOW RESISTANCE
						115								
							6			REFER TO CORED BOREHOLE LOG				
						114								

JK_LIB_CURRENT - V8.00.GLB Log J & K AUGERHOLE - MASTER 29990S GLEDSWOOD HILLS.GPJ <<DrawingFile>> 01/06/2017 10:42 Produced by gINT Professional, Developed by Datgel

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

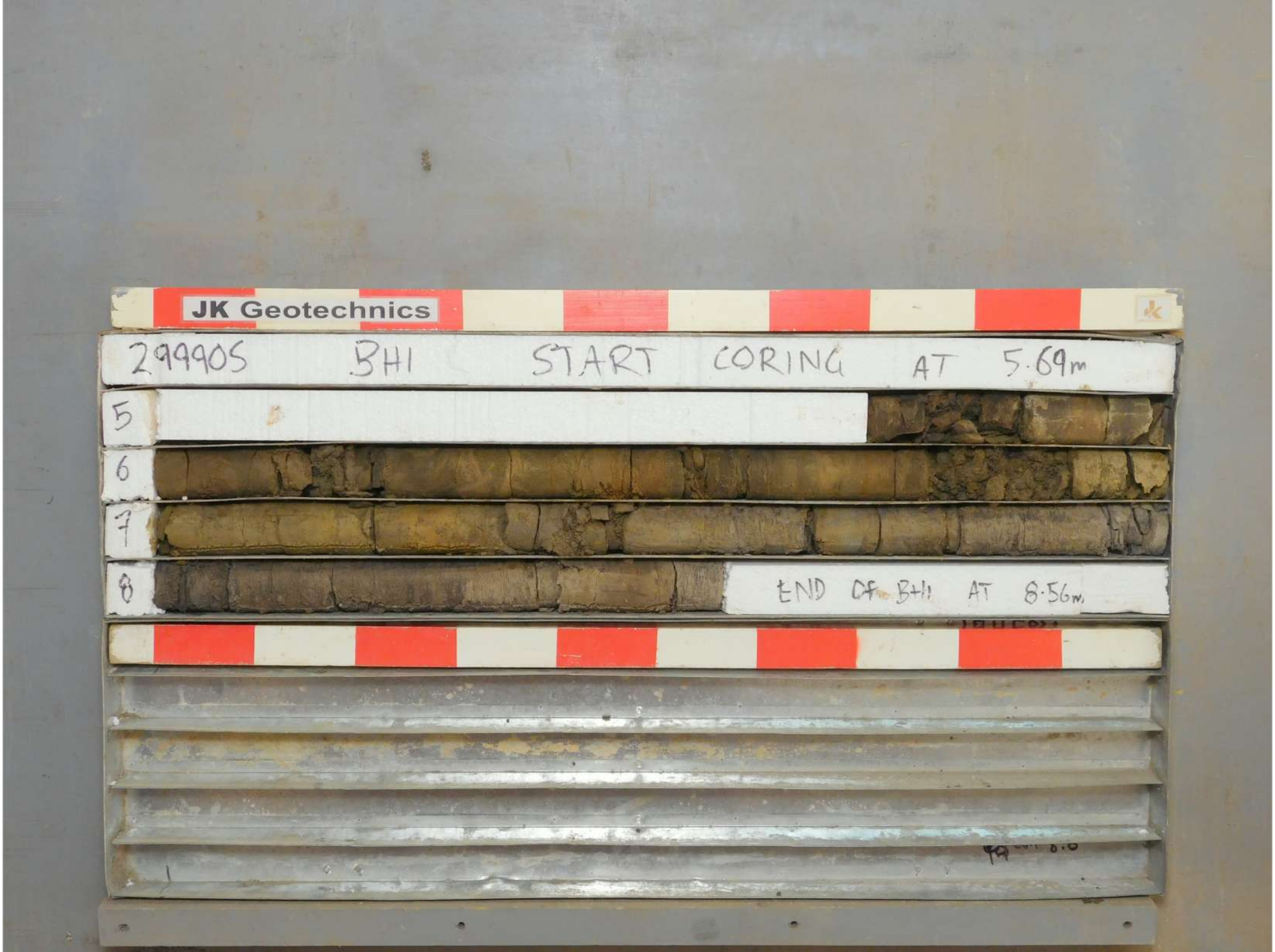
Borehole No. 1
2 / 2

CORED BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S | **Core Size:** NMLC | **R.L. Surface:** ~120.2 m
Date: 9/5/17 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK305 | **Bearing:** N/A | **Logged/Checked By:** K.S./P.S.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: DEFECT SPACING (mm) (500, 300, 100, 50, 30, 10)	DESCRIPTION: Type, inclination, thickness, planarity, roughness, coating. Specific / General
		115			START CORING AT 5.69m					
100% RETURN		114	6		SHALE: grey and brown, with iron indurated bands.	DW	M			(5.73m) J, 80°, Un, S (5.76m) FRAGMENTED ZONE, 0°, 100 mm.t (6.12m) XWS, 0°, 60 mm.t (6.23m) Cr, 0°, 7 mm.t (6.41m) XWS, 0°, 60 mm.t (6.52m) XWS, 0°, 24 mm.t (6.57m) XWS, 0°, 10 mm.t
		113	7			XW	EL			(7.21m) Be, 0°, P, S (7.34m) J, 70°, P, S
		112	8			DW	L - M			(7.65m) Be, 0°, P, S (7.78m) Be, 0°, P, S
						XW	EL			
		111	9		END OF BOREHOLE AT 8.56 m					
		110	10							
		109	11							


JK Geotechnics
299905 BH1 START CORING AT 5.69m
5
6
7
8
END OF BH1 AT 8.56m.

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 2
1 / 2

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~118.7 m
Date: 8/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low plasticity, brown, with fine to coarse grained igneous gravel and concrete fragments.	MC~PL			APPEARS MODERATELY TO WELL COMPACTED
					N = 14 4,7,7	118	1							
ON COMPLETION OF CORING					N = 9 3,4,5	117								
							2		CL-CH	SILTY CLAY: medium to high plasticity, light grey mottled red brown, with fine to coarse grained ironstone gravel.	MC~PL	H	420 470	RESIDUAL
AFTER 2 DAYS					N = 34 10,15,19	116	3							
						115				SHALE: grey, with clay seams	XW	EL		
							4				DW	VL - L		LOW 'TC' BIT RESISTANCE WITH XW BANDS
						114	5							
						113	6			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 8.0m, MACHINE SLOTTED 50mm PVC STANDPIPE 5m TO 8.0m, CASING 0m TO 5.0m, 2mm SAND FILTER PACK 4.8m TO 8.0m, BENTONITE SEAL 4.0m TO 4.8m, BACKFILLED WITH SAND TO SURFACE AND COMPLETED WITH A CONCRETED GATIC COVER
						112								

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

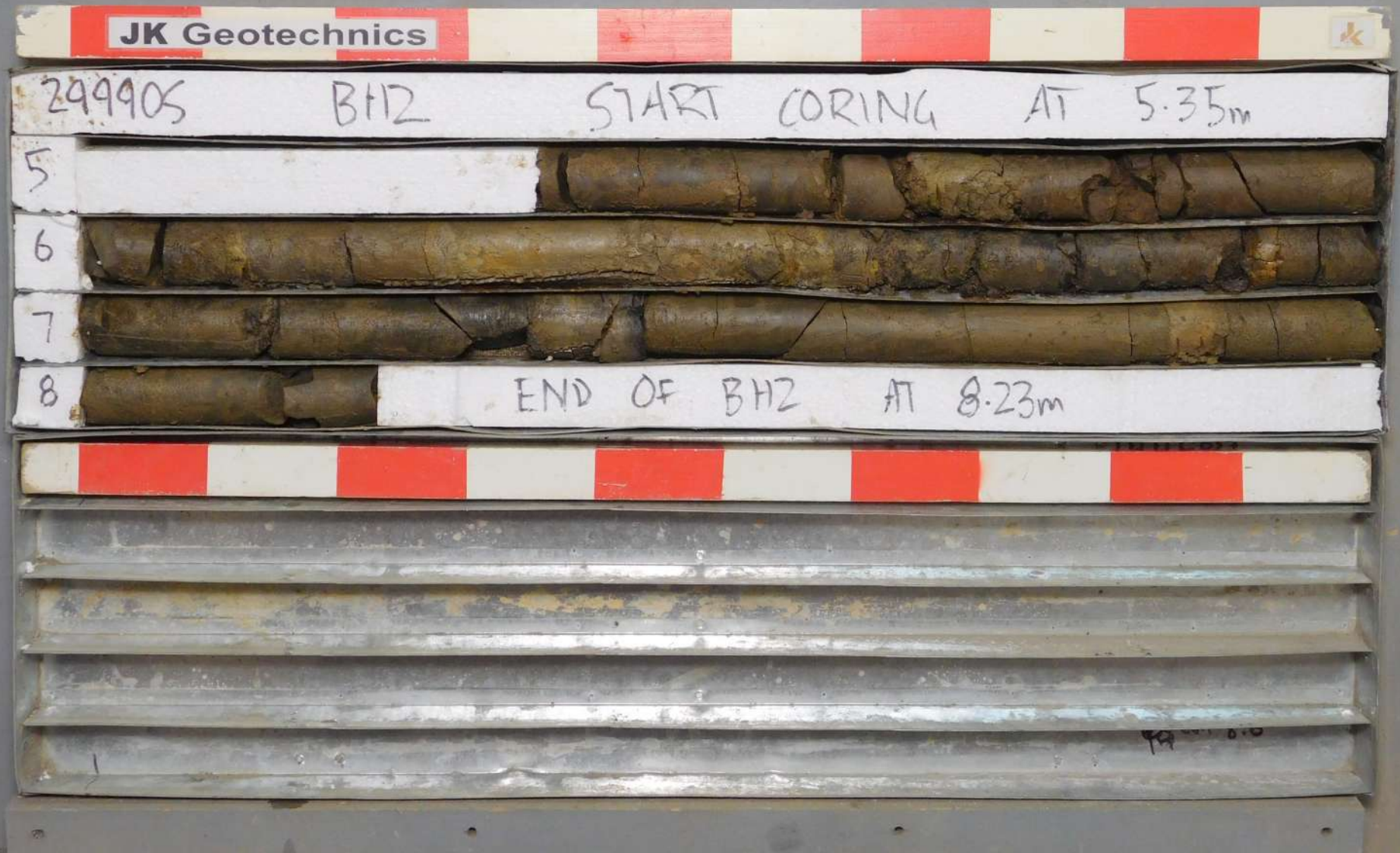
Borehole No.
2
2 / 2

CORED BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S | **Core Size:** NMLC | **R.L. Surface:** ~118.7 m
Date: 8/5/17 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK305 | **Bearing:** N/A | **Logged/Checked By:** K.S./P.S.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (EL .03, VL .1, L .3, M 1, H 3, VH 10, EH)	DEFECT DETAILS: DEFECT SPACING (mm) (500, 300, 100, 50, 30, 10)	DESCRIPTION: Type, inclination, thickness, planarity, roughness, coating. Specific / General
					START CORING AT 5.35m					
AFTER 3 WEEKS		113	6		SHALE: dark grey.	DW	L - M			(5.58m) J, 90°, P, R (5.62m) Be, 0°, P, R (5.63m) XWS, 0°, 100 mm.t (5.78m) FRAGMENTED ZONE, 40 mm.t (5.84m) XWS, 0°, 13 mm.t (6.00m) J, 40°, P, S (6.06m) Be, 0°, P, S
						XW	EL			
100% RETURN		112	7			DW	L - M			(6.68m) XWS, 0°, 18 mm.t (6.75m) J, 50°, P, S (6.76m) Be, 0°, P, S (6.87m) XWS, 0°, 50 mm.t (7.14m) Be, 0°, Un, R (7.27m) J, 60°, P, S (7.44m) Be, 0°, P, S (7.55m) J, 40°, P, S (7.84m) XWS, 0°, 45 mm.t (8.14m) Be, 0°, P, S
		111	8							
		110	9		END OF BOREHOLE AT 8.23 m					
		109	10							
		108	11							
		107								


JK Geotechnics
299905 BH2 START CORING AT 5.35m
5
6
7
8
END OF BH2 AT 8.23m

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 3
1 / 2

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~128 m
Date: 9/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low plasticity, dark brown, with roots and root fibres, and concrete fragments.	MC<PL			APPEARS MODERATELY COMPACTED
									CL-CH	SILTY CLAY: medium to high plasticity, light grey and orange brown, with fine to coarse grained ironstone gravel.	MC<PL	H		RESIDUAL
					N = 13 5,6,7								550 570 500	
ON COMPLETION OF CORING						127	1							
										SHALE: brown, with XW bands and clay seams and iron indurated bands.	XW - DW	EL - VL		VERY LOW TO LOW 'TC' BIT RESISTANCE
AFTER 1 DAY						126	2							
						125	3							
										SHALE: grey and brown.	DW	VL - L		LOW RESISTANCE
						124	4							
										REFER TO CORED BOREHOLE LOG				GROUNDWATER WELL INSTALLED TO 7.0m. MACHINE SLOTTED FROM 4.0m TO 7.0m. CASING FROM 0m TO 4.0m. SAND BACKFILL FROM 3.5m TO 7.0m. BENTONITE FROM 2.0m TO 3.5m. BACKFILL TO SURFACE AND GATIC COVER.
						123	5							
						122	6							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

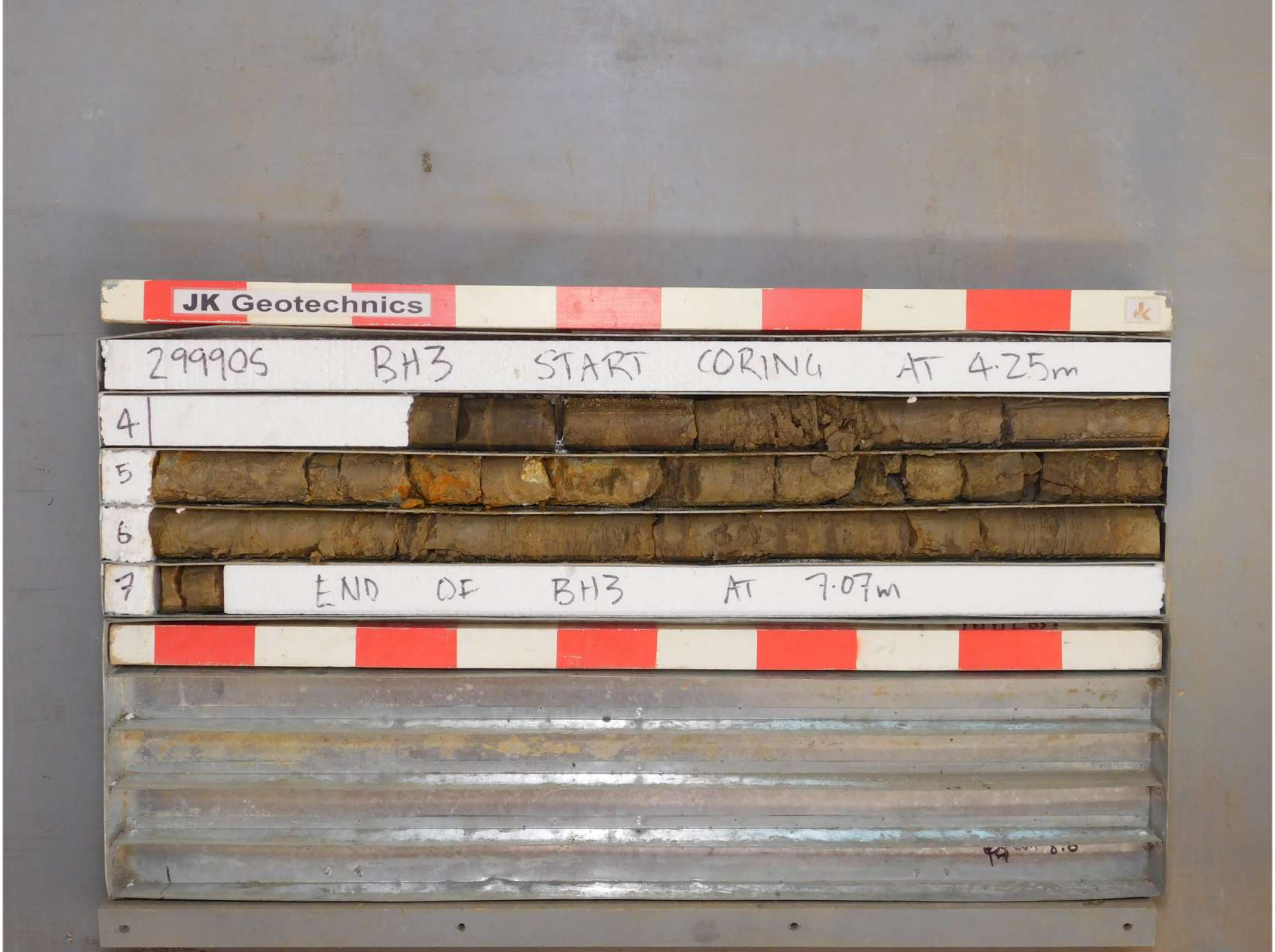
Borehole No. 3
2 / 2

CORED BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S | **Core Size:** NMLC | **R.L. Surface:** ~128 m
Date: 9/5/17 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK305 | **Bearing:** N/A | **Logged/Checked By:** K.S./P.S.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH	DEFECT DETAILS DEFECT SPACING (mm) 500, 300, 100, 50, 30, 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
					START CORING AT 4.25m					
AFTER 3 WEEKS					SHALE: dark grey, with iron indurated bands.	DW	L - M			(4.40m) Be, 0°, P, S (4.43m) XWS, 0°, 32 mm.t
100% RETURN		123	5		as above, but with L strength bands.	XW	EL			(4.84m) Be, 0°, P, S (5.25m) Be, 0°, P, S (5.47m) J, 40°, P, S (5.62m) Be, 0°, P, S (5.67m) J, 60°, P, S (5.88m) Be, 0°, P, S (6.24m) Be, 0°, P, S (6.28m) Be, 0°, P, S
		122	6							
		121	7							
					END OF BOREHOLE AT 7.07 m					
		120	8							
		119	9							
		118	10							


JK Geotechnics
299905 BH3 START CORING AT 4.25m
4
5
6
7
END OF BH3 AT 7.07m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 4
1 / 2

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~121.5 m
Date: 9/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low plasticity, dark brown, with roots and root fibres.				APPEARS MODERATELY COMPACTED
					N = 12 5,6,6	121	1		CH	SILTY CLAY: high plasticity, light grey mottled orange brown, with fine to coarse grained ironstone gravel.	MC<PL	H	>600 >600	RESIDUAL
					N = 21 11,12,9	120	2			SHALE: grey, with iron indurated bands.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
ON COMPLETION OF CORING					N > 9 15,9/ 50mm REFUSAL	119	3				DW	VL - L		LOW RESISTANCE
						118	4							
						117	5			REFER TO CORED BOREHOLE LOG				
						116	6							
						115								

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

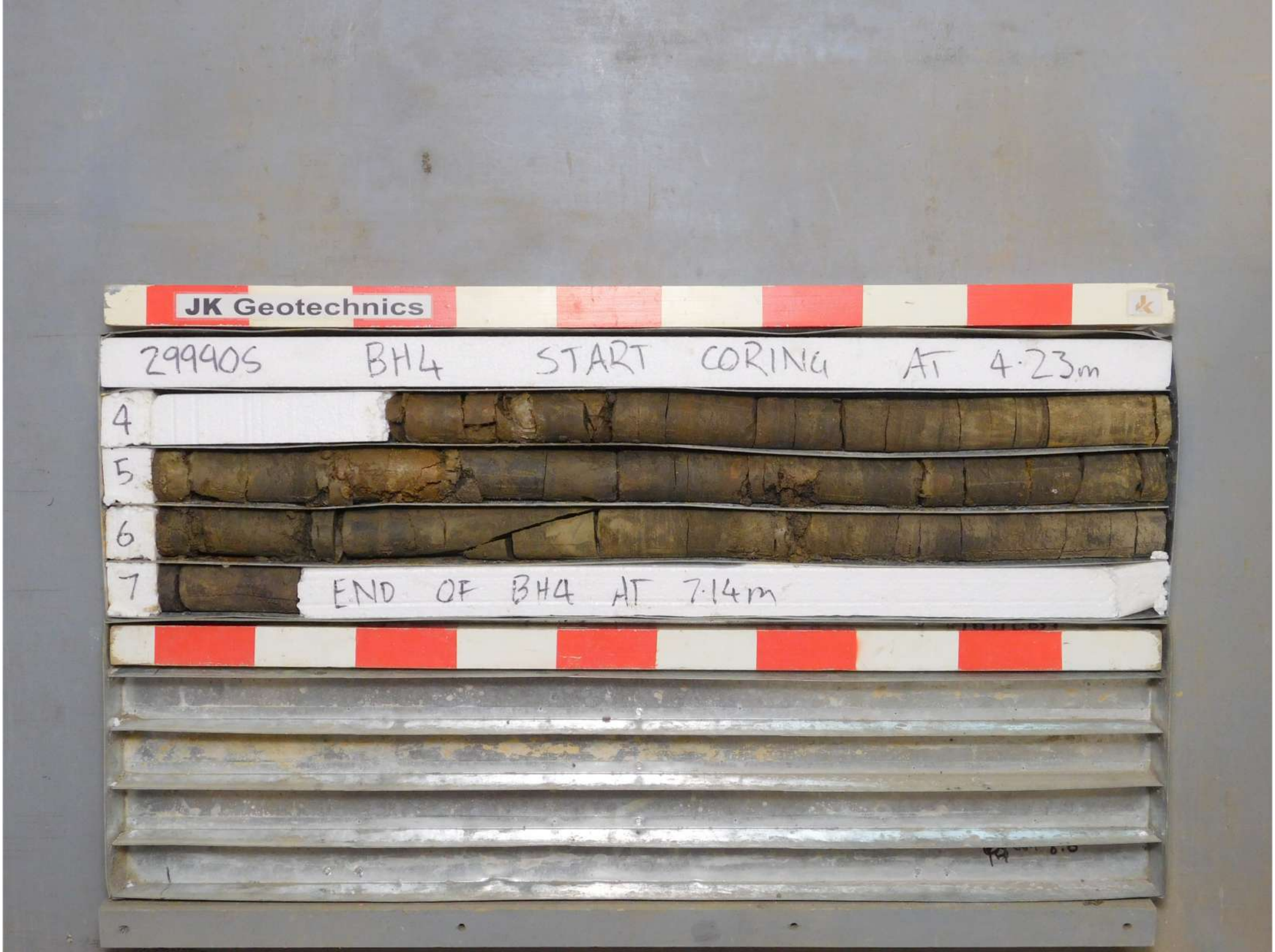
Borehole No. 4 2 / 2

CORED BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Core Size:** NMLC **R.L. Surface:** ~121.5 m
Date: 9/5/17 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK305 **Bearing:** N/A **Logged/Checked By:** K.S./P.S.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL -0.03 / VL -0.1 / L -0.3 / M -1 / H -3 / VH -10 / EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
					START CORING AT 4.23m					
100% RETURN		117	5		SHALE: grey and dark grey.	DW	M			(4.31m) J, 90°, P, S (4.34m) XWS, 0°, 36 mm.t (4.43m) Cr, 0°, 35 mm.t (5.01m) XWS, 0°, 43 mm.t (5.16m) XWS, 0°, 143 mm.t
		116	6							(5.46m) Be, 0°, P, S (5.59m) XWS, 0°, 70 mm.t (5.76m) XWS, 0°, 13 mm.t (5.86m) XWS, 0°, 8 mm.t (6.04m) XWS, 0°, 18 mm.t (6.14m) XWS, 0°, 9 mm.t (6.31m) J, 80°, P, S (6.44m) Be, 0°, P, S (6.61m) XWS, 0°, 35 mm.t
		115	7				L - M			(6.73m) XWS, 0°, 42 mm.t (7.02m) Be, 0°, P, S
					END OF BOREHOLE AT 7.14 m					
		114	8							
		113	9							
		112	10							
		111								


JK Geotechnics
299905 BH4 START CORING AT 4·23m
4
5
6
7
END OF BH4 AT 7·14m

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 5
1 / 1

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~117 m
Date: 8/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low to medium plasticity, dark brown, with roots.				
					N = 11 4,5,6	116	1		CL-CH	SILTY CLAY: medium to high plasticity, light grey mottled red brown, with fine to coarse grained ironstone gravel.	MC~PL	VSt - H	420 400 340	RESIDUAL
					N = 27 5,8,19	115	2			SHALE: brown.	XW	H EL	470 520	
						114	3				DW	VL - L		LOW 'TC' BIT RESISTANCE
						113	4							
						112	5			END OF BOREHOLE AT 4.50 m				
						111	6							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 6
1 / 1

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~120 m
Date: 8/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low plasticity, dark brown.				
									CL-CH	SILTY CLAY: medium to high plasticity, grey mottled orange brown, with fine to coarse grained ironstone gravel.	MC~PL	St - VSt		RESIDUAL
					N = 9 3,4,5								190 270 290	
						119	1							
					N > 13 9,13/ 100mm REFUSAL									
						118	2			SHALE: grey, with iron indurated bands.		EL		
												VL		VERY LOW 'TC' BIT RESISTANCE
						117	3							
						116	4					L		LOW RESISTANCE
										END OF BOREHOLE AT 4.50 m				
						115	5							
						114	6							

JK_LIB_CURRENT - V8.00.GLB Log J & K AUGERHOLE - MASTER 29990S GLEDSWOOD HILLS.GPJ <<DrawingFile>> 01/06/2017 10:42 Produced by gINT Professional, Developed by Datgel

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 7
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BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~128 m
Date: 10/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low to medium plasticity, brown, with fine to coarse grained shale and sandstone gravel and concrete and tile fragments.				APPEARS MODERATELY TO WELL COMPACTED
					N = 9 4,5,4	127	1							
					N = 22 7,11,11									
ON COMPLETION OF CORING						126	2		CL-CH	SILTY CLAY: medium to high plasticity, orange brown and red brown, with fine to coarse grained ironstone and shale gravel.	MC~PL	VSt - H		RESIDUAL
AFTER 3 HRS					N = 12 5,6,6	125	3						420 380	
										SILTY CLAY: medium to high plasticity, light grey mottled orange brown.	MC<PL			
						124	4							
					N = 25 4,11,14					SILTY CLAY: medium to high plasticity, orange brown mottled light grey, with fine to coarse grained ironstone gravel, trace of ash.	MC<PL	H	530 420	
						123	5		-	SHALE: grey, with iron indurated bands.	DW	VL		VERY LOW 'TC' BIT RESISTANCE
						122	6							
										SHALE: grey, with iron indurated bands.				

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 7
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BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~128 m
Date: 10/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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
									-	SHALE: grey, with iron indurated bands. *(continued)*	DW	VL		VERY LOW 'TC' BIT RESISTANCE
						120	8			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 10.0m, MACHINE SLOTTED 50mm PVC STANDPIPE 7m TO 10m, CASING 0m TO 7m, 2mm SAND FILTER PACK 6.5m TO 10m, BENTONITE SEAL 5m TO 6.5m, BACKFILLED WITH SAND TO SURFACE AND COMPLETED WITH A CONCRETED GATIC COVER
						119	9							
						118	10							
						117	11							
						116	12							
						115	13							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

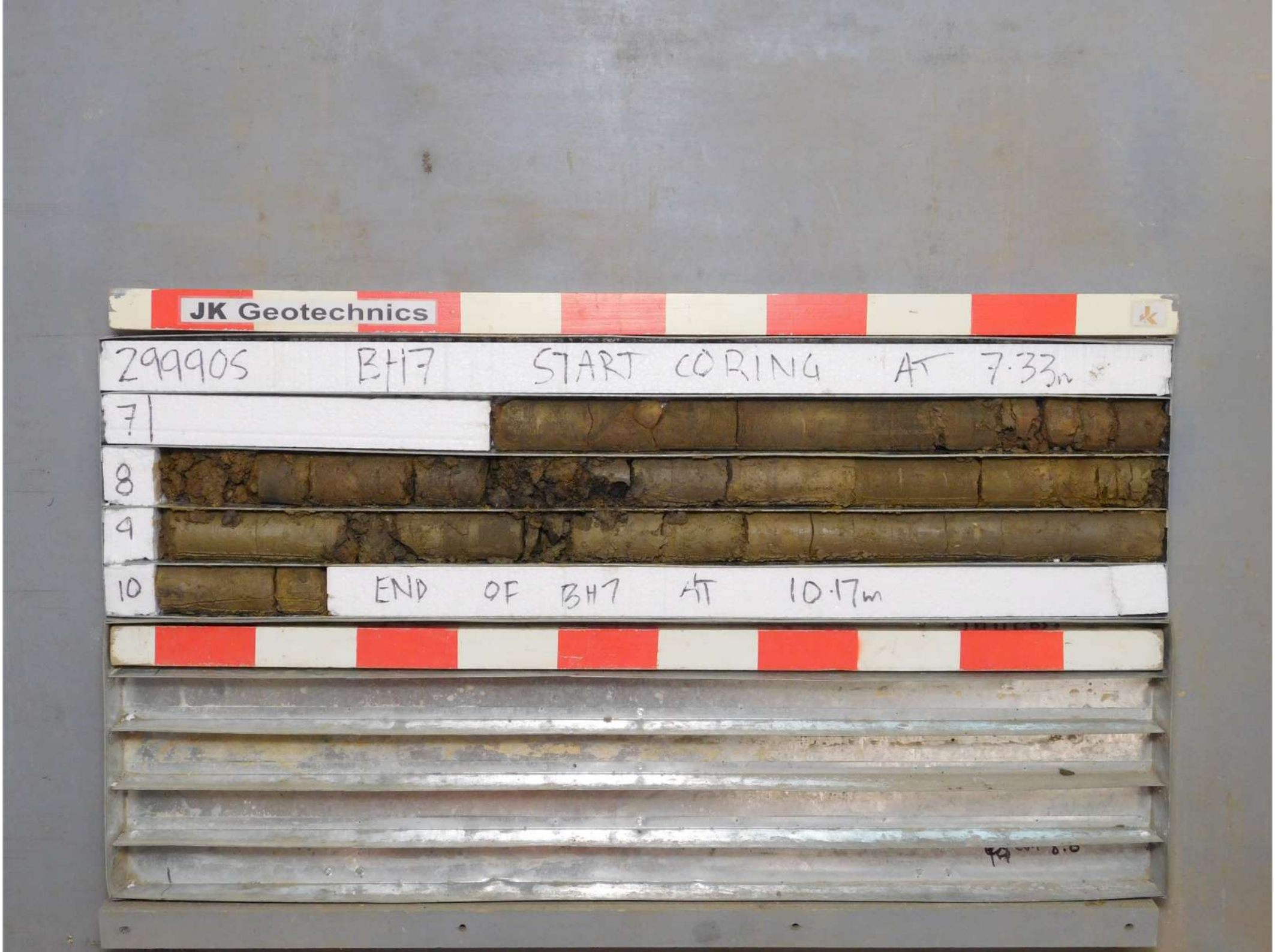
Borehole No. 7
3 / 3

CORED BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S | **Core Size:** NMLC | **R.L. Surface:** ~128 m
Date: 10/5/17 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK305 | **Bearing:** N/A | **Logged/Checked By:** K.S./P.S.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH	DEFECT DETAILS DEFECT SPACING (mm) 500, 300, 100, 50, 30, 10 DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
					START CORING AT 7.33m				
100% RETURN AFTER 3 WEEKS		120 119 118	8 9 10		SHALE: grey and brown, with iron indurated bands.	DW XW DW XW	L - M EL L EL		(7.48m) J, 20 - 50°, Un, S (7.58m) Be, 0°, P, S (7.77m) XWS, 0°, 9 mm.t (7.91m) XWS, 0°, 14 mm.t (7.93m) XWS, 0°, 22 mm.t (7.94m) XWS, 0°, 10 mm.t (8.00m) XWS, 0°, 109 mm.t (8.82m) Be, 0°, P, S
		117 116 115	11 12 13		END OF BOREHOLE AT 10.17 m				


JK Geotechnics
299905 BH7 START CORING AT 7.33m
7
8
9
10
END OF BH7 AT 10.17m

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
8
1 / 1

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~117.7 m
Date: 10/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty sandy clay, low plasticity, dark brown. with roots.	MC<PL			GRASS COVER APPEARS WELL COMPACTED
				■	N = 15 6,8,7	117	1							
	■			■	N = 8 4,3,5	116	2		CL-CH	SILTY CLAY: medium to high plasticity, grey mottled red brown. with fine to coarse grained ironstone gravel.	MC~PL	VSt	240 250 310	RESIDUAL
				■	N = 31 9,14,17	115	3					H	>600 >600	
				■		114	4			SHALE: grey, with iron indurated bands.	DW	VL - L		VERY LOW TO LOW 'TC' BIT RESISTANCE
						113	5			END OF BOREHOLE AT 4.50 m				
						112	6							
						111								

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
9
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BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~120.9 m
Date: 10/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low plasticity, dark brown. with roots.				GRASS COVER
									CL-CH	SILTY CLAY: medium to high plasticity, grey mottled orange brown.	MC~PL	VSt		RESIDUAL
					N = 7 3,3,4	120	1						290 320 370	
					N = 21 6,11,10	119	2					H	480 400 470	
										SHALE: grey, with iron indurated bands.	DW	VL		VERY LOW 'TC' BIT RESISTANCE
						118	3					VL - L		VERY LOW TO LOW RESISTANCE
						117	4					L		LOW TO MODERATE RESISTANCE
										END OF BOREHOLE AT 4.50 m				
						116	5							
						115	6							
						114								

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 10
1 / 1

BOREHOLE LOG

Client: WOOLACOTTS
Project: PROPOSED GLEDSWOOD HILLS PUBLIC SCHOOL
Location: HERMITAGE WAY, GLEDSWOOD HILLS, NSW

Job No.: 29990S **Method:** SPIRAL AUGER **R.L. Surface:** ~126.9 m
Date: 10/5/17 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** K.S./P.S.

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										FILL: Silty clay, low to medium plasticity, brown. with fine to coarse grained sandstone and shale gravel and concrete fragments.				APPEARS WELL COMPACTED
					N = 15 6,9,6	126	1		CL-CH	SILTY CLAY: medium to high plasticity, orange brown, with root fibres.	MC<PL	H	>600 >600	RESIDUAL
					N > 23 17,23/ 100mm REFUSAL	125	2			SILTY CLAY: medium to high plasticity, light grey and yellow brown.				TOO FRIABLE FOR HP TESTING
										SHALE: brown.	DW	VL - L		LOW 'TC' BIT RESISTANCE
						124	3							
												L		LOW TO MODERATE RESISTANCE
						123	4							
										END OF BOREHOLE AT 4.50 m				
						122	5							
						121	6							
						120								

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