Douglas Partners
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Report on
Geotechnical Investigation

Parramatta Leagues Club Hotel
1 Eels Place, Parramatta

Prepared for
Parramatta Leagues Club

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

	Signature	Date
Author		5/12/2018
Reviewer	pp MJT.	5/12/2018

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Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
43 Hobart Street
Riverstone NSW 2765
PO Box 267
Riverstone NSW 2765
Phone (02) 4666 0450

Executive Summary

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for the Parramatta Leagues Club Hotel at 1 Eels Place, Parramatta. The investigation was commissioned in an email dated 19 October 2018 by Mr Thomas Gould of APP Corporation Ltd on behalf of Parramatta Leagues Club and was undertaken in accordance with DPs proposal NWS180079.P.001.Rev2 dated 11 October 2018.

The development will include the construction of a new 17 storey hotel with a single level basement. Bulk excavation is expected to be required to a maximum depth of about 3.5 m within the basement footprint. Filling to raise site levels will occur outside the basement footprint.

The investigation included a review of previous investigations carried out on the site, the drilling of five boreholes, the installation of three groundwater monitoring wells, laboratory testing and engineering analysis.

The investigation indicated that the site is underlain by filling and natural soils to depths of 3.0 m to 4.8 m and then bedrock which progressively increases in strength with depth. Groundwater was not recorded in the monitoring wells (i.e. below RL 8.5 m AHD).

The report includes comments on excavation conditions, earthworks, retaining structures, foundations and the impact of the development on groundwater. The following preliminary comments are provided on some significant comments provided below:

- Bulk excavation to depths of up to 3.5 m will generally encounter filling, natural soils and possibly extremely low to very low strength bedrock. Excavation within the filling, natural soils and extremely low to low strength bedrock should be readily achieved by bulldozer blade or excavator with the possibility of some light ripping assistance.
- It is generally expected that the excavation will need to be supported by a retaining structure both during construction and as part of the final structure. Retaining wall structures that could be considered include soldier pile wall with shotcrete infill panels or contiguous pile walls. Parameters for the design of the retaining walls have been provided.
- The comments on groundwater include reference to the NSW Department for Planning and Environment have issued a Secretary's Environmental Assessment of Requirements (SEARs) for the preparation of an Environmental Impact Statement (Application Number SSD8800 dated 6 November 2017). Groundwater levels have been recorded below the proposed basement levels. Based on current groundwater recordings and previous measurements the development is not expected to interfere with the aquifer or require licensing in accordance with the definitions of aquifer interference or licensing as defined by the NSW DPI Aquifer Interference Policy 2012.
- Foundations that could be considered include shallow or piled footings. Parameters for the design of foundations have been provided.

DP carried out the investigation concurrently with a Detailed Site (Contamination) Investigation (DSI). The results of the DSI are reported separately. The DSI includes comments on the results of Acid Sulfate Soil (ASS) testing as required by the SEARs.

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Report on Geotechnical Investigation
Parramatta Leagues Club Hotel
1 Eels Place, Parramatta

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for the Parramatta Leagues Club Hotel at 1 Eels Place, Parramatta. The investigation was commissioned in an email dated 19 October 2018 by Mr Thomas Gould of APP Corporation Ltd on behalf of Parramatta Leagues Club and was undertaken in accordance with DPs proposal NWS180079.P.001.Rev2 dated 11 October 2018.

It is understood that the development will include the construction of a new 17 storey hotel with a single level basement. Bulk excavation is expected to be required to a maximum depth of about 4 m within the basement footprint. Filling to raise site levels will occur outside the basement footprint. Investigation was required to provide information on subsurface conditions for the planning and design of excavations, earthworks, retaining structures, groundwater and foundations.

The investigation included a review of previous investigations carried out on the site, the drilling of five boreholes, the installation of three groundwater monitoring wells, laboratory testing and engineering analysis. The details of the field work are presented in this report, together with comments and recommendations for design and construction.

DP carried out a detailed site investigation (DSI) for contamination in conjunction with this geotechnical investigation, the results of which are presented in a separate report. The DSI includes Acid Sulfate Soils testing and associated comments.

2. Site Description

The site is located at 1 Eels Place, Parramatta (Lot 369 in DP 752028, Lot 7054 in DP 1074335 and Residual Crown Plan 80-3000 (site)). The location of the proposed development is within the existing Parramatta Leagues Club and is irregular in shape with an area of approximately 3500 m^2. It is located to the southwest of the existing Parramatta Leagues Club building and to the southeast of the existing club multi-storey carpark.

At the time of the field work the site was occupied by an asphaltic concrete surfaced carpark and garden beds mainly located close to the southern boundary of the site. Some medium sized trees and small shrubs were observed within these garden beds.

The topography of the site generally falls gently from the east at approximately RL 13.7 m Australian Height Datum (AHD) down to the west at approximately RL 12.7 m AHD at gradients estimated to be less than 1%.

The site is bounded by Western Sydney Stadium (currently undergoing redevelopment) to the south and existing Parramatta Leagues Club infrastructure to the north-west and north-east. O'Connell Street is located approximately 30 m to the east of the site and the Parramatta River is located approximately 150 m to 200 m to the west of the site.

A location plan showing the site area is presented in Figure 1.

Figure 1: Site Location Plan (Source: Nearmap)

3. Geological Mapping

3.1 Geology

Reference to the Penrith 1:100 000 scale Geological Series Sheet indicates that the site is located close to the boundary between the Hawkesbury Sandstone Formation and the Ashfield Shale Formation. These rock units are often separated by the Mittagong Formation sandstone.

The Hawkesbury Sandstone Formation consists predominantly of medium and coarse grained quartz sandstone. The Mittagong Formation comprises fine to medium grained inter-laminated sandstone and black siltstone. Ashfield Shale typically comprises dark grey to black shale, siltstone and laminite which weathers to a residual clay profile of medium to high plasticity.

It is noted that some alluvial sediments (river deposited sands, silts and clays) may be present overlying the bedrock associated with the nearby Parramatta River and possible old creek line located to the south-west of the site.

3.2 Acid Sulfate Soils

Reference to the Acid Sulfate Soil (ASS) mapping for the area indicates that the site is in an area of no known occurrence however is within close proximity to the Parramatta River mapped as having a high probability of occurrence.

The NSW Acid Sulfate Soils Manual 1998 published by the Acid Sulfate Soils Advisory Committee (ASSMAC) indicates that ASS (and Potential Acid Sulfate Soils – PASS) normally occur in alluvial or estuarine soils below RL 5 m AHD although occasionally are encountered up to RL 12 m AHD. Considering the ASS mapping and given that the site soils are at site elevations between RL 6.0 m and RL 13.5 m AHD it is possible that ASS are present on-site.

Testing of the soils for ASS was carried out as part of the DSI. Reference should be made to the DSI for the test results and further comments.

4. Previous Investigations

Previous geotechnical investigations have been undertaken on the site of Parramatta Leagues Club incorporating the subject site and the reports were provided by the client to DP for review. This included the drilling of three cored boreholes (BH101, BH4 and BH5) and two augered boreholes (BH111 and BH116). The information from these boreholes has been included in the preparation of this current report.

The geotechnical reports provided for review are as follows:

- JK Geotechnics - Report to Parramatta Leagues Club on Stage 2 Geotechnical Investigation for Proposed Multi-storey Car Park at Parramatta Leagues Club, Grose St, Parramatta NSW REF: 28152SBrpt2, 8 July 2015.
- JK Geotechnics – Report to Parramatta Leagues Club on Geotechnical Investigation for Proposed Extensions to Leagues Club at Parramatta Leagues Club, Grose Street, Parramatta, NSW, REF: 28152SBrpt3, 27 July 2015.
- JK Geotechnics – Report on Parramatta Leagues Club Ltd on Seepage Analysis for Proposed Multistorey Car Park at Parramatta Leagues Club, Grose Street, Parramatta, NSW, REF: 28152SBrpt4, 27 July 2015.

A summary of the conditions encountered in the relevant boreholes is included in the development of the geotechnical model in Section 9.1 below. The relevant borehole logs are included in Appendix D.

5. Current Field Work Methods

The current field work included the following:

- Set-out of five borehole locations. Borehole locations were (BH201, BH201A, BH202, BH202A, BH203).
- The drilling of three boreholes (BH201 to BH203) using a track-mounted drilling rig and the drilling of two boreholes (BH201A) and (BH202A) using a bobcat-mounted drilling rig. BH201 and BH202 were drilled using solid flight augers to practical refusal at depths of 3.15 m and 5.4 m, respectively. BH203 was drilled to a depth of 6.0 m. Standard penetration tests (SPTs) were also completed at regular depth intervals within the overburden.
- The drilling of BH201A and BH202A, adjacent to BH201 and BH202 for the purpose of obtaining core samples of the underlying bedrock. The boreholes were commenced using solid flight augers and rotary drilling equipment until competent bedrock was encountered at depths of 3.15 m and 4.8 m, respectively in BH201A and BH202A. NMLC-coring was undertaken in the bedrock to obtain continuous 50 mm diameter core samples of the rock for identification and strength testing purposes. The boreholes were extended to depths of 8.0 m and 10.11 m, respectively.
- The installation of groundwater monitoring wells in BH201, BH202 and BH203 at the completion of drilling. The wells involved inserting Class 18 uPVC screen and casing to depths of 3 m, 5.0 m and 5.5 m, backfilling the screened length with clean sand, plugging the top of the sand with bentonite pellets and backfilling the casing with drilling spoil. The top of the well was finished with a road box mounted flush with the surface.

The ground surface levels (measured in 'm AHD') together with the Eastings and Northings at the borehole locations were determined by using a High Precision Differential GPS which is accurate to approximately 0.1 m. The locations of the boreholes are shown on Drawing 1 in Appendix B.

6. Field Work Results

The borehole logs from the current investigation are provided in Appendix C. Notes defining classification methods and terms used to describe the soils and rocks are included in Appendix A.

The subsurface conditions encountered in the current boreholes are described as follows:

Pavement: - Asphaltic concrete (70 mm – 150 mm thick) overlying roadbase gravels to depths ranging between 0.25 m and 0.4 m;

Filling: - Brown and grey silty clay or gravelly sand filling with traces of gravel and sand in BH202, BH201A and BH202A to depths of between 0.4 m and 0.6 m;

Natural Soil: - Typically very stiff or hard, red brown silty clay with traces of gravel. In BH203, clayey silt was encountered below the filling to a depth of 0.8 m and sandy clay was encountered below a depth of 5.5 m;

Weathered Rock: - Extremely and very low strength, orange brown sandstone was encountered in all bores except BH203 at depths of 3.1 m and 4.8 m, respectively. This layer included some high strength iron cemented bands. The thickness of the extremely or very low strength sandstone ranged from 0.6 m – 1.0 m.

Medium and High Strength Sandstone (Mittagong Formation): - Medium, medium to high strength and high strength, highly weathered to slightly weathered, fractured to slightly fractured, fine to medium grained, grey and brown sandstone with some extremely low and very strength bands (typically over the top 1 m of the unit) was encountered below depths of 4.2 m and 5.35 m in BH201A and BH202A.

High Strength Sandstone (Hawkesbury Sandstone) - High strength, moderately weathered to fresh, slightly fractured to unbroken, brown and grey, medium to coarse grained sandstone at depths of 7.0 m to 7.4 m in BH201A and BH202A.

Free groundwater was not observed during augering and the use of water as a drilling fluid prevented groundwater observations during rotary drilling and coring. The groundwater wells were measured for groundwater on completion of installation on 2 November 2018 and subsequently on 8 November 2018 and 30 November 2018. The wells were dry on each occasion inferring groundwater levels, at the time of measurement, were below the base of the wells at elevations less than RL 10.5 m, 9.0 m and 8.5 m AHD for BH201, BH202 and BH203 respectively.

7. Laboratory Testing

7.1 Chemical Soil Properties

Selected samples collected from the boreholes were tested in the laboratory to determine the pH, sulfate and chloride ion concentrations as well as the electrical conductivity to assess the aggressivity potential of the soil. The detailed results are given in Appendix E and are summarised in Table 1 below.

Table 1: Results of Chemical Testing

Bore	Material	Sample Depth (m)	pH	Chloride Ion (mg/kg)	Sulfate Ion (mg/kg)	Electrical Conductivity (µS/cm)
BH201	Filling	0.1 - 0.2	5.3	-	-	-
BH201	Silty Clay	0.5 - 0.6	4.8	-	-	-
BH201	Silty Clay	2.0 - 2.1	4.9	-	-	-
BH202	Silty Clay	1.5 - 1.6	4.6	-	-	-
BH202	Silty Clay	3.0 - 3.1	5.6	160	180	250
BH202	Silty Clay	3.0 - 3.1	4.8	-	-	-
BH202	Silty Clay	4.0 – 4.1	5.7	44	140	150

BH203	Clayey Silt	0.5	6.3	-	-	-
BH203	Silty Clay	2.0 – 2.1	4.4			

Note: All samples mixed at a ratio of 1(soil):5(water) prior to testing.

The results of aggressivity testing, when compared with Tables 6.4.2 (C) and 6.5.2 (C) in AS 2159-2009 "Piling: Design and Installation", indicates that an exposure classification of 'moderately - aggressive' is appropriate for subsurface concrete elements and 'non-aggressive' is appropriate of buried steel elements (e.g. pipes).

7.2 Rock Strength Classification

Point Load Strength Index (Is_{50}) testing was carried out on selected rock core specimens. The results of the tests are given on the borehole logs at the appropriate depths. Figure 2 below shows the range of Is_{50} results at the various depths (shown as Reduced Levels relative to AHD).

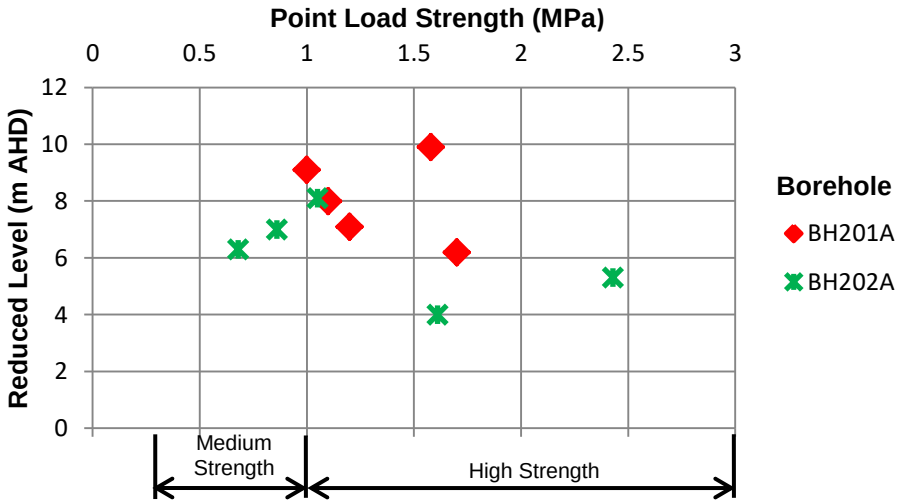

Figure 2: Point Load Strength (Is_{50}) Results at various depths

8. Proposed Development

It is proposed that the development will involve the construction of a 17 storey hotel building with a single level basement. The building footprint extends beyond the basement footprint on its western side. Additional fill material will be required on the western side to build up existing ground surface levels to the underside of the floor slab.

From information provided, the basement floor level is at RL 10.0 m AHD, lower ground floor is at RL 12.35 m AHD and upper ground floor at RL 13.8 m AHD. Based on these levels bulk excavation to 4 m depth is proposed. The basement footprint is not expected to extend to the site boundaries.

The layout of the development is shown on Drawing 1, Appendix B.

Column working loads are estimated by DP to be up to 6,000 kN, possibly higher.

DP understands that NSW Department for Planning and Environment have issued a Secretary's Environmental Assessment of Requirements (SEARs) for the preparation of an Environmental Impact Statement (Application Number SSD8800 dated 6 November 2017). In Section 10 of the SEARS the following:

- The potential impact of the development on groundwater levels, flow paths and quality.
- The potential impact of the development of the NSW Aquifer Policy (DPI, 2012)
- Any water licensing requirements or other approvals required under the Water Act 1912 or Water Management Act 2000.
- The geotechnical issues (including Acid Sulfate Soils) associated with the construction of the development.

Comments on these issues are included in the various sub-sections of Section 9 of this report.

9. Comments

9.1 Geotechnical Model

Based on information from the previous investigations and the current investigation, the following geotechnical model for the site can be considered to comprise the following units, in increasing depth order:

Unit 1 - Filling to depths up to 0.6 m.

Unit 2 - Natural soils to depths ranging from 3.0 m – 4.8 m. The depth of natural soils increases towards the west.

Unit 3 - Extremely and very low strength sandstone, generally in thicknesses of 0.6 m – 2.5 m. This unit includes high strength ironstone bands. JKs boreholes did not record this weathered sandstone layer in Boreholes 4, 5 or 101.

Unit 4 - Mittagong Formation Sandstone – medium, medium to high and high strength, highly weathered to slightly weathered, fractured to slightly fractured, grey and brown fine grained sandstone at depths of 4.2 – 5.4 m. This unit includes a significant number of extremely and very low strength bands in its top 1 m.

Unit 5 - Hawkesbury Sandstone – high strength, moderately weathered to fresh, slightly fractured to unbroken, brown and grey, medium to coarse grained sandstone at depths of 6.0 m to 7.4 m. DP has estimated the top of Hawkesbury Sandstone on the JK borehole logs from inspection of their core photos.

A summary of the depths and reduced levels (to AHD m) of the various strata levels is provided in Table 2.

Table 2: Summary of Material Strata Levels and Rock Classifications

Bore No.	Surface RL (m AHD)	Top of Natural Clays		Top of Extremely Low or Very Low Strength Bedrock		Top of Medium and High a Strength (fine grained) Sandstone (Mittagong Formation)		Top of High Strength (medium and coarse grained) Sandstone (Hawkesbury Sandstone)	
		D (m)	RL (m)	D (m)	RL (m)	D (m)	RL (m)	D (m)	RL (m)
4	13.5	0.4	13.1	-	-	-	-	6.0*	7.5
5	13.3	0.4	12.9	-	-	-	-	6.9*	6.4
101	13.6	0.5	13.1	-	-	5.8	7.8	7.2*	6.4
111	13.1	0.4	12.7	5.1	8.0	-	-	-	-
116	13.5	0.3	13.2	5.0	8.5	-	-	-	-
201	13.5	0.4	13.1	3.1	10.4	-	-	-	-
201A	13.5	0.6	12.9	3.2	10.3	4.2	9.3	7.0	6.5
202	13.5	0.5	13.0	4.8	8.7	-	-	-	-
202A	13.5	0.5	13.0	4.8	8.7	5.4	8.1	7.4	6.1
203	13.5	0.4	13.1	-	-	-	-	-	-

Note: D = Depth below ground surface level RL = Reduced Level

* = DP has inferred that this level is Hawkesbury Sandstone based on inspection of JKs core photos.

While the groundwater was not able to be measured in the current investigation, groundwater levels have previously been measured at RLs 8.3 to 8.5 m AHD. DP's measurements on-site and experience in the area indicate that the groundwater levels are generally below RL 8.5 m AHD. JK measured recorded one groundwater reading at RL 10.2 m but indicated in their report that this reading was considered anomalous. It is expected that the groundwater during the current investigation was locally deeper due to generally dry climate conditions. It is expected that groundwater seepage will occur at, or near, the soil/rock interface and along bedding planes and joints within the rock. Groundwater levels could change with variations in climatic conditions. Based on the local topography, groundwater is anticipated to flow downslope to the west or south-west towards the Parramatta River.

9.2 Site Preparation and Earthworks

9.2.1 Excavation Conditions

Bulk excavation to depths of up to 3.5 m will generally encounter filling, natural soils and possibly extremely low to very low strength bedrock. Excavation within the filling, natural soils and extremely low to low strength bedrock should be readily achieved by bulldozer blade or excavator. Some light to medium ripping assistance or the use of rock hammers may be required for excavation of high strength bands within the extremely low and very low strength bedrock (Unit 3).

All excavated materials disposed of off-site will need to be classified in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014). This includes filling and natural materials that may be removed from the site. Reference should be made to DP's DSI report for further comment regarding the preliminary waste classification.

Further comments on groundwater are included in Section 9.4.

9.2.2 Subgrade Preparation

The following site preparation measures are recommended for site platform filling placement for the development:

- remove any deleterious, soft, wet or highly compressible material or material rich in organics or root matter;
- test roll the exposed surface with at least six passes of a minimum 12 tonne deadweight smooth drum roller, with a final test roll pass accompanied by careful visual inspection to ensure that any deleterious materials such as soft, wet or highly compressible soil and any organics are identified and removed;
- place approved filling, where required, in layers not exceeding 300 mm loose thickness, with each layer compacted to a dry density ratio between 98 % and 102 % relative to Standard compaction and within 2% of optimum moisture content (OMC); new filling should be free of oversize particles (>75 mm) and deleterious material;
- moisture conditioning of clay soils may be required if soils are saturated. Moisture conditioning would involve drying in 'sunny and windy' weather, blending with other drier materials or lime stabilisation;
- promptly cover any exposed clay at subgrade level with a minimum 150 mm of select granular fill (minimum CBR 15%) to reduce potential wetting and drying and trafficability problems; and
- new filling required to achieve design levels for support of any on-ground slabs and/or structural loads will need to be carried out under Level 1 testing conditions as defined in AS 3798–2007 "Guidelines on Earthworks for Commercial and Residential Developments". Level 2 testing is recommended for filling materials beneath pavements, recreational and landscaping areas.

The above procedures will require geotechnical inspection and testing services to be employed during construction.

9.3 Excavation Support

9.3.1 General

Vertical excavations in filling and natural soils are not expected to be stable in the long-term. If there is sufficient space available it may be possible to temporarily batter some or all of the sides of the excavation during construction.

Where batter slopes cannot be accommodated, the excavation will need to be supported by a retaining structure both during construction and as part of the final structure.

9.3.2 Batter Slopes

Suggested maximum temporary and permanent batter slopes for unsupported internal excavations up to a maximum height of 3 m are shown in Table 3 below. These values assume that no surcharge loads are placed near the top of the batters.

Table 3: Recommended Safe Batter Slopes for Exposed Material

Exposed Material	Maximum Temporary Batter Slope (H : V)	Maximum Permanent Batter Slope (H : V)
Filling and natural clay	1.5 : 1	2 : 1
Extremely low to very low strength rock	1 : 1	2 : 1

Any soil or rock batter slopes that are exposed will require protection from erosion. Protection may include a mesh-reinforced shotcrete pinned to the excavation face with dowels. Drainage will need to be installed behind the shotcrete to intercept any seepage.

9.3.3 Retaining/Shoring Walls

Where space constraints preclude the use of battered excavations with associated block or concrete retaining walls the following methods of shoring support may be considered:

- **Soldier pile/infill panel wall system** - Soldier piles would generally be spaced at about 1.5 m to 3 m centres and should be founded at least two pile diameters below the lowest excavation level (both bulk and detailed) adjacent to the pile location.

  At the completion of the each excavation lift, reinforced shotcrete infill panels should be applied. At no stage should progressive vertical excavation proceed beyond 2 m without infill panel support being applied. Regular inspections by an experienced geotechnical professional following each progressive lift of excavation must be undertaken to determine if any additional stabilisation measures are required.

  Strip drains should be installed behind the shotcrete of the soldier pile/infill panel wall system to facilitate drainage and prevent build-up of water pressures behind the shoring.

- **Contiguous pile wall** – for retaining walls requiring greater stiffness (e.g. to support surcharge loads from adjacent structures) then consideration could be given to installing a contiguous pile wall. A contiguous pile wall involves the installation of piles immediately adjacent to each other to provide full support of the excavation. Piles should be installed at least two pile diameters below the lowest excavation level (both bulk and detailed) adjacent to the pile location.

Piles that could be considered for these wall systems typically involve either bored piles or continuous flight auger (CFA) piles. The piling contractor should confirm that their rig is able to penetrate medium and high strength sandstone.

9.3.4 Earth Pressure Design

The design of temporary shoring and the permanent basement retaining walls should take due account of both lateral earth pressures and surcharges acting on the walls.

The earth pressure coefficients and bulk unit weights in Table 4 are suggested for the design of single propped shoring walls using a triangular earth pressure distribution.

Table 4: Design Parameters for Shoring and Basement Walls

Strata	Bulk Unit Weight, (kN/m^3)	Earth Pressure Coefficients		
		'Active' (K_a)	'At Rest' (K_o)	Passive[1] (K_P)
Filling and Natural soils (Units 1 and 2)	20	0.3	0.4	NA
Extremely low and very low strength sandstone (Unit 3)	22	0.25	0.3	400 kPa
Medium and High Strength Sandstone (Units 4 and 5)	24	NA	NA	6000 kPa[2]

Note: 1 Only applicable below bulk excavation level, from one pile diameter beneath either bulk excavation level or the base of any drainage trenches, lift pits or other localised excavation.

2. Higher design parameters may be appropriate with additional investigation.

The active earth pressure coefficient, $K_{a,}$ to be used for estimating soil pressures in Table 4 is for a relatively 'flexible' wall which would allow some lateral or inward "tilting" movement. Where it is necessary to limit wall movements (e.g. adjacent to an existing building), it is suggested that the shoring wall be designed for K_0 (lateral earth pressure coefficients "at rest") pressures in combination with an analytical approach that considers the progressive excavation and propping sequence.

The passive pressures provided in Table 4 are ultimate and an appropriate factor of safety should be used to limit movement.

Wall design using the above parameters and suggested earth pressure distributions assume the following:

- A level surface behind the top of the excavation;
- Shoring / retaining walls will need to allow for hydrostatic pressures from the ground surface level if adequate drainage behind the walls is not installed or maintained;
- Construction traffic and other surcharge loadings (e.g. stacked materials) are not applied at the crest of the retaining walls, for a distance of say 5 m behind the wall/shoring (otherwise the resultant additional lateral loads need to be considered);
- Passive resistance may be developed in medium or high strength sandstone at least one pile diameter below the bulk excavation level or below the base of any adjacent localised excavation (e.g. perimeter drainage trench). The passive pressures calculated are ultimate values to which an appropriate factor of safety (say 3) should be incorporated so as to limit the movement that otherwise is required to develop full passive pressure.

9.4 Groundwater

The basement excavation (FFL 10.0 m AHD) is generally located above the recorded groundwater levels in two separate investigations (Maximum level recorded at RL 8.4 m AHD). Accordingly, groundwater is not expected to be intersected by the basement excavations. Notwithstanding, these historical readings there may be some localised seepage of groundwater into the excavation, particularly following prolonged periods of wet weather. It is therefore considered sound engineering practice to allow for some minor seepage to flow into the basement during extreme weather events as a contingency plan. Such seepage will need to be collected during construction by the judicious placement of drainage sumps and by intermittent pumping. At this stage, it is not possible to estimate the likely extent and rate of seepage although it is anticipated that it should be readily handled by 'sump-and-pump' measures. It is suggested that monitoring of any seepage inflows during the early phases of excavation be undertaken to assess long-term drainage requirements.

The NSW DPI Aquifer Policy 2012 indicates the following:

"Section 1.3 What is aquifer interference?

The Water Management Act 2000 defines an aquifer interference activity as that which involves any of the following:

- The penetration of an aquifer
- The interference with water in an aquifer
- The obstruction of the flow of water in an aquifer
- The taking of water from an aquifer in the course of carry out mining of any other activity prescribed by the regulations, and
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations."

Section 2 Licensing the water through aquifer interference

"A water licence is required under the Water Management Act 2000 (unless an exemption applies or water is being taken under a basic landholder right) where any act by a person carry out an aquifer interference activity causes:

- The removal of water for a water source; or
- The movement of water from one water source to another water source, such as
  - From an aquifer to an adjacent aquifer; or
  - From an aquifer to a river/lake; or
  - From a river/lake to an aquifer."

Based on current groundwater recordings and previous measurements the development is not expected to interfere with the aquifer or require licensing in accordance with the definitions of aquifer interference or licensing as defined by the NSW DPI Aquifer Interference Policy 2012.

Construction activities are likely to collect water from rainfall and site activities and possible seepage inflows during extreme weather events. It is therefore considered prudent to seek approval for the disposal of collect stormwater off-site into existing stormwater systems from Council.

9.5 Foundations

Footing loads for the structure are assumed to be up to 6,000 kN (ultimate) for the building.

It is anticipated that either natural soils or weathered bedrock (extremely low and very low strength sandstone - Unit 3) will be exposed at the bulk excavation levels. The top of the Mittagong Formation (Unit 4 – Medium and High Strength Sandstone) is at a level estimated to be below the BEL of RL 10.0 m AHD at RL 7.8 – 9.3 m. It is recommended that all footing loads be transferred to a consistent stratum to achieve uniform founding conditions so as to avoid potential differential settlement across the building. A combination of shallow foundations and piles, or piles throughout the structure, is therefore recommended over the basement area to uniformly found on the same rock layer.

The design of shallow or piled footings, for axial compression loading, may be based on the maximum Limit State Design or Working Stress parameters given in Table 5.

Table 5: Maximum Foundation Design Parameters

Unit	Working Stress Design Values		Limit State Design Values		Elastic Modulus (MPa)
	Allowable End Bearing Pressure (kPa)	Shaft Adhesion (kPa)	Ultimate End Bearing Pressure (kPa)	Shaft Adhesion (kPa)	
Weathered Bedrock (Unit 3)	700	70	3000	150	100
Medium, Medium to High and High Strength Sandstone – Mittagong Formation (Unit 4)[1]	3500[2]	350	20,000[2]	800	1000
High strength sandstone– Hawkesbury Sandstone (Unit 5)[3]	6000	600	50,000	1500	2000

Note: 1, Spoon testing of shallow footings will need to be carried out at least 30% of the footings across the site.
2. These values may be adopted provided at least 1 m of embedment into this Unit is achieved (i.e. below the extremely low and very low strength bands).
3. An additional two cored boreholes extending into this unit would be required to confirm the suitability of these higher design parameters.

It should be noted that the allowable pressures for “Working Stress Design Values” given in Table 5 are based on a ‘limiting settlement’ of 1% of the footing width. Higher applied bearing pressures could likely be adopted if a limit state approach to design is employed, provided that settlements remain within the tolerable limits.

The design of footings is usually governed by settlement criteria and performance rather than the ultimate bearing capacity or Ultimate Limit State condition. The Serviceability limit could be assessed, for normal 'static' load cases, using the elastic modulus value given in Table 5. This modulus value is appropriate for the anticipated working stress values or strain expected under serviceability loading.

The foundation design parameters presented in Table 5 assume that the shallow or pile footings are clean at the base and free of loose debris prior to concrete placement.

All footings should be inspected by an experienced geotechnical professional to check the adequacy of the foundation material.

9.6 Seismic Design

In accordance with Part 4 of the Structural design actions Standard, AS1170.4 – 2007, the site is assessed to have a Site Sub-Soil Class of "Ce".

9.7 Floor Slabs

Where the building is to be designed with a suspended floor slab, site preparation measures will be minimal. If slabs are to be cast on ground (but designed as suspended slabs), then checks should be made to ensure that concrete is not poured onto softened or wet ground that could lead to deformation of the slab. Furthermore, in areas where clay filling is present, to reduce the potential for swelling of soils beneath the slab, the top 100 mm of the ground surface should be scarified and loosened prior to forming up for the slab. Alternatively, void formers could be used.

Where site preparation is undertaken in accordance with Section 9.2.2 on-grade slabs could be constructed in place of suspended slabs. Based on the results of the subsurface investigations, subgrade conditions are expected to be formed over clay and/or clay filling.

Floor slabs should be cast independently of pile and beam footings and incorporate control joints to allow for differential movements. Edge protection, such as deepened stiffening edge beams in conjunction with surface paving should also be included to minimise the effects of reactivity movements due to the moderate reactivity of the site clays.

10. Limitations

Douglas Partners (DP) has prepared this report for this project at 1 Eels Place, Parramatta in accordance with DP's proposal NWS180079 dated 11 October 2018 and acceptance received from Mr Thomas Gould dated 19 October 2018. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Parramatta Leagues Club Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In

preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

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

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

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

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

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

Cohesive Soils

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

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

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

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

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

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

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

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

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

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

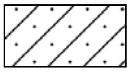
Soils


Topsoil

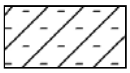

Peat


Clay

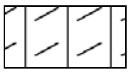

Silty clay

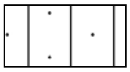

Sandy clay

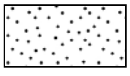

Gravelly clay

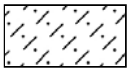

Shaly clay

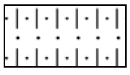

Silt


Clayey silt


Sandy silt

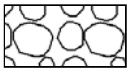

Sand

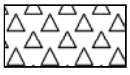

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

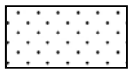

Talus

Sedimentary Rocks

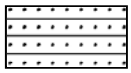

Boulder conglomerate

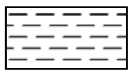

Conglomerate


Conglomeratic sandstone

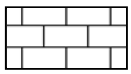

Sandstone


Siltstone


Laminite

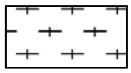

Mudstone, claystone, shale

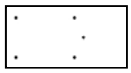

Coal


Limestone

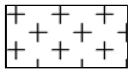
Metamorphic Rocks

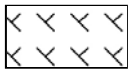

Slate, phyllite, schist

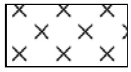

Gneiss

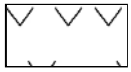

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite

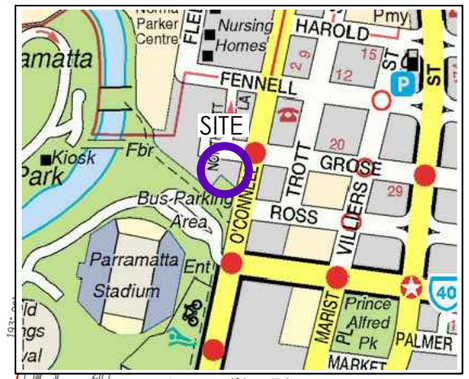

Dacite, epidote


Tuff, breccia


Porphyry

Appendix B

Drawing



Locality Plan

OUTLINE OF NEW MULTI LEVEL CARPARK

APPROXIMATE OUTLINE OF BASEMENT LEVEL

OUTLINE OF LOWER GROUND FLOOR LEVEL

5733
DP 1225424

962
DP 42643

963
DP 42643

BENCH MARK CUT ON KERB RL 13.71

4 W
111
113
5
202
202A
80–3000
114
117
201A
201
101
116
203
118

NOTE:
1: Base drawing from LTS Lockley Pty Ltd (Ref. 50413001DT, dated 19.7.2018)
2: Test locations are approximate only and are shown with reference to existing features.

0 2 4 6 8 10 15 20 30 40m
1:400 @ A3

LEGEND
- Previous environmental borehole
- Previous environmental & geotechnical borehole
- W Previous environmental & geotechnical borehole with well
- Cored borehole
- Augered borehole with well

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Parramatta Leagues Club		TITLE: **Location of Tests** **Parramatta Leagues Club Hotel** **1 Eels Place, PARRAMATTA**	PROJECT No: 94523.00
OFFICE: Riverstone	DRAWN BY: PSCH		DRAWING No: 1
SCALE: 1:400 @ A3	DATE: 9.11.2018		REVISION: 2

Appendix C

Current Field Work Results

BOREHOLE LOG

CLIENT: Parramatta Leagues Club
PROJECT: Parramatta Leagues Club Hotel
LOCATION: 1 Eels Place, Parramatta

SURFACE LEVEL: 13.6 mAHD
EASTING: 315005.3
NORTHING: 6257462.9
DIP/AZIMUTH: 90°/--

BORE No: 201A
PROJECT No: 94523.00
DATE: 8-11-2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
13.5	0.1	ASPHALTIC CONCRETE										
	0.4	ROADBASE FILLING - grey, gravelly sand roadbase filling, humid										
	0.6	FILLING - light brown, silty clay filling, humid										
13	1	SILTY CLAY - light brown, silty clay, humid 1m: colour change to brown mottled red						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0° and 10°				
12	2											
11	3											
	3.15	SANDSTONE - very low strength, highly weathered, fractured and slightly fractured, pale grey, fine grained sandstone, with some high strength, red brown iron cemented bands						3.2-3.25m: Cs 3.32 & 3.47m: B(x2) 0°, fe, cly 3.58-3.62m: Ds 3.64m: J, 45°, un, ro, he 3.7, 3.82 & 3.97m: B(x3), fe, cly 4.0-4.2m: Ds	C	92	25	PL(A) = 1.58
10	4											
	4.2	SANDSTONE - medium to high then high strength, moderately then slightly weathered, slightly fractured, pale grey and brown, fine to medium grained sandstone, with some extremely low strength bands						4.3m: B0°, cly, 5mm 4.36m: B0°, cly, 30mm 4.56m: B5°, cly, 10mm 4.75-4.85m: fg 4.85m: CORE LOSS: 200mm 5.1m: B0°, cly 30mm				PL(A) = 0.99
9	5											
	5.05							5.35m: J50°, un, ro, cln 5.5 & 5.75m: B0°-5°, fg, 10mm 5.92m: B10°, cbs 10mm 6.16, 6.22, & 6.43m: B(x3) 0°-5°, fe 6.5m: B0°, cly 10mm, fe 6.9m: B0°, fe 7-7.03m: Cs	C	100	83	PL(A) = 1.1 PL(A) = 1.2
8	6											
	7											
	7.03	SANDSTONE - high strength, moderately weathered, unbroken, medium to coarse grained, brown sandstone										PL(A) = 1.69
	8											
	8.0	Bore discontinued at 8.0m										
5	9											
4												

RIG: Bobcat **DRILLER:** JE/GM **LOGGED:** SI/JY **CASING:** HW to 2.5m; HQ to 3.15m

TYPE OF BORING: 150mm diameter spiral flight auger to 2.5m. Rotary (water) to 3.15m; NLMC casing to 8.0m. Rock coring to 8.04m.

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Parramatta Leagues Club
PROJECT: Parramatta Leagues Club Hotel
LOCATION: 1 Eels Place, Parramatta

SURFACE LEVEL: 13.5 mAHD
EASTING: 314986.9
NORTHING: 6257467.2
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 94523.00
DATE: 2-11-2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	ASPHALTIC CONCRETE			0.15				Concrete 0-0.3m
	0.25	FILLING - grey gravelly sand filling (possible roadbase)		E			PID=0.1		
				A	0.35				
	0.5	FILLING - brown silty clay filling, with a trace of gravel		A/E	0.45		PID=0.2		
		SILTY CLAY - brown mottled red silty clay			0.5				
					0.6		4,8,14		
	1.0	SILTY CLAY - very stiff, red brown mottled brown silty clay, with a trace of gravel		D	1.0		N = 22		Soil backfill 0.3-1.5m
				S	1.1		PID=0.1		Blank 0-2.0m
					1.45				
				A/E	1.5		PID=0.1		
					1.6				Bentonite 1.5-1.8m
		- below 2m light grey mottled red brown		A	2.0				
					2.1				
					2.5				
				S			3,11,17		
					2.95		N = 28		
				A	3.0				
					3.1				
									PVC 50mm screen 2.0-5.0m
									Sand 1.8-5.4m
				D	4.0				
				S	4.1		4,14,15		
					4.45		N = 29		
	4.8	SANDSTONE - extremely low strength, extremely weathered, orange brown sandstone		A	4.9				
					5.0				
				A	5.3				
	5.4	Bore discontinued at 5.4m			5.4				
		- practical refusal on at least very low strength sandstone							

RIG: 109 DB-8 **DRILLER:** Terratest **LOGGED:** PF **CASING:** Uncased

TYPE OF BORING: 125mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. BD1 with sample 0.15-0.35m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Parramatta Leagues Club
PROJECT: Parramatta Leagues Club Hotel
LOCATION: 1 Eels Place, Parramatta

SURFACE LEVEL: 13.5 mAHD
EASTING: 314987.2
NORTHING: 6257466.1
DIP/AZIMUTH: 90°/--

BORE No: 202A
PROJECT No: 94523.00
DATE: 8-11-2018
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	10.11	Bore discontinued at 10.11m										PL(A) = 1.54

RIG: Bobcat **DRILLER:** JE/GM **LOGGED:** SI/JY **CASING:** HW to 2.5m; HQ to 4.8m

TYPE OF BORING: 150mm diameter spiral flight auger to 2.5m. Rotary (water) to 4.8m; NLMC casing to 10.11m. Rock coring to 10.11m.

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Parramatta Leagues Club
PROJECT: Parramatta Leagues Club Hotel
LOCATION: 1 Eels Place, Parramatta

SURFACE LEVEL: 13.5 mAHD
EASTING: 314972.8
NORTHING: 6257447.1
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 94523.00
DATE: 2-11-2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
13	0.07	ASPHALTIC CONCRETE		A/E	0.1		PID=0.1		Concrete 0-0.3m
	0.4	FILLING - dark grey mottled brown silty clay filling, with a trace of sand and gravel			0.2				
		CLAYEY SILT - brown clayey silt, with a trace of fine sand		A/E	0.5		PID=0.1		
	0.8				0.6				
12	1	SILTY CLAY - hard, mottled orange brown and grey silty clay, with a trace of ironstone gravel		S	1.0		12,17,18 N = 35		Soil backfill 0.3-2.0m Blank 0-2.5m
				A/E	1.45		PID=0.1		
					1.5				
					1.6				
		1.8m: possible clayey sand band							
11	2	2.0 SILTY CLAY - hard, grey mottled red brown silty clay, with a trace of ironstone gravel		A	2.0				Bentonite 2.0-2.3m
					2.1				
				S	2.5		7,17,25 N = 42		
	3				2.95				
				A	3.0				
10					3.1				
				A	3.5				
					3.6				
	4			S	4.0		11,22,25/110 refusal		PVC 50mm screen 2.5-5.5m Sand 2.3-6.0m
9					4.41				
				A	4.5				
					4.6				
	5	5.0 SILTY CLAY - grey mottled red silty clay, with a trace of fine sand and gravel		A	5.0				
8					5.1				
	5.5	SANDY CLAY - red brown sandy clay, with some silt		A	5.5				
					5.6				
				A	5.9				
	6	6.0 Bore discontinued at 6.0m			6.0				
7									
6									
5									
4									

RIG: 109 DB-8 **DRILLER:** Terratest **LOGGED:** PF **CASING:** Uncased

TYPE OF BORING: 125mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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Appendix D

Previous Field Work Results

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 4
1/2

Client: PARRAMATTA LEAGUES CLUB
Project: PROPOSED MULTI STOREY CAR PARK
Location: GROSE STREET, PARRAMATTA, NSW

Job No. 28152SB
Date: 23-2-15
Method: SPIRAL AUGER JK300
Logged/Checked by: B.F./D.B.
R.L. Surface: ≈ 13.5m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION OF AUGER-ING	■					0		-	ASPHALTIC CONCRETE: 70mm.t FILL: Silty clay, medium plasticity, grey, with medium to coarse grained angular gravel.	MC<PL			
	■			■	N = 14 6,7,7			CL	SILTY CLAY: medium plasticity, yellow brown and red brown.	MC<PL	H	>600 >600 >600	
	■					1							
				■	N = 25 8,11,14				as above, but grey and red brown.			>600 >600 >600	
	■					2							
				■	N = 25 7,10,15	3			as above, but with fine to coarse grained angular to sub angular ironstone gravel.			550 >600 550	
▼ ON 3/3/15													
				■	N = 18 5,7,11	4			SANDY CLAY: medium plasticity, grey, fine to medium grained sand.	MC>PL	St	150 180 170	
						5		SM	SILTY SAND: fine to medium grained, grey.	M	MD		
									as above, but with fine to coarse grained ironstone gravel.				HIGH 'TC' BIT RESISTANCE BANDS
				■		6		-	SANDSTONE: fine to coarse grained, light grey.	DW	M-H		HIGH RESISTANCE
						7			REFER TO CORED BOREHOLE				


JK Geotechnics
6
JOB No: 28152SB BH4 START CORING AT 6.87m
7
8
9
10
11
12
END OF CORED BH5 12.55m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

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

Client: PARRAMATTA LEAGUES CLUB
Project: PROPOSED MULTI STOREY CAR PARK
Location: GROSE STREET, PARRAMATTA, NSW

Job No. 28152SB | **Core Size:** NMLC | **R.L. Surface:** ≈ 13.3m
Date: 23-2-15 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: JK300 | **Bearing:** - | **Logged/Checked by:** B.F./D.B.

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
		6		START CORING AT 6.91m					
FULL RET-URN		7		SANDSTONE: fine grained, orange brown and grey, with iron indurated bands.	DW-SW	M-H			- Be, 5°, P, R - Be, 5°, P, R - J, 35°, P, R, FILLED XWS, 2mm.t - XWS, 0°, 40mm.t - XWS, 0°, 40mm.t
		8		SANDSTONE: fine to coarse grained, orange brown.		H			
		9							
		10		as above, but light grey, with dark grey laminae at 0-10°	SW FR				- Be, 0-10°, Un, R - Be, 5°, P, R
		11							
		12		END OF BOREHOLE AT 11.65m					

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **101** 1/2

Client: PARRAMATTA LEAGUES CLUB

Project: PROPOSED MULTI STOREY CAR PARK

Location: O'CONNELL STREET, PARRAMATTA, NSW

Job No. 28152SB **Method:** SPIRAL AUGER JK350 **R.L. Surface:** ≈ 13.6m

Date: 11-6-15 **Datum:** AHD

Logged/Checked by: C.J.M./P.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
DRY ON COMPLETION OF AUGERING						0		-	ASPHALTIC CONCRETE: 30mm.t FILL: Sandy clay, fine to medium grained, brown grey, with igneous gravel.	D			APPEARS MODERATELY COMPACTED
					N = 24 12,10,14			CL-CH	SILTY CLAY: medium to high plasticity, brown mottled red.	MC<PL	H	>600 >600 >600	
						1			SILTY CLAY: medium to high plasticity, red grey, trace of ironstone gravel.				
					N = 33 19,13,20							>600 >600 >600	
						2			as above, but with ironstone gravel.				
					N = 39 19,13,26	3						>600 >600 >600	
								CL	SILTY CLAY: low plasticity, light grey, with fine grained sand.			>600 >600 590	
						4			as above, but with H strength ironstone gravel.				BANDED
						5							
						6		-	SANDSTONE: fine to medium grained, orange brown.	DW	L		LOW TO MODERATE 'TC' BIT RESISTANCE
						7			REFER TO CORED BOREHOLE				


JK Geotechnics
JOB No. 28152SB BH101 START CORING AT 6.86m
6
7
8
9
END OF BH101 AT 9.58m


JK Geotechnics
JOB No. 28512SB BH102 START CORING AT 8.49m
8
CORE LOSS 1.47m
9
10
11
CORE LOSS 0.91m
12
13
14
END OF BH102 AT 14.04

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **111** **2/2**

Environmental logs are not to be used for geotechnical purposes

Client: PARRAMATTA LEAGUES CLUB

Project: PROPOSED MULTI STOREY CAR PARK

Location: O'CONNELL STREET, PARRAMATTA, NSW

Job No. E28152KH **Method:** SPIRAL AUGER JK350 **R.L. Surface:** ≈ 13.1m

Date: 12-6-15 **Datum:** AHD

Logged/Checked by: G.F./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									SANDSTONE: fine to medium grained, light grey and red brown, with iron indurated bands.	DW	VL-L		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

Appendix E

Laboratory Test Results

Misc Inorg - Soil			
Our Reference		205023-1	205023-2
Your Reference	UNITS	BH202 4.0-4.1	BH201 3.0-3.1
Date Sampled		02/11/2018	02/11/2018
Type of sample		Soil	Soil
Date prepared	-	09/11/2018	09/11/2018
Date analysed	-	09/11/2018	09/11/2018
pH 1:5 soil:water	pH Units	5.7	5.6
Chloride, Cl 1:5 soil:water	mg/kg	44	160
Sulphate, SO4 1:5 soil:water	mg/kg	140	180
Electrical Conductivity 1:5 soil:water	µS/cm	150	250

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			09/11/2018	[NT]	[NT]	[NT]	[NT]	09/11/2018	[NT]
Date analysed	-			09/11/2018	[NT]	[NT]	[NT]	[NT]	09/11/2018	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	99	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	98	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 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.

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

CERTIFICATE OF ANALYSIS 205027

Client Details

Client	Douglas Partners Pty Ltd (Riverstone)
Attention	Gavin Boyd, Petrina Fielding, Cindy Murphy, Jeremie Young
Address	43 Hobart St, Riverstone, NSW, 2765

Sample Details

Your Reference	**94523.00, Parramatta Leagues Club Hotel**
Number of Samples	5 Soil
Date samples received	07/11/2018
Date completed instructions received	07/11/2018

Analysis Details

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

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

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

Report Details

Date results requested by	14/11/2018
Date of Issue	12/11/2018

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

Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 205027-A

Client Details

Client	Douglas Partners Pty Ltd (Riverstone)
Attention	Gavin Boyd
Address	43 Hobart St, Riverstone, NSW, 2765

Sample Details

Your Reference	**94523.00, Parramatta Leagues Club Hotel**
Number of Samples	5 Soil
Date samples received	07/11/2018
Date completed instructions received	13/11/2018

Analysis Details

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

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

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

Report Details

Date results requested by	20/11/2018
Date of Issue	19/11/2018

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Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Method ID	Methodology Summary
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	1	4.8	4.7	2	[NT]	[NT]

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.

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Measurement Uncertainty estimates are available for most tests upon request.