



**REPORT**

**TO**  
**DESIGNINC SYDNEY PTY LTD**

**ON**  
**GEOTECHNICAL INVESTIGATION**

**FOR**  
**NEW ULTIMO PYRMONT PUBLIC SCHOOL**

**AT**  
**ULTIMO PUBLIC SCHOOL,**  
**QUARRY ROAD, ULTIMO, NSW**

**16 May 2017**  
**Ref: 30361SBprt**



**JK Geotechnics**  
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

**PO Box 976, North Ryde BC NSW 1670**  
Tel: 02 9888 5000 Fax: 02 9888 5001  
[www.jkgeotechnics.com.au](http://www.jkgeotechnics.com.au)

Jeffery & Katauskas Pty Ltd, trading as  
JK Geotechnics ABN 17 003 550 801



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Report prepared by:

**Daniel Bliss**  
Senior Associate | Geotechnical Engineer

Report reviewed by:

**Paul Stubbs**  
Principal I Geotechnical Engineer

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

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## **1 INTRODUCTION**

This report presents the results of a geotechnical investigation for the new Ultimo Pymont Public School at Quarry Street, Ultimo, NSW. The location of the site is shown in Figure 1. The investigation was commissioned by Mr Sandeep Amin of DesignInc Sydney Pty Ltd and was carried out in accordance with our proposal dated 22 March 2017, Ref: P44487Brev1.

From the supplied architectural drawings by DesignInc Sydney Pty Ltd (Project No: S15124, Drawing Nos: DA-2301 to DA-2306, DA-3001, DA-3002, DA-4001 and DA-4002, Revision 1, dated 16/12/16) the existing school will be completely demolished and a new school constructed, which will extend to all site boundaries. The new development will step up the hillside and will be formed at three main floor levels of RL4.5m at the western end, RL11.7m within the central portion and RL15.3m at the eastern end. However, a lower parking area is proposed within the north-western corner at RL2.9m. To achieve these levels excavation will be required to maximum depths of about 6m at the eastern edge of each step in level. At the western end of each level the proposed level will be up to about 2m higher than the exiting surface, but it is unknown if fill will be placed or a void left below the lowest floor slabs.

The purpose of the investigation was to obtain geotechnical information on subsurface conditions at eight nominated locations and use that together with the results of previous geotechnical investigations as a basis for comments and recommendations on excavation, retention and footings.

This geotechnical investigation was carried out in conjunction with an environmental site assessment by our specialist division, Environmental Investigation Services (EIS). Reference should be made to the separate report by EIS, Ref: E30361KHrpt, for the results of the environmental site assessment.

## **2 PREVIOUS GEOTECHNICAL INVESTIGATION**

We have been provided with a copy of a preliminary geotechnical investigation carried out at the site by the NSW Public Works. The results of that preliminary investigation are provided within Report No. 15-GS94A, dated 26 October 2015. The report collates investigations carried out by NSW Public Works in 2001 and 2015. The results of each investigation are summarised below and have been used in preparing sections through the site as shown on Figures 3 to 8. The locations of the previous boreholes are shown on Figure 2.



### ***2001 Investigation***

The 2001 investigation involved the drilling of boreholes B1 to B6 using an Explorer drilling rig to depths ranging from 4.0m to 8.1m and boreholes HA1 to HA8 using a hand auger to refusal at depths ranging from 0.3m to 0.85m. The boreholes encountered fill comprising a combination of clayey sand and sandy clay with various inclusions such as gravel, cobbles, glass, bricks and a suspected boulder in one borehole. Based on the testing carried out in the rig drilled boreholes the fill was assessed to be of variable compaction. All of the hand auger drilled boreholes (HA1 to HA8) and B4 to B6 refused within the fill.

In B1, B2 and B3 sandstone was encountered at depths of 5.3m, 3.75m and 7.6m, respectively. The sandstone was assessed to be of very low to low strength and the boreholes were terminated shortly after encountering the sandstone.

No groundwater was encountered within these boreholes.

Due to the shallow refusal the results of boreholes HA1 to HA8 these have not be used within the sections that have prepared for this report.

### ***2015 Investigation***

The 2015 investigation involved the drilling of boreholes B1 to B6 using a Geoprobe rig to depths ranging from 3.0m to 7.5m. These boreholes encountered fill to depths ranging from 2.5m to 7.3m, which again was variable containing both sands and clays and inclusions such as gravel, bricks, glass and bitumen. Again, the fill was assessed to be of variable compaction.

Natural soils were encountered in some boreholes and comprised sand, silty clayey sand and silty sand. The sandy soils were assessed to be of loose or medium dense relative density.

Sandstone was encountered in all boreholes at depths ranging from 2.9m to 7.3m and was assessed to be of very low strength, but all boreholes were terminated a few hundred millimetres into the sandstone.

Groundwater was encountered within B4 to B6 at the western end of the site at depths ranging from 2.4m to 2.9m. No groundwater was encountered within B1 to B3 at the eastern end of the site.



### **3 CURRENT INVESTIGATION PROCEDURE**

The current investigation comprised the drilling of boreholes BH1 to BH8 using our track mounted JK205 drilling rig. The boreholes were initially auger drilled to depths ranging from 3.76m to 8.30m below the existing ground surface and were then continued by diamond coring techniques using an NMLC core barrel with water flush to total depths ranging from 6.90m to 13.31m.

The borehole locations, as shown in Figure 2, were set out as close as possible to the locations nominated by Taylor Thomson Whitting, but the final locations were dictated by access for the rig and the presence of buried services. The approximate surface levels, as shown on the borehole logs, were estimated by interpolation between spot levels and contours shown on the supplied survey plan by NSW Public Works (Ref: 57345, Sheet No. 1, dated 7/9/15). The datum of the levels is Australian Height Datum (AHD).

The apparent compaction of the fill and the relative density of the natural sandy soils was assessed from Standard Penetration Test (SPT) 'N' values. Within the augered portions of the boreholes, the strength of the underlying sandstone was assessed by observation of the drilling resistance of a Tungsten Carbide (TC) bit attached to the augers, together with inspection of the recovered rock chips. The strength of the cored sandstone was assessed with reference to point load strength index ( $I_{s50}$ ) test results. The results of the point load strength index tests are summarised in the attached STS Table A and on the cored borehole logs.

Groundwater observations were made during and on completion of auger drilling. The use of water for core drilling limited further meaningful measurements of groundwater levels. No longer-term monitoring of groundwater levels was carried out.

Our geotechnical engineer, Mr Michael Serra, set out the borehole locations, nominated sampling and testing locations, and prepared logs of the subsurface strata encountered. The borehole logs are attached to this report, together with colour photographs of the rock core and a set of explanatory 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, for testing to determine point load strength index values, pH, sulphate contents, chloride contents and resistivity. The results of the laboratory testing are summarised in the attached STS Table A and Envirolab Certificate of Analysis 165481. Samples



were also collected from the boreholes for testing as part of the environmental site assessment by EIS.

## **4 RESULTS OF INVESTIGATION**

### **4.1 Site Description**

The site is located on the side of a hillside that slopes down towards the west at about 10°, with the base of the hill at Wattle Street at the western end of the site. Wentworth Park lies on the western side of Wattle Street and is relatively flat. The site is bound by three streets, with Jones Street to the east, Quarry Street to the north and Wattle Street to the west.

The site is entirely occupied by the existing Ultimo Public School. The site is made up of three main relatively flat terraces. The upper, eastern level is a synthetic surfaced 'playground' area, with several large trees around the perimeter and a mulch covered garden area at the southern end. A brick retaining wall is located along the eastern boundary and this wall supports the footpath of Jones Street. The wall has a maximum height of about 1.7m and contains some horizontal and stepped cracking and horizontal displacement up to 15mm.

The middle level of the school contains a two and three storey brick building at the northern end and a single storey brick amenities building at the southern end. Between these buildings is a concrete paved sports court. At the eastern end of the northern building is a concrete retaining wall about 1.5m from the building. However, access between the building and the wall was not possible. The wall retains the upper level of the school and seems to be about 5m in height. To the east of the concrete paved sports court and the single storey building is a batter sloping down from the upper level at about 20°, with a concrete retaining wall at the base of the batter of about 1.2m in height. To the west of the concrete paved sports court and the single storey building is a series of terraced gardens supported by masonry block walls of about 1.1m to 1.6m in height. These walls appeared to be in good condition. At the base of these terraces is the lowest level of the school.

The lowest, western level of the school contains an asphaltic concrete (AC) paved car park accessed via Wattle Street, a three storey brick building covering the entire eastern portion of this level, and a single storey demountable building near the north-western corner of the site. These buildings appeared to be in good external condition.

The existing pavement surfaces within the site generally appeared to be in good condition.



The changes in level along the Quarry Street frontage are supported by brick retaining walls up to about 3.5m in height. A ramp leading to a pedestrian bridge over Wattle Street is located within the north-western corner of the site along the Quarry Street frontage.

The properties to the south of the site contain a series of multi-level apartment buildings, set back about 1.1m to 3.4m from the common boundary. Inspection of the conditions along the southern boundary were limited, but it appears that the adjoining property also steps down the hillside slope via a series of terraces that are both above and below the levels within the subject site. The differences in level between the subject site and the adjoining property appear to be supported by retaining walls.

#### **4.2 Subsurface Conditions**

Reference to the Sydney 1:100,000 Geological Series Sheet indicates that the site is underlain by fill and alluvial soils overlying Hawkesbury Sandstone. The area is also shown to contain several dykes running approximately north-west to south-east through the sandstone. In summary, the boreholes encountered fill with some natural sandy soils and then sandstone bedrock generally of good quality. Further comments on the subsurface conditions encountered are provided below. Sections through the site summarising the borehole information, both the current and previous boreholes, are presented as Figure 3 to 8.

#### ***Pavements and Surfacing***

Different pavements were encountered within each of the three areas of the site. In BH1 and BH2, within the lowest level, asphaltic concrete was encountered of 30mm thick, underlain by silty sand and gravelly sand fill to depths of 0.4m and 0.5m. This silty sand and gravelly sand fill would be the base and subbase layers of the pavement, evidenced by the igneous gravel within the fill.

In BH3 to BH5, within the central level, concrete was initially encountered of 80mm to 180mm thick, but there was no obvious roadbase layer below the concrete.

In BH6 to BH8, with the upper level, a synthetic surfacing was initially encountered of 10mm to 15mm thick. In BH6 and BH7, a sandy gravel fill was encountered below the surfacing to depths of 0.15m and 0.3m, respectively. In BH8, the surfacing was underlain by concrete of 120mm thick and then fill to a depth of 0.7m where a second concrete layer of 300mm thick was encountered. During drilling there were indications that a void may be present below this lower concrete, but given the depth this could not be confirmed within the small diameter borehole.



### ***Fill***

Fill was encountered in all boreholes similar to that encountered within the previous 2001 and 2015 boreholes. In BH1 and BH2, at the western end of the site, the fill extended to depths of 2.2m and 1.5m, but within the remaining boreholes the fill extended to greater depths ranging from 3.8m to 8.1m.

The fill predominately comprised silty sand, with varying proportions of gravel (igneous, sandstone, ironstone), clay, brick fragments, slag and ash. In BH6 and BH7, some sandstone cobbles appeared to be present within the fill. A layer of silty clay fill was encountered within BH3. Based on the SPT 'N' values, the fill was assessed to be variably compacted, but mostly poorly compacted, with some moderately and well compacted layers.

### ***Natural Soils***

What appeared to be natural soils were encountered within BH1 to BH3, but the upper layers of this may comprise fill. No natural soils were encountered within BH4 to BH8. In BH1 and BH2, clayey sand and silty sand were encountered, which were generally of very loose or loose relative density, with some medium dense clayey sand in BH1. In BH3, sandy clay was encountered and was assessed to be of medium to high plasticity and soft to firm strength, based on a tactile assessment.

### ***Weathered Sandstone Bedrock***

Weathered sandstone bedrock was encountered in all boreholes at depths ranging from 3.3m to 8.1m. The surface of the sandstone steps down towards the west and north-west down the hillside slope. We expect that this surface would comprise a series of steps or buried cliff lines, but the exact location of each cliff line is not known. On first contact the sandstone was predominately distinctly weathered and of low to medium strength, but within BH1, extremely weathered sandstone of extremely low strength was encountered within the upper layers.

The sandstone was cored from just below first contact and the cored sandstone was assessed to generally be slightly weathered and of medium or high strength. However, in BH1 a zone of core loss was experienced at a depth of 9.01m and was 1.08m thick. This core loss is likely to represent a poor quality rock layer or could even indicate the presence of a volcanic lens that has weathered to soil like properties. Defects within the cored sandstone were generally widely spaced and comprised extremely low strength seams, clays seams, sub-horizontal bedding partings and joints inclined at up to 90°.



## **Groundwater**

Groundwater seepage was encountered during auger drilling in BH1, BH2 and BH3 at depths of 2.2m, 2.5m and 7.6m, respectively. On completion of auger drilling groundwater was measured within these boreholes at depths of 2.2m, 2.5m and 8.2m, respectively. No groundwater was observed within the remaining boreholes during or on completion of auger drilling.

### **4.3 Laboratory Test Results**

The point load strength index test results on the recovered rock core showed reasonably good correlation with our field assessments of rock strength. The Unconfined Compressive Strength (UCS) of the sandstone, estimated from the point load strength index test results, generally ranged from 6MPa to 44MPa, with some results of 1MPa to 4MPa and one result of 72MPa.

The pH values of the samples tested ranged from 6.8 to 8.4, indicating neutral to alkaline conditions. The sulphate contents generally ranged from 78mg/kg to 99mg/kg with one result of 7,400mg/kg, the chloride contents ranged from <10mg/kg to 20mg/kg and the resistivity values generally ranged from 64ohm.m to 110ohm.m with one result of 5.2ohm.m. Based on these results most of the samples tested would be classified as 'non-aggressive' exposure classification for both concrete and steel piles in accordance with Tables 6.4.2(C) and 6.5.2(C) of AS2159-2009 'Piling – Design and Installation'. However, the sample from BH3 at a depth of 1.5m to 1.95m would be classified as 'mild' exposure classification for concrete piles and 'moderate' exposure classification for steel piles in accordance with AS2159-2009.

## **5 COMMENTS AND RECOMMENDATIONS**

### **5.1 Geotechnical Issues**

Based on the results of this geotechnical investigation the main geotechnical issues for the proposed development are summarised below. Further comments on these issues are provided within the following sections of this report.

- Care must be taken during demolition that support is maintained to the surrounding footpaths and the development to the south. Several retaining walls are present on the site boundaries and must be maintained or additional support provided during demolition. A detailed work program and methods may be required detailing how the walls are to be demolished while maintaining support. The structural engineer may not be able to assess this until some buildings are demolished where access to the existing walls is currently not possible.



- The site is underlain by several metres of variability compacted sandy fill. Although such material will be able to be excavated using conventional equipment, some difficulties may be experienced if large obstructions are present within the fill.
- The sandy fill will not be self-supporting and would need to be formed at suitable temporary batters or full depth retention systems installed prior to the start of excavation.
- The existing fill is of variable compaction and since we are unaware of any records of placement or compaction control it must be considered 'uncontrolled'. Therefore, the fill is not considered suitable for support of footings or floor slabs. All structures, including floor slabs, will need to be supported on piles founded within the underlying sandstone bedrock. Where playgrounds or courtyards are proposed between the proposed buildings, the required surfacing may be supported on the fill provided the risk of future settlement of the fill and the potential for increased maintenance is accepted. To allow the use of footings or floor slabs supported on the fill all of the uncontrolled fill would need to be fully excavated and replaced within controlled, engineered fill, but such works are not considered practical given the depth of the fill.
- Difficulties may be experienced during pile drilling due to the potential for obstructions within the fill and the risk of collapse of the sandy fill if open pier holes were attempted.
- The area is known to contain dykes and the present of such features may affect the piles supporting the proposed structures.

## **5.2 Demolition and Adjoining Properties**

Since the site has been formed into three flat areas, various retaining walls are present both within the site and along the site boundaries. Therefore, the demolition works must be carefully planned and scheduled so that support of the adjoining properties is maintained. Similarly, it may be easier to leave the existing retaining walls within the site in place until the new walls have been constructed to avoid creation of temporary batters, stockpiling of material and subsequent backfilling.

The support required will vary depending on the nature and location of the existing walls and the design levels required within each area of the site. Some walls may be able to be left in place where levels are to remain the same, or for others new retaining walls may need to be built either behind or in front of the existing walls prior to demolition. Specific structural advice should be obtained on support of existing walls, including any temporary propping or anchoring required to allow demolition of buildings or existing walls. The demolition plan should be approved by the structural engineer prior to the start of work. Some of the existing retaining walls may not be able to be assessed until demolition of some buildings and this must be taken into account in determining the demolition program.



Prior to the start of demolition and excavation we recommend that dilapidation surveys be carried out on the adjoining developments to the south. The dilapidation surveys should comprise detailed inspections of the adjoining properties, both externally and internally, with all defects rigorously described, i.e. defect location, defect type, crack width, crack length, etc. The respective owners of the adjoining properties should be asked to confirm that the dilapidation reports represent a fair record of actual conditions. The preparation of the dilapidation reports will help to guard against opportunistic claims for damage that was present prior to the start of demolition and excavation.

### **5.3 Excavation and Groundwater**

Excavation to the required maximum depths of about 6m will encounter predominantly sandy fill, but within the south-eastern corner of the excavation for the proposed floor level at RL4.5m (near BH4) sandstone bedrock may be encountered. However, we expect that sandstone will only be encountered for a small area, if at all.

Excavation of the soils will be achievable using conventional excavation equipment, such as the buckets of hydraulic excavators. Any sandstone of extremely low strength, if encountered, may also be able to be excavated using such equipment.

Excavation of the sandstone of low or higher strength will require assistance with rock excavation equipment, such as hydraulic rock hammers, rotary grinders, ripping hooks or rock saws. However, given the expected limited extent of rock excavation and the likely location close to the southern boundary of the site we do not recommend the use of hydraulic rock hammers due to the risk of damage to the adjoining structures from the vibrations generated by such equipment. Our preference would be to use equipment that results in much less vibrations, such as rotary grinders, ripping hooks and rock saws.

If rock hammers were used they should be limited in size and the vibrations transmitted to the adjoining structures quantitatively monitored at all times during rock hammer use. The vibration monitors should be attached to flashing warning lights, or other suitable warning devices, so that the operator can cease work once acceptable limits have been reached. Reference should be made to the attached Vibration Emission Design Goals sheet for acceptable limits of transmitted vibrations. Where the vibrations are excessive it would be necessary to change to alternative excavation equipment, which is our preference as recommended above.

Groundwater seepage was only encountered within BH1 to BH3 where it was below the depth of the proposed excavation. Therefore, the proposed development will be above the standing



groundwater table and dewatering during excavation or design for hydrostatic pressures will not be required. However, some seepage may occur, particular during and following rainfall, as water flows down the hillside slope, which may emerge through the fill or at the soil/rock interface where sandstone is encountered. Some trapped or perched water may also be present within the fill, but this would drain quickly once released. Allowance should be made for some seepage into the excavation during construction and in the long term, drainage should be allowed for behind all retaining walls to direct seepage into the piped stormwater system and prevent development of hydrostatic pressures.

#### **5.4 Earthworks and Filling**

The proposed floor levels will be above the existing ground surface at the western end of each level. This may be accommodated by the placement of fill or a void could be left below suspended floor slabs.

Since the existing fill is uncontrolled and of variable compaction it is not suitable for support of floor slabs and fully suspended slabs will be required. Therefore, where additional fill is required even if this fill was placed as controlled engineered fill it would still be underlain by uncontrolled fill requiring the use of suspended floor slabs. We recommend that where additional fill is to be placed below the floor slabs that it be placed as 'form fill' with nominal compaction so that it can support the floor slabs while they are poured. The fill should still be compacted, but strict control of the density of the fill would not be required.

The excavated sandy fill may be reused as form fill and should preferably be compacted to a density of at least 95% of its Standard Maximum Dry Density (SMDD). Prior to placement of any fill any existing pavements or vegetation and root affected soils within garden beds should be removed and the base rolled to improve the surface compaction.

Where external playgrounds or courtyards are proposed the subgrade preparation and earthworks will depend on the risk that can be accepted for settlement of the fill and the allowance for future maintenance. This will depend on what surfacing is proposed, as a greater risk may be acceptable where grass is proposed as topping up depressions would be possible. Where rigid paving is proposed maintenance would be more involved and costly.

The existing fill is variably compacted and may continue to settle over time, which will not be uniform due to the variable depth and quality of the fill. If the risk of such settlement affecting the



playgrounds or courtyards cannot be accepted then these would need to be designed as fully suspended slabs supported on piles founded within the sandstone bedrock.

As the fill has almost certainly been in place for some time, comprises mostly sandy soils and is not generally underlain by soft clays, the risk of long term settlement of the fill affecting pavements above would not be great. This is evidence by the relatively good condition of the exiting pavement surfaces. Nevertheless, where pavements are to be cast on grade we recommend that some subgrade improvement works be carried out to reduce the risk of settlement. A bridging layer of good quality granular fill should be placed to below these areas should be at least 0.3m to 0.5m thick. Following excavation to the underside of the bridging layer the 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 within the presence of a geotechnical engineer to detect any weak subgrade areas. The aim of the proof rolling is also to improve the compaction of the upper fill layers.

The need for treatment of any weak subgrade areas detected during proof rolling should be assessed by the geotechnical engineer taking into account the bridging layer that will be placed over the subgrade. Where poor conditions are encountered the geotechnical engineer may recommend an increased thickness of the bridging layer or the placement of a geogrid layer towards the base of the granular bridging layer.

The bridging layer should comprise good quality granular material, such as ripped or crushed sandstone or recycled roadbase. Such material should be compacted in maximum 300mm loose thickness layers to a density of at least 98% of SMDD.

## **5.5 Retention**

Given the changes in level required, we recommend that retention systems be installed prior to the start of excavation as temporary batters would not be practical. However, temporary batters could be used within the north-western corner of the site where excavations are limited.

### **5.5.1 Batters and Low Height Retaining Walls**

Temporary batters of no more than 3m in height should be no steeper than 1 Vertical in 1.5 Horizontal (1V:1.5H). 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, which are unlikely to be required, of no more than 3m in height 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. 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.

Where batters can be used and retaining walls constructed at the base of the batters such walls may be designed based on a triangular earth pressure distribution using an active earth pressure coefficient,  $K_a$ , of 0.33 and a bulk unit weight of  $20\text{kN/m}^3$  where some resulting ground movements will be tolerable. Where movements are to be kept low, or walls are restrained from some lateral movement by other structural elements in front of the wall, an 'at rest' earth pressure coefficient,  $K_0$ , of 0.6 should be used.

The above coefficients assume horizontal backfill surfaces and where inclined backfill is proposed the coefficients 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.

Where temporary 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. Reference should be made to the comments given in Section 5.3 on filling and the compaction specifications that should be adopted.

### **5.5.2 Sandstone Cut Faces**

If sandstone is encountered within the deeper excavations, such as near BH4, it would be suitable for vertical unsupported excavation based on the cored sandstone recovered. However, this must be confirmed by regular inspections of the sandstone by a geotechnical engineer. Such inspections should be carried out at depth intervals of no more than 1.5m in order to check for inclined joints or weak seams that require additional support.

Additional support may comprise rockbolts or shotcrete and mesh and must be installed as directed by the geotechnical engineer prior to further excavation.



### 5.5.3 Piled Retaining Walls

Where temporary batters cannot be accommodated, which we expect will be for the majority of the site, the excavations should be supported by full depth retention systems installed prior to the start of excavation or removal of existing retaining walls. Such retention systems may comprise contiguous pile retaining walls.

Bored piers would not be suitable for the walls as the sandy fill would almost certainly collapse. Auger, grout injected (CFA) piles would be appropriate for this site. The piles should be founded within the sandstone below the base of the proposed excavation. If sandstone is encountered above the base of the proposed excavation the piles could be terminated within sandstone of at least medium strength, provided the sandstone is inspected as recommended within Section 5.5.2 and additional lateral support of the pile toes is provided, such as by anchoring the toes.

Temporary lateral support of the retaining walls would be provided by external anchors or internal props, with each anchor or prop installed progressively as each restraining point is uncovered. We assume that permanent lateral support would be provided by the buildings within the excavation, but if this is not possible then permanent anchors would be required. Permission will need to be obtained from the owners of adjoining properties prior to the installation of anchors below their properties. Such permission can take some time to obtain and we recommend it be sought early to allow time for negotiation. The presence of any basements within adjoining properties and buried services behind the walls should be considered during design of the anchors and the structures generally.

Propped or anchored walls may be designed based on a rectangular earth pressure distribution of  $6H$  kPa (where  $H$  is the retained height in metres) where some resulting ground movements are tolerable and existing structures and movement sensitive services are not located within a horizontal distance of  $2H$  from the wall. Where structures and services are located within  $2H$  of the wall, a rectangular earth pressure distribution of  $8H$  kPa should be used.

These lateral pressure assume horizontal backfill and any inclined backfill would need to be 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.

We understand that the proposed retaining walls may be designed using Wallap, but Plaxis may also be used to analyse the walls sections. We have found that design using such software can



result in more economical designed than adoption of the above rectangular earth pressure distributions. Such analysis must only be undertaken by designers who have a thorough knowledge of the soil-structure interaction effects, such as when soil/wall friction is and is not appropriate, and where water balancing at the toe should be adopted. We can assist in completing such analysis if required. The following parameters may be used for analysis, provided the designer carries out sensitivity checks on the parameters as part of the design. The rock parameters are for intact rock only, and appropriate defects must be accounted for in the design. Wallap does not model joints as such and it is therefore necessary to mimic the effect of joints in the input parameters. One conservative approach in the rock would be to model all rock materials as extremely low to very low strength sandstone thereby ignoring the effect of the joints, but with a sensitivity analysis case where the sandstone toe socket is assigned parameters for medium to high strength sandstone.

<b>Material</b>	<b>Bulk Unit Weight (kN/m<sup>3</sup>)</b>	<b>Drained Cohesion (kPa)</b>	<b>Friction Angle (°)</b>	<b>Elastic Modulus (MPa)</b>
Fill	18	0	28	6
Natural Soils	20	0	28	6
Extremely Low to Very Low Strength Sandstone	22	5	30	100
Low Strength Sandstone	23	50	35	500
Medium to High Strength Sandstone	24	1000	35	900
Bedding/Joints	Not applicable	0	25	50

Anchors should have their bond formed within the sandstone below a line drawn up at 45° from the base of the wall. Anchors should be designed with a minimum free length of 3m and a minimum bond length of 3m. Preliminary design of the anchors may be based on an allowable bond stress of 200kPa for sandstone of low strength or 400kPa for sandstone of medium or higher 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 design 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 completed on a design and construct basis in order to avoid contractual disputes if the anchors fail to hold their test loads.



## 5.6 Footings

Since the existing fill is uncontrolled and of variable compaction the only competent founding strata at this site is the sandstone bedrock. Therefore, all footings should be founded within the sandstone. In addition, as detailed above all floor slabs should be designed as fully suspended slabs supported on the piled footing system.

For the majority, if not all, of the site piles will be required to reach the sandstone. However, within the deepest excavations, such as near BH4, sandstone may be exposed or be at shallow depths allowing the use of pad or strip footings. Bored piers would not be suitable due to the risk of collapse of the sandy fill and the presence of groundwater at the western end of the site, and auger, grout injected (CFA) piles will be appropriate.

Generally the sandstone encountered was of medium to high strength with few defects, but some low strength sandstone was encountered in BH4 and a section of core loss was experienced in BH1. The site is located within an area that is known to contain dykes and this core loss section may be a lens or offshoot of a dyke that has weathered to soil-like material. In addition, the surface of the sandstone is likely to comprise a series of steps or buried cliff lines and care must be taken that piles are not founded on the edge of these steps. Due to these factors we recommend that footings founded within the sandstone be designed based on an allowable bearing pressure of 1500kPa provided the footings are founded within sandstone of at least low strength.

Where piles are drilled they should be socketed at least 0.5m into the sandstone to reduce the risk of piles being located at the top of steps within the sandstone surface. All pile drilling should be inspected by a geotechnical engineer and where it is considered that piles may be located at the crest of the step in the sandstone deeper drilling or additional subsurface investigations may be required by the geotechnical engineer.

An allowable shaft adhesions of 150kPa for piles in compression and 75kPa for piles in tension, may be used for design below the 0.5m nominal socket and provided socket roughness and cleanliness is maintained.

Higher bearing pressures would be appropriate within sandstone of medium or high strength, of say 3500kPa. However, where such higher bearing pressures are required additional cored boreholes should be drilled at the actual pile locations to confirm that consistent good quality rock is present and determine the founding depth of the piles. For example, in BH1, piles would need



to be founded below the core loss zone to achieve such a bearing pressure even though sandstone of medium strength was initially encountered.

The above allowable bearing pressures are based on a serviceability limit state of settlement of no more than 1% of the footing width or pile diameter.

Footings may also be designed using limit state analysis procedures based on ultimate bearing pressures and ultimate shaft adhesion values, which may be taken as 4000kPa and 300kPa, respectively, for sandstone of at least low strength. Ultimate values must be used in conjunction with an appropriate load factors and geotechnical reduction factors in accordance with AS2159-2009, which will need to be assessed by the designer depending on the design and proving methods adopted. The use of ultimate values will result in higher settlements and therefore specific analysis of the pile settlements must be carried out to confirm that it is consistent with the required structural performance. Such analysis may be based on an elastic modulus of the low strength sandstone of 250kPa.

Based on the subsurface conditions encountered, the site would be classified for earthquake design as Class C<sub>e</sub> in accordance with Section 4 of AS1170.4-2007. Since the site is located within the Sydney region, a Hazard Factor of 0.08 would be appropriate in accordance with Table 3.2 of AS1170.4-2007.

## **6 GENERAL COMMENTS**

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. 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.

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.

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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**TABLE A**  
**POINT LOAD STRENGTH INDEX TEST REPORT**

<b>Client:</b>	JK Geotechnics	<b>Ref No:</b>	30361SB
<b>Project:</b>	Proposed Redevelopment of Ultimo Public School	<b>Report:</b>	A
<b>Location:</b>	Ultimo Public School, Quarry Road, Ultimo, NSW	<b>Report Date:</b>	21/04/2017
		<b>Page 1 of 3</b>	

BOREHOLE NUMBER	DEPTH m	$I_s(60)$	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH
		MPa	(MPa)
1	7.44-7.48	0.3	6
	7.74-7.78	0.5	10
	8.20-8.24	0.9	18
	8.68-8.72	0.8	16
	10.22-10.27	0.3	6
	10.68-10.72	1.3	26
	11.19-11.23	1.1	22
	11.66-11.71	1.6	32
	12.28-12.32	1.4	28
	12.75-12.78	0.8	16
2	13.17-13.21	1.9	38
	3.82-3.86	0.5	10
	4.22-4.26	0.6	12
	4.69-4.74	0.7	14
	5.22-5.26	1.3	26
	5.71-5.75	1.0	20
	6.19-6.23	1.1	22
3	6.68-6.72	1.0	20
	8.35-8.39	1.4	28
	8.75-8.78	1.0	20
	9.24-9.27	1.3	26
	9.70-9.72	1.3	26
	10.12-10.16	1.2	24
	10.57-10.61	1.1	22
11.11-11.14	1.1	22	

**NOTES: See Page 3 of 3**

**TABLE A**  
**POINT LOAD STRENGTH INDEX TEST REPORT**

<b>Client:</b>	JK Geotechnics	<b>Ref No:</b>	30361SB
<b>Project:</b>	Proposed Redevelopment of Ultimo Public School	<b>Report:</b>	A
<b>Location:</b>	Ultimo Public School, Quarry Road, Ultimo, NSW	<b>Report Date:</b>	21/04/2017
		<b>Page 2 of 3</b>	

BOREHOLE NUMBER	DEPTH m	$I_{s(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH
			(MPa)
4	4.39-4.43	0.06	1
	4.88-4.92	0.3	6
	5.19-5.23	0.2	4
	5.68-5.72	0.1	2
	6.20-6.24	0.1	2
	6.75-6.79	0.7	14
	7.17-7.21	0.3	6
5	3.96-4.00	3.6	72
	4.25-4.28	1.3	26
	4.73-4.76	1.5	30
	5.31-5.35	1.2	24
	5.76-5.80	0.7	14
	6.16-6.20	1.4	28
	6.66-6.70	2.0	40
6	8.35-8.38	0.9	18
	8.75-8.79	1.5	30
	9.14-9.18	2.2	44
	9.62-9.66	1.8	36
	10.15-10.18	1.8	36
	10.60-10.63	1.4	28
	11.16-11.20	2.2	44
7	8.08-8.12	1.3	26
	8.56-8.60	1.6	32
	9.13-9.17	0.6	12
	9.53-9.56	2.0	40
	10.07-10.11	2.1	42

**NOTES: See Page 3 of 3**

**TABLE A**  
**POINT LOAD STRENGTH INDEX TEST REPORT**

<b>Client:</b>	JK Geotechnics	<b>Ref No:</b>	30361SB
<b>Project:</b>	Proposed Redevelopment of Ultimo Public School	<b>Report:</b>	A
<b>Location:</b>	Ultimo Public School, Quarry Road, Ultimo, NSW	<b>Report Date:</b>	21/04/2017
		<b>Page 3 of 3</b>	

BOREHOLE NUMBER	DEPTH m	$I_{S(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH
			(MPa)
7	10.51-10.55	2.2	44
	10.85-10.89	1.7	34
8	6.32-6.36	1.0	20
	6.70-6.74	1.2	24
	7.11-7.15	1.1	22
	7.59-7.63	2.0	40
	8.12-8.15	1.2	24
	8.55-8.58	1.6	32
	9.02-9.07	0.7	14

**NOTES:**

- In the above table testing was completed in the Axial direction.
- The above strength tests were completed at the 'as received' moisture content.
- Test Method: RMS T223.
- 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
- 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](mailto:sydney@envirolab.com.au)  
[envirolab.com.au](http://envirolab.com.au)

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

## CERTIFICATE OF ANALYSIS

165481

### **Client:**

**JK Geotechnics**  
PO Box 976  
North Ryde BC  
NSW 1670

**Attention:** M Serra

### **Sample log in details:**

Your Reference:	<b>30361SB, Ultimo</b>
No. of samples:	5 Soils
Date samples received / completed instructions received	19/04/17 / 19/04/17

### **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: 27/04/17 / 27/04/17  
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

Envirolab Reference: 165481  
Revision No: R 00



Misc Inorg - Soil						
Our Reference:	UNITS	165481-1	165481-2	165481-3	165481-4	165481-5
Your Reference	-----	BH1	BH1	BH3	BH6	BH7
	-					
Depth	-----	0.5-0.95	3.0-3.45	1.5-1.95	0.5-0.95	1.5-1.95
Date Sampled		12/04/2017	12/04/2017	10/04/2017	12/04/2017	11/04/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/04/2017	21/04/2017	21/04/2017	21/04/2017	21/04/2017
Date analysed	-	21/04/2017	21/04/2017	21/04/2017	21/04/2017	21/04/2017
pH 1:5 soil:water	pH Units	7.2	6.8	7.5	8.4	8.4
Chloride, Cl 1:5 soil:water	mg/kg	20	20	<10	<10	20
Sulphate, SO4 1:5 soil:water	mg/kg	78	83	7,400	99	89
Resistivity in soil*	ohmm	94	110	5.2	85	64

MethodID	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 Analyser.
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.

**Client Reference: 30361SB, Ultimo**

QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Misc Inorg - Soil						Base II Duplicate II %RPD		
Date prepared	-			20/04/2017	165481-1	21/04/2017    21/04/2017	LCS-1	20/04/2017
Date analysed	-			20/04/2017	165481-1	21/04/2017    21/04/2017	LCS-1	20/04/2017
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	165481-1	7.2    7.3    RPD: 1	LCS-1	101%
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	165481-1	20    29    RPD: 37	LCS-1	96%
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	165481-1	78    99    RPD: 24	LCS-1	109%
Resistivity in soil*	ohmm	1	Inorg-002	<1.0	165481-1	94    76    RPD: 21	[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  
NR: Test not required  
<: Less than

PQL: Practical Quantitation Limit  
RPD: Relative Percent Difference  
>: Greater than

NT: Not tested  
NA: Test not required  
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.



**Borehole No.**  
**1**  
 1 / 3

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~3.9 m  
**Date:** 12/4/17 TO 13/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
									ASPHALTIC CONCRETE: 30mm.t	D			ROADBASE	
					N = 15 5,8,7	3	1		FILL: Silty sand, fine to medium grained, brown, with fine grained igneous gravel.				APPEARS MODERATELY TO WELL COMPACTED	
									as above, but dark grey, with fine to medium grained igneous and sandstone gravel.					
									as above, but dark grey and orange brown.					
					N = 8 4,5,3	2	2		FILL: Clayey sand, fine to medium grained, light grey mottled red and yellow brown, trace of fine to medium grained ironstone gravel.	M				
									CLAYEY SAND: fine to medium grained, grey.	W	VL		ALLUVIAL	
					N = 2 3,1,1	1	3		as above, but with bands of clayey silt.					
									as above, but grey and grey brown,		MD			
					N = 12 4,7,5	-1	5		CLAYEY SAND: fine to medium grained, yellow brown mottled red brown and grey brown.					
					N=SPT 3/ 20mm REFUSAL	-2	6		SANDSTONE: fine to medium grained, light grey and yellow brown.	DW	L - M		LOW TO MODERATE 'TC' BIT RESISTANCE	
										XW	EL		SOIL RESISTANCE	
						-3								

JK\_LIB\_CURRENT - V8.00.GLB Log J & K AUGERHOLE - MASTER 30361SB ULTIMO.GPJ <-DrawingFile>> 11/05/2017 14:22 Produced by gINT Professional. Developed by Datgel



**Borehole No.**  
**1**  
 2 / 3

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~3.9 m  
**Date:** 12/4/17 TO 13/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
										SANDSTONE: fine to medium grained, light grey and yellow brown. <i>(continued)</i>	XW	EL		
										REFER TO CORED BOREHOLE LOG				
						-4	8							
						-5	9							
						-6	10							
						-7	11							
						-8	12							
						-9	13							
						-10								

JK\_LIB\_CURRENT - V8.00.GLB Log J & K AUGERHOLE - MASTER 30361SB ULTIMO.GPJ <-DrawingFile>- 11/05/2017 14:22 Produced by gINT Professional. Developed by Datgel



**Borehole No.**  
**1**  
 3 / 3

# CORED BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Core Size:** NMLC      **R.L. Surface:** ~3.9 m  
**Date:** 12/4/17 TO 13/4/17      **Inclination:** VERTICAL      **Datum:** AHD  
**Plant Type:** JK205      **Bearing:** N/A      **Logged/Checked By:** M.S./D.B.

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 <sub>s</sub> (50)	DEFECT DETAILS	
									DEFECT SPACING (mm)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating.
					START CORING AT 7.34m					
			4	[Dotted pattern]	SANDSTONE: fine to medium grained, light grey, with dark grey laminae, bedded at 0-10°, with quartz inclusions.	SW	M	[Strength scale]	[Defect spacing scale]	(7.65m) XWS, 0°, 15 mm.t
		8	as above, but orange brown mottled light grey, with dark grey laminae, bedded at 10-20°.		(7.81m) J, 35°, P					
			9		CORE LOSS 1.08m					(8.11m) Be, 20°, P, R
			10							(8.80m) Be, 0°, P, R
			11	[Dotted pattern]	SANDSTONE: fine to medium grained, yellow brown and brown mottled light grey, bedded at 10-25°, with quartz inclusions.	XW DW - SW	EL M H	[Strength scale]	[Defect spacing scale]	(8.95m) J, 35°, P, R
		12			(8.96m) J, 80°, P, R					
			13							(10.32m) J, 80°, Un
			14							(10.50m) XWS, 30°, 5 mm.t
			15							(10.90m) J, 90°, Un
			16							(10.97m) Be, 20°, P, R
			17							(11.93m) Be, 0°, P, R
			18							(11.94m) J, 85°, P, R
			19							(12.82m) XWS, 0°, 70 mm.t
			20							(13.21m) J, 75°, P, R
					END OF BOREHOLE AT 13.31 m					

JK\_LIB\_CURRENT - V8.00.GLB Log J & K CORED BOREHOLE - MASTER 30361SB ULTIMO.GPJ <<DrawingFiles>> 11/05/2017 14:22 Produced by gINT Professional. Developed by Datgel

JOB NO: 303615B

BH1

START CORING AT: 7.34m

7

8

9

CORE LOSS: 1.08m

10

11

12

13

FINISH AT 13.31m



**Borehole No.**  
**2**  
 1 / 2

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~4 m  
**Date:** 13/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
ON COMPLETION OF AUGERING ON COMPLETION OF CORING					N = 17 11,11,6	3	1		-	ASPHALTIC CONCRETE: 30mm.t FILL: Silty sand, fine to medium grained, brown, with fine to medium grained igneous gravel. FILL: Gravelly sand, fine to coarse grained, fine to coarse grained, dark grey. FILL: Silty sand, fine to coarse grained, green grey, with fine to medium grained igneous gravel, trace of clay and slag.	M			ROAD BASE  APPEARS WELL COMPACTED
					N = 5 5,3,2	2	2		SC	CLAYEY SAND: fine to coarse grained, light grey mottled red and yellow brown.	M	L		POSSIBLY FILL
					N > 2 0,2/ 120mm REFUSAL	1	3		SM	SILTY SAND: fine to medium grained, grey and dark red brown, trace of fine to medium grained ironstone gravel.	W	VL		ALLUVIAL
						0	4			SANDSTONE: fine to medium grained, yellow brown, with XW bands. as above, but yellow brown and light grey.	DW	L - M		LOW TO MODERATE 'TC' BIT RESISTANCE  HIGH RESISTANCE
						-1	5							
						-2	6			REFER TO CORED BOREHOLE LOG				

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**Borehole No.**  
**2**  
 2 / 2

# CORED BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Core Size:** NMLC      **R.L. Surface:** ~4 m  
**Date:** 13/4/17      **Inclination:** VERTICAL      **Datum:** AHD  
**Plant Type:** JK205      **Bearing:** N/A      **Logged/Checked By:** M.S./D.B.

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 <sub>s</sub> (50)	DEFECT DETAILS	
									DEFECT SPACING (mm)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating.
					START CORING AT 3.76m					
			0		SANDSTONE: fine to medium grained, yellow brown and light grey.	SW	M			(4.04m) J, 10°, P, R
			-1		as above, but light grey mottled yellow brown, with dark grey laminae, bedded at 0-10°.		H			(4.77m) Be, 5°, P, R
			-2		as above, but light grey mottled yellow brown, with dark grey lenses.	FR				(5.62m) Be, 0°, P, R
			-3		END OF BOREHOLE AT 6.90 m					
			-4							
			-5							

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JOB NO: 303615B

BH2

START CORING AT: 3.76m

3

4

5

6

EOBH  
6.90m



**Borehole No.**  
**3**  
 1 / 3

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~10.4 m  
**Date:** 10/4/17 TO 11/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
						10			CONCRETE: 100mm.t					
					N > 15 12,15/ 100mm REFUSAL		1		FILL: Silty sand, fine to medium grained, dark brown, trace of fine to medium grained sandstone gravel.	M				APPEARS WELL COMPACTED
							9		FILL: Silty clay, medium plasticity, dark grey and brown, with fine to medium grained sand, fine to medium grained sandstone gravel, trace of slag and ash.	MC~PL				APPEARS POORLY COMPACTED
					N = 7 4,4,3		2		FILL: Silty sand, fine to medium grained, dark brown, with bands of silty clay, fine to medium grained sandstone and igneous gravel, trace of slag and ash.	M				
							8		as above,					
							3		but trace of clay, fine to coarse grained sandstone gravel, slag, ash and brick fragments.					
					N = 12 2,5,7		7		as above,					APPEARS MODERATELY COMPACTED
							4		but with fine to coarse grained sandstone gravel, fine grained slag gravel, ash and brick fragments.					
							6							
					N = 10 6,6,4		5							
							5							
							6							
					N = 9 3,3,6		4							

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**Borehole No.**  
**3**  
 2 / 3

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~10.4 m  
**Date:** 10/4/17 TO 11/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
ON COMPLETION OF AUGERING						3		-	FILL: Silty sand, fine to medium grained, dark brown, with sandstone gravel, slag gravel, ash and brick fragments.	M				
					N = 6 2,1,5	8		CL-CH	SANDY CLAY: medium to high plasticity, dark grey mottled red brown and yellow brown.	MC>PL	(S - F)			POSSIBLY FILL
						2			SANDSTONE: fine to medium grained, light grey mottled yellow brown.  REFER TO CORED BOREHOLE LOG	SW	M - H			HIGH 'TC' BIT RESISTANCE
						9								
						1								
						10								
						0								
						11								
						-1								
						12								
						-2								
						13								
						-3								

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**Borehole No.**  
**3**  
 3 / 3

# CORED BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Core Size:** NMLC      **R.L. Surface:** ~10.4 m  
**Date:** 10/4/17 TO 11/4/17      **Inclination:** VERTICAL      **Datum:** AHD  
**Plant Type:** JK205      **Bearing:** N/A      **Logged/Checked By:** M.S./D.B.

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 <sub>s</sub> (50)	DEFECT DETAILS	
									DEFECT SPACING (mm)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating.
					START CORING AT 8.22m					
		2			SANDSTONE: fine to medium grained, light grey, red and yellow brown, cross bedded at 0-15°, with quartz inclusions.	SW	H			(8.29m) Be, 0°, P, R
		9	as above, but light grey mottled red and yellow brown, with dark brown laminae, cross bedded at 10-20°.							
		10								
		0			SANDSTONE: fine to medium grained, light grey, with dark grey laminae, bedded at 5-15°.	FR				(10.23m) XWS, 5°, 5 mm.t
					END OF BOREHOLE AT 11.33 m					
		-1								
			12							
		-2								
			13							
		-3								
			14							
		-4								

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JOB NO: 30361SB

BH 3

START CORING AT: 8.22m

8

9

10

11

FINISH AT 11.33m



**Borehole No.**  
**4**  
 1 / 2

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~10.3 m  
**Date:** 10/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
DRY ON COMPLETION OF AUGERING						10			CONCRETE: 80mm.t	M			8mm DIA. REINFORCEMENT, 45mm TOP COVER	
					N = 17 4,7,10	1		FILL: Silty sand, fine to coarse grained, yellow brown, trace of fine to medium grained sandstone gravel and root fibres.	APPEARS WELL COMPACTED					
					N = 7 2,3,4	9		as above, but brown, dark brown mottled red and yellow brown, with medium to coarse grained sandstone gravel and fine to medium grained igneous gravel.						
					N = 3 2,2,1	7		as above, but dark brown.	APPEARS POORLY COMPACTED					
						8								
						6			SANDSTONE: fine to medium grained, light brown.	DW	L		LOW TO MODERATE 'TC' BIT RESISTANCE	
						6				SW	M - H		HIGH RESISTANCE	
						5			REFER TO CORED BOREHOLE LOG					
						5								
						6								
						4								

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**Borehole No.**  
**4**  
 2 / 2

# CORED BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Core Size:** NMLC      **R.L. Surface:** ~10.3 m  
**Date:** 10/4/17      **Inclination:** VERTICAL      **Datum:** AHD  
**Plant Type:** JK205      **Bearing:** N/A      **Logged/Checked By:** M.S./D.B.

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 <sub>s</sub> (50)	DEFECT DETAILS	
									DEFECT SPACING (mm)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating.
					START CORING AT 4.29m					
			6		SANDSTONE: fine to coarse grained, light grey mottled yellow and dark red brown, bedded at 0-15°.	SW	L	●	■	— (4.36m) Be, 0°, P, R
			5	M			— (4.53m) Be, 15°, P, R			
			5		as above, but light grey, with dark brown laminae mottled yellow brown, bedded at 10-20°.	FR	L	●	■	— (5.59m) Be, 15°, P, R
			6				— (5.79m) XWS, 15°, 3 mm.t			
			7	M						
			3		END OF BOREHOLE AT 7.32 m					— (7.25m) XWS, 5°, 2 mm.t
			8							
			2							
			9							
			1							
			10							
			0							

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JOB NO: 30361SB

BH 4

START CORING AT: 4.29m

4

5

6

7

FINISH AT 7.32m



**Borehole No.**  
**5**  
 1 / 2

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~10.6 m  
**Date:** 10/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
DRY ON COMPLETION OF AUGERING 										CONCRETE: 180mm.t				
					N = 22 9,13,9	10			-	FILL: Silty sand, fine to medium grained, dark brown, with fine to medium grained igneous gravel, trace of fine to coarse grained sandstone gravel and slag.	M			APPEARS WELL COMPACTED
					N = 8 3,4,4	9			-	as above, but trace of ash.				APPEARS POORLY COMPACTED
					N = 16 3,7,9	7			-	as above, but trace of clay.				APPEARS MODERATELY COMPACTED
						4			-	SANDSTONE: fine to medium grained, dark red brown.	DW	M - H		HIGH 'TC' BIT RESISTANCE
						6				REFER TO CORED BOREHOLE LOG				

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**Borehole No.**  
**5**  
 2 / 2

# CORED BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Core Size:** NMLC      **R.L. Surface:** ~10.6 m  
**Date:** 10/4/17      **Inclination:** VERTICAL      **Datum:** AHD  
**Plant Type:** JK205      **Bearing:** N/A      **Logged/Checked By:** M.S./D.B.

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 <sub>s</sub> (50)	DEFECT DETAILS	
									DEFECT SPACING (mm)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating.
			7		START CORING AT 3.94m					
			4		SANDSTONE: fine to medium grained, dark red brown, with quartz inclusions.	DW	H			(4.98m) J, 80°, Un, R  (5.63m) XWS, 5°, 2 mm.t (5.83m) XWS, 15°, 2 mm.t  (6.80m) Be, 5°, P, R
		6	as above, but yellow brown mottled red brown and light grey.							
		5	as above, but light grey, with dark brown laminae and yellow brown bands, bedded at 0-15°.		SW	M				
		4	as above, but yellow brown and light grey mottled red brown, bedded at 5-20°.			H				
			7		END OF BOREHOLE AT 6.98 m					

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JOB NO: 30361SB

BH5

START CORING AT: 3.94m

3

4

5

6

FINISH AT 6.98m



**Borehole No.**  
**6**  
 1 / 3

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~15.7 m  
**Date:** 12/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
DRY ON COMPLETION OF AUGERING  ON COMPLETION OF CORING						15.7	0		-	SYNTHETIC SURFACE: 15mm.t FILL: Sandy gravel, fine grained igneous, dark grey. FILL: Silty sand, fine to medium grained, dark brown. as above, but brown and grey, with fine to medium grained sandstone gravel, fine grained igneous gravel and slag.	M			APPEAR MODERATELY COMPACTED
					N = 13 5,7,6	15	1			as above, but trace of glass, brick and metal fragments.				
					N = 14 7,7,7	14	2			FILL: Silty sand, fine to medium grained, dark brown, trace of fine to coarse grained sandstone gravel, brick fragments, slag and ash.				
					N = 17 7,11,6	13	3			FILL: Silty sand, fine to medium grained, dark brown and grey, with fine to coarse gained igneous and sandstone gravel.				
					N = 14 8,8,6	12	4			as above, but with sandstone cobbles, trace of clay.				
					N = 17 7,9,8	11	5							
					9	6								

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**Borehole No.**  
**6**  
 2 / 3

# BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Method:** SPIRAL AUGER      **R.L. Surface:** ~15.7 m  
**Date:** 12/4/17      **Datum:** AHD  
**Plant Type:** JK205      **Logged/Checked By:** M.S./D.B.

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										
						8		-	FILL: Silty sand, fine to medium grained, dark brown and grey, with cobble sized igneous gravel, trace of clay.	M				
						8		-	SANDSTONE: fine to medium grained, light grey and yellow brown.	DW	M			MODERATE 'TC' BIT RESISTANCE
						7			REFER TO CORED BOREHOLE LOG					
						9								
						6								
						10								
						5								
						11								
						4								
						12								
						3								
						13								
						2								

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**Borehole No.**  
**6**  
 3 / 3

# CORED BOREHOLE LOG

**Client:** DESIGNINC SYDNEY PTY LTD  
**Project:** NEW ULTIMO PYRMONT PUBLIC SCHOOL  
**Location:** ULTIMO PUBLIC SCHOOL, QUARRY ROAD, ULTIMO, NSW

**Job No.:** 30361SB      **Core Size:** NMLC      **R.L. Surface:** ~15.7 m  
**Date:** 12/4/17      **Inclination:** VERTICAL      **Datum:** AHD  
**Plant Type:** JK205      **Bearing:** N/A      **Logged/Checked By:** M.S./D.B.

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 <sub>s</sub> (50)	DEFECT DETAILS		
									DEFECT SPACING (mm)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating.	
					START CORING AT 8.30m						
			7		SANDSTONE: fine to medium grained, light grey mottled yellow brown, with dark brown laminae, bedded at 0-15°, with quartz inclusions.	SW	M - H			(8.47m) XWS, 0°, 25 mm.t	
		9				H				(9.22m) Be, 0°, P, R	
		6			as above, but light grey and yellow brown.						(10.39m) J, 65°, P, R
		10									(11.00m) XWS, 5°, 20 mm.t
			11		END OF BOREHOLE AT 11.37 m						
			4								
			12								
			3								
			13								
			2								
			14								
			1								

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JOB NO: 30361SB

BH6

START CORING AT: 8.30m

8

9

10

11

FINISH AT 11.37m