POWERHOUSE PARRAMATTA
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX S
GEOTECHNICAL DESKTOP ASSESSMENT

JK Geotechnics

NSW GOVERNMENT

REPORT TO

INFRASTRUCTURE NSW

ON

GEOTECHNICAL DESKTOP ASSESSMENT

FOR

POWERHOUSE PARRAMATTA

AT

30B PHILLIP STREET, PARRAMATTA, NSW

Date: 22 April 2020
Ref: 33090ANrpt

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DOCUMENT REVISION RECORD

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33090ANrpt	Updated project details	22 April 2020

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ATTACHMENTS

1 INTRODUCTION

This report presents the results of a geotechnical desktop assessment for the proposed Powerhouse Parramatta project. The location of the site is shown in Figure 1. Our commission was on the basis of our proposal Ref. P51341AN (Stage 1) dated 2 March 2020.

We have been supplied with the following documents:

- Services Brief (Ref. IP1979) prepared by Infrastructure NSW;
- Geotechnical Investigation Brief (Ref. 200204 dated 13 February 2020) prepared by Arup;
- Architectural drawings (Dwg Nos. DA000[3], DA001[3], DA050[3], DA051[3], DA052[3], DA060[3], DA061[4], DA062[3], DA070[1], DA100[7], DA101[5], DA102[5], DA103[5], DA110[5], DA111[5], DA112[5], DA120[5], DA121[5], DA122[5], DA130[5], DA131[5], DA132[5], DA140[5], DA101[4], DA150[5], DA160[5], DA161[5], DA200[4], DA201[4], DA202[4], DA203[4], DA250[4], DA251[5], DA252[4], DA300[3], DA400[3], DA500[3], DA501[1], DA502[1], DA503[1], DA504[3] all dated 1 April 2020) prepared by Moreau Kusunoki and Genton.

From the above documents, we understand the proposed Powerhouse Museum development will comprise two separate towers linked by a bridge, one of about 75m height and one of about 55m height. A single level undercroft with a finished floor level at RL3.5m is proposed below the northern portion of the site, and excavation to a maximum depth of about 3m below existing surface levels is expected to be required. . Excavation will also be required for lift pits, stormwater detention structures, and for services. From the Arup brief, it is anticipated the buildings will be supported on piles to bedrock, and maximum pile working loads of about 25MN are anticipated. A floor loading of 20kPa is also anticipated for the ground floor slabs. We anticipate that on-grade pavements will also be required.

The purpose of the assessment was to review the subsurface information obtained from our previous geotechnical investigations completed on, and in the immediate vicinity of, the site, and to use this as a basis for providing preliminary comments and recommendations on geotechnical aspects of the proposed development, including site preparation, earthworks, retaining walls, footing design, external pavements, and the required additional geotechnical investigation.

2 PREVIOUS INVESTIGATIONS

JK Geotechnics (JKG) has completed two previous investigations on the subject site, as well as for the new apartment buildings immediately to the west of the site, and for the commercial building between the site and Phillip Street. Relevant borehole logs from our previous investigations are attached in Appendix A and their locations are shown on the attached Geotechnical Site Plan (Figure 2).

3 RESULTS OF ASSESSMENT

3.1 Site Description

A site visit was not completed as a part of this assessment. The site description below is based on site descriptions from our previous investigations, and a review of available Google Earth Pro imagery.

The site is located within gently sloping terrain on the southern bank of the Parramatta River and slopes down to the north at between about 2°and 5°. Wilde Avenue bounds the site to the east, and Phillip Street to the south.

At the time this report was prepared, the site contained a three level concrete framed carpark over the northern portion of the site, a single storey brick building in the centre of the site, and several one and two storey brick commercial buildings in the south-east corner of the site, along with driveways, several at-grade carparks, and landscaped areas. The existing structures and pavements on site were previously assessed to be in good condition based on cursory inspections.

Over the south-western portion of the site, an existing multi-storey commercial building with basement carparking was located between the site and Phillip Street.

To the west of the site were several properties, including a multi-storey residential apartment building with basement carparking, a single storey commercial building of brick construction, and a multi-storey hotel building with basement carparking.

At the southern end of the eastern boundary, Wilde Avenue was at grade, and about midway along the eastern boundary, transitioned to a bridge across the Parramatta River.

3.2 Subsurface Conditions

The 1:100,000 Geological Map of Sydney indicates the site is underlain by Ashfield Shale of the Wianamatta Group. However, the site is located close to the contact between the Ashfield Shale and the underlying Hawkesbury Sandstone.

The boreholes from our previous investigations disclosed a generalise subsurface profile, beneath existing pavements, comprising shallow to moderately deep fill over variable alluvial soils, then sandstone bedrock at shallow to moderate depths. Groundwater was encountered within the soil profile. For details of the encountered conditions, reference should be made to the borehole logs attached in Appendix A. A summary of the encountered conditions is presented below:

Pavements and Fill

Pavements comprising asphaltic concrete, concrete, and pavers were encountered from surface in BHA2, BHA3, BH1, BH3, BH106, BH110, BH201 and BH202. The asphaltic concrete ranged between 20mm (BH202) and 120mm (BHA2) thick, and the concrete was between 100mm (BH3) and 120mm (BHA3) thick.

In BH106 and BH110, pavers, mortar, and concrete with a total thickness of 245mm and 205mm, respectively, was encountered.

Fill comprising predominantly granular soils, but also clays and silts, was encountered from the surface or from beneath the pavements in all of the boreholes and extended to depths ranging from 0.3m (BH1 and BH3) to 2.65m (BHA2). The fill was assessed to be variably compacted. BH201 refused within the fill profile at a depth of 0.25m.

Alluvial Soils

Alluvial soils, predominantly comprising interlayered sands and clays, but with occasional silt and gravel layers, were encountered beneath the fill in all of the boreholes. The silts and clays were of stiff to hard strength in the upper profile, but decreased to very soft to firm strength with depth. The sands and gravels were predominantly of loose and medium dense relative density, but some very loose sands were also encountered. BH202 was terminated within the alluvial soil profile at a depth of 3.0m.

Sandstone Bedrock

Sandstone bedrock was encountered in all of the boreholes except BH201 and BH202, from depths between 3.3m (BH4) and 9.85m (BHA1). The sandstone was typically of very low and low strength on first contact, but in all boreholes improved to medium or high strength after less than 1m penetration. In the boreholes which were cored, relatively few defects were encountered within the cored lengths, and predominantly comprised sub-horizontal bedding partings and weathered seams. However, in both BH106 and BH108, core loss zones were encountered in the basal portion of the boreholes, likely representing more weathered material which was washed away during coring, and that more frequent defects were also encountered over the basal portions of these boreholes.

Groundwater

Groundwater seepage was encountered within the soil profile during drilling in all of the boreholes except BHA1 to BHA3 and BH201, at depths between 1.5m (BH4) and 6.0m (BH3). On completion of coring BH108, artesian pressures were encountered, with ground water discharging from the borehole at ground surface. This only occurred following the final run of coring and is likely to be due to a 'charged seam' within the bedrock profile. Between completion of drilling and up to about 2 weeks after the completion of drilling, standing water was measured within the boreholes at depths between 0m (BH108) and 6m (BH3).

3.3 Buried Services

From reference to available Dial Before You Dig information, obtained on 25 March 2020, a number of buried services cross the site, including high pressure gas, electricity, communications, and sewer. With regards to the sewer pipes, these include a 525mm diameter vitreous clay pipe running generally east-west close to Parramatta River, several 225mm diameter vitreous clay pipes running generally north-south below the site, and an abandoned pipe of unknown diameter running generally east-west below the centre of the site

From reference to 'The Excavation of a Brick Barrel-Drain at Parramatta, NSW' by Mr Edward Higginbotham (Australian Historical Archaeology, 1, 1983, pages 35-39), and the previous presence of a sinkhole beneath the multi-storey carpark on site, as investigated by JK Geotechnics in 2016, it is possible that a convict era brick lined barrel drain is present beneath the site, however, this has not been confirmed.

The approximate locations of the abandoned sewer and possible brick lined barrel drain are shown on Figure 2.

4 PRELIMINARY COMMENTS AND RECOMMENDATIONS

The comments and recommendations in the following sections of the report are preliminary in nature. These must be reviewed and updated as required following the completion of a detailed geotechnical investigation targeted for the proposed buildings, as detailed in Section 4.1 below.

Notwithstanding the above, based on the known subsurface conditions, we consider the site to be geotechnical suitable for the proposed development. We note that the site is subject to inundation during flood events.

4.1 Geotechnical Investigation

To confirm the subsurface conditions across the site and to allow for the optimisation of pile design parameters, we recommend the following geotechnical investigation be completed:

- Drilling of 8 boreholes, 4 for each of building. Boreholes to be spiral auger drilled through the soil profile, and rotary diamond core drilled through the bedrock profile, with at least 9m of diamond core drilling to be completed in each borehole.
- Groundwater monitoring wells to be installed in three boreholes, and groundwater levels monitored over the course of the investigation.
- Standard Penetration Tests (SPT) to be completed through the soil profile at no greater than 1.5m depth increments.
- Seismic Dilatometer Tests (SDMT) to be completed through the soil profile at no greater than 0.5m depth increments.
- Laboratory testing to include:
  - Moisture content tests;
  - Atterberg Limit and linear shrinkage tests;
  - Particle Size Distribution tests;
  - Soil and groundwater pH, sulfate/chloride content and resistivity tests;
  - Standard compaction and soaked CBR tests.
  - Point Load Strength Index tests; and
  - Unconfined Compressive Strength tests.

If further investigation is required to confirm the presence, or otherwise, of existing unmapped buried services e.g. the possible barrel drain, we also recommend that cross hole seismic tomography testing be

completed, with this targeted at specific locations. To facilitate such testing, additional boreholes and installation of casing would be required.

4.2 Geotechnical Design Considerations

The soil profile at the site is highly variable, and includes both poorly compacted fill and alluvial soils of limited strength/relative density. Given the anticipated, relatively high floor loads and expected limited capacity for differential settlement or tilt of the ground floor slabs, we consider the soils to be an unsuitable subgrade. We therefore recommend that the floor slab be fully suspended on piles founded in the sandstone bedrock profile.

Similarly, the building columns should also be supported on piles founded in the sandstone bedrock profile.

4.3 Dilapidation Surveys

Prior to any demolition or earthworks commencing, we recommend that detailed dilapidation reports be prepared for the adjoining properties to the south and west. The dilapidation surveys should comprise a detailed inspection both externally and internally, with all defects rigorously described, e.g. defect location, defect type, crack width, crack length, etc. and photographed. The respective property owners should be provided with a copy of the dilapidation reports and be asked to confirm that they present a fair representation of the existing conditions. We note that Council may also require dilapidation reports be prepared for adjoining Council assets (i.e. roads and footpaths).

Such reports can be used as a baseline against which to assess possible future claims for damage arising from the works.

4.4 Earthworks

The following recommendations are applicable for areas where external pavements are proposed. Where the buildings are proposed, as these are to be fully suspended, no particular site preparation would be required, other than removal of grass, shrubs, treed (including their root balls), topsoil and root affected soils.

The following comments and recommendations must be complemented by reference to AS3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments'.

4.4.1 Existing Fill

The existing fill was assessed to be poorly compacted in areas, and no documentation on the fill placement or compaction is available, and given the nature of the site, we anticipate the fill was most likely placed in an uncontrolled manner. As such, the fill cannot be considered to be an engineered fill, and may not be

suitable to support new pavements without subgrade improvement works as discussed in Section 4.4.4 below.

4.4.2 Site Drainage and Stripping

The clayey/silty fill and alluvial silts/clays at the site are expected to undergo substantial loss in strength when wet. Furthermore, the clays may have some shrink-swell reactive potential. Therefore, it is important to provide good and effective site drainage both during construction and for long-term site maintenance. The principle aim of the drainage is to promote run-off and reduce ponding. A poorly drained clay subgrade may become untraffickable when wet. The earthworks should be carefully planned and scheduled to maintain good cross-falls during construction.

Good surface and subsurface drainage must also be provided post construction to improve the long-term performance of the structures and pavements.

4.4.3 Site Preparation and Excavation

All grass, shrubs, trees (including their root balls), as well as topsoil and root affected soils must be stripped from the site.

Stripped topsoil/root affected soils must be stockpiled separately as they are considered unsuitable for reuse as engineered fill. They may however be reused for landscaping purposes, subject to approval by the environmental consultant.

Where required, excavation may then be carried out to achieve design subgrade levels. We have assumed a maximum depth of excavation of about 3m for the undercroft, lift pits and services. The required excavations are expected to encounter the soil profile only and can be readily completed using buckets fitted to hydraulic excavators and dozers.

Where space permits, temporary batter slopes through the soil profile appear feasible and should be cut no steeper than 1 Vetical (V) on 1.5 Horizontal (H) above the water table. Where temporary batters cannot be accommodated within the site geometry or where they will extend below groundwater, temporary shoring will be required along with temporary dewatering.

Any permanent batter slopes should be graded no steeper than 1V on 2.5H, provided the slopes are protected from erosion by quickly establishing a vegetative cover or by applying a reinforced shotcrete facing, together with surface drains along the crests of the batters to intercept surface water run-off. Where access for mowing etc. is required, permanent batters will likely need to be flattened to no steeper than 1V on 4H.

4.4.4 Subgrade Preparation

Following excavation to design levels, the exposed soil subgrade should be proof rolled with at least eight passes of a static (non-vibratory) smooth drum roller of at least 12 tonnes deadweight. The final passes of proof rolling should be witnessed by an experienced geotechnical engineer or earthworks superintendent for the detection of unstable or soft areas.

If soft or heaving areas are detected during proof rolling, then the heaving areas should be locally removed to a stable base and replaced with engineered fill, as outlined in Section 4.4.5 below, or further geotechnical advice should be sought. Further guidance on the treatment of heaving areas (e.g. subgrade improvement by provision of bridging layers) must be provided by the geotechnical engineer during or following the proof rolling inspection. Based on the investigation results, heaving may occur where under compacted existing fill is present, where the in-situ soil moisture content is elevated, where groundwater is at shallow depth below excavation levels, and/or where the alluvial soils of limited strength/relative density are present.

If soil softening occurs after rainfall, then the subgrade should be over-excavated to below the depth of moisture softening and replaced with engineered fill. Conversely, if a clayey subgrade exhibits shrinkage cracking, then the surface should be lightly watered and rolled until the shrinkage cracks are no longer evident.

4.4.5 Engineered Fill

Preferably, engineered fill should comprise an imported well graded granular material, e.g. crushed sandstone, with a maximum particle size not exceeding 75mm. Such materials are less susceptible to softening than clayey soils, and have reduced reactive movement to moisture content change. From a geotechnical perspective, the existing fill materials and alluvial soils, with the exception of any silts, are also considered suitable for reuse as engineered fill on condition that they are ‘clean’, free of organic matter and contain a maximum particle size not exceeding 75mm. Any other imported fill must be Virgin Excavated Natural Material (VENM) and have a maximum particle size not exceeding 75mm. Any excavated silts must be thoroughly blended with other materials at a ratio of no greater than 1 part silt to 3 parts other material prior to being used as engineered fill.

The abovementioned materials should be compacted in maximum 250mm thick loose layers using a large static (non-vibratory) roller to a density ratio of at least 98% of Standard Maximum Dry Density (SMDD) and within 2% of Standard Optimum Moisture Content (SOMC). The vibratory mode on the roller should not be used due to the potential for vibration induced damage to nearby building and for pumping of groundwater to the surface.

In order to achieve adequate compaction at the edge of fill platforms, the outer edge of each fill layer should extend a horizontal distance of at least 1m beyond the design geometry. The roller must extend over the edge of each placed layer in order to seal the batter surface. On completion of filling, the excess under-compacted edge fill should be trimmed back to the design geometry.

Backfilling of service trenches must be carried out using engineered fill in order to reduce post-construction settlements. Due to the reduced energy output of the compaction plant that can be placed in trenches, backfilling should be carried out in maximum 150mm thick loose layers and compacted using a trench roller, a pad foot roller attachment fitted to an excavator, and/or a vertical rammer compactor (also known as a 'Wacker Packer'). Due to the reduced loose layer thickness, the maximum particle size of the backfill material should also be reduced to no more than 50mm. The compaction specification provided above is applicable.

As for services trenches, retaining wall backfilling must also be carried out using engineered fill in order to reduce post-construction settlements. Compaction of the engineered backfill should be carried out using a trench roller or hand operated vertical rammer compactor for the lower layers and immediately behind the wall in the upper layers. Elsewhere a small static roller could be used. As per service trenches, backfilling should be carried out in 150mm thick loose layers and the maximum particle size of the backfill material should be reduced to no more than 50mm. The compaction specification provided above is applicable.

Compaction of engineered fill behind retaining walls is difficult and laborious. Consideration should be given to using a single sized hard, durable free draining aggregate, such as 'Blue Metal' or crushed concrete aggregate (free of fines), which do not require significant compactive effort. Such material should be nominally compacted using a hand operated vibrating plate (sled) compactor in maximum 200mm thick loose layers. A non-woven geotextile filter fabric such as Bidim A34 should be placed as a separation layer immediately above the cut batter slope (prior to backfilling) to control subsoil erosion into the aggregate. Provided the aggregate backfill is placed as recommended above, density testing would not be required in that material. The geotextile should then be wrapped over the surface of the aggregate backfill and capped with at least a 0.3m thick compacted layer of engineered fill, to reduce the potential for surface water infiltrating the retaining wall drainage.

In-situ density tests must be carried out on the engineered fill to confirm the above specification is achieved, as outlined below. The frequency of testing must be in accordance with the requirements of Table 8.1 of AS3798-2007, with due consideration given to lot sizes.

We recommend that Level 1 control of fill placement and compaction in accordance with AS3798-2007 be carried out, including for the trench and retaining wall backfill. Due to a potential conflict of interest, we strongly recommend that the geotechnical inspection and testing authority (GITA) be directly engaged by the Client or builder, and not by the earthworks contractor or sub-contractors.

4.4.6 Earthworks Testing Overview

The long-term successful performance of the proposed external 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. This should be detailed in the tender documents.

We also recommend that the GITA be requested to provide a summary of test results, including a test location plan, and daily site reports on a fortnightly basis for review by the Project Superintendent and/or JK Geotechnics. On completion of the earthworks, the GITA should be requested to provide a Level 1 'sign off' report for our review, including a statement that the fill has been placed and compacted in accordance with the specification.

4.5 Hydrogeology

As the site is flood prone, we recommend that all structures below design flood level be tanked, and designed to resist hydrostatic pressures, including uplift, equivalent to the design flood level. Reference should be made to the flood study completed by Parramatta Council.

The potential for seepage to occur into excavations will depend on the excavation depth below existing levels. Based on previously recorded groundwater levels, seepage is expected to be encountered below about 2m to 3m depth. If seepage is encountered, temporary dewatering will be required. Further advice on this will be provided following completion of the geotechnical investigation detailed in Section 4.1 above.

4.6 Retention

As well as proposed lift pits and stormwater detention tanks, retaining walls are also expected to be required for landscaping purposes.

The major consideration in the selection of earth pressures for the design of retaining walls is the need to limit deformations occurring outside the excavation. The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the design of temporary and permanent retention systems.

Free standing cantilever walls, where minor wall movements are tolerable, should be designed using a triangular lateral earth pressure distribution with an 'active' earth pressure coefficient (K_a) of 0.33 for the soil profile, assuming a horizontal retained/backfill surface.

Cantilever walls which will be propped or restrained by structures and subsequently backfilled, e.g. lift pits, or where wall movements are to be limited, should be designed using a triangular lateral earth pressure

distribution with an 'at rest' earth pressure coefficient, K_0, of 0.5 for the soil profile, assuming a horizontal retained/backfill surface.

A bulk unit weight of 20kN/m^3 should be adopted for the soil profile.

Any surcharge affecting the walls (e.g. traffic loading, construction loads, inclined backfill, adjacent high level footings, etc.) should be allowed for in the design using the appropriate earth pressure coefficient from above.

With the exception of the tanked structures, retaining walls should be designed as 'drained' and measures taken to provide permanent and effective drainage of the ground behind the walls. The subsoil drains should incorporate a non-woven geotextile fabric (e.g. Bidim A34) to act as a filter against subsoil erosion. As discussed in Section 4.5, tanked structures must be designed to resist hydrostatic pressures up to design flood level.

Lateral toe restraint of cantilever walls independent of the proposed buildings may be achieved by the passive resistance of the soil profile in front of the wall using a triangular lateral earth pressure distribution with a 'passive' earth pressure coefficient, K_P, of 2.8 for the existing fill. We note that significant movement is required in order to mobilise the full passive pressure of a soil, and therefore a factor of safety of at least 2 should be adopted to reduce such movements. Any localised excavations in front of the wall should be taken into account in the embedment design. Friction on the base of a wall can be calculated using a friction angle of 28˚ between the retaining wall base and the existing fill below, provided the base is clean, rough and dry when the retaining wall footing is poured.

4.7 Footing Design

As discussed in section 4.2 above, we recommend that the proposed buildings be uniformly supported on piles socketed into the underlying sandstone bedrock.

Piles socketed at least 0.3m into sandstone bedrock of consistent medium or greater strength may be tentatively designed based on an allowable end bearing pressure of 2,500kPa. For pile rock sockets longer than this 0.3m, allowable shaft adhesions of 250kPa in compression and 125kPa in tension (uplift) may be adopted provided the socket is satisfactorily cleaned and roughened.

Due to the high groundwater level and collapsing nature of the granular soils, conventional bored pile are considered inappropriate. Instead, either continuous flight auger (CFA) piles, or cased bored piles would be suitable for this site.

We note that higher end bearing pressures, in the order of 6MPa (allowable) and 40MPa (ultimate) will most likely be feasible for the competent bedrock, subject to the results of the recommended investigation. However, if the poorer quality bedrock encountered in the basal portions of BH106 and BH10-8 are consistent across the site, founding of the piles sufficiently above this strata i.e. at least 2 pile diameters above the strata, or piles founded below this strata, may be necessary.

If clayey fill or alluvial clays are present within 1.5m below the soffit of the ground floor slabs or ground beams, void formers will need to be incorporated to protect such elements against uplift pressures resulting from potential swelling of such soils. Such void formers should be suitable for swell movements of about 50mm. We therefore recommend that a 75mm cardboard void former be tentatively included in the design.

All piles should be inspected by a geotechnical engineer to confirm that an appropriate founding strata has been achieved. We note that for CFA piles, certification must be provided by the piling contractor.

Light weight, flexible structures, e.g. landscaping walls, light poles, etc. founded in the existing fill and/or alluvial soil profile could be considered. For such structures, an allowable bearing pressure of 50kPa can tentatively be adopted.

4.8 Pavements

For external pavements, provided the subgrade has been prepared in accordance with recommendations described in Section 4.4 above, a preliminary CBR value of 2% can be adopted for design.

Subgrade improvement comprising the placement and compaction imported crushed sandstone could be adopted to reduce the thickness of the granular and bound pavement layers. The thickness and quality of such a select layer, if adopted, should be taken into account in the pavement design.

We recommend that all basecourse materials for flexible pavements and sub-base materials for rigid pavements comprise DGB20 in accordance with RMS QA Specification 3051 unbound base. The DGB20 material should be compacted in maximum 200mm thick loose layers using a large smooth drum roller to at least 98% of Modified Maximum Dry Density (MMDD). Adequate moisture conditioning to within 2% of Modified Optimum Moisture Content (MOMC) should be provided during placement to reduce the potential for material breakdown.

We further recommend that all sub-base materials for flexible pavements comprise DGS40, DGS20 or DGB20 in accordance with RMS QA Specification 3051. The sub-base material should be compacted in maximum 200mm thick loose layers using a large smooth drum roller to at least 95% of MMDD. Again, adequate moisture conditioning to within 2% of MOMC should be provided during placement.

The final material and compaction specification must be determined by the pavement designer.

Density tests should be carried out on the granular pavement materials to confirm the above specifications are achieved. The frequency of density testing should be at least one test per layer per 1,000m^2, three tests per lot, or three tests per visit, whichever requires the most tests. Level 2 testing in accordance with AS3798-2007 would be considered acceptable for the pavement layers. The geotechnical testing authority (GTA) should be directly engaged by the Client or builder and not by the earthworks contractor or sub-contractors.

Subsoil drains should be provided below the perimeter of the proposed pavements, including any internal planters etc. with invert levels at least 200mm below design subgrade level. The drainage trenches 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.

4.9 Earthquake Design

In accordance with Table 4.1 of AS1170.4-2007 'Structural Design Actions – Earthquake Actions in Australia, the 'Hazard Design Factor (z) is 0.09 and the site subsoil class is 'Class De'.

4.10 Further Geotechnical Input

The following is a summary of the further geotechnical input which is required and which has been detailed in the preceding sections of this report:

- Completion of the geotechnical investigation detailed in Section 4.1;
- Proof rolling inspections;
- Density testing of all engineered fill, sub-base and base course materials; and
- Geotechnical inspection of pile drilling.

5 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.

This report provides preliminary advice on geotechnical aspects for the proposed civil and structural design. Contract Documents and Specifications should only be prepared based on the results of the recommended geotechnical investigation (Section 4.1).

A waste classification is required for any soil and/or bedrock excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM), General Solid, Restricted Solid or Hazardous Waste. Analysis can take up to seven to ten working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is

encountered, then substantial further testing (and associated delays) could be expected. We strongly recommend that this requirement is addressed prior to the commencement of excavation on site.

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

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title:	**SITE LOCATION PLAN**
Location:	30B PHILLIP STREET, PARRAMATTA, NSW
Report No:	33090AN
Figure:	1

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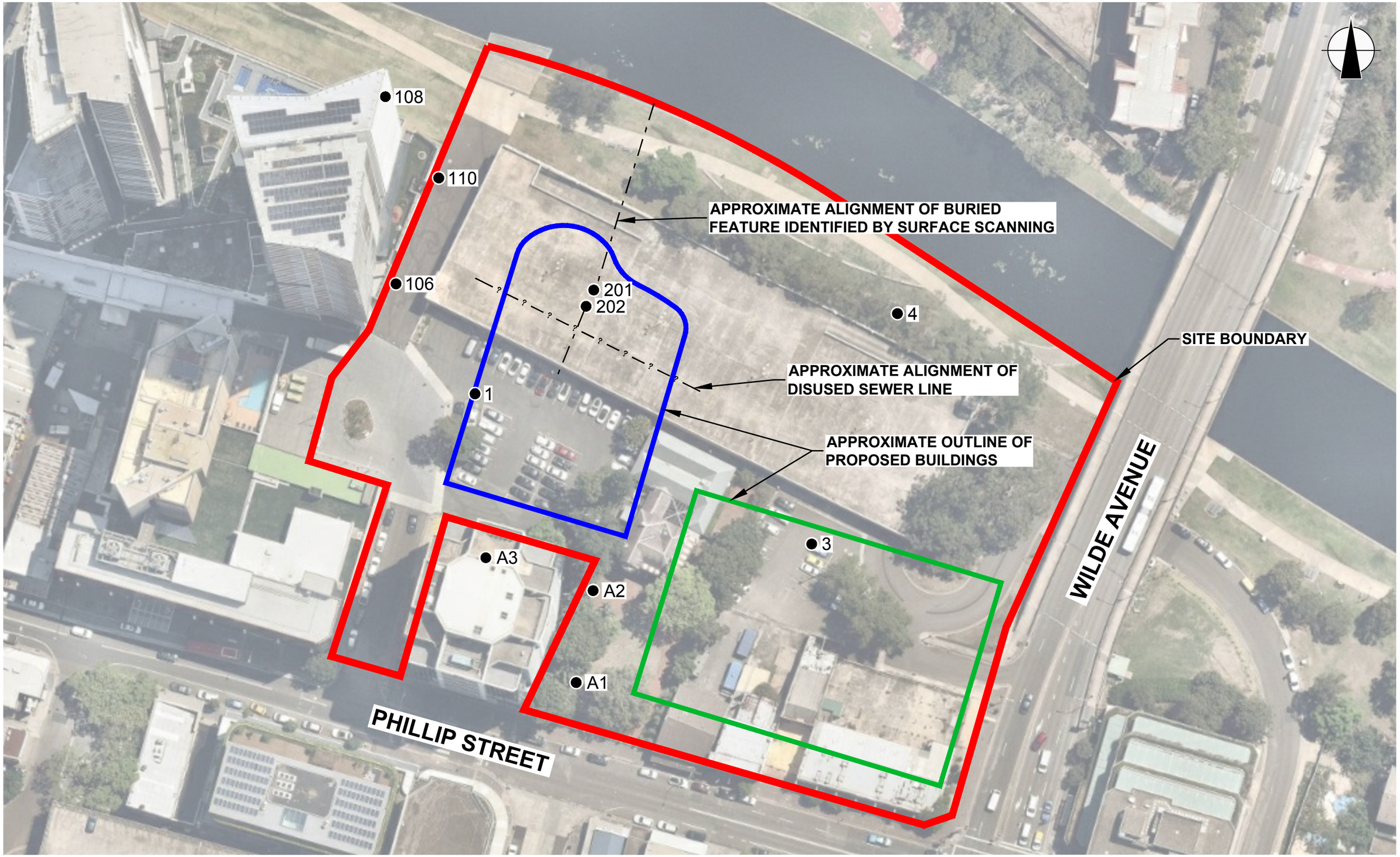
PLOT DATE: 15/04/2020 3:25:38 PM DWG FILE: Z:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\33000'S\33090AN PARRAMATTA\CAD\33090AN.DWG



LEGEND

● BOREHOLES FROM PREVIOUS JK GEOTECHNICS INVESTIGATIONS

0 8 16 24 32 40
SCALE 1:800 @A3 METRES

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

Title: **GEOTECHNICAL SITE PLAN**

Location: 30B PHILLIP STREET, PARAMATTA, NSW

Report No: 33090AN

Figure: 2

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PLOT DATE: 21/04/2020 2:50:37 PM DWG FILE: Z:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\33000'S\33090AN PARRAMATTA\CAD\33090AN.DWG

APPENDIX A

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. A1 1/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA. N.S.W

Job No. 5056 JS
Date: 11·5·87
Method: SPIRAL AUGER
G.C.H RIG
(HAND AUGER TO 1m.)

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
						FILL: topsoil, silty sand, fine grained, brown very loose				FILL
						FILL: sand, fine to medium grained, yellowish brown with clay lumps and sandstone gravel (ripped sandstone)	D	L		
	D.S.	N=9 3,4,5	1			FILL: silty sand, fine grained, brown with trace of root fibres and gravel			200 170 150	GRAVEL AT END OF SPT
			2			SILTY SAND: dark brown with some clay	D-M	L-MD		ALLUVIUM
	D.S.	N=13 2,5,8							380 350 360	
ON SPT AND AFTER 3hours			3		CH	CLAY: medium to high plasticity, brownish black with reddish brown laminations and trace of fine sand.	MC>PL	V.St		
	D.S.	N=15 7,6,9	4			as above, but becoming medium plasticity, whitish grey			360 330 350	
			5							
	D.S.	N=5 3,2,3			SM	SILTY SAND: fine to medium grained, yellowish brown	W	L		650mm
			6							
			7							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. A1 2/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA. N.S.W

Job No. 5056 JS
Date: 11·5·87
Method: SPIRAL AUGER G.C.H RIG (HAND AUGER TO 1m.)

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			7		SM	SILTY SAND: as above	W	L		200mm 200mm 20mm 50mm 60mm 100mm ESTIMATED 'V' BIT REFUSAL
			8							
			9							
			10 10·3m			SANDSTONE: fine to medium grained, moderately weathered, medium strong, light grey				MODERATE 'TC' BIT RESISTANCE
			11			(REFER TO CORED BOREHOLE LOG.)				
			12							
			13							

JEFFERY AND KATAUSKAS PTY. LTD.

CORED BOREHOLE LOG

Borehole No. A1 3/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA. N.S.W

Job No: 5056 JS
Date Drilled: 11·5·87
Drill Type: G.C.H. RIG.
Core Size: N.M.L.C.
Inclination: 90°
Bearing: —

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$ (EW VW W MS S VS ES)	DEFECT DETAILS: DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		10		START CORING AT 10.1m					
				SANDSTONE: fine to medium grained, light grey, laminated grey	MW	S			DEFECTS NOT DESCRIBED ARE NEAR HORIZONTAL BEDDING PARTINGS.
		11		Grading to medium to coarse grained, whitish grey, laminated grey	SW				CLAY SEAM 0,° 5mm
		12							CLAY SEAM 0°. 15mm
		12.9m							
		13		END OF BOREHOLE					
		14							
		15							
		16							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. A2 1/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA . N.S.W

Job No. 5056 JS
Date: 11·5·87
Method: SPIRAL AUGER G.C.H RIG (HAND AUGER TO 1m.)

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
						BITUMEN over ROADBASE				120mm
						FILL: sandy silt, reddish brown, fine grained sand.	D			FILL MODERATE COMPACTION
	D.S.	N=10 5,4,6	1						250 260 240	
			2			as above, but yellow brown, with clay lumps and trace of root fibres			240 340 360	
	D.S.	N=19 7,9,10			CL	SANDY CLAY: low plasticity, grey, mottled yellow brown, fine grained sand.	MC≒PL	V.St		ALLUVIUM
▼ ON SPT			3			as above, but low-medium plasticity, grey	MC>PL			
	D.S.	N>20 15,20/150mm	4		SM	SILTY SAND: fine to medium grained, orange brown	M-W	MD		
			5				W			160mm 200mm 50mm 40mm
			6							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. A2 2/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA . N.S.W

Job No. 5056 JS
Date: 11·5·87
Method: SPIRAL AUGER
G.C.H RIG
(HAND AUGER TO 1m.)

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			7		SM	SILTY SAND: as above as above, grading to medium to coarse grained, grey	W	(VL)		800mm
			8		CL	SANDY CLAY: low to medium plasticity, grey fine to medium grained, sand	MC>PL	(V.St)		0mm 10mm
			9							0mm ESTIMATED 'V' BIT REFUSAL
	D.S.					SANDSTONE: fine to medium grained, moderately weathered, medium strong, light grey				MODERATE 'TC' BIT RESISTANCE
			10			(REFER TO CORED BOREHOLE LOG.)				
			11							
			12							
			13							

JEFFERY AND KATAUSKAS PTY. LTD.

CORED BOREHOLE LOG

Borehole No. A2 3/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA. N.S.W

Job No: 5056 JS
Date Drilled: 11·5·87
Drill Type: G.C.H. RIG.
Core Size: N.M.L.C.
Inclination: 90°
Bearing: —

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$ (EW VW W MS S VS ES)	DEFECT DETAILS: DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		10		START CORING AT 10.1m					
		11		SANDSTONE: fine to medium grained, light grey, laminated grey	MW	MS			BEDDING PARTING 15°, ROUGH CLAY SEAM 0°, 3mm BEDDING PARTING JOINT 0°, ROUGH CRUSHED, 15mm
		12		as above, yellowish grey	SW	S			4 BEDDING PARTINGS 0° ROUGH
		12.75m		END OF BOREHOLE					
		13							
		14							
		15							
		16							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. A3 1/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA. N.S.W

Job No. 5056 JS
Date: 14·5·87
Method: SPIRAL AUGER
JACRO RIG

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
						CONCRETE: Floor slab				120mm
						FILL: Sandy silt, silty sand, yellowish brown				
						FILL: gravel, fine to medium grey				
						FILL: sandy silt, silty sand, brown				
						FILL: crushed sandstone				
	D.S.	N=1½ 1, ½, 1	1		ML	CLAYEY SANDY SILT: dark brown, fine grained sand	M	V.L/VS	120 100 100	ALLUVIUM
					CL	SANDY CLAY: low plasticity, yellowish brown, mottled dark brown and grey, fine grained, sand	MC>PL	V.St		
			2			as above, becoming brown				
	D.S.	N=22 5, 9, 13							470 380 380 330 340	
			3			SANDY CLAY: low plasticity, dark brown, fine to medium grained sand				
					SM	SILTY SAND: fine to medium grained, greyish brown	W	MD		
	D.S.	N=13 3, 7, 6	4							
			5							
						Becoming grey				
			6							
			7							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. A3 2/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA. N.S.W

Job No. 5056 JS
Date: 14·5·87
Method: SPIRAL AUGER
JACRO RIG.

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			7		SM	SILTY SAND: as above				
			8		CL	SANDY CLAY: low to medium plasticity, grey, fine to medium grained sand. (extremely weathered sandstone)	MC>PL	(St.)		
	D.S.		9							
			9.65m			SANDSTONE: fine to medium grained, slightly weathered, medium strong - strong grey				'V' BIT REFUSAL
			10			END OF BOREHOLE				
			11							
			12							
			13							

JEFFERY AND KATAUSKAS PTY. LTD.

CORED BOREHOLE LOG

Borehole No. A3 3/3

Client:
Project: PROPOSED 5 STOREY OFFICE BLOCK
Location: 23 PHILLIP STREET, PARRAMATTA. N.S.W

Job No: 5056 JS
Date Drilled: 14.5.87
Drill Type: JACRO RIG

Core Size: N.M.L.C.
Inclination: 90°
Bearing: —

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$ (EW VW W MS S VS ES)	DEFECT DETAILS: DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		9		START CORING AT 9.65m					
		10		SANDSTONE: fine to medium grained, light grey with grey laminations	SW	MS / S			N.B.: DEFECTS ARE BEDDING PARTINGS AT 0°, DRILLING BREAKS ARE NOT INCLUDED
		11							CLAY SEAM, 0°
		12		as above, but grey					CRUSHED, 20mm
		12.7m		SHALE seam 40mm.					
				END OF BOREHOLE					
		13							
		14							
		15							

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BOREHOLE LOG

Borehole No. **106** 1/4

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Method:** SPIRAL AUGER JK350 **R.L. Surface:** ≈ 6.3m

Date: 3-12-12 **Datum:** AHD

Logged/Checked by: A.P.C./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			PAVERS: 55mm.t over				
								-	Mortar 70mm.t				8mm DIA.
								-	CONCRETE: 120mm.t	D			REINFORCEMENT,
								CL	FILL: Gravelly clay, medium plasticity, brown, fine to coarse grained igneous gravel.	MC>PL	VSt		100mm TOP COVER
					N = 15 5,8,7							210 240 250	ALLUVIAL
						1			SILTY CLAY: low to medium plasticity, red brown mottled grey, with fine grained sand.				
					N = 10 3,4,6			CL/ML	SILTY CLAY/CLAYEY SILT: low to medium plasticity, dark brown mottled grey, trace of fine grained sand.			280 300 290	
ON COMPLET-ION OF CORING ▼						2							
					N = 14 6,5,9	3		CL	SILTY CLAY: medium plasticity, grey mottled orange brown, with fine grained sand.		St	150 100 120	
▶ ▼ ON COMPLET-ION OF AUGER-ING						4		SC	CLAYEY SAND: fine to coarse grained, grey and orange brown, with roots and root fibres.	W	L		
					N = 8 7,5,3	5							
					N = 7 4,4,3	6			as above, but with fine grained ironstone gravel, trace of clay nodules.				
						7							

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BOREHOLE LOG

Borehole No. **106** 2/4

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

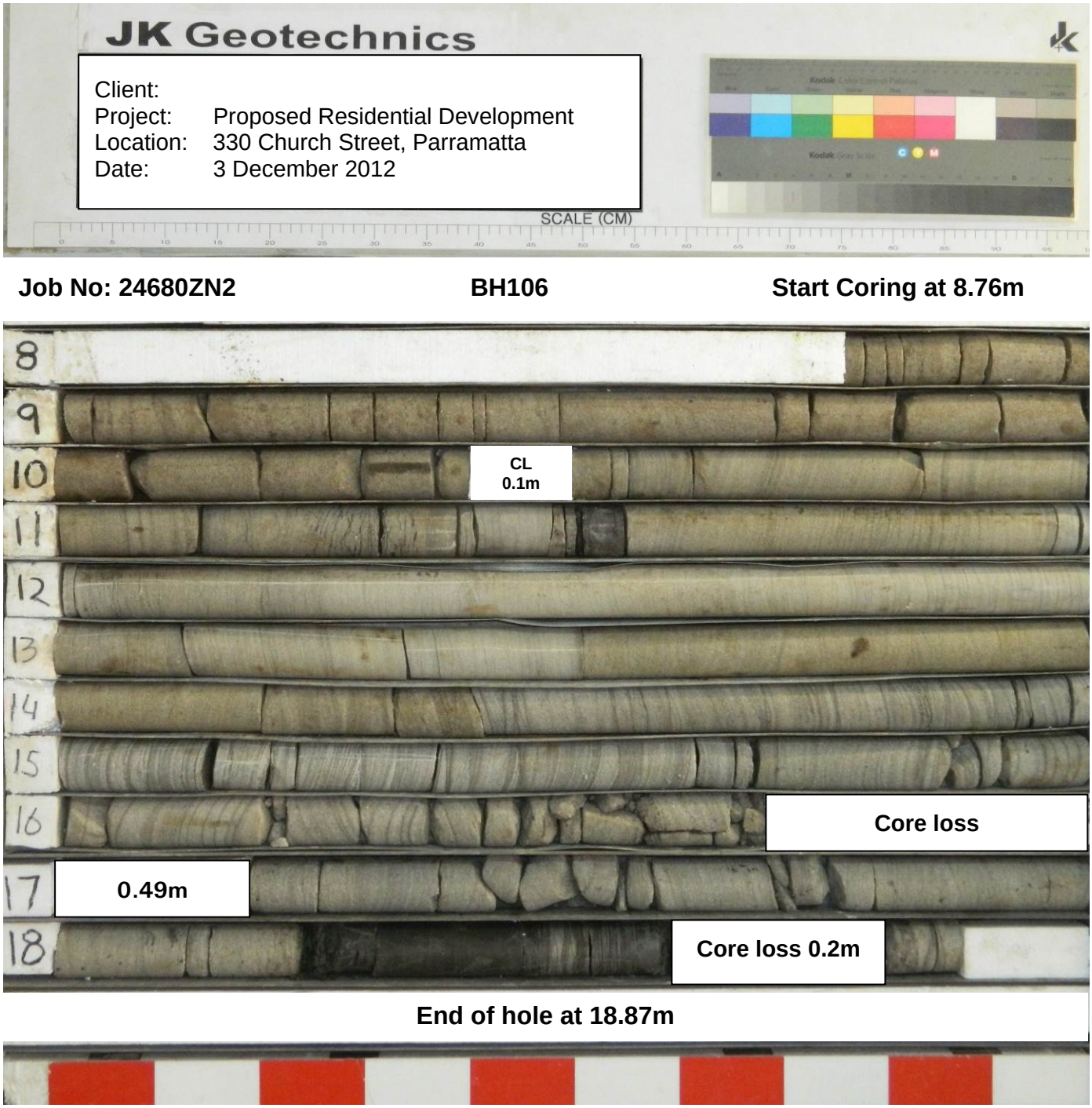
Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Method:** SPIRAL AUGER JK350 **R.L. Surface:** ≈ 6.3m

Date: 3-12-12 **Datum:** AHD

Logged/Checked by: A.P.C./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 6 4,3,3	8		CL-CH	GRAVELLY CLAY: medium to high plasticity, grey mottled brown, with fine to coarse grained ironstone and shale gravel, roots and root fibres.	MC>PL	F		
								-	SANDSTONE: fine to medium grained, grey.	FR	L-M		LOW TO MODERATE 'TC' BIT RESISTANCE
						9			REFER TO CORED BOREHOLE LOG				
						10							
						11							
						12							
						13							
						14							



Job No: 24680ZN2 **BH106** **Start Coring at 8.76m**

End of hole at 18.87m

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CORED BOREHOLE LOG

Borehole No. **106** **3/4**

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Core Size:** NMLC **R.L. Surface:** ≈ 6.3m

Date: 3-12-12 **Inclination:** VERTICAL **Datum:** AHD

Drill Type: JK350 **Bearing:** - **Logged/Checked by:** A.P.C./N.E.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		8		START CORING AT 8.76m					
		9		SANDSTONE: medium to coarse grained, light grey, with occasional grey laminae, bedded at 5-20°.	FR	M			- J, 25°, P, R
		10		CORE LOSS 0.10m					
		11		SANDSTONE: fine grained, light grey, with grey and dark grey laminae, bedded at 10-20°, with occasional shale lenses.	FR	M H			- CS, 2°, 2mm.t
FULL RET-URN		12							
		13							
		14		SANDSTONE: medium to coarse grained, light grey, bedded at 5-10°.					- CS, 5°, 2mm.t

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CORED BOREHOLE LOG

Borehole No. **106** **4/4**

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Core Size:** NMLC **R.L. Surface:** ≈ 6.3m

Date: 3-12-12 **Inclination:** VERTICAL **Datum:** AHD

Drill Type: JK350 **Bearing:** - **Logged/Checked by:** A.P.C./N.E.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		16		SANDSTONE: fine to coarse grained, light grey, with dark grey laminae, bedded at 5-20°.	FR	H			- XWS, 5°, 5mm.t - J, 55°, P, R - Cr, 5°, 20mm.t - HEALED J, 20°, Un - J, 20°, P, R - J, 80-90°, Un, R
		17		CORE LOSS 0.49m					
		18		SANDSTONE: fine to coarse grained, light grey, with grey laminae, bedded at 5-15°, with occasional shale lenses.	FR	H			- J, 40°, P, R - HEALED J, 40°, P - J, 5°, P, R - HEALED J, 25°, P - XWS, 5°, 5mm.t
				SHALE: dark grey, with fine grained sandstone bands.		M			- CS, 10°, 10mm.t
				CORE LOSS 0.20m					- Cr, 5°, 20mm.t
		19		SANDSTONE: fine grained, light grey, with dark grey laminae, bedded at 5-15°.	FR	M			
				END OF BOREHOLE AT 18.87m					
		20							
		21							

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BOREHOLE LOG

Borehole No. **108** 1/4

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Method:** SPIRAL AUGER JK305 **R.L. Surface:** ≈ 3.4m

Date: 5-12-12 **Datum:** AHD

Logged/Checked by: A.P.C./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
ON COMPLET-ION OF CORING & AFTER 24 HRS					N = 15 8,9,6	0			FILL: Silty clay, medium plasticity, brown, with fine to coarse grained sand, roots and root fibres.	MC<PL			GRASS COVER
						1			FILL: Clayey sand, fine grained, yellow brown, with fine grained sandstone gravel.	D			TOO FRIABLE FOR HP TESTING
								CL	SILTY CLAY: medium plasticity, brown mottled red brown, with fine to coarse grained gravel and root fibres.	MC≈PL			ALLUVIAL
										MC>PL	St		
ON COMPLET-ION OF AUGER-ING ▼					N = 7 2,2,5				SANDY CLAY: medium plasticity, grey mottled light grey and orange brown, medium grained sand, fine grained shale and ironstone gravel, trace of root fibres.			150 180 160	
▶						2							
					N = 10 4,5,5	3		GC	CLAYEY GRAVEL: fine to coarse grained shale and sandstone, grey mottled brown, with fine to coarse grained sand.	W	L-MD		
						4		SM	SILTY SAND: medium grained, grey and dark grey, with clay bands.		(L)		
					N = 3 2,2,1			CH/MH	SILTY CLAY/CLAYEY SILT: high plasticity, brown and grey, trace of root fibres.	MC>PL	VS-S	30 30 50	
						5							
					N = 0 0,0,0	6							SPT SUNK UNDER SELF WEIGHT. NO SAMPLE RETURN IN SPT
						7							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **108** 2/4

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

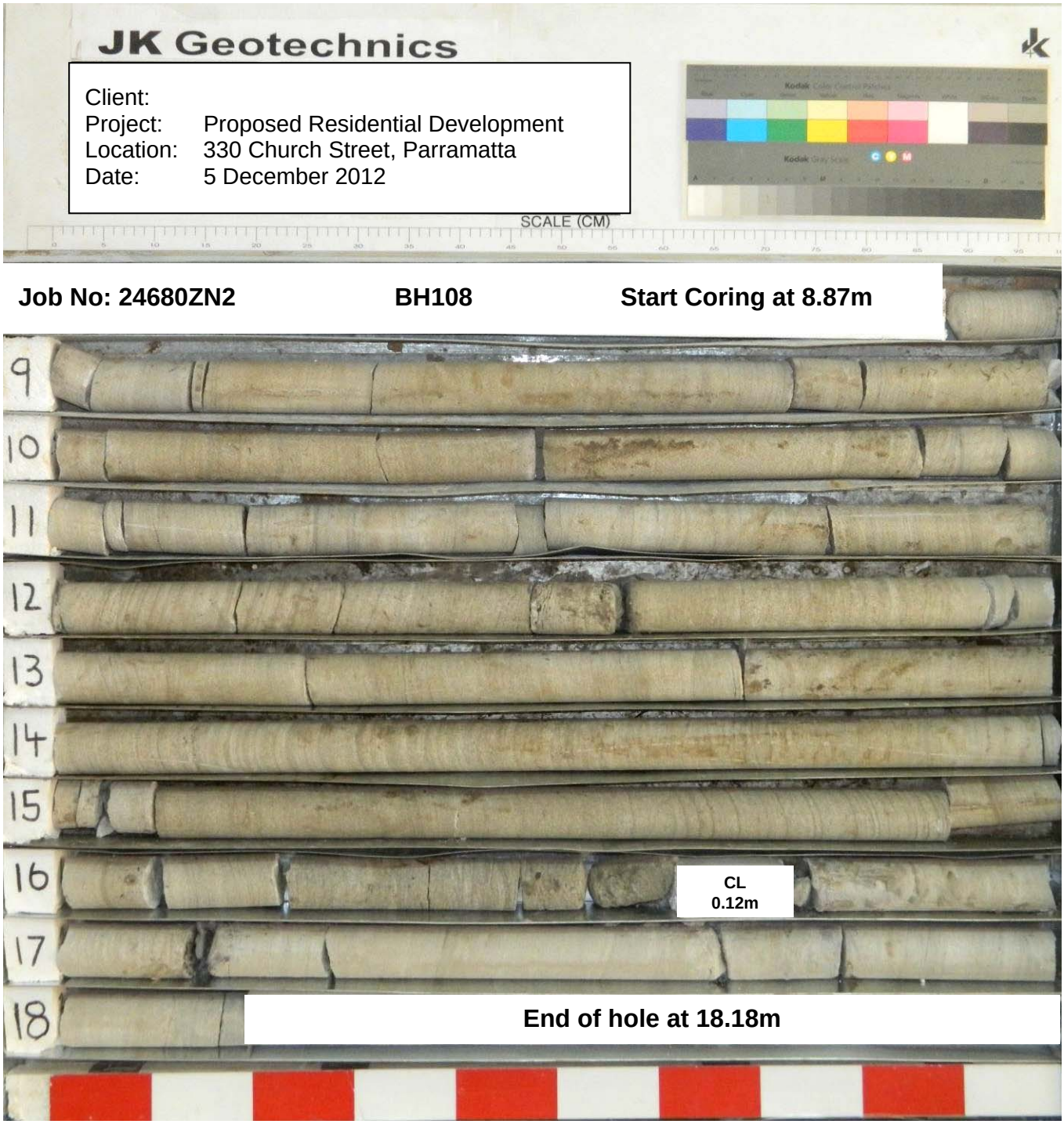
Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Method:** SPIRAL AUGER JK305 **R.L. Surface:** ≈ 3.4m

Date: 5-12-12 **Datum:** AHD

Logged/Checked by: A.P.C./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								SC	CLAYEY SAND: fine to coarse grained, grey and brown, with fine grained sandstone gravel.	W	(L)		
				■	N > 25 9,19,6/ 50mm REFUSAL	8		-	SANDSTONE: fine to medium grained, light grey and grey, with occasional clay seams.	SW	VL-L		VERY LOW 'TC' BIT RESISTANCE WITH LOW BANDS
											L-M		LOW TO MODERATE RESISTANCE WITH LOW BANDS
						9			REFER TO CORED BOREHOLE LOG				50mm DIA. PVC STANDPIPE PIEZOMETER INSTALLED TO 9.0m DEPTH, SLOTTED FROM 3m TO 9m, CASING FROM 3m TO SURFACE, 2mm SAND FILTER PACK FROM 2m TO 9m, BACKFILL FROM 0.5m TO 1.2m, CAST IRON GATIC COVER AT SURFACE
						10							
						11							
						12							
						13							
						14							


JK Geotechnics
Client:
Project: Proposed Residential Development
Location: 330 Church Street, Parramatta
Date: 5 December 2012
SCALE (CM)
Job No: 24680ZN2
BH108
Start Coring at 8.87m
9
10
11
12
13
14
15
16
17
18
CL
0.12m
End of hole at 18.18m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No. **108** **3/4**

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Core Size:** NMLC **R.L. Surface:** ≈ 3.4m

Date: 5-12-12 **Inclination:** VERTICAL **Datum:** AHD

Drill Type: JK305 **Bearing:** - **Logged/Checked by:** A.P.C./N.E.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		8		START CORING AT 8.87m					
		9		SANDSTONE: fine to medium grained, light grey and grey, with grey laminae, bedded at 0-15°.	FR	H			
		10		as above, but fine to coarse grained.					- XWS, 2°, 20mm.t
		11		SANDSTONE: fine grained, light grey, with grey laminae, bedded at 0-15°.					- CS, 2°, 2mm.t - CS, 5°, 2mm.t
		12		SANDSTONE: medium to coarse grained, grey, with dark grey and grey laminae, bedded at 0-15°.					- XWS, 5°, 30mm.t - XWS, 5°, 30mm.t
FULL RET-URN		13							- CS, 5°, 2mm.t
		14		as above, but fine grained.					- XWS, 5°, 10mm.t

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No. **108** **4/4**

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Core Size:** NMLC **R.L. Surface:** ≈ 3.4m

Date: 5-12-12 **Inclination:** VERTICAL **Datum:** AHD

Drill Type: JK305 **Bearing:** - **Logged/Checked by:** A.P.C./N.E.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
				SANDSTONE: fine to medium grained, grey and light grey, with dark grey laminae, bedded at 5-20°.	FR	H			- XWS, 10°, 20mm.t
				as above, but medium grained.					
		16		SANDSTONE: coarse grained, light grey and grey, with grey laminae, bedded at 5-20°.		M			- J, 25°, P, R
				CORE LOSS 0.12m					
				SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 5-20°.	FR	H			- XWS, 8°, 40mm.t - XWS, 2°, 30mm.t - XWS, 5°, 20mm.t - CS, 8°, 2mm.t
		17							
		18		END OF BOREHOLE AT 18.18m					- CS, 10°, 2mm.t
		19							
		20							
		21							

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BOREHOLE LOG

Borehole No. 110 1/2

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Method:** SPIRAL AUGER JK305 **R.L. Surface:** ≈ 4.5m

Date: 6-12-12 **Datum:** AHD

Logged/Checked by: A.P.C./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0		-	PAVERS: 55mm.t over Mortar 50mm.t				8mm DIA. REINFORCEMENT, 75mm TOP COVER
								-	CONCRETE: 110mm.t	D			
				■	N = 8 4,4,4				FILL: Clayey gravel, fine to coarse grained igneous, grey and brown, with fine to medium grained sand.	MC<PL			
						1			FILL: Silty clay, low to medium plasticity, dark brown and brown, with fine to coarse grained sand.				
				■	N = 7 3,3,4				FILL: Sand, fine to coarse grained, yellow brown and brown, with clay bands.	M			
▶										W			
▼ ON COMPLET-ION						2		CL-CH	SANDY CLAY: medium to high plasticity, grey mottled brown, fine to medium grained sand, with roots and root fibres, trace of fine to coarse grained shale and sandstone gravel.	MC>PL	St		ALLUVIAL
				■	N = 8 4,5,3	3						180 200 160	
						4		CL-CH	SILTY CLAY/CLAYEY SILT: medium to high plasticity, dark grey, with fine grained sand, roots and root fibres.		S		
				■	N = 0 1,0,0							50 40 20	
						5		CH	SILTY CLAY: high plasticity, dark grey and grey, with fine grained sand, roots and root fibres.		VSt		
				■	N > 6 4,6/50mm	6						210 250	
					REFUSAL			-	SANDSTONE: fine to medium grained, light grey and grey.	SW-FR	L		LOW 'TC' BIT RESISTANCE WITH MODERATE BANDS
						7							

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BOREHOLE LOG

Borehole No. 110
2/2

Client:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 330 CHURCH STREET, PARRAMATTA, NSW

Job No. 24680ZN2 **Method:** SPIRAL AUGER JK305 **R.L. Surface:** ≈ 4.5m

Date: 6-12-12 **Datum:** AHD

Logged/Checked by: A.P.C./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■		8			SANDSTONE: fine to coarse grained, light grey and grey, with occasional low strength bands.	SW	M-H		HIGH RESISTANCE WITH LOW BANDS
				■		9							
						10							
				■		11							HIGH RESISTANCE WITH OCCASIONAL MODERATE BANDS
				■		12			END OF BOREHOLE AT 11.8m				'TC' BIT REFUSAL
						13							
						14							

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BOREHOLE LOG

Borehole No. 1
1/2

Client:

Project: PROPOSED MIXED USE DEVELOPMENT

Location: RIVERBANK SQUARE (30B PHILLIP STREET), PARRAMATTA, NSW

Job No. 26863ZN
Date: 19-9-13

Method: SPIRAL AUGER
JK300

R.L. Surface: N/A
Datum:

Logged/Checked by: G.F./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES SAL	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			ASPHALTIC CONCRETE: 90mm.t				
								-	FILL: Sandy silty gravel, fine to medium grained quartz, ironstone and igneous, brown.	D			
								SM	SILTY SAND: fine to medium grained, orange brown.	D	L		ALLUVIAL
					N = 8 3,4,4	1							
					N = 8 4,4,4	2							
					N = 9 5,4,5	3							
▼ 30-9-13													
▼ ON COMPLET-ION						4				W			
						5			SILTY SAND: fine to medium grained, grey, trace of clay.				
						6			SILTY SAND: fine to medium grained, brown.		VL		SPT SANK 0.3m UNDER OWN WEIGHT
					N = 1 0,0,1								
						7		CH	SILTY CLAY: high plasticity, grey, trace of fine to medium grained sand.	MC>PL	(F-St)		

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BOREHOLE LOG

Borehole No. 1
2/2

Client:

Project: PROPOSED MIXED USE DEVELOPMENT

Location: RIVERBANK SQUARE (30B PHILLIP STREET), PARRAMATTA, NSW

Job No. 26863ZN
Date: 19-9-13
Method: SPIRAL AUGER JK300
Logged/Checked by: G.F./N.E.S.
R.L. Surface: N/A
Datum:

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES SAL	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								CH	SILTY CLAY: high plasticity, grey, trace of fine grained sand.	MC>PL	(F-St)		
						8		CL	SANDY CLAY: medium plasticity, light grey, fine to medium grained sand.		VSt		
					N > 8 2,8/150mm	9						300	
					REFUSAL			-	SANDSTONE: fine to medium grained, light grey.	DW	M-H		MODERATE TO HIGH 'TC' BIT RESISTANCE
						10							
									END OF BOREHOLE AT 10.4m				'TC' BIT REFUSAL 50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 6m, MACHINE SLOTTED FROM 6m TO 3m, CASING FROM 3m TO SURFACE, 2mm FILTER SAND FROM 6m TO 1.8m, BENTONITE SEAL FROM 1.8m TO 1.2m, BACKFILLED WITH SAND AND CUTTINGS TO SURFACE, COMPLETED WITH LOCKABLE GATIC COVER
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. 3
1/2

Client:

Project: PROPOSED MIXED USE DEVELOPMENT

Location: RIVERBANK SQUARE (30B PHILLIP STREET), PARRAMATTA, NSW

Job No. 26863ZN
Date: 19-9-13
Method: SPIRAL AUGER JK300
Logged/Checked by: G.F./N.E.S.
R.L. Surface: N/A
Datum:

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES SAL	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			ASPHALTIC CONCRETE: 50mm.t				
								-	CONCRETE: 100mm.t	M			
								CH	FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained igneous gravel and clay nodules.	MC>PL	H		ALLUVIAL
					N = 12 5,5,7				SILTY CLAY: high plasticity, light brown, red brown and orange brown, trace of fine to medium grained sand.			>600 >600 >600	
						1							
					N = 23 6,12,11							>600 >600 >600	
						2							
								SM	SILTY SAND: fine to medium grained, orange brown, partly cemented.	M	MD		
					N = 18 8,8,10	3							
						4							
						5		CL	SILTY CLAY: medium plasticity, grey mottled light brown, trace of fine to medium grained sand.	MC>PL	St-VSt		
ON COMPLET-ION					N = 10 4,5,5	6						200 230 180	
								CL-CH	SILTY CLAY: medium to high plasticity, dark grey, trace of		(S)		
						7							

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BOREHOLE LOG

Borehole No. **3** 2/2

Client:

Project: PROPOSED MIXED USE DEVELOPMENT

Location: RIVERBANK SQUARE (30B PHILLIP STREET), PARRAMATTA, NSW

Job No. 26863ZN **Method:** SPIRAL AUGER JK300 **R.L. Surface:** N/A

Date: 19-9-13 **Datum:**

Logged/Checked by: G.F./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES SAL	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								CL-CH	woodchips.	MC>PL	(S)		
		■							SANDY SILTY CLAY: medium to high plasticity, light grey, fine to medium grained sand.		(St)		
						8		-	SANDSTONE: fine to medium grained, orange brown and light grey.	DW	M-H		HIGH 'TC' BIT RESISTANCE
			■			9			END OF BOREHOLE AT 8.9m				'TC' BIT REFUSAL
						10							
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. 4
1/1

Client:

Project: PROPOSED MIXED USE DEVELOPMENT

Location: RIVERBANK SQUARE (30B PHILLIP STREET), PARRAMATTA, NSW

Job No. 26863ZN
Date: 19-9-13
Method: SPIRAL AUGER JK300
Logged/Checked by: G.F./
R.L. Surface: N/A
Datum:

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES SAL	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Sandy silt, low plasticity, orange brown, trace of root fibres, terracotta fragments and fine grained igneous gravel.	MC<PL			GRASS COVER APPEARS POORLY COMPACTED
					N = 5 4,3,2				as above, but brown.				
						1		SC	SILTY CLAYEY SAND: fine to medium grained, brown.	M	VL		POSSIBLY FILL
ON COMPLETION 30-9-13					N = 1 1,0,1					W			
						2							
								SM/CL	SILTY SAND interbedded with SILTY CLAY: fine to medium grained, low to medium plasticity, grey, trace of fine to medium grained ironstone gravel.				
					N > 15 3,5,10/ 10mm REFUSAL	3							
								-	SANDSTONE: fine to medium grained, light grey.	DW	L		LOW TO MODERATE 'TC' BIT RESISTANCE
						4					M-H		MODERATE TO HIGH RESISTANCE 'TC' BIT REFUSAL
									END OF BOREHOLE AT 4.5m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 4.5m MACHINE SLOTTED FROM 4.5m-1.5m, CASING FROM 1.5m TO SURFACE, 2mm FILTER SAND FROM 4.5m -1.0m, BENTONITE SEAL FROM 1.0m-0.5m BACKFILLED WITH SAND AND CUTTINGS TO SURFACE, COMPLETED WITH LOCKABLE GATIC COVER
						5							
						6							
						7							

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BOREHOLE LOG

Borehole No. **201** 1/1

Client:

Project: EXISTING SINKHOLE IN BASEMENT LEVEL

Location: RIVERBANK CARPARK, 30B PHILLIP STREET, PARRAMATTA, NSW

Job No. 29620ZA **Method:** HAND AUGER **R.L. Surface:** ≈ 4.0m

Date: 27-7-16 **Datum:** AHD

Logged/Checked by: D.A.F./A.J.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION					REFER TO DCP TEST RESULTS	0			ASPHALTIC CONCRETE: 30mm.t FILL: Sandy gravel, fine to coarse grained, dark brown and dark grey, fine to coarse grained sand, with silt.	M			APPEARS WELL COMPACTED
									END OF BOREHOLE AT 0.25m				HAND AUGER REFUSAL
						0.5							
						1							
						1.5							
						2							
						2.5							
						3							
						3.5							

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BOREHOLE LOG

Borehole No. **202** 1/1

Client:

Project: EXISTING SINKHOLE IN BASEMENT LEVEL

Location: RIVERBANK CARPARK, 30B PHILLIP STREET, PARRAMATTA, NSW

Job No. 29620ZA **Method:** HAND AUGER **R.L. Surface:** ≈ 4.0m

Date: 27-7-16 **Datum:** AHD

Logged/Checked by: D.A.F./A.J.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					REFER TO DCP TEST RESULTS	0			ASPHALTIC CONCRETE: 20mm.t FILL: Sandy gravel, fine to coarse grained, dark brown and dark grey, fine to coarse grained sand, with silt.	M			APPEARS WELL COMPACTED
						0.5			FILL: Silty clay, low plasticity, dark brown and dark grey, with fine to medium grained sand, trace of glass and ceramic fragments.	MC>PL			APPEARS POORLY TO MODERATELY COMPACTED
						1		CL	SILTY CLAY: low plasticity, grey and orange brown, with fine grained sand.	MC>PL	St		ALLUVIAL
						1.5		SC	CLAYEY SAND: fine to medium grained, grey and orange brown, with silt.	M	L		
											MD		
▼ ON COMPLET-ION						2				W			
						2.5			as above, but trace of iron indurated sand nodules.				
						3			END OF BOREHOLE AT 3.0m				
						3.5							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

DYNAMIC CONE PENETRATION TEST RESULTS

Client:			
Project:	EXISTING SINKHOLE IN BASEMENT LEVEL		
Location:	RIVERBANK CARPARK. PHILLIP STREET, PARRAMATTA, NSW		
Job No.	29620ZA	Hammer Weight & Drop:	9kg/510mm
Date:	27-7-16	Rod Diameter:	16mm
Tested By:	D.A.F.	Point Diameter:	20mm

Number of Blows per 100mm Penetration

Test Location	RL ~4.0m	RL ~4.0m		Test Location			
Depth (mm)	**201**	**202**		Depth (mm)	**201**	**202**	
0 - 100	16	EXCAVATED		3000-3100	10	15	
100 - 200	26			3100-3200	11	14	
200 - 300	47			3200-3300	11	14	
300 - 400	45			3300-3400	11	14	
400 - 500	16	2		3400-3500	14	17	
500 - 600	9	2		3500-3600	15	15	
600 - 700	5	2		3600-3700	30/90mm	7/20mm	
700 - 800	5	2		3700-3800	REFUSAL	REFUSAL	
800 - 900	7	4		3800-3900			
900 - 1000	8	4		3900-4000			
1000 - 1100	5	3		4000-4100			
1100 - 1200	5	3		4100-4200			
1200 - 1300	5	5		4200-4300			
1300 - 1400	5	7		4300-4400			
1400 - 1500	5	4		4400-4500			
1500 - 1600	4	4		4500-4600			
1600 - 1700	4	3		4600-4700			
1700 - 1800	4	5		4700-4800			
1800 - 1900	4	7		4800-4900			
1900 - 2000	5	5		4900-5000			
2000 - 2100	4	5		5000-5100			
2100 - 2200	3	8		5100-5200			
2200 - 2300	4	9		5200-5300			
2300 - 2400	5	10		5300-5400			
2400 - 2500	7	10		5400-5500			
2500 - 2600	10	6		5500-5600			
2600 - 2700	9	11		5600-5700			
2700 - 2800	10	18		5700-5800			
2800 - 2900	12	23		5800-5900			
2900 - 3000	10	12		5900-6000			

Remarks:
1. The procedure used for this test is similar to that described in AS1289.6.3.2-1997, Method 6.3.2.
2. Usually 8 blows per 20mm is taken as refusal
3. Survey datum is AHD.