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Report on
Geotechnical Investigation

Gunyama Park Stage 2 and George Julius Avenue North
17 Zetland Avenue and 13 George Julius Avenue, Zetland

Prepared for
Place Design Group Pty Ltd

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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.

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1. Introduction

This report presents the results of a geotechnical investigation undertaken for the Gunyama Park Stage 2 and George Julius Avenue North project at 17 Zetland Avenue and 13 George Julius Avenue, Zetland. The investigation was commissioned by Place Design Group Pty Ltd and was undertaken in accordance with Douglas Partners' proposal 73743.06.P.001.Rev0 dated 9 January 2023.

We understand that:

- Stage 2 will complete the Gunyama Park project of the City of Sydney Council (CoS) and includes a new amenities building, playground, landscaping and skate park; and
- the project will also deliver a portion of George Julius Avenue to the east of Gunyama Park, which will be the CoS's first substantial portion of roadway and public domain constructed with a low embodied carbon target.

The geotechnical investigation was carried out to supplement the existing geotechnical information for the site previously obtained by DP for CoS. The aim of the investigation was to assess the subsurface soil and groundwater conditions across the site and provide comments on the relevant issues, including:

- site classification in accordance with AS 2870:2011 Residential Slabs and Footings;
- site preparation and earthworks;
- excavations and retaining walls;
- suggested footings systems, design parameters and estimated settlements;
- vibrations and seismic site classification;
- acid sulfate soil potential;
- soil aggressivity; and
- ground slab and pavement design parameters.

The investigation included the drilling of eight boreholes and laboratory testing of selected samples. The details of the field work and laboratory testing are presented in this report, together with comments on the issues listed above.

This report should be read in conjunction with the notes 'About this Report' given in Appendix A.

2. Background

DP has previously undertaken geotechnical investigations for the Gunyama Park Aquatic and Recreation Centre on behalf of the City of Sydney (Ref: Project No. 73743, Document No. 1, Revision No. 2 dated 25 September 2015 and 73743.02.R.002.Rev0 dated 11 April 2016).

The field work undertaken by DP in 2013/2014 included the drilling of four cored boreholes (BH1 to BH4), one augered borehole (BH5) and the completion of 12 cone penetration tests (CPT1 to CPT12). One of the CPTs (CPT10) was located within the southern part of the subject site at the approximate location shown on Drawing 1 in Appendix B. The field work undertaken in 2015/2016 included the drilling of 21 cored boreholes (BH115, BH118, BH119, BH122, BH128 and BH130 to BH145) and the completion of 30 cone penetration tests (CPT101 to CPT130). Three of the boreholes (BH118, BH122 and BH130) and six of the CPTs (CPT117, CPT118, CPT121, CPT122, CPT123 and CPT124) were located within the present site at the locations also shown on Drawing 1 in Appendix B.

The CPTs within the subject site were carried out to termination depths of between 6.0 m and 24.9 m. The boreholes drilled within the subject site were terminated at depths of between 20.3 m and 22.7 m.

A CPT involves pushing a 35 mm diameter instrumented cone and friction sleeve into the ground using hydraulic thrust from a ballasted truck-mounted testing rig. Measurements of cone resistance and sleeve friction are made at 20 mm depth intervals.

The boreholes were drilled by truck-mounted drilling rigs and were commenced using solid flight augers to drill through the overburden materials. Disturbed soil samples were collected from the tip of the auger and Standard Penetration Tests (SPTs) were undertaken at regular depth intervals throughout the fill/soil profile. Rotary drilling equipment was used to progress the boreholes to prevent hole collapse below the groundwater table. Once weathered rock was encountered, NMLC-sized diamond core drilling equipment was used to obtain 50 mm diameter continuous core samples of the rock for identification and strength testing purposes.

Three of the boreholes drilled within the subject site (BH118, BH122, BH128) were converted to monitoring wells at the completion of drilling. This involved inserting Class 18 uPVC screen and casing to the required depth, backfilling the screened length with gravel, plugging the top of the gravel with bentonite pellets and backfilling the casing with drilling spoil.

The ground profile interpreted from the previous boreholes and CPTs undertaken within the subject site comprised:

- **FILL** – concrete and asphalt pavement, underlain by gravelly sand, crushed sandstone, sandy clay, silty sand and building rubble (including bonded asbestos fragments) to depths of between 1.9 m and 4.0 m;
- **NATURAL SOILS** – loose to dense sands to depths of between 11.8 m and 16.0 m, and firm to hard clays to depths of between 20.3 m to 24.9 m depth. Some layers of peat/organic clay were also encountered;
- **SANDSTONE** –extremely low to very low strength grading to low, medium or high strength from depths of between 20 m and 24.4 m, to the base of the cored bores at 26.5 m to 29.1 m depth.

Groundwater was encountered at depths of between 3.0 m and 3.8 m during auger drilling of the boreholes and at depths of between 4.8 m and 5.7 m at some of the CPTs following withdrawal of the

CPT rods from the ground. Subsequent measurement of the groundwater depths in the installed monitoring standpipes on 6 April 2016 indicated that the groundwater table ranged from depths of between 2.2 m and 4.3 m, i.e., from RL 15.6 m to RL 16.0 m, relative to the Australian height datum (AHD), within the subject site.

It should be noted that there was no evidence of the monitoring standpipes observed at the site during the field work for the present investigation, and it is therefore assumed that the standpipes were destroyed during construction works following the previous investigations.

3. Site Description

The site is an irregular-shaped area of approximately 8540 m^2 in total, of which about 6170 m^2 comprises the Gunyama Park Stage 2 project sub-site and about 2370 m^2 comprises the George Julius Avenue North project sub-site (along the eastern perimeter). The site and sub-site areas are shown on Drawing 1 in Appendix B.

The site is in an area of generally flat topography and is bounded by the Gunyama Park Stage 1 site to the west, by an industrial property and public road to the north, and by commercial and residential developments to the east and south, respectively. The northern part of the site appears to form an elevated fill platform of up to approximately 1.5 m above the surrounding ground surface levels.

The ground surface over the northern part of the overall site is generally relatively flat bare ground exposing granular fill material with some concrete slabs and asphaltic concrete (AC) pavement surfaces near the northern perimeter, and is currently occupied by temporary sheds, spoil and building material stockpiles. The southern part of the site is mostly covered by bark mulch and a small area of lawn over its western portion rising gently to the south, which is occupied by a small shed with the tops of several steel screw piles exposed at the ground surface around it.

A shotcrete-lined stormwater detention basin and adjacent access road are located on the eastern side. The base of the concrete-lined detention basin and adjacent access road surface on the eastern side of the southern portion are about 2 – 3.5 m below the level of the adjacent site areas. The access road appears to be mostly surfaced with gravel and is locally covered by concrete in places. A sheet pile retaining wall supports adjacent land south of the George Julius Avenue sub-site, while the access road rises to the south to meet Epsom Road at the toe of the sheet pile retaining wall on its western side.

4. Published Data

4.1 Geology

The Geological Survey of NSW Seamless Geology Web Map indicates that the site is underlain by marine-deposited and aeolian-reworked coastal sand dunes of the Holocene Epoch.

The bedrock underlying these coastal deposits is indicated to be Ashfield Shale of the Triassic Period, though the approximate geological boundary with Hawkesbury Sandstone (also of the Triassic Period), is indicated to be located some 350 - 400 m east of the site. Ashfield Shale typically comprises black to

light grey shale and laminite. Hawkesbury Sandstone underlies Ashfield Shale and typically comprises medium to coarse-grained quartz sandstone with minor shale and laminite lenses.

4.2 Hydrogeology

The site is located within the '*Botany Sands'* groundwater source, according to the NSW Government *'Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011'* under Section 50 of the *'Water Management Act 2000'*. In particular, the site is located within *'Botany Management Zone 1'* of the Botany Sands groundwater source.

The groundwater system that operates within the unconsolidated sediments of the *'Botany Sandbed Aquifer'(BSA)*, as the 'Botany Sands' groundwater source is also known, is understood to be recharged primarily through direct rainfall infiltration with minor contributions attributable to irrigation, leaky service mains and flow from the underlying bedrock units. Secondary and subordinate components of recharge are further understood to be those which are derived from the surrounding bedrock geology and from those sourced from outside the basin, including irrigation water, leaky stormwater, water- and sewer-mains, and creeks draining off the surrounding basin geology.

The major component of groundwater flow within the Botany Sands of the Botany Basin is understood to be broadly southward below the site towards Botany Bay, the centre of the basin. In the northern part of the basin, where the site is located, water levels are reported to average a depth below ground surface level of generally less than 5 m, and the BSA is indicated to be generally unconfined.

4.3 Soil Landscape

The Soil Conservation Service of NSW 1:100 000 Soil Landscape Series Sheet 9130 (Sydney) indicates that the site is located within the 'Tuggerah' aeolian soil landscape unit. The map notes indicated that the 'Tuggerah' soil landscape is characterised by gently undulating to rolling coastal dune fields with local relief of up to 20 m and slope grades generally ranging from 1% to 10%, but occasionally up to 35%. The map notes further indicate that the soil profile comprises deep (i.e., greater than 2 m) podzols on dunes and podzol/humus podzol intergrades on swales.

4.4 Acid Sulfate Soils

The ASRIS national map of published acid sulfate soil mapping indicates that there is an extremely low probability of occurrence of acid sulfate soils (ASS) at the site, albeit with very low confidence. Based on the presence of fill, however, ASS may nevertheless be present at this site.

5. Field Work

5.1 Methods

The field work was carried out on 13 May 2023 and consisted of:

- A site inspection by a senior geotechnical engineer;
- Electromagnetic scanning and Ground Penetrating Radar (GPR) survey of proposed test locations to check for the presence of buried services and set out of boreholes;
- Drilling of eight (8) boreholes by a 5-tonne excavator using a 300 mm diameter auger attachment to depths of between 1.6 m and 3.0 m;
- Eight (8) Perth sand penetrometer (PSP) tests, at the rate of one PSP test per borehole, to depths ranging from 0.9 m to 3.6 m for assessment of in situ soil strength;
- Recovery of disturbed and bulk soil samples for logging and laboratory testing; and
- Backfilling of the boreholes with excavated spoil.

The locations of the boreholes are shown on Drawing 1 in Appendix B. The positions of the boreholes relative to the Map Grid of Australia (MGA2020 Zone 56) were obtained using a differential GPS receiver. The surface levels at the borehole locations were instead estimated relative to AHD using the NSW Government Spatial Services 1 m resolution Digital Elevation Model (DEM, © Department of Customer Service), obtained using a Leica ALS80 Light Detection and Ranging (LiDAR) sensor, and it should be noted that the DEM used has a reported accuracy of 0.3 m vertical and 0.8 m horizontal.

5.2 Results

Descriptions of the subsurface conditions encountered at each borehole are given on the logs in Appendix C, together with notes defining classification methods and descriptive terms.

In summary, the ground profile encountered in the boreholes generally comprised fill of (in order of decreasing volumetric significance) gravelly sand, clayey sand, sand, gravelly clay, clay, gravel, gravel and cobble mixtures, to the termination depth of all boreholes (1.6 m to 3.0 m depth). Surficial concrete 50 mm and 100 mm thick was encountered at BH201 and BH204, respectively.

The fill was variably compacted, ranging from loose to very dense for the granular portions and from stiff to hard for the clayey portions of the material.

Groundwater was not encountered in any borehole during drilling, and the boreholes were backfilled immediately following completion of drilling.

6. Laboratory Testing

Laboratory testing of selected disturbed and bulk samples recovered from the boreholes was carried out by NATA-accredited laboratories and consisted of:

- 10 soil aggressivity suite tests (pH, electrical conductivity, sulphate and chloride-ions);
- 20 acid sulfate soil (ASS) screening tests; and
- four, 4-day soaked, California bearing ratio (CBR) tests of subgrade bulk soil samples for pavement design parameters.

The details and results of the laboratory testing are provided on the test reports in Appendix D. The laboratory test results are briefly summarised in Tables 1 to 3.

Table 1: Summary of Laboratory Aggressivity Test Results

Test Location	Depth (m)	Soil Description	pH	SO_4 (mg/kg)	Cl (mg/kg)	EC (µS/m)
BH201	0.4 – 0.5	FILL/Gravelly CLAY	8.7	91	59	150
BH202	0.4 – 0.5	FILL/Gravelly SAND	7.1	140	47	230
BH203	0.4 – 0.5	FILL/Gravelly SAND	7.0	160	56	270
BH204	0.4 – 0.5	FILL/Gravelly SAND	7.9	130	20	210
BH205	0.4 – 0.5	FILL/SAND	8.3	61	<10	110
BH205	2.4 – 2.5	FILL/Clayey SAND	7.0	40	<10	77
BH206	2.4 – 2.5	FILL/SAND	6.1	140	<10	100
BH207	0.4 – 0.5	FILL/Gravelly SAND	9.1	43	<10	75
BH208	0.4 – 0.5	FILL/Gravelly SAND	8.7	10	<10	74
BH208	2.1 – 2.2	FILL/Clayey SAND	9.8	170	25	190

Notes: Cl = Chloride-ion concentration SO_4 = Sulphate-ion concentration EC = Electrical Conductivity

Table 2: Summary of ASS Screening Test Results

Test Location	Depth (m)	Soil Description	pH_F[1]	pH_{FOX}[2]	pH_{FOX} - pH_F	Reaction[3]
BH201	0.4 – 0.5	FILL/Gravelly CLAY	8.6	9.0	0.4	Volcanic
BH201	1.4 – 1.5	FILL/SAND	8.0	6.8	-1.2	Volcanic
BH202	0.4 – 0.5	FILL/Gravelly SAND	7.5	5.3	-2.2	Volcanic
BH202	1.4 – 1.5	FILL/Gravelly SAND	7.8	6.5	-1.3	Volcanic
BH203	0.4 – 0.5	FILL/Gravelly SAND	7.2	5.0	-2.2	Volcanic
BH203	1.4 – 1.5	FILL/Gravelly SAND	8.0	7.0	-1.0	Volcanic
BH204	0.4 – 0.5	FILL/Gravelly SAND	8.0	7.0	-1.0	Volcanic

Test Location	Depth (m)	Soil Description	pH_F[1]	pH_{FOX}[2]	pH_{FOX} - pH_F	Reaction[3]
BH204	1.4 – 1.5	FILL/Gravelly SAND	8.2	7.2	-1.0	Volcanic
BH204	2.4 – 2.5	FILL/Gravelly SAND	8.4	7.5	-0.9	Volcanic
BH205	0.4 – 0.5	FILL/SAND	8.3	5.5	-2.8	Volcanic
BH205	1.4 – 1.5	FILL/Clayey SAND	6.5	4.0	-1.5	Volcanic
BH205	2.4 – 2.5	FILL/Clayey SAND	6.7	2.6	-4.1	Volcanic
BH206	0.4 – 0.5	FILL/SAND	7.4	6.8	-0.6	Volcanic
BH206	1.4 – 1.5	FILL/SAND	6.2	3.7	-2.5	Volcanic
BH206	2.4 – 2.5	FILL/SAND	5.9	3.3	-2.6	Volcanic
BH207	0.4 – 0.5	FILL/Gravelly SAND	8.9	8.5	-0.4	Volcanic
BH207	1.4 – 1.5	FILL/Clayey SAND	8.1	6.5	-1.6	Volcanic
BH208	0.4 – 0.5	FILL/Gravelly SAND	8.6	7.9	-0.7	Volcanic
BH208	1.4 – 1.5	FILL/Clayey SAND	8.8	6.7	-2.1	Volcanic
BH208	2.1 – 2.2	FILL/Clayey SAND	8.3	6.6	-1.7	Volcanic

Notes: [1] Field pH test.
[2] Field peroxide test.
[3] Test not covered by NATA.

Table 3: Summary of CBR Test Results

Borehole	Depth (m)	Soil Description	FMC[1] (%)	CBR (%)	Swell (%)	SMDD[2] (t/m^3)	OMC[3] (%)
BH201	0.5 – 1.5	FILL/SAND	7.5	60	0.0	1.91	11.5
BH202	0.5 – 1.5	FILL/Gravelly SAND	15.4	20	0.0	1.71	16.0
BH203	0.5 – 1.5	FILL/Gravelly SAND	4.2	30	0.0	1.79	9.5
BH204	0.5 – 1.5	FILL/Gravelly SAND	6.6	40	0.0	1.82	12.5

[1] Field moisture content
[2] Standard maximum dry density
[3] Optimum moisture content

7. Geotechnical Model

The general ground profile interpreted from the previous and current boreholes and the previous CPTs undertaken within the subject site may be summarised as:

- **FILL** – variably but often moderately to well compacted gravelly sand with some rubble and cobbles to 2 – 2.5 m depth overlying sandy clay/clayey sand to typical depths 3 – 3.5 m. Concrete (slabs) of 50 mm and 100 mm thickness were encountered in some areas. The fill was overlying;
- **NATURAL SOILS** – loose to dense sands to depths of between 11.8 m and 16.0 m with some layers of firm peat/organic clay, and firm to hard clays to depths of between 20.3 m to 24.9 m depth; overlying
- **SANDSTONE** –extremely low to very low strength grading to low, medium or high strength from depths of between 20 m and 24.4 m, to the base of the cored bores at 26.5 m to 29.1 m depth.

The groundwater table ranges from depths of between 2.2 m and 4.3 m, i.e., from RL 15.6 m to RL 16.0 m, relative to the Australian height datum (AHD), within the subject site. It is noted, however, that groundwater levels can vary due to seasonal and climatic factors, and following periods of rainfall.

Interpreted geotechnical cross-sections through the site, based on the borehole logs and CPT results, are shown on Drawings 2 – 5 in Appendix B. It should be noted that the subsurface conditions shown on the cross-sections are accurate at the borehole and CPT locations only, that variations in subsurface conditions may occur between borehole locations, and that the interpreted strata boundaries shown are approximate and should be used as a guide only.

8. Proposed Development

Based on the available information provided by the client in the Brief, it is understood that:

- Stage 2 will complete the Gunyama Park project and will include a new amenities building, playground, landscaping and skate park, following earthworks estimated to be a maximum of around 1 m cut and fill; and
- the project will also deliver a portion of George Julius Avenue to the east of Gunyama Park.

It is further understood that the skate park is proposed to be constructed in-ground, requiring excavation of an additional 1.5 m below the overall cut depth proposed for the site (i.e., 3 m below present site levels). Based on discussion with CoS personnel, it is also understood that the proposed Design Subgrade Level (DSL) for George Julius Avenue North will be similar to the present site levels over the northern part of the site, and that additional fill of up to 1.5 m is to be placed over the existing ground surface in the southern part of the road alignment up to the required DSL, which is understood to range from about RL 19.7 m to RL 21.0 m AHD from north to south along the road alignment.

Details of foundation loadings for the amenities building and playground are not known at this stage, but it is assumed that building loads will be comparable to those of single storey dwellings or similar, light commercial buildings.

The concept plan of the proposed works is shown on Drawing 6 in Appendix B.

9. Comments

9.1 Site Classification

Due to the presence of uncontrolled, variably compacted and variable (though predominantly granular) fill to depths more than 800 mm, the site is “Class P” as defined in AS 2870 – 2011. Slabs and footings for the development should therefore be designed in accordance with engineering principles as recommended in AS 2870.

9.2 Site Preparation and Earthworks

It is understood that an overall cut of about 1 m is proposed for the Gunyama Park Stage 2 site, but that additional fill of up to 1 m is proposed at the southern end of the George Julius Avenue North site.

Prior to the commencement of bulk earthworks, all debris such as old footings, concrete slabs, buried pipes and the like, should be removed to sufficient depth to reduce the risk of inconvenience during the subsequent excavations and foundation works. The resulting excavations in areas to receive fill should be themselves backfilled to the same standard as that required for subsequent filling operations.

The area to receive fill in the southern part of the George Julius Avenue North site (i.e., which is to form the ‘foundation’ of the fill), should be prepared by first scarifying the surface to a minimum depth of 150 mm then moisture conditioning to within 2% of the optimum moisture content (at Standard compaction) of the existing subgrade material, before compacting the foundation to a minimum dry density ratio of 98% relative to Standard compaction. The ground surface should then be proof rolled using a minimum 12-tonne smooth drum roller in the presence of a geotechnical engineer, to check for areas of excessive deflection or heaving under rolling, which should be delineated by the engineer and treated in accordance with the advice of the geotechnical engineer. This would usually involve stripping of material to a nominal depth of, say, 600 mm and subsequently backfilling with clean granular fill compacted in maximum 300 mm (loose thickness) layers to a minimum dry density ratio of 98% relative to Standard compaction.

After the foundation preparation is completed in the area to receive fill, additional fill should be placed up to the DSL in horizontal layers not exceeding 300 mm loose thickness, with each layer compacted to a minimum dry density ratio of 98% Standard. It is recommended that the upper 0.5 m of fill subgrade to support the pavement (particularly where truck or other heavy vehicle movements are anticipated) be compacted to a minimum dry density ratio of 100% Standard. Where the fill material used is clayey, moisture content within the fill should be maintained within 2% of OMC (where OMC is the optimum moisture content at Standard compaction) during and after compaction.

Where sloping ground greater than 8H:1V forms the foundation for the engineered fill, the foundation of the fill should be further prepared but cutting in level benches with a minimum vertical height of 0.3 m to ensure compaction and interlocking, and to reduce the potential for instability between the existing soils and any newly placed controlled fill.

From an engineering perspective, it is possible that the existing fill material to be stripped from the northern half of the Gunyama Park site may be made suitable for re-use in an engineered fill, provided it is screened to remove all unsuitable and oversize (i.e., greater than 100 mm) material. This includes asphalt and concrete surfacing materials (ie. pavements), which would need to be crushed and mixed

with sand and gravels. It would be prudent to separate and not mix the upper sand/gravel (and pavement) fill materials from the underlying clayey soils, which would generally be an inferior source of earthfill for raising surface levels. Also, before re-use of the cut materials (including pavements) in an engineered fill subgrade is contemplated, however, it is recommended that contamination assessment be undertaken to confirm it is suitable for re-use from an environmental and Worker Health and Safety perspective.

For the section of existing subgrade for the proposed road pavement that is close to the DSL in the northern part of the George Julius Avenue North site, there would be an elevated risk of future pavement distress and reduced life due to the uncontrolled and variably compacted nature of the existing subgrade fill. Accordingly, the following options are suggested to manage the risks associated with the existing uncontrolled fill:

Low Level of Potential Risk – The option with maximum additional work but generally the lowest risk (of poor pavement performance) is to remove all the existing fill and test roll the underlying natural ground for soft or loose conditions. The fill material would then be screened to remove all coarse, oversize or deleterious material prior to replacement in layers of maximum 300 mm 'loose' thickness up to the required DSL. Each fill layer should be compacted under a 'Level 1' inspection and testing regime in accordance with AS 3798. Complexities with this approach include the possible need to undertake temporary dewatering to lower the groundwater table, so as to allow excavation and removal of material to typical depths of 3-3.5 m, which depending on the preceding weather conditions may be below the groundwater table.

Intermediate Level of Risk – It follows from the above that varying thicknesses of the existing fill may be removed, screened and recompacted (as for 'Low Level Risk' above), leaving an existing thickness of 'uncontrolled' fill in place (after proof rolling with a 12-tonne roller as above), with an inherent mid-level of risk of future subgrade movement. For example, excavation to 1.0 m below the design subgrade level followed by proof rolling (and geotechnical inspection) and replacement using granular (sand and/or gravel) material compacted in layers, as described above, would significantly reduce the risk of long-term pavement problems.

The above procedures will require geotechnical inspection and testing services to be employed during construction. It is further noted that the intermediate level risk option will potentially require ongoing maintenance where this option is adopted beneath a heavy pavement area. For lightly loaded pavements and hardstand areas, however, maintenance requirements should be generally in line with that expected of normal flexible (AC) pavements over a subgrade comprising deep variable fill (and natural soil) materials. A further reduction in risk (of poor pavement performance) for the intermediate option could be achieved by using impact rolling at 1 m depth below DSL, however, due to the expected constraints on vibration with respect to neighbouring structures and infrastructure, this approach has not been considered further.

9.3 Excavations

Excavations for the proposed structures and any remediation works required on the park site are likely to be limited to less than 3 m depth. Excavation will therefore primarily be required within fill and soils above the groundwater table which should be readily achievable using conventional earthmoving equipment such as a hydraulic excavator with bucket attachment, or bulldozers. The use of a hydraulic rock hammer or impact breaker will generally be required to break up surface concrete slabs and any buried obstructions like remnant footings, tanks or concrete slabs.

It should be noted that any off-site disposal of spoil will generally require assessment for re-use or classification in accordance with current *Waste Classification Guidelines* (NSW EPA, 2014).

9.4 Groundwater

Merrick (1985) and other researchers refer to rises of up to 2 m in the groundwater level within the Botany Sands Aquifer. It is therefore recommended that a design groundwater level of at least 1.5 m above the highest groundwater level (i.e., up to RL 19 m AHD) be adopted for the project to allow for increases in water levels that could occur from time to time following prolonged periods of wet weather and over the long term due to factors such as climate change.

Given the proposed in-ground skate park is to be excavated to about 3 m below the present site levels within the Gunyama Park Stage 2 footprint, the base of the skate park would have a founding level of about RL 17 m AHD. The skate park will therefore be exposed to buoyancy uplift forces. This will need to be considered in the design of the skate park by either providing sufficient ballast or permanent anchoring to resist uplift forces or by providing pressure relief valves in the base of the skate park. Also, due regard for waterproofing of concrete slabs, joints and other structural elements forming the skate park will generally be necessary.

9.5 Excavation Support

9.5.1 General

Vertical excavations in the existing fill and soil are not expected to be self-supporting. Temporary batters are expected to be feasible for supporting excavations on the site and should be not steeper than 1.5H:1V for cuts up to 3 m depth. This advice is provided on the assumption that excavation below the groundwater table is not required and that there is sufficient space to construct batters. Substantially flatter batter slopes would be required for excavation below the groundwater table.

9.5.2 Earth Pressures

Where temporary batters are not suitable, temporary and permanent retaining structures will be subjected to earth pressures from the ground surface down to the base of the excavation. Table 4 suggests material and strength parameters that could be used for the design of retaining structures.

Table 4: Material and Strength Parameters for Excavation Support Structures

Material	Bulk Density (kN/m^3)	Coefficient of Active Earth Pressure, Ka		Coefficient of Earth Pressure at Rest, Ko	Ultimate Passive Earth Pressure
		Temporary	Permanent		
Fill	20	0.3	0.4	0.6	K_p = 2.5
Sand, loose to medium dense	20	0.35	0.35	0.5	K_p = 3.0
Sand, dense to very dense	20	0.25	0.25	0.4	K_p = 3.5
Clay, stiff to very stiff	20	0.25	0.3	0.45	100 kPa
Sandstone, very low to low strength	22	0.1	0.15	0.20	2000 kPa

Cantilevered retaining structures could be designed by assuming a triangular lateral earth pressure distribution (increasing linearly with depth). A rectangular lateral earth pressure distribution could be assumed for retaining walls fully propped at the top and bottom. Lateral pressures due to surcharge loads from adjacent buildings, water pressures (behind the wall), road pavements and construction machinery should be included where relevant.

9.6 Footings and Foundations

In general, footings for any structure should be found on a bearing stratum with uniform engineering properties to reduce the risk of excessive differential settlements. For this reason, it is considered that the existing uncontrolled fill is generally not suitable for the (foundation) support of permanent structures.

Piles founded within the medium dense (or denser) sands, below the existing fill, could be used to support lightly loaded structures, such as the amenities building. End-bearing piles such as CFA piles, cased bored piles or steel screw piles could be used to support these structures and could be designed using the parameters provided in Table 5. A minimum pile length of 3 m should be provided when using these parameters.

Table 5: Design Parameters for Lightly Loaded End-Bearing Piles

Material Description	Allowable End-Bearing Pressure (kPa)[1]
Medium Dense Sand	400
Dense Sand	1000

Note: [1]Provided that weaker material is not present within 5 piles diameters of the pile toe

Settlement of a pile is dependent on the loads applied to the pile and the foundation conditions below the pile toe. The total settlement of a pile designed using the 'allowable' parameters provided in Table 5 would be expected to be less than 1% of the pile diameter. Differential settlements between adjacent piles loaded similarly would be expected to be less than 50% of the total settlements.

Due consideration should be given to fully suspending all building and structure loads on piles to reduce the potential for differential movement between piles and ground bearing slabs or similar 'floating' structures. Alternatively, lightweight structures and ground bearing slabs could potentially be supported on engineered fill constructed in accordance with the recommendations given in Section 9.2, with due consideration of the respective risks of long-term settlement problems.

Piles for piled rafts could be designed using the bearing (i.e., strength) parameters provided in Table 5. It is noted, however, that serviceability will probably be the governing design case for a piled raft and therefore settlement analysis of the composite pile/raft structure would be required to determine the effective capacity of the piles (i.e., the maximum load the piles can support before excessive settlement becomes an issue). Moduli of elasticity for various materials are provided in Table 6.

Table 6: Modulus of Elasticity Values for Various Materials

Material	Vertical Modulus of Elasticity, E_v (MPa)	Horizontal Modulus of Elasticity, E_h (MPa)
Uncontrolled Fill	10 to 20	7.5 to 15
Medium Dense Sand	30	22.5
Dense Sand	75	55
Sandstone, very low to low strength	100	75
Sandstone, low to medium strength	500	375
Sandstone, high strength	1000	700

In respect of the existing steel screw piles pre-installed at the proposed amenities building location, confirmation of their geotechnical capacity to support the proposed building should be sought from the piling contractor that installed them.

9.7 Seismicity

A Hazard Factor (*Z*) of 0.08 would be appropriate for the development site in accordance with Australian Standard AS 1170.4 – 2007 *Structural design actions – Part 4: Earthquake actions in Australia*. The site sub-soil class would be Class D_e based on the strengths of the materials encountered in the current and previous boreholes and CPTs.

9.8 Acid Sulfate Soils

Acid sulfate soils (ASS) are commonly used to label soils and sediments that contain iron sulfides, which, when oxidised by draining or exposure to air, form sulfuric acid. The main form of iron sulfide present is pyrite or iron di-sulfide (FeS_2). Monosulfides are also found in certain circumstances.

It is important to note that ASS, although commonly associated with estuarine muds and clays, may have any texture and are also found in sands and gravel beds. They may also be found in inland locations.

Acid sulfate soils are further subdivided into 'actual' and 'potential' ASS as follows:

- Actual Acid Sulfate Soils (AASS) are soils that are rich in sulfides already exposed to oxidation. These soils have pH values of 4 or less and are often identifiable by the presence of yellow (straw coloured) mottlings and irregular coatings, typical of the mineral jarosite.
- Potential Acid Sulfate Soils (PASS) are soils rich in sulfides that have not been exposed to air or oxidation. Their field pH values are generally greater than 4 and are commonly neutral (pH 7) or slightly alkaline. Any lowering of the water table, or exposure to air through excavation, will result in PASS generating acid and becoming ASS.

The results for ASS field screening tests were compared to the following criteria given in the relevant guidelines (see references given in Section 10):

- For pH_F (pH in water):
  - $pH_F \leq 4$ indicates AASS are present.
  - $4 < pH_F < 5.5$ indicates the soil is acidic. This may be because of limited oxidation of sulfides but may also be because of the presence of organic acids.
- For pH_{FOX} (pH in hydrogen peroxide):
  - $pH_{FOX} < 3$, plus a strong reaction with peroxide, plus a pH_{FOX} value of at least one pH unit below pH_F, strongly indicates a PASS. The higher the reaction, the lower the drop between pH_F and pH_{FOX}, and the lower the pH_{FOX} value, the higher the potential for PASS.
  - $3 < pH_{FOX} < 4$ is less positive.
  - $4 < pH_{FOX} < 5$ is neither positive nor negative, as some sulfides may be present in small quantities.
  - $pH_{FOX} > 5$ and little or no drop from pH_F to pH_{FOX} indicate little net acid generating ability. Acid generation can be buffered, however, by carbonate material in the samples (such as shell fragments).

Based on the screening test results and the soil descriptions given in the borehole logs, it is considered that PASS is likely to be present within the site soils.

While dewatering may not be required for the proposed development, given that PASS have been identified at the site and significant bulk earthworks are proposed, it is considered that an Acid Sulfate Soils Management Plan (in accordance with Acid Sulfate Soils Management Advisory Committee, *Acid Sulfate Soils Manual*, 1998) is required for the proposed development.

9.9 Soil Aggressivity

In accordance with Table 6.4.2(C) and Table 6.5.2(C) in AS 2159-2009, the results of the chemical laboratory testing indicate that the fill present at the site is generally 'non-aggressive' to both buried concrete and buried steel. Given the variability and composition of the existing fill and acid sulphate soils at the site, however, it would be considered prudent to assume at least 'mild' aggressivity for the existing fill.

Appropriate allowances for concrete cover, concrete strength, steel-section loss and steel protection requirements should be made in the design of buried structural elements, such as piles.

9.10 Pavements

The uncontrolled fill on the site will require site preparation in accordance with Section 9.2 to be made suitable for supporting pavements. Providing site preparation and earthworks are undertaken in accordance with the recommendations provided in this report, a design subgrade CBR of 8% is considered appropriate for the predominantly granular fill materials encountered during the investigation. This design value would generally not be appropriate where clay soils are within 1.0 m of the design subgrade level (DSL) and laboratory (CBR) testing would be necessary to determine a suitable value for design purposes.

10. References

AS 1170.4. (2007). *Structural Design Actions, Part 4: Earthquake Actions in Australia.* Reconfirmed 2018. Incorporating Amendments 1 & 2: Standards Australia.

AS 2159. (2009). *Piling - Design and Installation.* Standards Australia.

AS 2870. (2011). *Residential Slabs and Footings.* Standards Australia.

AS 3798. (2007). *Guidelines on Earthworks for Commercial and Residential Developments.* Standards Australia.

AS 4678. (2002). *Earth-retaining structures.* Standards Australia.

Hatley, R. K. (2004, September). Hyrdrogeology of the Botany Basin. *Australian Geomechanics, 39*(3), 73-90.

Stone, Y., Ahern, C. R., & Blunden, B. (1998). *Acid Sulfate Soil Manual.* Acid Sulfate Soil Management Committee (ASSMAC).

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Sampling and Identification Methods Manual.* Canberra ACT CC BY 4.0: Department of Agriculture and Water Resources.

11. Limitations

Douglas Partners (DP) has prepared this report for this project at 13 George Julius Avenue, Zetland, in accordance with DP's proposal dated 9 January 2023 and Work Change Notification No. 1 dated 4 May 2023 and acceptance received from Place Design Group Pty Ltd (PDG) dated 14 April and 8 May 2023, respectively. The work was carried out under DP's Conditions of Engagement pending agreement with PDG with respect to the alternative proposed Short Form Subconsultant Agreement. This report is provided for the exclusive use of PDG for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or another 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 both this investigation and previous investigation by DP (Ref: Project No. 73743, Document No. 1, Revision No. 2 dated 25 September 2015 and 73743.02.R.002.Rev0 dated 11 April 2016). 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 assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all 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 scope of work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials.

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

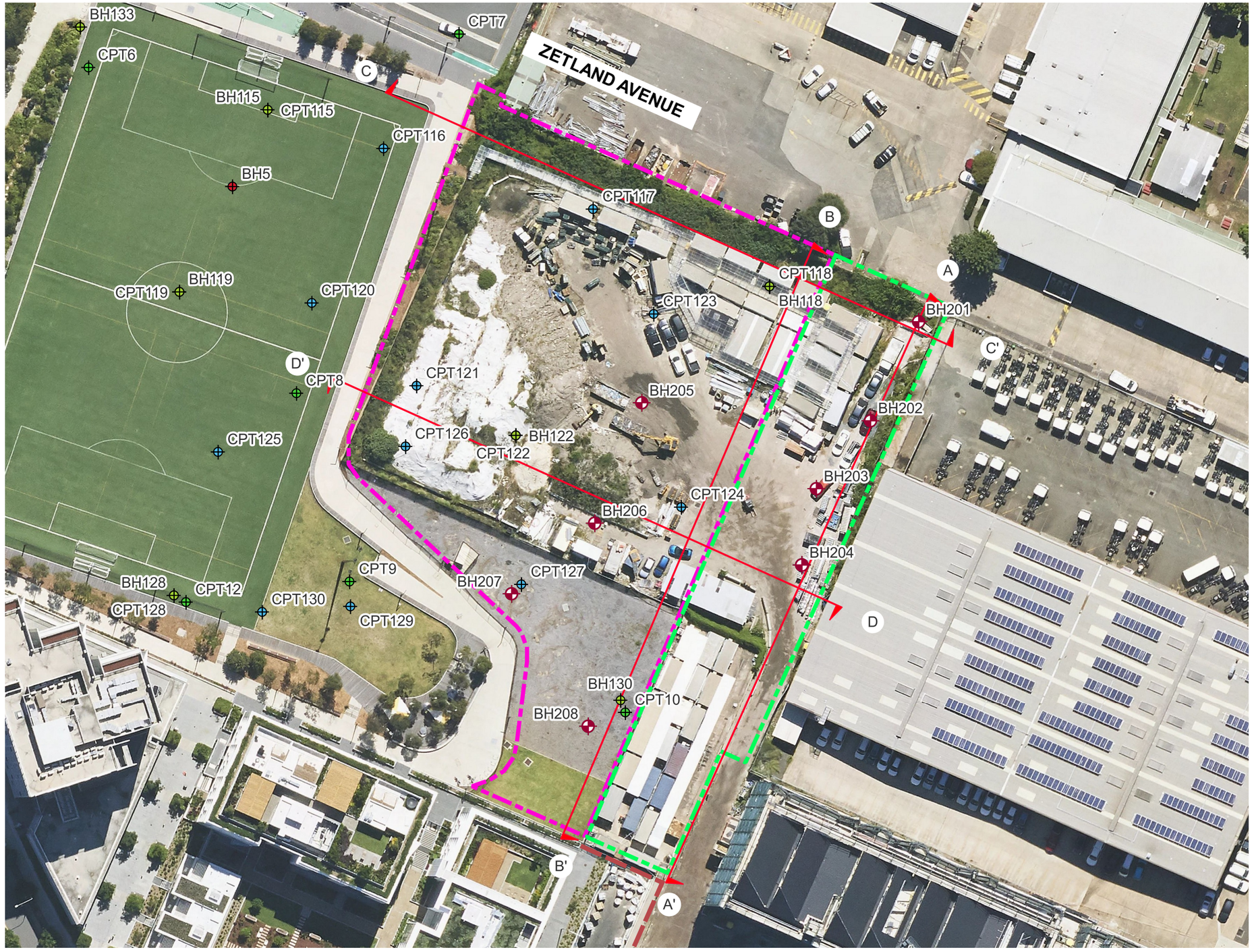
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate 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.

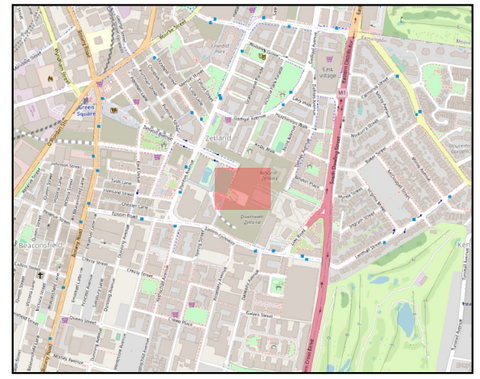
Site Inspection

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.

Appendix B

Drawings





Locality Plan

LEGEND

- Gunyama Park Stage 2
- George Ju us Avenue North
- Boreho e

73743 Test Locat ons (2015)

- Boreho e
- CPT

73743.02 Test Locat ons (2016)

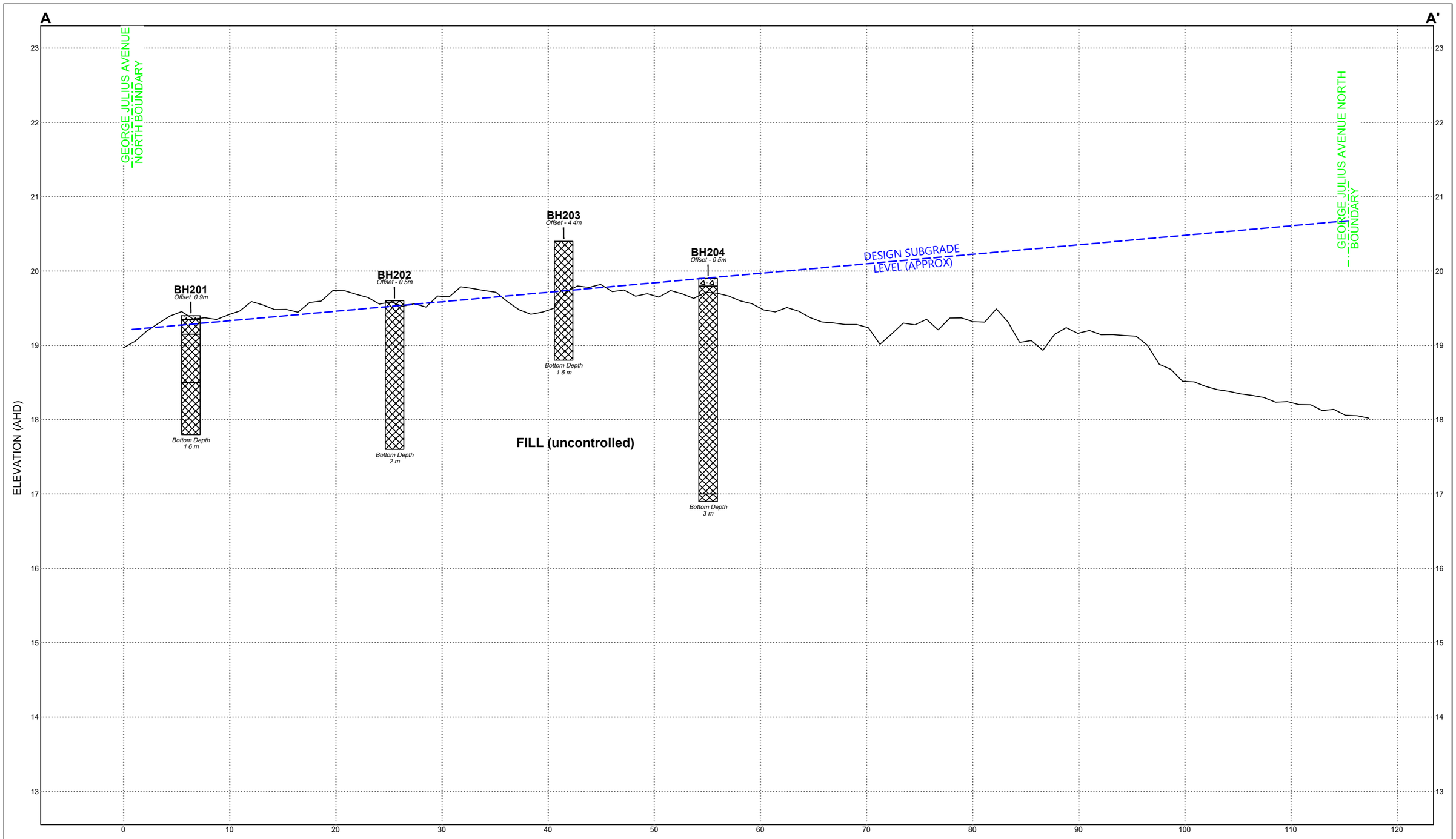
- Boreho e
- CPT
- Cross-Sect on
- Sheetp e Wa

NOTE:
1: Basemap from Metromaps (Dated 17 March 2023)

0 20 40 60 80 100 m

1:750 @ A3

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: P ace Des gn Group Pty Ltd	TITLE: **Test Location Plan** **Gunyama Park Stage 2 and George Julius Avenue North** **13 George Julius Avenue, Zetland**	PROJECT No: 73743.06
	OFFICE: Sydney / DRAWN BY: AK		DRAWING No: 1
	SCALE: 1:750 @ A3 / DATE: 27.06.2023		REVISION: 0



LEGEND

- Concrete
- Filling

NOTES:

1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

ROCK STRENGTH		SOIL CONSISTENCY		SOIL DENSITY	
EL	Extremely Low	vs	Very Soft	vl	Very Loose
VL	Very Low	s	Soft	l	Loose
L	Low	f	Firm	md	Medium Dense
M	Medium	st	Stiff	d	Dense
H	High	vst	Very Stiff	vd	Very Dense
		h	Hard		

0 7

Horizontal Scale (metres)

Vertical Exaggeration = 7.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Place Design Group Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section A - A'**	PROJECT No: 73743.06
OFFICE: Sydney	DRAWN BY: AK/MN/EC	**Gunyama Park Stage 2 and George Julius Avenue North**	DRAWING No: 2
SCALE: 1:350 (H) 1:50 (V) @ A3	DATE: 27.06.2023	**13 George Julius Avenue, Zetland**	REVISION: 0

B

B'

GUNYAMAY PARK STAGE 2 - BOUNDARY

GUNYAMAY PARK STAGE 2 - BOUNDARY

DESIGN SUBGRADE LEVEL (APPROX) FOR GEORGE JULIS AVENUE NORTH (BEHIND)

BH118
Offset - 4 1m

N = 8
s-f
N = 4
md
N = 19
refusal
refusal
vd
N = 33
refusal
refusal
vd
N = 30
st
N = 10
vd
refusal
f
N = 5
st / l-md
N = 10
md
N = 28
EL
VL
L-M
L-M
H

Bottom Depth 28 1 m

CPT124
Offset - 3 3m

md-d
vd
st-vst
vd
st-h
vd
vst
vst-h
st-vst

Bottom Depth 24 86 m

BH208
Offset - 3 4m

Bottom Depth 2 2 m

BH130
Offset 0 2m

N = 13
md
N = 17
N = 15
md
N = 12
N = 26
d
N = 46
N = 9
f-st
N = 8
refusal
vd
refusal
N = 7
st
N = 8
vst
N = 19
st
VL
refusal
VL
M & H
M
H
L
M

Bottom Depth 29 06 m

FILL (uncontrolled)

SAND

CLAY

SANDSTONE

ELEVATION (AHD)

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Clayey Sand
- Concrete
- Filling
- Peat
- Sand
- Sandstone coarse grained
- Sandstone fine grained
- Sandy Clay
- Silty Clay

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

ROCK STRENGTH	SOIL CONSISTENCY	SOIL DENSITY	TESTS / OTHER
EL - Extremely Low	vs - Very Soft	vl - Very Loose	N - Standard penetration test value
VL - Very Low	s - Soft	l - Loose	— ? — - Interpreted geotechnical boundary
L - Low	f - Firm	md - Medium Dense	▽ - Water level
M - Medium	st - Stiff	d - Dense	
H - High	vst - Very Stiff	vd - Very Dense	
	h - Hard		

0 7
Horizontal Scale (metres)
Vertical Exaggeration = 1.4

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Place Design Group Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section B - B'**	PROJECT No: 73743.06
OFFICE: Sydney	DRAWN BY: AK/MN/EC	**Gunyama Park Stage 2 and George Julius Avenue North**	DRAWING No: 3
SCALE: 1:350 (H) 1:250 (V) @ A3	DATE: 27.06.2023	**13 George Julius Avenue, Zetland**	REVISION: 0

C

C'

ELEVATION (AHD)

25 20 15 10 5 0 -5 -10 -15 -20

0 10 20 30 40 50 60 70 80 90 100 110 120

GUNYAMAY PARK STAGE 2 BOUNDARY

GUNYAMAY PARK STAGE 2 BOUNDARY

GEORGE JULIUS AVENUE NORTH BOUNDARY

CPT116
Offset - 9 5m
0 Qc 50
md-d
md/vst-h
d-vd
vd
md/st-vst
d-vd
vst
h
Bottom Depth 23 m

CPT117
Offset - 4 0m
0 Qc 50
md-d
vd
vst-vd
vd
st-vst
vst-h
Bottom Depth 22 9 m

BH118
Offset - 3 7m
N = 8
N = 4
md
N = 19
refusal
vd
refusal
N = 33
refusal
vd
refusal
N = 30
st
N = 10
vd
refusal
f
N = 5
st / l-md
N = 10
md
N = 28
EL
VL
L-M
L-M
H
Bottom Depth 28 1 m

BH201
Offset 1 0m
Bottom Depth 1 6 m

FILL (uncontrolled)

SAND

CLAY

SANDSTONE

DISTANCE ALONG PROFILE (m)

LEGEND

- Asphaltic Concrete
- Filling
- Peat
- Sand
- Sandy Clay
- Clayey Sand
- Sandstone fine grained
- Sandstone coarse grained
- Concrete
- Clay
- Silty Clay

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High

SOIL CONSISTENCY
vs - Very Soft
s - Soft
f - Firm
st - Stiff
vst - Very Stiff
h - Hard

SOIL DENSITY
vl - Very Loose
l - Loose
md - Medium Dense
d - Dense
vd - Very Dense

TESTS / OTHER
N - Standard penetration test value
— ? — — - Interpreted geotechnical boundary
▽ - Water level

0 7
Horizontal Scale (metres)
Vertical Exaggeration = 1.4

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Place Design Group Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section C - C'**	PROJECT No: 73743.06
OFFICE: Sydney	DRAWN BY: AK/MN/EC	**Gunyama Park Stage 2 and George Julius Avenue North**	DRAWING No: 4
SCALE: 1:350 (H) 1:250 (V) @ A3	DATE: 27.06.2023	**13 George Julius Avenue, Zetland**	REVISION: 0

D

D'

GEORGE JULIUS AVENUE NORTH BOUNDARY

GUNYAMAY PARK STAGE 2 BOUNDARY

GUNYAMAY PARK STAGE 2 BOUNDARY

BH204
Offset - 3 9m
Bottom Depth 3 m

CPT124
Offset - 4 9m
Bottom Depth 24 86 m

BH206
Offset 4 4m
Bottom Depth 3 m

BH122
Offset - 4 4m
Bottom Depth 26 5 m

CPT126
Offset 5 6m
Bottom Depth 20 88 m

FILL (uncontrolled)

SAND

CLAY

SANDSTONE

ELEVATION (AHD)

DISTANCE ALONG PROFILE (m)

LEGEND

- Filling
- Sand
- Clay
- Sandstone fine grained
- Sandstone coarse grained
- Concrete
- Silty Clay
- Silty Sand

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High

SOIL CONSISTENCY
vs - Very Soft
s - Soft
f - Firm
st - Stiff
vst - Very Stiff
h - Hard

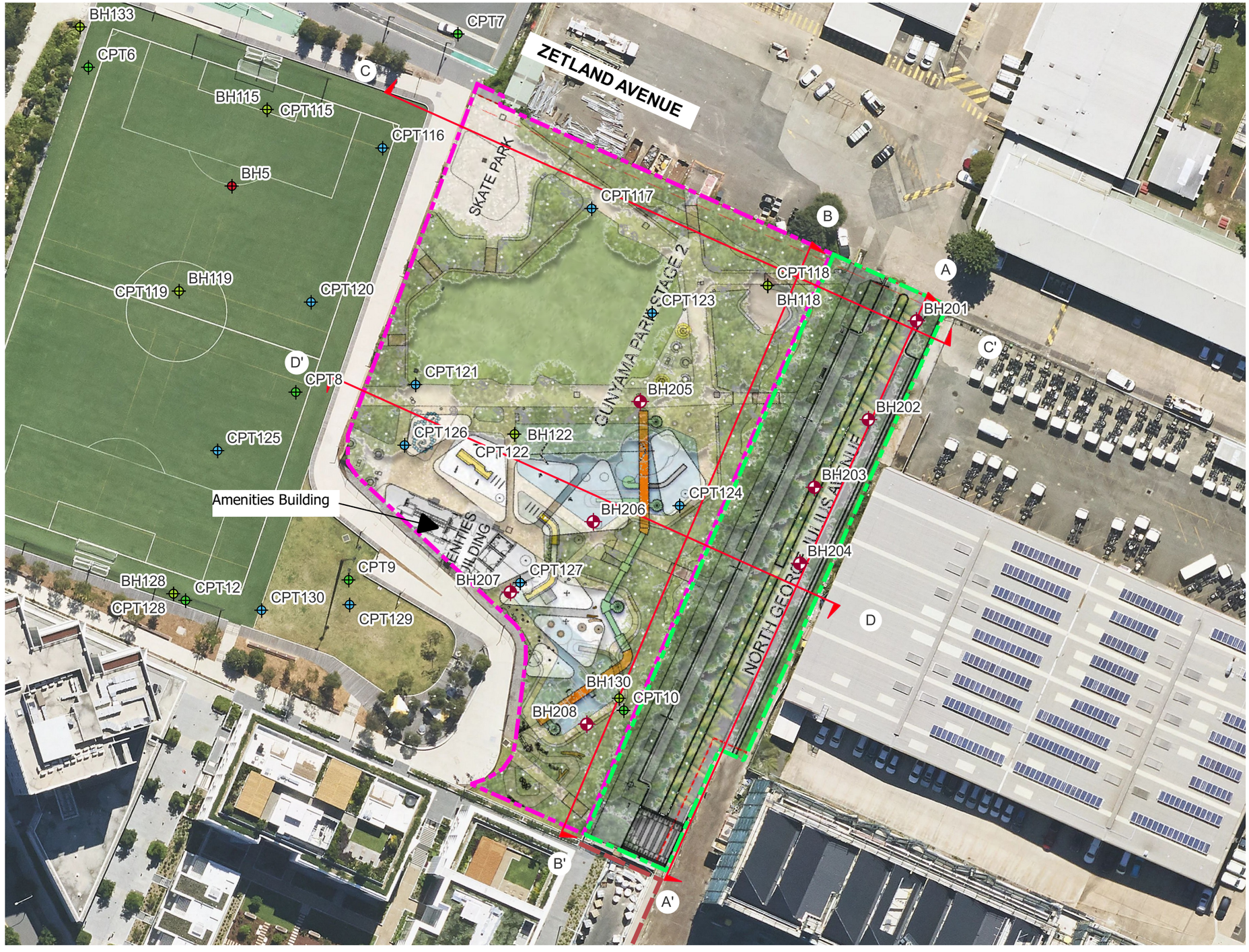
SOIL DENSITY
vl - Very Loose
l - Loose
md - Medium Dense
d - Dense
vd - Very Dense

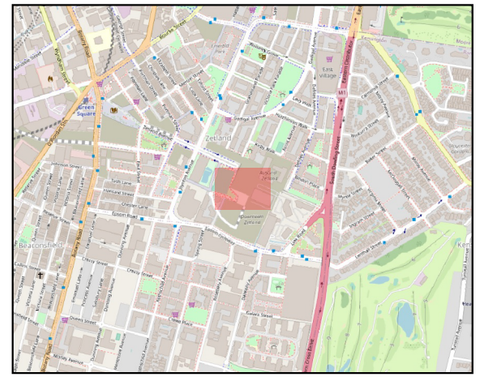
TESTS / OTHER
N - Standard penetration test value
- Interpreted geotechnical boundary
- Water level

Horizontal Scale (metres)
Vertical Exaggeration = 1.4

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Place Design Group Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section D - D'**	PROJECT No: 73743.06
OFFICE: Sydney	DRAWN BY: AK/MN/EC	**Gunyama Park Stage 2 and George Julius Avenue North**	DRAWING No: 5
SCALE: 1:350 (H) 1:250 (V) @ A3	DATE: 27.06.2023	**13 George Julius Avenue, Zetland**	REVISION: 0





Locality Plan

LEGEND

- Gunyama Park Stage 2
- George Ju us Avenue North
- Boreho e

73743 Test Locat ons (2015)

- Boreho e
- CPT

73743.02 Test Locat ons (2016)

- Boreho e
- CPT
- Cross-Sect on
- Sheetp e Wa

NOTE:
1: Basemap from Metromaps (Dated 17 March 2023)

0 20 40 60 80 100 m

1:750 @ A3

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: P ace Des gn Group Pty Ltd		TITLE: **Plan of Proposed Works**	PROJECT No: 73743.06
OFFICE: Sydney	DRAWN BY: AK	**Gunyama Park Stage 2 and George Julius Avenue North**	DRAWING No: 6
SCALE: 1:750 @ A3	DATE: 03.07.2023	**13 George Julius Avenue, Zetland**	REVISION: 1

Appendix C

Field Work Results

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.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

The soil group symbol classifications are given as follows based on two major soil divisions:

- Coarse-grained soils
- Fine-grained soils

Major Divisions				Description	
				Group Symbol*	Typical Name
COARSE-GRAINED SOILS	More than 65% by dry mass, (excluding that larger than 63 mm) is greater than 0.075 mm	GRAVEL	More than 50% of coarse grains are greater than 2.36 mm	GW	Well graded gravels and gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
		GRAVELLY SOILS		GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clay gravels, gravel-sand-clay mixtures.
		SAND	More than 50% of coarse grains are less than 2.36 mm	SW	Well graded sands and gravelly sands, little or no fines.
				SP	Poorly graded sands and gravelly sands, little or no fines.
		SANDY SOILS		SM	Silty sand, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.

* For coarse grained soils where the fines content is between 5% and 12%, the soil shall be given a dual classification eg GP-GM.

FINE-GRAINED SOILS	More than 35% by dry mass, (excluding that larger than 63 mm) is less than 0.075 mm	Liquid Limit less than 35%	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity
		35% <LL< 50%	CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Liquid Limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity.
			Pt	Peat muck and other highly organic soils.

Soil Descriptions

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	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

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

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay, trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand, trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand, trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

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
Friable	Fr	-

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	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

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;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈LL' (i.e. near the liquid limit).
- 'Wet' or 'w >LL' (i.e. wet of the liquid limit).

Symbols & Abbreviations

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

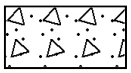
Symbols & Abbreviations

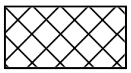
Graphic Symbols for Soil and Rock

General

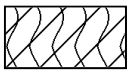

Asphalt

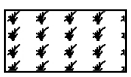

Road base

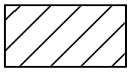

Concrete

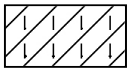

Filling

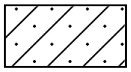
Soils


Topsoil

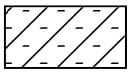

Peat

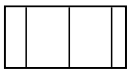

Clay

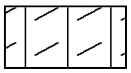

Silty clay

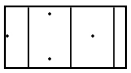

Sandy clay

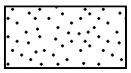

Gravelly clay

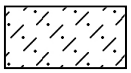

Shaly clay

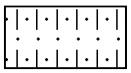

Silt


Clayey silt


Sandy silt

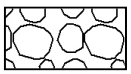

Sand

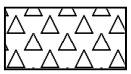

Clayey sand


Silty sand


Gravel

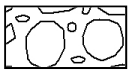

Sandy gravel


Cobbles, boulders

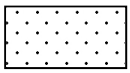

Talus

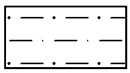
Sedimentary Rocks

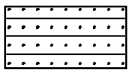

Boulder conglomerate

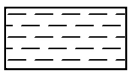

Conglomerate


Conglomeratic sandstone

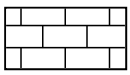

Sandstone


Siltstone

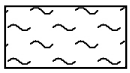

Laminite

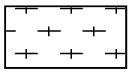

Mudstone, claystone, shale

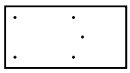

Coal


Limestone

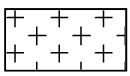
Metamorphic Rocks

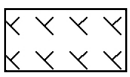

Slate, phyllite, schist

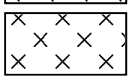

Gneiss

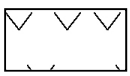

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Place Design Group Pty Ltd
PROJECT: George Julius Avenue
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 19.4 AHD
EASTING: 334497
NORTHING: 6246458
DIP/AZIMUTH: 90°/--

BORE No: BH201
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
19	0.05	CONCRETE: 50mm thick							
		FILL/Gravelly SAND: fine to medium, dark grey, fine to medium sandstone and igneous gravel, moist, sulphuric odour		A	0.1 0.2				
	0.25	FILL/Gravelly CLAY: low to medium plasticity, pale brown, sub-angular to sub-rounded, fine to medium, sandstone and igneous gravel, w>PL, apparently in hard condition, slight chemical odour		A/E	0.4 0.5				
	0.9	FILL/SAND: fine to medium, brown, with fine to medium sandstone and igneous gravel, moist, apparently dense to very dense, slight chemical odour		A B	0.9 1.0				
18				A/E	1.4 1.5				
	1.6	Bore discontinued at 1.6m Refusal in fill/concrete							

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 1.60m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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: Place Design Group Pty Ltd
PROJECT: George Julius Avenue
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 19.6 AHD
EASTING: 334488
NORTHING: 6246441
DIP/AZIMUTH: 90°/--

BORE No: BH202
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
19	0	FILL/Gravelly SAND: fine to medium, dark grey, fine to medium sub-rounded sandstone and igneous gravel, apparently in loose to medium dense condition, moist, sulphuric odour		A	0.1 0.2				
		At 0.40m: trace plastic and sandstone cobble		A/E	0.4 0.5				
	1	Below 0.90m: trace clay		A B	0.9 1.0				1
		Below 1.05m: apparently in medium dense to dense condition							
18				A/E	1.4 1.5				
		Below 2.1m: apparently in loose condition Below 2.4m: apparently in medium dense condition Below 3.3m: apparently in dense condition		A	1.9				
	2	2 0 Bore discontinued at 2.0m - due to auger refusal on rubble and hole collapse (continued as PSP test to 3.6m)			2.0				2
17	3								3
16	4								4
15									

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 2.00m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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: Place Design Group Pty Ltd
PROJECT: George Julius Avenue
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 20.4 AHD
EASTING: 334478
NORTHING: 6246428
DIP/AZIMUTH: 90°/--

BORE No: BH203
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
20	0	FILL/Gravelly SAND: fine, brown, fine to medium sub-rounded sandstone and igneous gravel, apparently in medium dense to dense condition, dry, slight chemical odour		A	0.1				
					0.2				
				A/E	0.4				
					0.5				
					0.9				
19	1			A B	1.0				
				A/E	1.4				
	1.6				1.5				
		Bore discontinued at 1.6m Refusal in fill							

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 1.60m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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: Place Design Group Pty Ltd
PROJECT: George Julius Avenue
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 19.9 AHD
EASTING: 334476
NORTHING: 6246414
DIP/AZIMUTH: 90°/--

BORE No: BH204
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
19	0.1	CONCRETE: 100mm thick			0.1				
		FILL/Gravelly SAND: fine, brown, sub-rounded sandstone gravel, dry, slight chemical odour		A	0.2				
		At 0.40m: trace brick fragment		A/E	0.4 0.5				
	1			A B	0.9 1.0				1
				A/E	1.4 1.5				
18		Below 1.90m: yellow and brown		A	1.9 2.0				
	2			A/E	2.4 2.5				2
17	2.9	At 2.8m: trace sandstone and concrete cobbles Below 2.85m: apparently in loose condition		A	2.9				
	3 3.0	FILL/Clayey SAND: fine to medium, dark grey, low plasticity clay, trace sandstone gravel, apparently in medium dense to very dense condition, moist, sulphuric odour			3.0				3
		Below 3.0m: apparently in dense condition Bore discontinued at 3.0m Termination Depth Reached							
16	4								4
15									

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 3.00m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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: Place Design Group Pty Ltd
PROJECT: Gunyama Park Stage 2
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 20.2 AHD
EASTING: 334447
NORTHING: 6246444
DIP/AZIMUTH: 90°/--

BORE No: BH205
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
20	0.1	FILL/SAND: fine to medium, pale brown, dry			0.1				
	0.2	FILL/GRAVEL AND COBBLES: sandstone and igneous gravel and cobbles		A	0.2				
		FILL/SAND: fine to medium, pale brown, with fine to medium sandstone gravel, moist, apparently dense, organic odour		A/E	0.4 0.5				
		Below 0.9m: wet		A	0.9 1.0				
19	1.2	FILL/Clayey SAND: fine to medium, dark grey, low plasticity clay, trace igneous and sandstone gravel, wet, apparently loose to dense, organic odour		A/E	1.4 1.5				
		At 1.90m: sandstone cobble		A	1.9 2.0				
18				A/E	2.4 2.5				
				A	2.9				
	3.0	Bore discontinued at 3.0m Termination Depth Reached			3.0				
17									
16									

1 2 3 4 5 10 15 20

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 3.00m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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: Place Design Group Pty Ltd
PROJECT: Gunyama Park Stage 2
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 20.5 AHD
EASTING: 334438
NORTHING: 6246422
DIP/AZIMUTH: 90°/--

BORE No: BH206
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
20	0.3	FILL/Gravelly SAND: fine to medium, grey-brown, fine to medium sub-rounded sandstone gravels, moist, apparently dense, organic odour		A	0.1–0.2				
		FILL/SAND: fine, dark grey, trace gravels, moist, apparently dense, sulphuric odour		A/E	0.4–0.5				
				A	0.9–1.0				
19				A/E	1.4–1.5				
				A	1.9–2.0				
18		At 2.40m: trace steel reinforcing bar		A/E	2.4–2.5				
	2.6	FILL/CLAY: medium plasticity, grey, with fine to medium sand, w~PL, apparently stiff, sulphuric odour		A	2.9				
17	3.0	Bore discontinued at 3.0m Termination Depth Reached			3.0				

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 3.00m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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: Place Design Group Pty Ltd
PROJECT: Gunyama Park Stage 2
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 20.1 AHD
EASTING: 334423
NORTHING: 6246409
DIP/AZIMUTH: 90°/--

BORE No: BH207
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
20	0.1	FILL/GRAVEL: fine to medium rounded to sub-rounded sandstone gravel, with bark mulch		A	0.1				
		FILL/Gravelly SAND: fine to medium, pale brown and yellow, sub-rounded to rounded, fine to medium, sandstone gravels, moist, apparently dense			0.2				
				A/E	0.4				
		At 0.50m: layer of geofabric			0.5				
	0.8	FILL/Clayey SAND: fine to medium, dark grey, low plasticity clay, with fine to medium igneous and sandstone gravel, moist, apparently very dense, sulphuric odour		A	0.9				
19	1				1.0				1
		Below 1.40m: wet		A/E	1.4				
					1.5				
				A	1.7				
	1.8	Bore discontinued at 1.8m Refusal in fill/concrete			1.8				
18	2								2
17	3								3
16	4								4

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 1.80m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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: Place Design Group Pty Ltd
PROJECT: Gunyama Park Stage 2
LOCATION: 13 George Julius Avenue, Zetland

SURFACE LEVEL: 24.2 AHD
EASTING: 334437
NORTHING: 6246385
DIP/AZIMUTH: 90°/--

BORE No: BH208
PROJECT No: 73743.06
DATE: 13/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
24	0.1	FILL/GRAVEL: fine to medium rounded to sub-rounded sandstone gravels, with bark mulch		A	0.1				
		FILL/Gravelly SAND: fine to medium, pale brown and yellow, sub-rounded to rounded, fine to medium sandstone gravel, moist, apparently dense			0.2				
				A/E	0.4				
		At 0.50m: layer of geofabric			0.5				
	0.7	FILL/Clayey SAND: fine to medium, dark grey, low plasticity clay, trace igneous gravel, moist, apparently very dense, sulphuric odour							
23	1	At 0.90m: sandstone cobble		A	0.9				1
					1.0				
		Below 1.40m: wet		A/E	1.4				
					1.5				
22	2	Below 1.90m: with sandstone cobbles and gravel		A	1.9				2
					2.0				
				A/E	2.1				
	2 2	Bore discontinued at 2.2m Refusal in fill/rubble			2.2				
21	3								3
20	4								4

RIG: 5.5 tonne CAT excavator **DRILLER:** A & A Hire Service **LOGGED:** AN **CASING:** Uncased

TYPE OF BORING: 300mm diameter SFA (TC-bit) to 2.20m

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Location coordinates are in MGA2020 Zone 56.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	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

Appendix D

Laboratory Test Results

Material Test Report

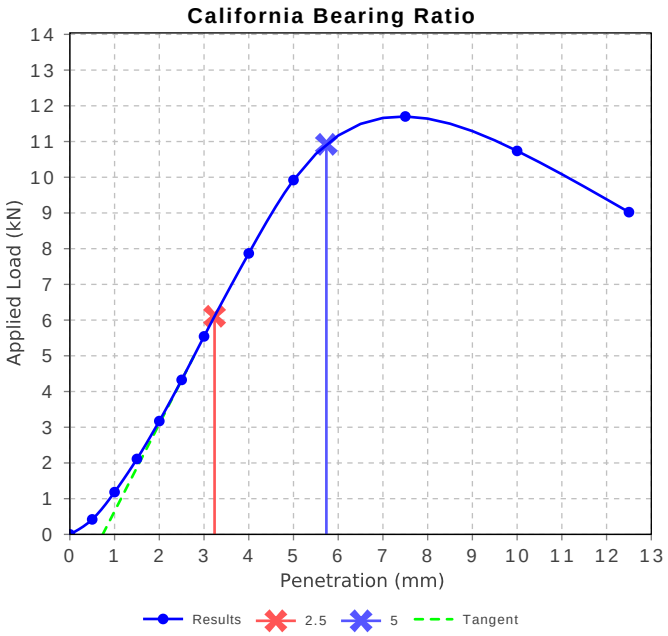
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Email: andrew.hutchings@douglaspartners.com.au

Accredited for compliance wi h ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **73743.06-1**
Issue Number: 1
Date Issued: 06/06/2023
Client: Place Design Group Pty Ltd
3b/830-832 Elizabeth Street, Waterloo NSW 2017
Contact: Tim Field
Project Number: 73743.06
Project Name: Gunyama Park Stage 2 and George Julius Avenue North
Project Location: 13 George Julius Avenue, Zetland NSW
Work Request: 10526
Sample Number: SY-10526A
Date Sampled: 13/05/2023
Dates Tested: 22/05/2023 - 05/06/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **BH201 (0.5-1.5m)**
Material: FILL/SAND: fine to medium, brown, with fine to medium sandstone and igneous gravel

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**60**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.91		
Optimum Moisture Content (%)	11.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	97.0		
Dry Density after Soaking (t/m^3)	1.92		
Field Moisture Content (%)	7.5		
Moisture Content at Placement (%)	11.3		
Moisture Content Top 30mm (%)	12.4		
Moisture Content Rest of Sample (%)	12.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	140.4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	9.2		



Material Test Report

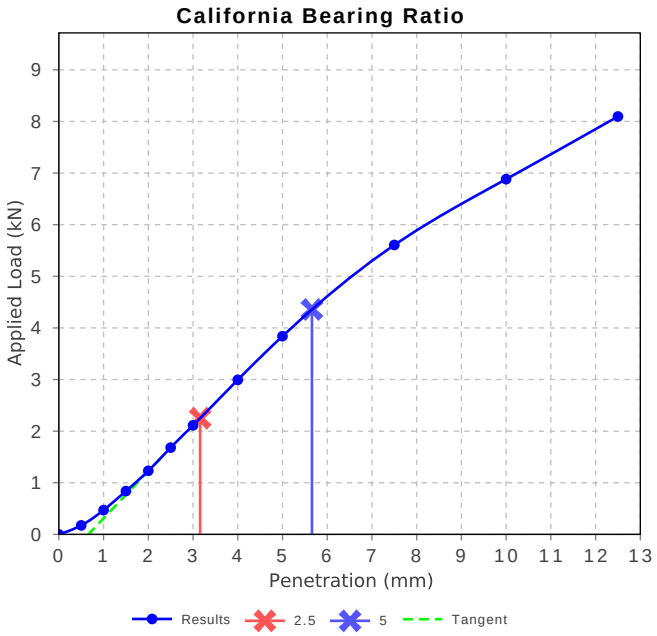
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Email: andrew.hutchings@douglaspartners.com.au

Accredited for compliance wi h ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **73743.06-1**
Issue Number: 1
Date Issued: 06/06/2023
Client: Place Design Group Pty Ltd
3b/830-832 Elizabeth Street, Waterloo NSW 2017
Contact: Tim Field
Project Number: 73743.06
Project Name: Gunyama Park Stage 2 and George Julius Avenue North
Project Location: 13 George Julius Avenue, Zetland NSW
Work Request: 10526
Sample Number: SY-10526B
Date Sampled: 13/05/2023
Dates Tested: 22/05/2023 - 05/06/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **BH202 (0.5-1.5m)**
Material: FILL/Gravelly SAND: fine to medium, dark grey, fine to medium sub-rounded sandstone, trace clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**20**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.71		
Optimum Moisture Content (%)	16.0		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	97.0		
Dry Density after Soaking (t/m^3)	1.72		
Field Moisture Content (%)	15.4		
Moisture Content at Placement (%)	15.5		
Moisture Content Top 30mm (%)	16.8		
Moisture Content Rest of Sample (%)	16.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	141.7		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	11.7		



Material Test Report

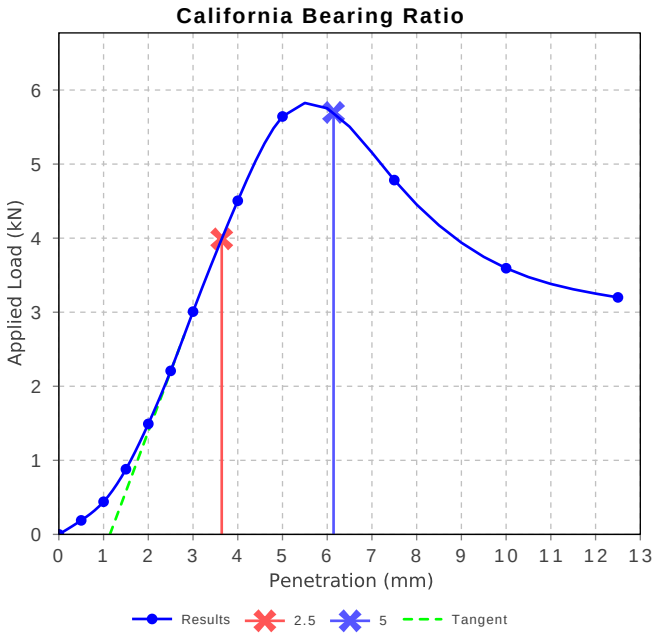
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Email: andrew.hutchings@douglaspartners.com.au

Accredited for compliance wi h ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **73743.06-1**
Issue Number: 1
Date Issued: 06/06/2023
Client: Place Design Group Pty Ltd
3b/830-832 Elizabeth Street, Waterloo NSW 2017
Contact: Tim Field
Project Number: 73743.06
Project Name: Gunyama Park Stage 2 and George Julius Avenue North
Project Location: 13 George Julius Avenue, Zetland NSW
Work Request: 10526
Sample Number: SY-10526C
Date Sampled: 13/05/2023
Dates Tested: 22/05/2023 - 05/06/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **BH203 (0.5-1.5m)**
Material: FILL/Gravelly SAND: fine, brown, fine to medium sub-rounded sandstone and trace igneous gravel

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**30**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.79		
Optimum Moisture Content (%)	9.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.78		
Field Moisture Content (%)	4.2		
Moisture Content at Placement (%)	9.5		
Moisture Content Top 30mm (%)	14.2		
Moisture Content Rest of Sample (%)	14.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	141.8		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	8.4		



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
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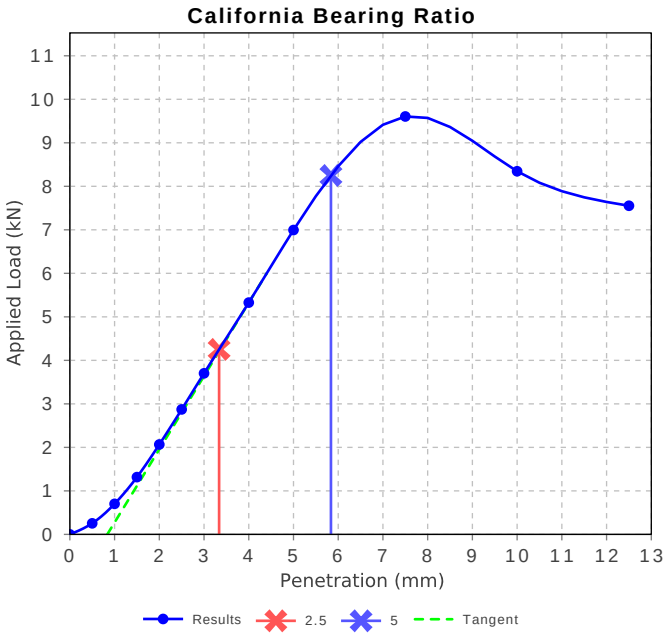
Accredited for compliance wi h ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **73743.06-1**
Issue Number: 1
Date Issued: 06/06/2023
Client: Place Design Group Pty Ltd
3b/830-832 Elizabeth Street, Waterloo NSW 2017
Contact: Tim Field
Project Number: 73743.06
Project Name: Gunyama Park Stage 2 and George Julius Avenue North
Project Location: 13 George Julius Avenue, Zetland NSW
Work Request: 10526
Sample Number: SY-10526D
Date Sampled: 13/05/2023
Dates Tested: 22/05/2023 - 05/06/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **BH204 (0.5-1.5m)**
Material: FILL/Gravelly SAND: fine, brown, sub-rounded sandstone gravel

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**40**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.82		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.82		
Field Moisture Content (%)	6.6		
Moisture Content at Placement (%)	12.5		
Moisture Content Top 30mm (%)	13.8		
Moisture Content Rest of Sample (%)	13.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	142.0		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	7.4		



Envirolab Services Pty Ltd
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www.envirolab.com.au

CERTIFICATE OF ANALYSIS 323631

Client Details

Client	Douglas Partners Pty Ltd
Attention	Atha Kapitanof
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**73743.06, Gunyama Park Zetland**
Number of Samples	20 Soil
Date samples received	19/05/2023
Date completed instructions received	19/05/2023

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	29/05/2023
Date of Issue	25/05/2023

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Soil Aggressivity						
Our Reference		323631-1	323631-3	323631-5	323631-7	323631-10
Your Reference	UNITS	BH201	BH202	BH203	BH204	BH205
Depth		0.4-0.5m	0.4-0.5m	0.4-0.5m	0.4-0.5m	0.4-0.5m
Date Sampled		13/05/2023	13/05/2023	13/05/2023	13/05/2023	13/05/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
pH 1:5 soil:water	pH Units	8.7	7.1	7.0	7.9	8.3
Electrical Conductivity 1:5 soil:water	µS/cm	150	230	270	210	110
Chloride, Cl 1:5 soil:water	mg/kg	59	47	56	20	<10
Sulphate, SO4 1:5 soil:water	mg/kg	91	140	160	130	61

Soil Aggressivity						
Our Reference		323631-12	323631-15	323631-16	323631-18	323631-20
Your Reference	UNITS	BH205	BH206	BH207	BH208	BH208
Depth		2.4-2.5m	2.4-2.5m	0.4-0.5m	0.4-0.5m	2.1-2.2m
Date Sampled		13/05/2023	13/05/2023	13/05/2023	13/05/2023	13/05/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
pH 1:5 soil:water	pH Units	7.0	6.1	9.1	8.7	9.8
Electrical Conductivity 1:5 soil:water	µS/cm	77	100	75	74	190
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10	<10	25
Sulphate, SO4 1:5 soil:water	mg/kg	40	140	43	10	170

sPOCAS field test						
Our Reference		323631-1	323631-2	323631-3	323631-4	323631-5
Your Reference	UNITS	BH201	BH201	BH202	BH202	BH203
Depth		0.4-0.5m	1.4-1.5m	0.4-0.5m	1.4-1.5m	0.4-0.5m
Date Sampled		13/05/2023	13/05/2023	13/05/2023	13/05/2023	13/05/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
Date analysed	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
pH_F (field pH test)	pH Units	8.6	8.0	7.5	7.8	7.2
pH_{FOX} (field peroxide test)	pH Units	9.0	6.8	5.3	6.5	5.0
Reaction Rate*	-	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction

sPOCAS field test						
Our Reference		323631-6	323631-7	323631-8	323631-9	323631-10
Your Reference	UNITS	BH203	BH204	BH204	BH204	BH205
Depth		1.4-1.5m	0.4-0.5m	1.4-1.5m	2.4-2.5m	0.4-0.5m
Date Sampled		13/05/2023	13/05/2023	13/05/2023	13/05/2023	13/05/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
Date analysed	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
pH_F (field pH test)	pH Units	8.0	8.0	8.2	8.4	8.3
pH_{FOX} (field peroxide test)	pH Units	7.0	7.0	7.2	7.5	5.5
Reaction Rate*	-	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction

sPOCAS field test						
Our Reference		323631-11	323631-12	323631-13	323631-14	323631-15
Your Reference	UNITS	BH205	BH205	BH206	BH206	BH206
Depth		1.4-1.5m	2.4-2.5m	0.4-0.5m	1.4-1.5m	2.4-2.5m
Date Sampled		13/05/2023	13/05/2023	13/05/2023	13/05/2023	13/05/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
Date analysed	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
pH_F (field pH test)	pH Units	6.5	6.7	7.4	6.2	5.9
pH_{FOX} (field peroxide test)	pH Units	4.0	2.6	6.8	3.7	3.3
Reaction Rate*	-	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction

sPOCAS field test						
Our Reference		323631-16	323631-17	323631-18	323631-19	323631-20
Your Reference	UNITS	BH207	BH207	BH208	BH208	BH208
Depth		0.4-0.5m	1.4-1.5m	0.4-0.5m	1.4-1.5m	2.1-2.2m
Date Sampled		13/05/2023	13/05/2023	13/05/2023	13/05/2023	13/05/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
Date analysed	-	24/05/2023	24/05/2023	24/05/2023	24/05/2023	24/05/2023
pH_F (field pH test)	pH Units	8.9	8.1	8.6	8.8	8.3
pH_{FOX} (field peroxide test)	pH Units	8.5	6.5	7.9	6.7	6.6
Reaction Rate*	-	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction	Volcanic reaction

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
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.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Soil Aggressivity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	8.7	8.9	2	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	150	160	6	107	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	59	81	31	105	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	91	100	9	112	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			24/05/2023	[NT]	[NT]	[NT]	[NT]	24/05/2023	[NT]
Date analysed	-			24/05/2023	[NT]	[NT]	[NT]	[NT]	24/05/2023	[NT]
pH_F (field pH test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
pH_{FOX} (field peroxide test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	[NT]	[NT]	[NT]	[NT]	24/05/2023	[NT]
Date analysed	-			[NT]	[NT]	[NT]	[NT]	[NT]	24/05/2023	[NT]
pH_F (field pH test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]
pH_{FOX} (field peroxide test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	73743.06	**Suburb:**	Zetland	**To:**	Envirolab
Project Name:	Gunyama Park Stage 2	**Order Number**			
Project Manager:	Atha Kapitanof	**Sampler:**	Angus Nelson	**Attn:**	Aileen
Emails:	atha.kapitanof@douglaspartners.com.au			**Phone:**	0418 747 383
Date Required:	Standard			**Email:**	
Prior Storage:	Shelved	Do samples contain 'potential' HBM?	Yes (If YES, then handle, transport and store in accordance with FPM HAZID)		

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: ASS Screening	Analytes: Soil Aggressivity	Analytes	Analytes	Analytes	Analytes	Analytes	Analytes	Notes/preservation
BH201, 0.4-0.5m	1	13/05/23	S	G	X	X							
BH201, 1.4-1.5m	2	13/05/23	S	G	X								
BH202, 0.4-0.5m	3	13/05/23	S	G	X	X							
BH202, 1.4-1.5m	4	13/05/23	S	G	X								
BH203, 0.4-0.5m	5	13/05/23	S	G	X	X							
BH203, 1.4-1.5m	6	13/05/23	S	G	X								
BH204, 0.4-0.5m	7	13/05/23	S	G	X	X							
BH204, 1.4-1.5m	8	13/05/23	S	G	X								
BH204, 2.4-2.5m	9	13/05/23	S	G	X								
BH205, 0.4-0.5m	10	13/05/23	S	G	X	X							
BH205, 1.4-1.5m	11	13/05/23	S	G	X								
BH205, 2.4-2.5m	12	13/05/23	S	G	X	X							
BH206, 0.4-0.5m	13	13/05/23	S	G	X								
BH206, 1.4-1.5m	14	13/05/23	S	G	X								
BH206, 2.4-2.5m	15	13/05/23	S	G	X	X							
PQL (S) mg/kg												**ANZECC PQLs req'd for all water analytes** ☐	

RB
12 Ashley St
Chatswood NSW
Ph: (02) 9...
32368
Date Received: 19/5/23
Time Received: 1615
Received By: AW
Temp: Cool/Ambient
Cooling: Ice/Ice pack
Security: Intact

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Lab Report/Reference No:

Metals to Analyse: 8HM unless specified here:

Total number of samples in container: **Relinquished by** **Transported to laboratory by:**

Send Results to Douglas Partners Pty Ltd **Address** **Phone:** **Fax:**

Signed: **Received by:** AW **Date & Time:** 1615 19/5/23.

		Date	Sample Type	Container Type	Analytes

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	73743.06	**Suburb:** Zetland	**To:** Envirolab
Project Name:	Gunyama Park Stage 2	**Order Number**	
Project Manager:	Atha Kapitanof	**Sampler:** Angus Nelson	**Attn:** Aileen
Emails:	atha.kapitanof@douglaspartners.com.au		**Phone:** 0418 747 383
Date Required:	Standard		**Email:**
Prior Storage:	Shelved	Do samples contain 'potential' HBM? Yes (If YES, then handle, transport and store in accordance with FPM HAZID)	

Sample ID	Lab ID	Sampling D	S - soil W - water	G - glass P - plastic	ASS Screening		Soil Aggressivit v							Notes/preservation
BH207, 0.4-0.5m	16	13/05/23	S	G	X		X							
BH207, 1.4-1.5m	17	13/05/23	S	G	X									
BH208, 0.4-0.5m	18	13/05/23	S	G	X		X							
BH208, 1.4-1.5m	19	13/05/23	S	G	X									
BH208, 2.1-2.2m	20	13/05/23	S	G	X		X							
PQL (S) mg/kg														**ANZECC PQLs req'd for all water analytes** ☐

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No:

Total number of samples in container:	**Relinquished by**	**Transported to laboratory by:**
Send Results to Douglas Partners Pty Ltd	**Address**	**Phone:** **Fax:**
Signed:	**Received by:** EW	**Date & Time:** 16/5. 19/5/23

323631
EW

Appendix E

Previous Field Work Results

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it 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 Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

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

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

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 occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or stronger. 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

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

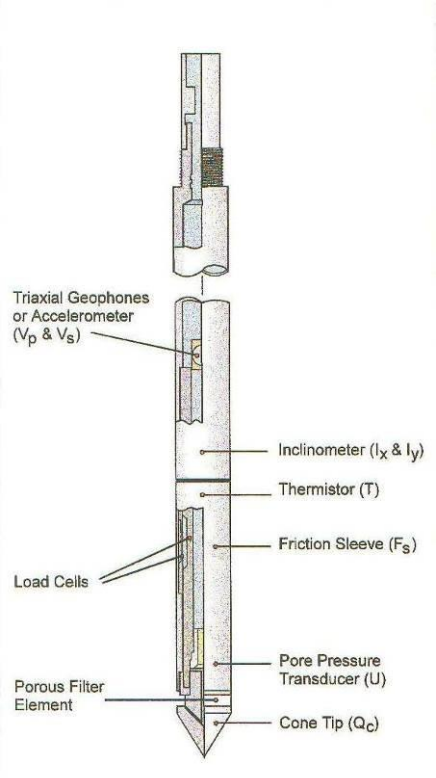

Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

Cone Penetration Tests

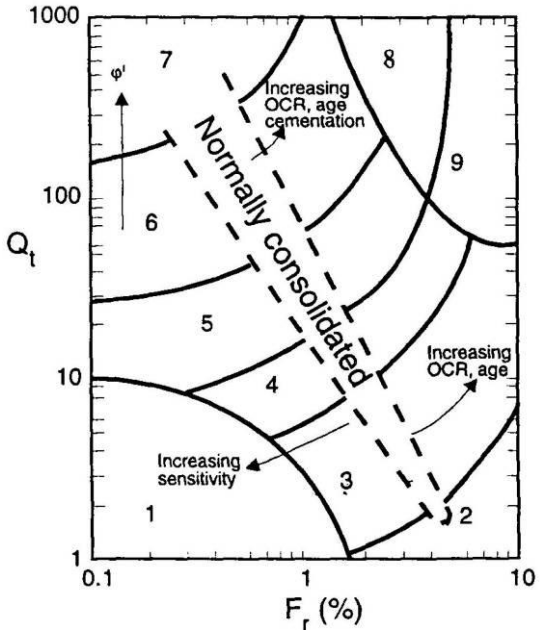

Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

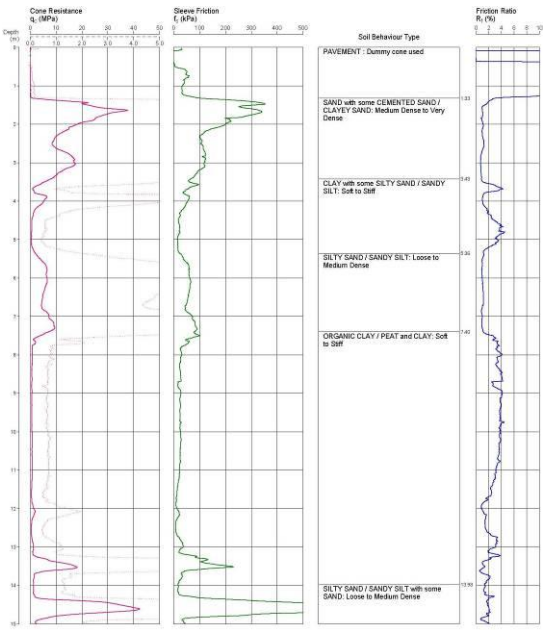

Figure 4: Sample Cone Plot

BOREHOLE LOG

CLIENT: C ty of Sydney Counc
PROJECT: Gunyama Park Aquat c and Recreat on Centre
LOCATION: Joynton Ave, Zet and

SURFACE LEVEL: 20.3 AHD
EASTING: 334470
NORTHING: 6246464
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 1 OF 3

RL	Depth (m)	Descr pt on of Strata	Type	Core Rec. %	RQD %	Test Resu ts & Comments
20	0 02	ASPHALT	A			
	0 4	FILLING ght grey brown, crushed sandstone, med um to coarse sand and f ne to med um sandstone grave , damp	A			
19	1	FILLING dark brown, s ty sand w th some c ay and f ne to med um basa t c grave , hum d	S			3 3 5 N = 8
18	2					
	2 5	PEAT soft to f rm, dark grey b ack, sandy peat, mo st	S			2 2 2 N = 4
17	2 95	SAND med um dense, ght grey, f ne sand, mo st 3.0m: becom ng wet				
16	4		S			2 8 11 N = 19
15	5					
	5 5	SAND very dense, brown to dark brown, f ne sand	S			20/100mm refusal
14	6					
13	7		S			13 25/100mm refusal
12	8					
11	9		S			10 15 18 N = 33
	10 0					

Graphic Log: Ex Low / Very Low / Low / Medium / High / Very High / Ex High
Degree of Weather ng: EW HW MW SW FS FR
Water: 0.01 0.05 0.10 0.50 1.00
Fracture Spac ng (m)
D scont nu t es: B - Bedding J - Joint S - Shear F - Fault

RIG: Scout 2 **DRILLER:** WG/GT **LOGGED:** JHS/PO/JES **CASING:** HW to 5.5m

TYPE OF BORING: So d f ght auger (TC b t) to 5.5m; Rotary to 21.8m; NMLC Cor ng to 28.1m

WATER OBSERVATIONS: Free groundwater observed at 3.0m wh st auger ng

REMARKS: Standp pe nsta ed to 12.0m (screen 3.0 12.0m; grave 2.5 12.0m; benton te 1.0 1.2m; backf to GL w th Gat c cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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: C ty of Sydney Counc
PROJECT: Gunyama Park Aquat c and Recreat on Centre
LOCATION: Joynton Ave, Zet and

SURFACE LEVEL: 20.3 AHD
EASTING: 334470
NORTHING: 6246464
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 2 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spac ng (m) (0.01, 0.05, 0.10, 0.50, 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
10		SAND very dense, ght grey, f ne to med um sand							S			22 25/100mm refusal
9	11											
8		11.5 13.45m: w th pockets of organ c c ay/peat							S			15 22/100mm refusal
	12											
7	13								S			15 19 11 N = 30
6	14											
	14 5	SANDY CLAY st ff, dark grey, f ne to med um sandy c ay							S			1 3 7 N = 10
5	15 14 95	SAND very dense, pa e grey wh te, f ne sand										
	16								S			25/100mm refusal
4	16 1	SANDY CLAY f rm, grey pa e grey, f ne to med um sandy c ay										
3	17								S			1 3 2 N = 5
2	18 17 95	SANDY CLAY/CLAYEY SAND pa e grey, f ne to med um sandy c ay/c ayey sand										
1	19								S			3 4 6 N = 10
	19 45	CLAYEY SAND med um dense, mott ed pa e grey wh te, orange brown, red brown, f ne to med um c ayey sand										

RIG: Scout 2 **DRILLER:** WG/GT **LOGGED:** JHS/PO/JES **CASING:** HW to 5.5m

TYPE OF BORING: So d f ght auger (TC b t) to 5.5m; Rotary to 21.8m; NMLC Cor ng to 28.1m

WATER OBSERVATIONS: Free groundwater observed at 3.0m wh st auger ng

REMARKS: Standp pe nsta ed to 12.0m (screen 3.0 12.0m; grave 2.5 12.0m; benton te 1.0 1.2m; backf to GL w th Gat c cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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: C ty of Sydney Counc
PROJECT: Gunyama Park Aquat c and Recreat on Centre
LOCATION: Joynton Ave, Zet and

SURFACE LEVEL: 20.3 AHD
EASTING: 334470
NORTHING: 6246464
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 3 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spac ng (m) (0.01, 0.05, 0.10, 0.50, 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
0		CLAYEY SAND med um dense, mott ed pa e grey wh te, orange brown, red brown, f ne to med um c ayey sand *(continued)*										
									S			5 12 16 N = 28
-1	20 95	SANDSTONE extreme y ow strength, ght grey brown, f ne to med um gra ned sandstone						Note Unless otherwise stated rock is fractured along rough planar bedding dipping 0°- 10°				
	21 8	SANDSTONE very ow strength, h gh y weathered, s ght y fractured, grey, med um gra ned sandstone w th ronstone bands						22 87m B0° pl ro fe	C	100	0	
-2	22											
	23											
-3												
	24							24 07m B0° pl ro				
-4	24 35	SANDSTONE ow to med um strength, moderate y weathered, fractured, grey mott ed ye ow, med um gra ned sandstone w th ronstone bands						24 28m Cs 50mm 24 35-24 85m J80° partially he pl ro fe 24 51m B5° pl ro fe 24 64m B5° pl ro fe				PL(A) = 0 4
	25 25 0							24 9m B0° pl ro				PL(A) = 0 5
-5		SANDSTONE med um and ow to med um strength, fresh, s ght y fractured, ght grey, med um gra ned sandstone						25 36-25 78m B (x4) 0°-5° pl ro cly 25 6-25 66m J45° pl ro cly	C	100	90	PL(A) = 0 4
	26							25 93m J55° pl ro cly 26m J50° pl ro cly				PL(A) = 0 3
-6								26 31m J60° pl ro cly 26 43m Cs 200mm				
	27 27 0	SANDSTONE h gh strength, fresh, s ght y fractured, ght grey, med um to coarse gra ned sandstone						26 73-26 9m J80° pl ro 27 16m J50° pl ro cly 27 45m B0°- 5° pl ro cly 27 59m B0° - 5° pl ro cly 3mm	C	100	95	PL(A) = 0 4
-7								27 93m B0° pl ro cly				PL(A) = 1 2
	28 28 1	Bore d scont nued at 28.1m										
-8	29											
-9												

RIG: Scout 2 **DRILLER:** WG/GT **LOGGED:** JHS/PO/JES **CASING:** HW to 5.5m

TYPE OF BORING: So d f ght auger (TC b t) to 5.5m; Rotary to 21.8m; NMLC Cor ng to 28.1m

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SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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: C ty of Sydney Counc
PROJECT: Gunyama Park Aquat c and Recreat on Centre
LOCATION: Joynton Ave, Zet and

SURFACE LEVEL: 19.9 AHD
EASTING: 334424
NORTHING: 6246437
DIP/AZIMUTH: 90°/--

BORE No: 122
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 1 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spac ng (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
19	0	FILLING apparent y we compacted, ght grey brown, f ne to coarse sand and f ne to coarse, grave f ng, mo st							A			
	0.5											
	1	FILLING dark grey brown, s ty sand f ng w th root ets and a trace of med um to coarse grave , mo st 1.0 1.45m: as above							S			2 4 4 N = 8
18	2								S			2 3 2 N = 5
17	3					▼						
16	4								S			3 6 8 N = 14
	4.0	SAND med um dense, ght brown to brown, f ne sand, mo st										
15	5											
14	6								S			6 8 10 N = 18
13	7								S			6 8 9 N = 17
12	8											
11	9								S			10 13 16 N = 29
10	10.0											

RIG: Scout 2 **DRILLER:** GT **LOGGED:** PO/JEH/SI **CASING:** HW to 5.5m

TYPE OF BORING: So d f ght auger (TC b t) to 5.5m; Rotary to 20.3m; NMLC Cor ng to 26.5m

WATER OBSERVATIONS: Free groundwater observed at 3.0m wh st auger ng

REMARKS: Standp pe nsta ed to 12.0m (screen 3.0 12.0m; grave 2.5 12.0m; benton te 1.0 1.2m; backf to GL w th Gat c cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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: C ty of Sydney Counc
PROJECT: Gunyama Park Aquat c and Recreat on Centre
LOCATION: Joynton Ave, Zet and

SURFACE LEVEL: 19.9 AHD
EASTING: 334424
NORTHING: 6246437
DIP/AZIMUTH: 90°/--

BORE No: 122
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 2 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spac ng (m) (0.01, 0.05, 0.10, 0.50, 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
9	11	SAND med um dense, brown to dark brown, f ne gra ned sand							S			5 10 14 N = 24
8	12	11.5 11.95m: grey							S			6 7 7 N = 14
7	13								S			1 6 7 N = 13
6	14	14.5 14.9m: pa e grey wh te, very dense							S			8 19 25/100mm refusal
5	15											
4	16 16 0	CLAY st ff, b ack dark grey c ay							S			4 4 6 N = 10
3	17											
2	18	17.5 17.45m: ght grey, f rm							S			1 2 4 N = 6
1	19	19.0 19.45m: very st ff							S			5 12 14 N = 26
0												

RIG: Scout 2 **DRILLER:** GT **LOGGED:** PO/JEH/SI **CASING:** HW to 5.5m

TYPE OF BORING: So d f ght auger (TC b t) to 5.5m; Rotary to 20.3m; NMLC Cor ng to 26.5m

WATER OBSERVATIONS: Free groundwater observed at 3.0m wh st auger ng

REMARKS: Standp pe nsta ed to 12.0m (screen 3.0 12.0m; grave 2.5 12.0m; benton te 1.0 1.2m; backf to GL w th Gat c cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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: C ty of Sydney Counc
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BORE No: 122
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 3 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spac ng (m) (0.01, 0.05, 0.10, 0.50, 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
		CLAY st ff, b ack dark grey c ay *(continued)*						Note Unless otherwise stated rock is fractured				
	20 3	SANDSTONE very ow strength, h gh y weathered, s ght y fractured, ght grey, f ne to med um gra ned sandstone						along rough planar bedding dipping 0°- 10°				
	20 65	SANDSTONE ow to med um then med um strength, s ght y weathered, s ght y fractured, ght grey brown, med um gra ned sandstone						20 88m J80° pl ro cly 20 92m B5°- 10° pl ro cly 21 03m B0° pl ro cly 21 16m J60° pl ro cly 21 2m B0°- 5° pl ro cly 21 46-21 77m J80° pl he 22 22-22 45m J80° pl ro cly	C	100	88	PL(A) = 0 3 PL(A) = 0 4 PL(A) = 0 7
	23 25	SANDSTONE very ow then ow to med um strength, s ght y weathered, unbroken, ght grey brown, med um gra ned sandstone						23 06-23 18m J85° pl he 23 2m J45° pl ro cly 23 39m B0° pl ro cly fe	C	100	82	PL(A) = 0 1 PL(A) = 0 2
									C	100	100	PL(A) = 0 3 PL(A) = 0 3
								26 46m B10° pl ro cly fe				
	26 5	Bore d scont nued at 26.5m										

RIG: Scout 2 **DRILLER:** GT **LOGGED:** PO/JEH/Sl **CASING:** HW to 5.5m

TYPE OF BORING: So d f ght auger (TC b t) to 5.5m; Rotary to 20.3m; NMLC Cor ng to 26.5m

WATER OBSERVATIONS: Free groundwater observed at 3.0m wh st auger ng

REMARKS: Standp pe nsta ed to 12.0m (screen 3.0 12.0m; grave 2.5 12.0m; benton te 1.0 1.2m; backf to GL w th Gat c cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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: C ty of Sydney Counc
PROJECT: Gunyama Park Aquat c and Recreat on Centre
LOCATION: Joynton Ave, Zet and

SURFACE LEVEL: 18.5 AHD
EASTING: 334443
NORTHING: 6246389
DIP/AZIMUTH: 90°/--

BORE No: 130
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 1 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spac ng (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
18	0 15	CONCRETE							A			
	0 3	FILLING dark grey, f ne to coarse sand and f ne to coarse grave , mo st							A			
	1	FILLING brown, med um to coarse sandy c ay w th some f ne sandstone grave , mo st							A			
									S			2 5 8 N = 13
17	1 4	FILLING dark grey, med um to coarse sand w th some f ne sandstone grave , mo st										
	2											
16	2 5	SAND med um dense, brown, f ne to med um sand, mo st							S			4 8 9 N = 17
	2 95	SAND med um dense, wh te and brown to dark brown, f ne sand										
15	3											
		3.8m: becom ng wet				▼						
	4								S			4 7 8 N = 15
14												
	5											
13									S			2 7 5 N = 12
	6											
12												
	7	7.0 7.45m: s ght y s ty, brown							S			8 13 13 N = 26
11	8											
	8 0	SAND dense, ght grey brown, f ne to med um gra ned sand										
10									S			12 21 25 N = 46
	9											
9	10 0											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN/PO **CASING:** HW to 5.5m

TYPE OF BORING: D atube to 0.15m; So d f ght auger (TC b t) to 5.5m; Rotary to 20.5m; NMLC Cor ng to 29.1m

WATER OBSERVATIONS: Free groundwater observed at 3.8m wh st auger ng

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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: C ty of Sydney Counc
PROJECT: Gunyama Park Aquat c and Recreat on Centre
LOCATION: Joynton Ave, Zet and

SURFACE LEVEL: 18.5 AHD
EASTING: 334443
NORTHING: 6246389
DIP/AZIMUTH: 90°/--

BORE No: 130
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 2 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spac ng (m) (0.01, 0.05, 0.10, 0.50, 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
8		PEAT f rm to st ff, dark brown to b ack, peaty c ay							S			10 6 3 N = 9
7	11											
6	12								S			3 4 4 N = 8
5	13 13 0	SAND very dense, brown, f ne sand							S			13 24 25/100mm refusal
4	14	14.5 14.6m: as above, mott ed wh te and brown							S			25/100mm refusal
3	15											
2	16 16 0	CLAY f rm, dark grey b ack c ay							S			3 3 4 N = 7
2	16 45	SANDY CLAY st ff, pa e grey wh te, f ne to coarse sandy c ay										
1	17								S			3 3 5 N = 8
0	18											
-1	19	19.0 19.45m: very st ff							S			5 9 10 N = 19

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN/PO **CASING:** HW to 5.5m

TYPE OF BORING: D atube to 0.15m; So d f ght auger (TC b t) to 5.5m; Rotary to 20.5m; NMLC Cor ng to 29.1m

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Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

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SURFACE LEVEL: 18.5 AHD
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BORE No: 130
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 3 OF 3

RL	Depth (m)	Descr pt on of Strata	Degree of Weather ng (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spac ng (m) (0.01, 0.05, 0.10, 0.50, 1.00)	D scont nu t es (B - Bedding J - Joint S - Shear F - Fault)	Samp ng & In S tu Test ng: Type	Core Rec. %	RQD %	Test Resu ts & Comments
-2	20 5	SANDY CLAY st ff, pa e grey wh te, f ne to coarse sandy c ay *(continued)*						Note Unless otherwise stated rock is fractured along rough planar bedding dipping 0°- 10°				
	20 65	SANDSTONE very ow strength, ght grey, f ne to med um gra ned sandstone							S			25/150mm refusal
-3	21	SANDSTONE very ow strength, h gh y weathered, fractured and s ght y fractured, grey brown, med um to coarse sandstone w th some extreme y ow strength bands (poss b e weathered dyke)						20 8m Cs 20mm 20 99m Cs 10mm 21 17-22 15m J (x3) 40°- 45° pl sm cln 21 82m J45° pl sm cly				
	22							22 15m Cs 150mm	C	100	41	PL(A) = 0 1
-4	22 4	SANDSTONE med um and h gh strength, moderate y weathered, fractured, red and grey brown, med um to coarse sandstone w th ronstone bands and some extreme y ow and very ow strength sandstone bands						22 49m Cs 10mm 22 56m J45°- 80° st ro fe st 22 8m Cs 30mm 22 83m fg 70mm 22 83 &23 64m J80°- 90° cu ro cln 23 0-23 46m J45°- 90° un ro fe st 23 42m Cs 40mm				PL(A) = 0 4
-5	23											
-6	24 24 0							23 86-23 96m J45°- 90° cu ro cly 23 96m CORE LOSS 40mm 24 0-24 06m J0°- 90° un ro cln 24 32m Cs 110mm 24 43-24 56m J90° pl ro cly	C	97	84	PL(A) = 0 2
-7	25							24 53 24 78m J30°- 45° cu ro cln 24 78m Cs 50mm 25 15-25 46m J75°- 90° pl partially he 25 46m Ds 30mm 25 5-25 8m J (x3) pl ro cly				PL(A) = 1 2
-8	26 26 05	SANDSTONE med um strength, s ght y weathered, s ght y fractured, red and brown, med um to coarse sandstone w th some ronstone bands						26m Ds 50mm 26 05m CORE LOSS 450mm	C	76	44	
	26 5							26 6m B10° fe st 26 73-28 85m J60°- 90° co ro cln 26 85m Cs 200mm				PL(A) = 0 9
-9	27 27 0	SANDSTONE med um strength, fresh, fractured and s ght y fractured, ye ow brown, med um to coarse sandstone w th extreme y ow strength bands						27 05-27 2m J60°- 90° cu ro cln 27 13m B5° cbs st 27 18m J45° pl ro cln 27 31-27 38m J60° pl ro cln				PL(A) = 0 9
	28							27 51-23 56m J30°- 45° cu ro cly 27 66-28 1m J30°- 45° pl ro cln	C	100	70	
-10	29 29 06							28 1m Cs 300mm 28 37m J45° pl ro cln 28 45m Cs 30mm				PL(A) = 0 6
-11		Bore d scont nued at 29.06m										

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN/PO **CASING:** HW to 5.5m

TYPE OF BORING: D atube to 0.15m; So d f ght auger (TC b t) to 5.5m; Rotary to 20.5m; NMLC Cor ng to 29.1m

WATER OBSERVATIONS: Free groundwater observed at 3.8m wh st auger ng

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	P D	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test s(50) (MPa)
BLK	Block sample	U$_x$	ube sample (x mm dia)	PL(D)	Point load diametral test s(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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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

REDUCED LEVEL 18.7

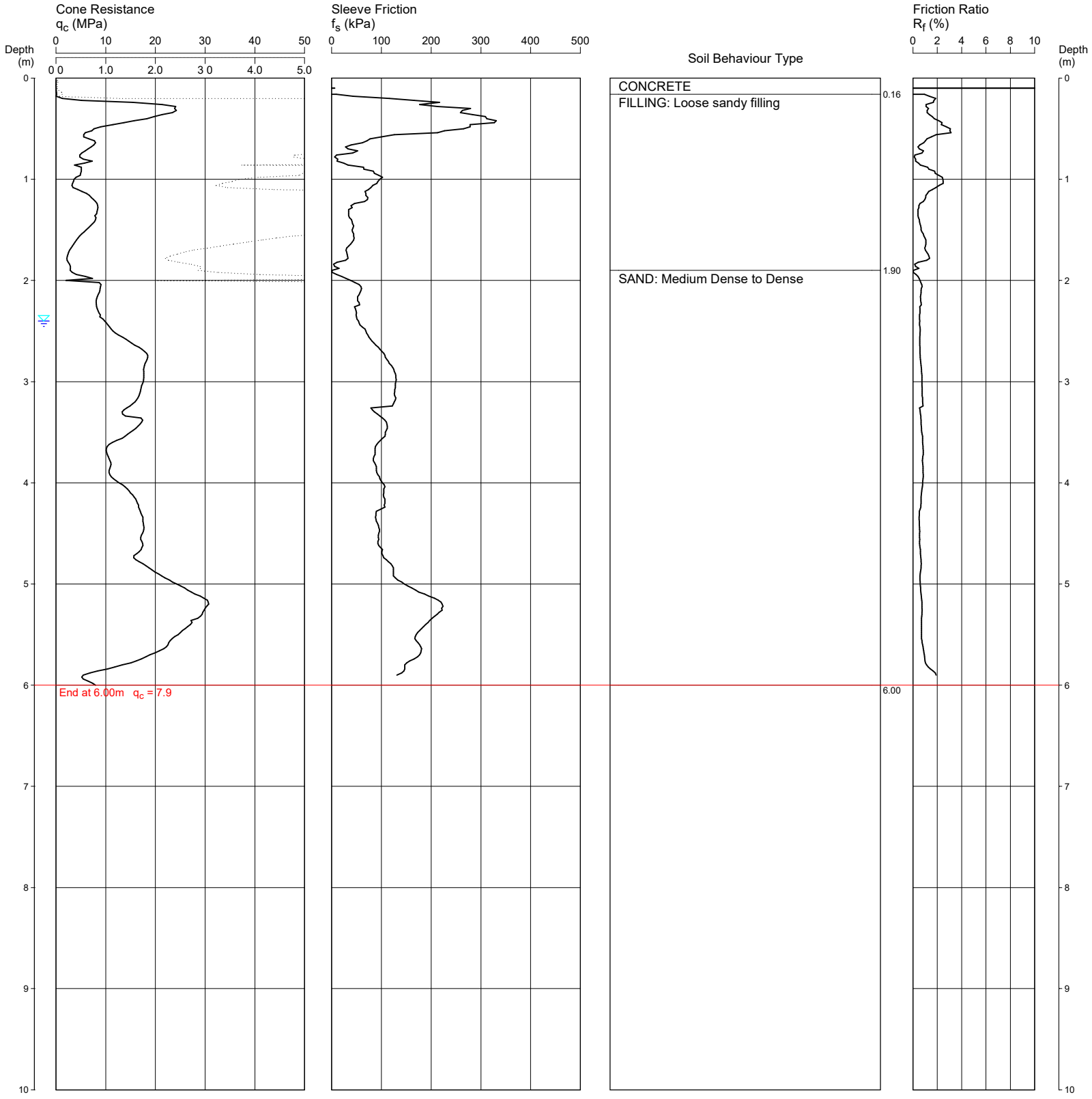
COORDINATES

CPT10

Page 1 of 1

DATE 16/1/2014

PROJECT No 73743



REMARKS CONCRETE SLAB TO 0.16 m DEPTH
HOLE COLLAPSE AT 2.4 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test **2.40m depth (assumed)**

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT10.CP5

Cone ID 120631 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

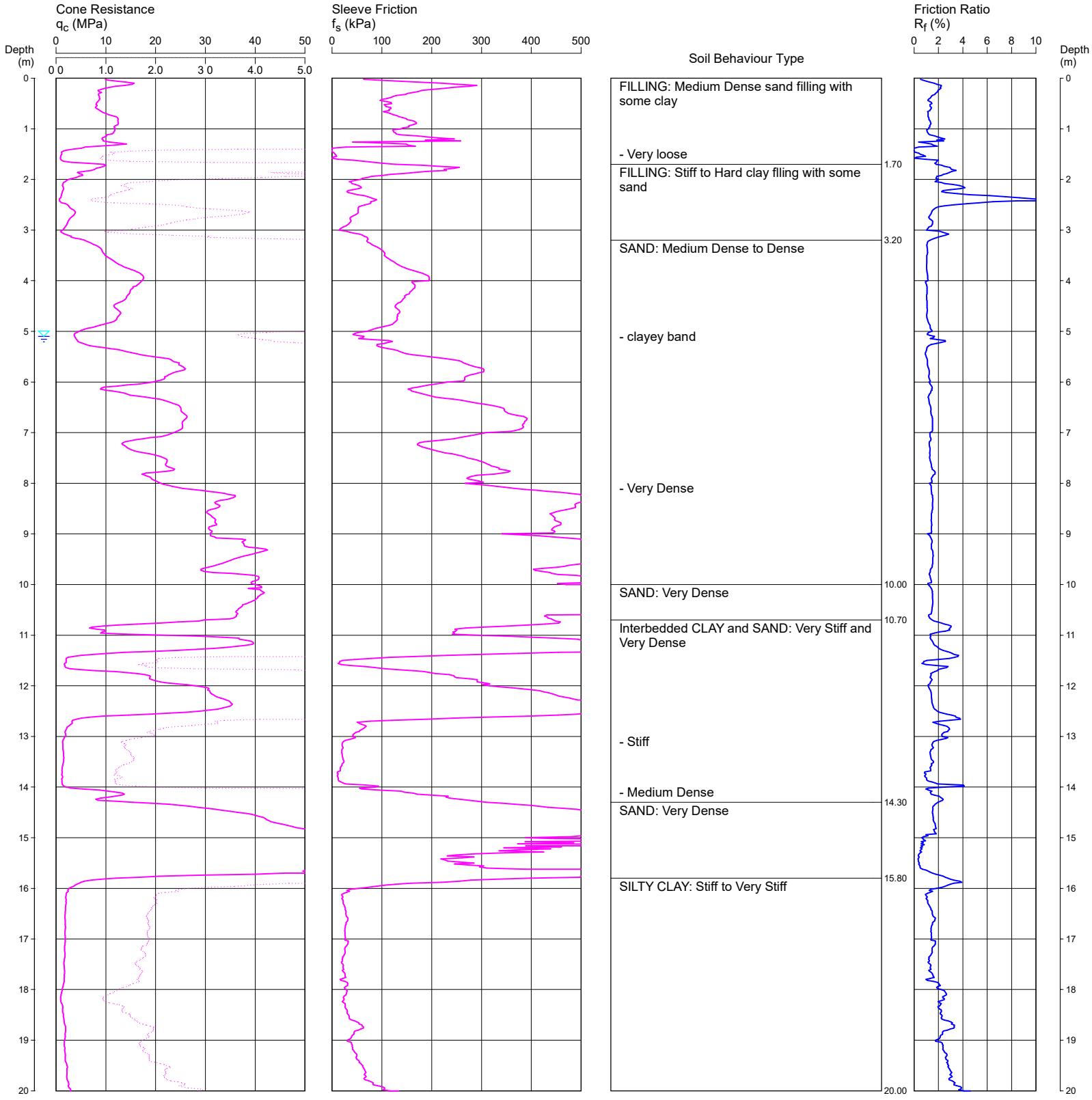
REDUCED LEVEL 20.1

COORDINATES 334438E 6246478N

CPT117

DATE 21/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 5.1M DEPTH AFTER REMOVAL OF RODS.

Water depth after test **5.10m depth (measured)**

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT117A.CP5

Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

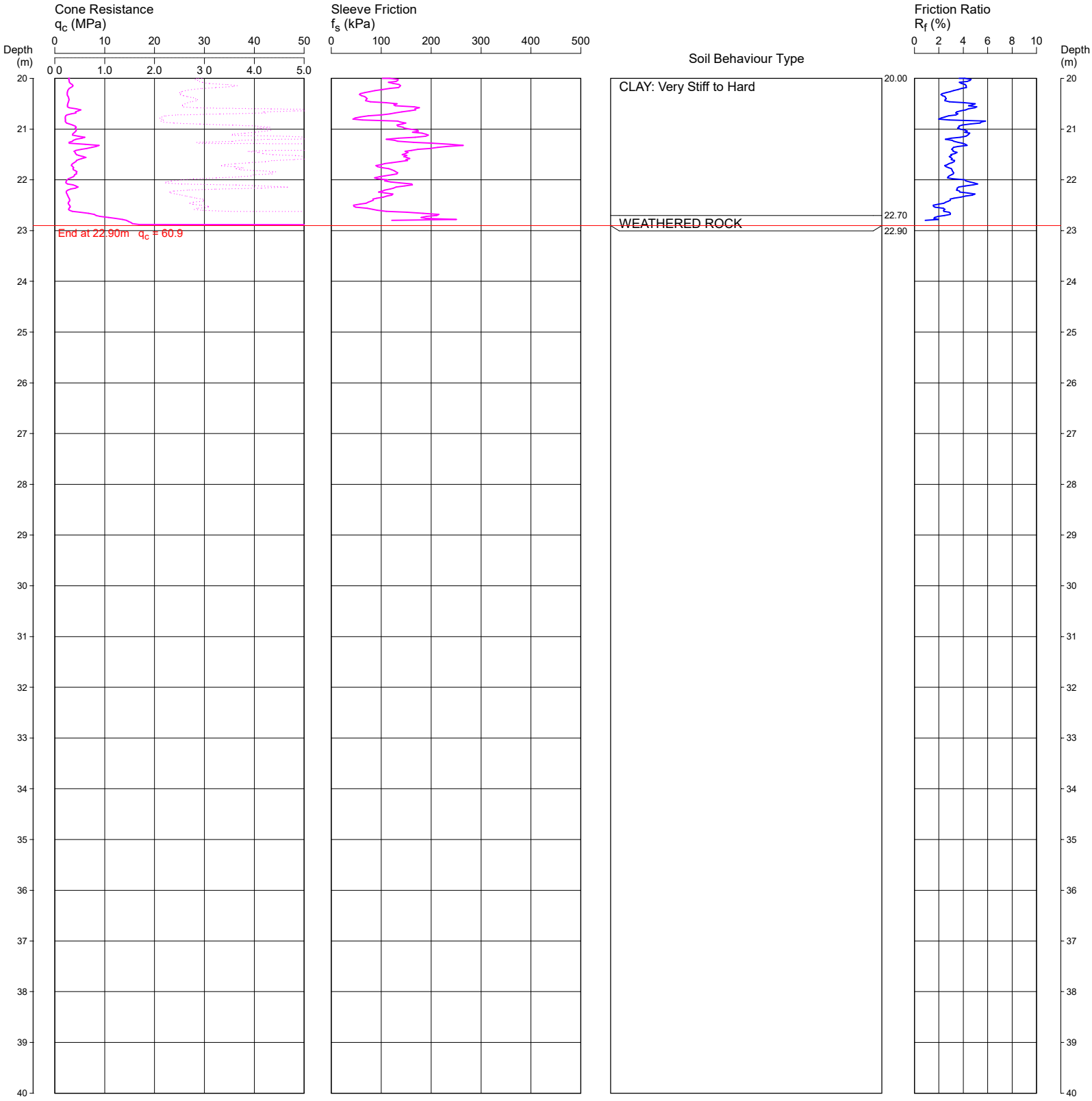
REDUCED LEVEL 20.1

COORDINATES 334438E 6246478N

CPT117

DATE 21/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 5.1M DEPTH AFTER REMOVAL OF RODS.

Water depth after test **5.10m depth (measured)**

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT117A.CP5

Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

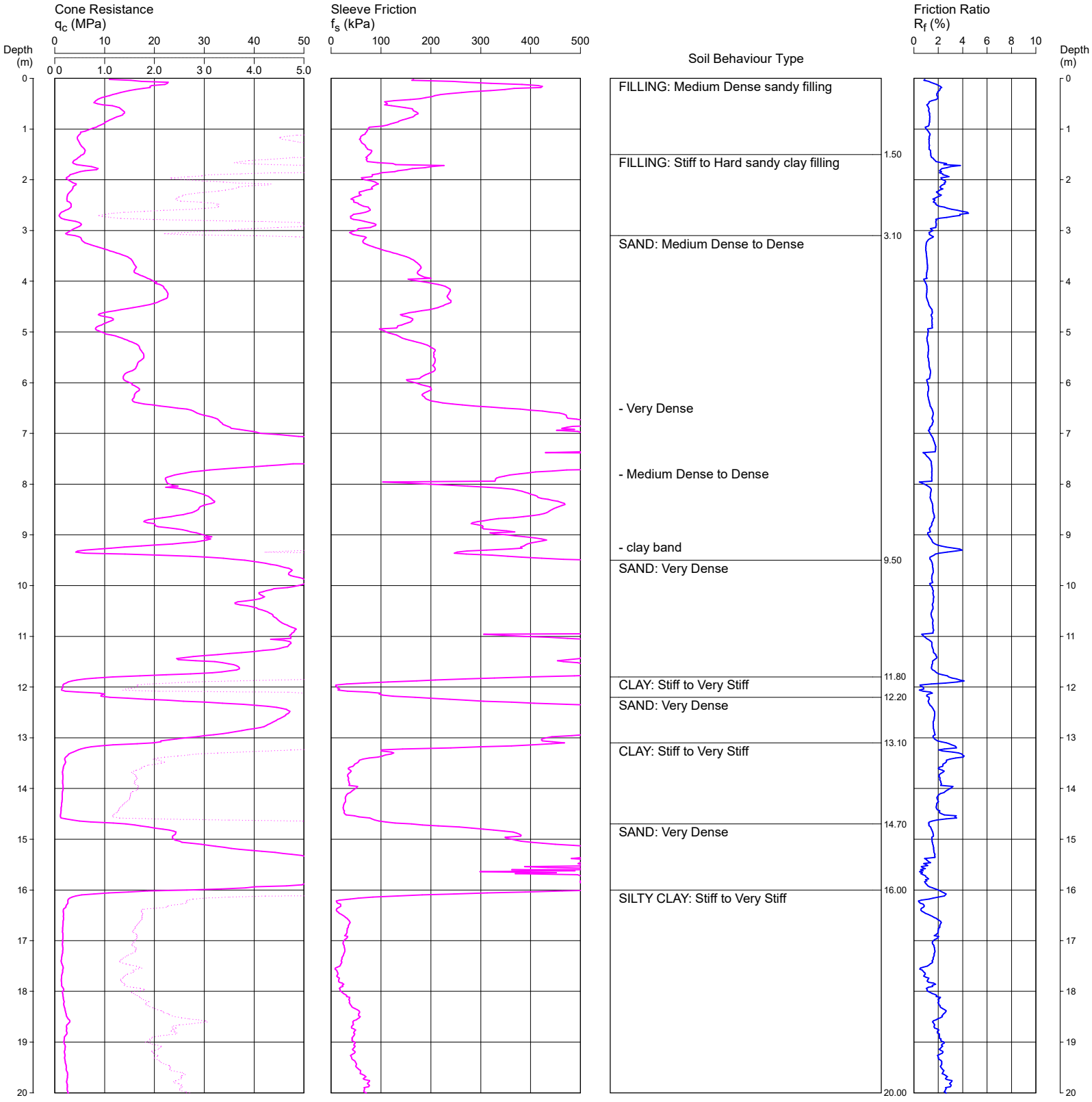
REDUCED LEVEL 20.3

COORDINATES 334470E 6246464N

CPT118

DATE 21/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 4.75M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT118.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

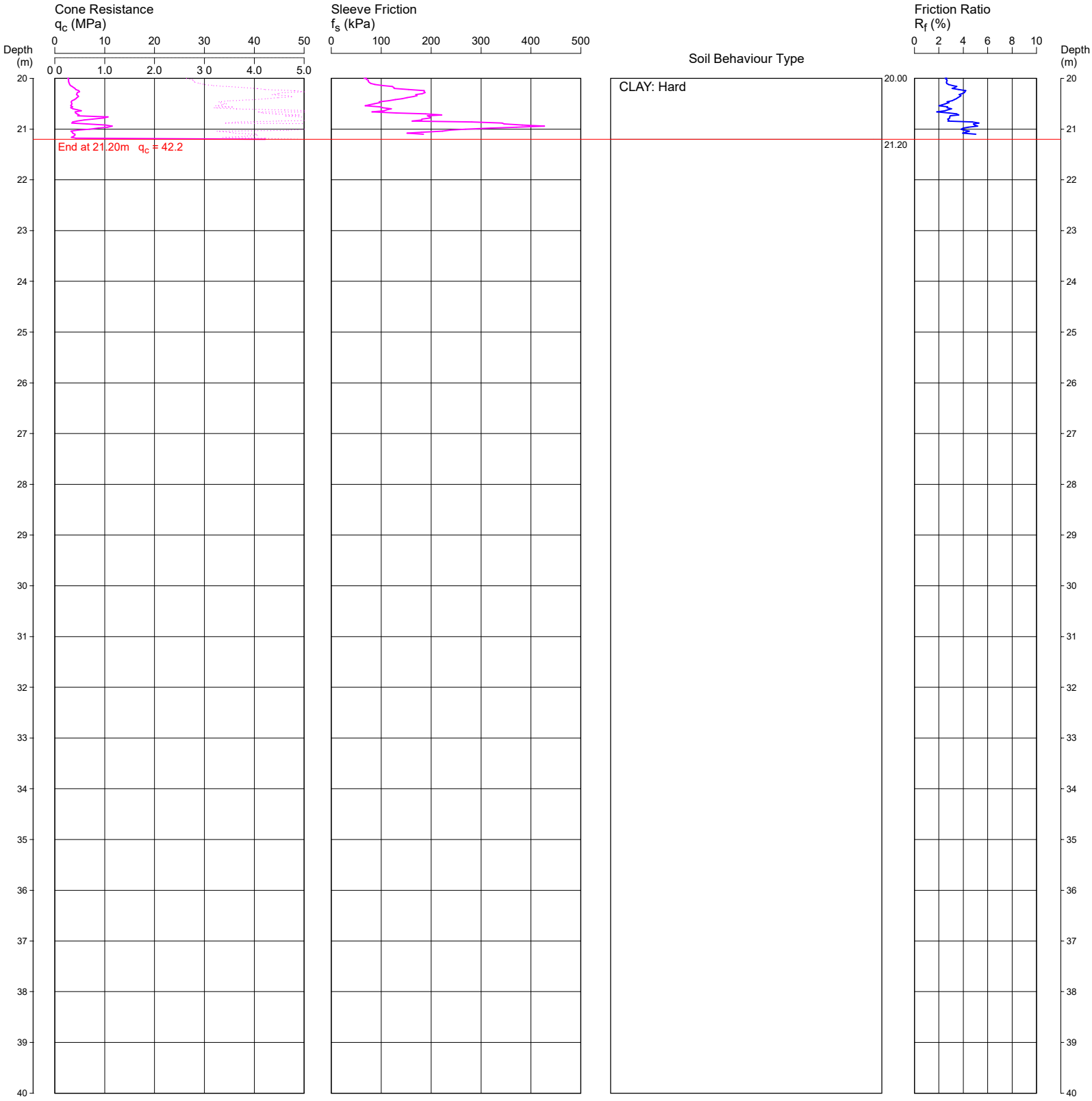
REDUCED LEVEL 20.3

COORDINATES 334470E 6246464N

CPT118

DATE 21/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 4.75M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT118.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

REDUCED LEVEL 20.4

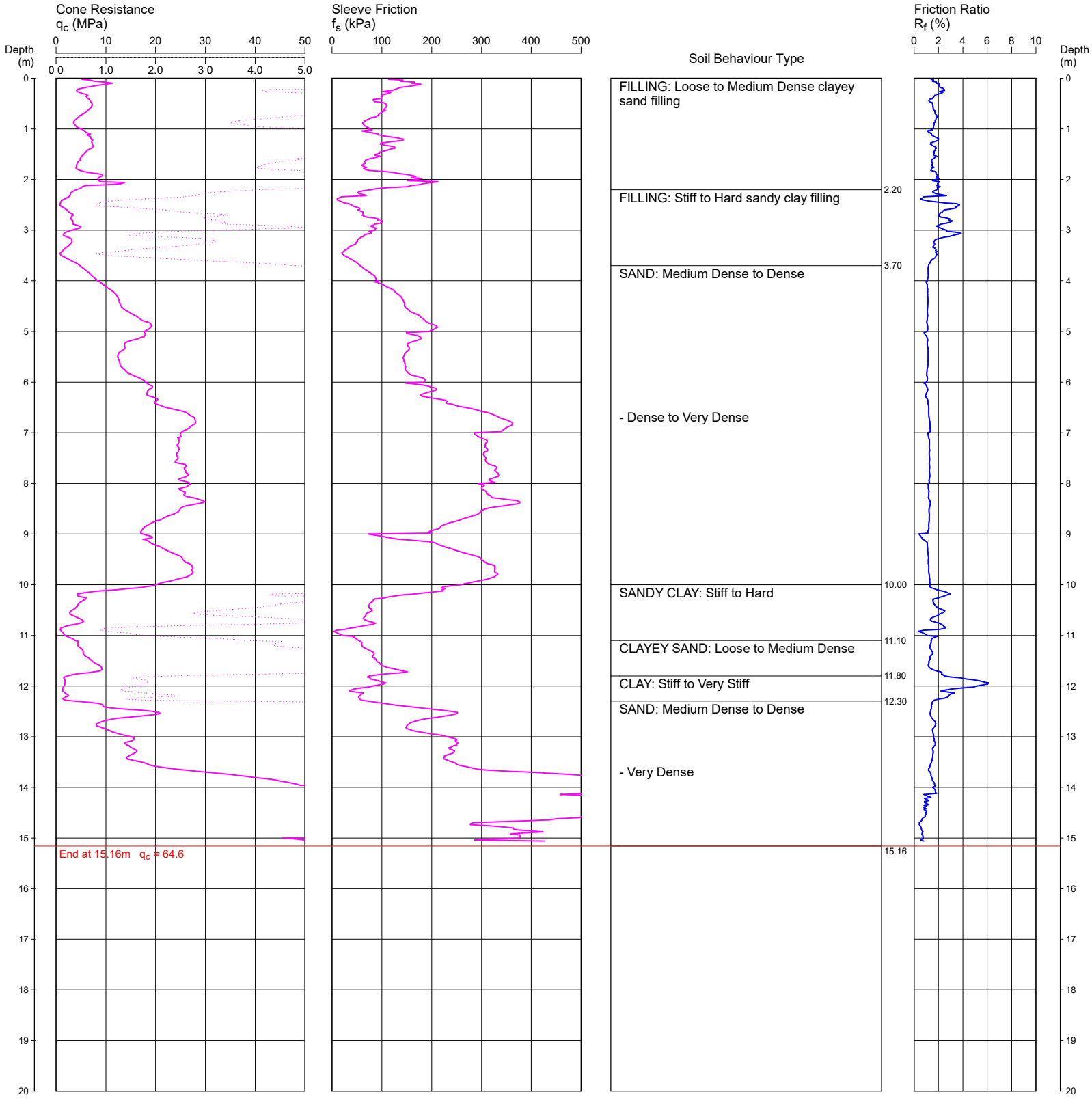
COORDINATES 334406E 6246446N

CPT121

Page 1 of 1

DATE 21/12/2015

PROJECT No 73743.02



REMARKS TEST ENDED DUE TO TRUCK L FT NG. HOLE COLLAPSE MEASURED AT 5 5M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT121.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

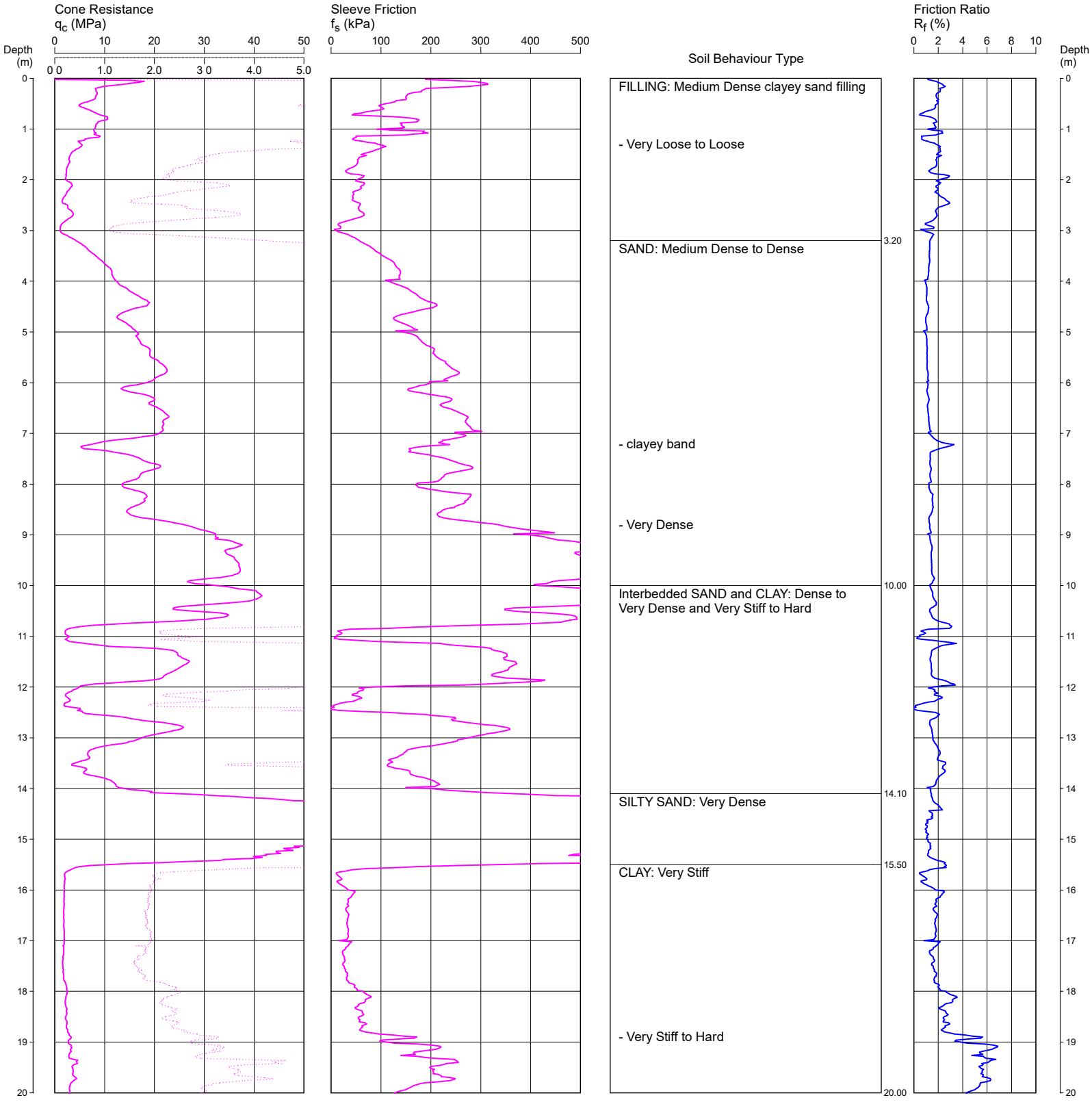
REDUCED LEVEL 19.9

COORDINATES 334424E 6246437N

CPT122

DATE 22/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 5.7M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT122.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

REDUCED LEVEL 19.9

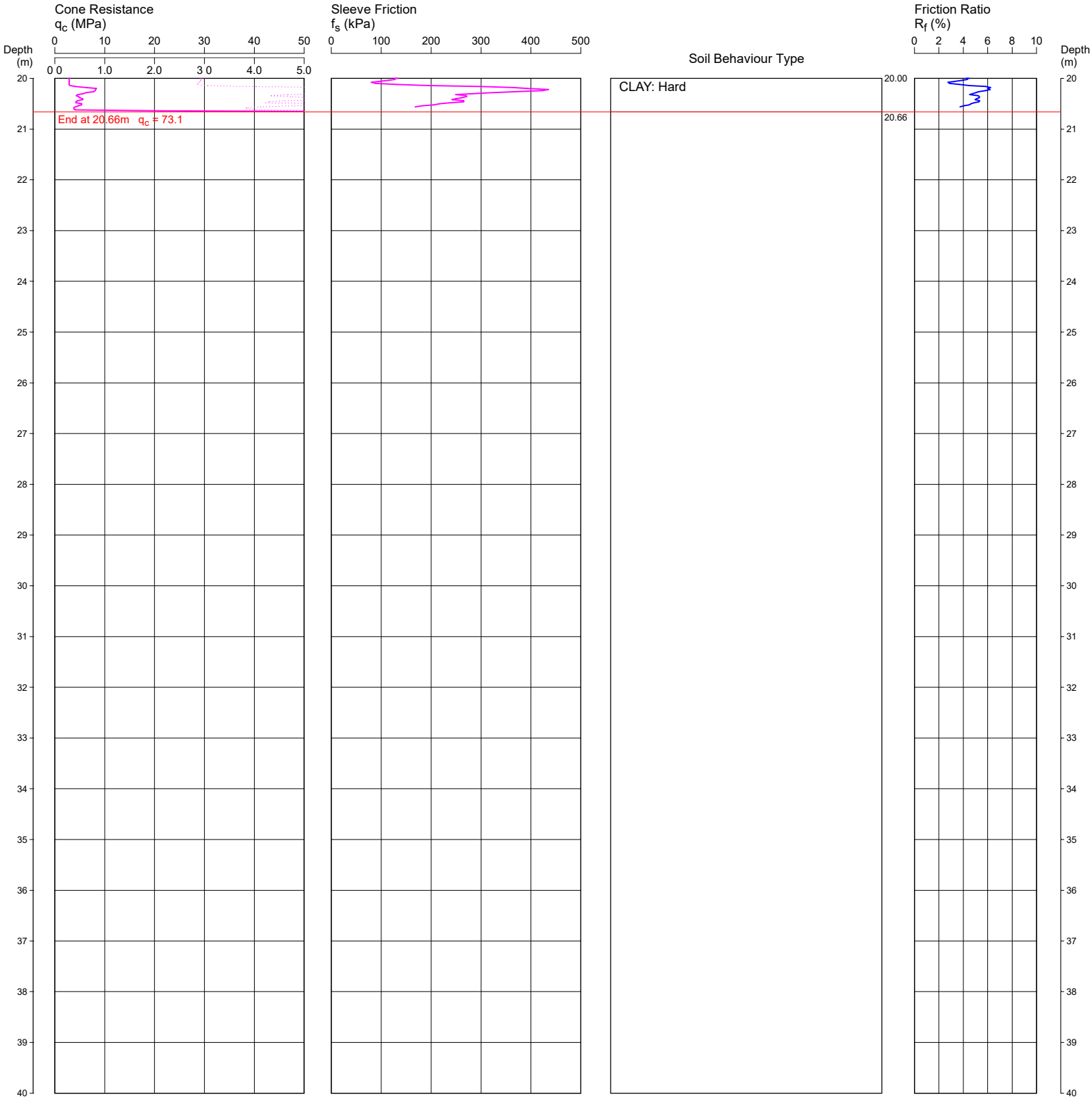
COORDINATES 334424E 6246437N

CPT122

Page 2 of 2

DATE 22/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 5.7M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT122.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

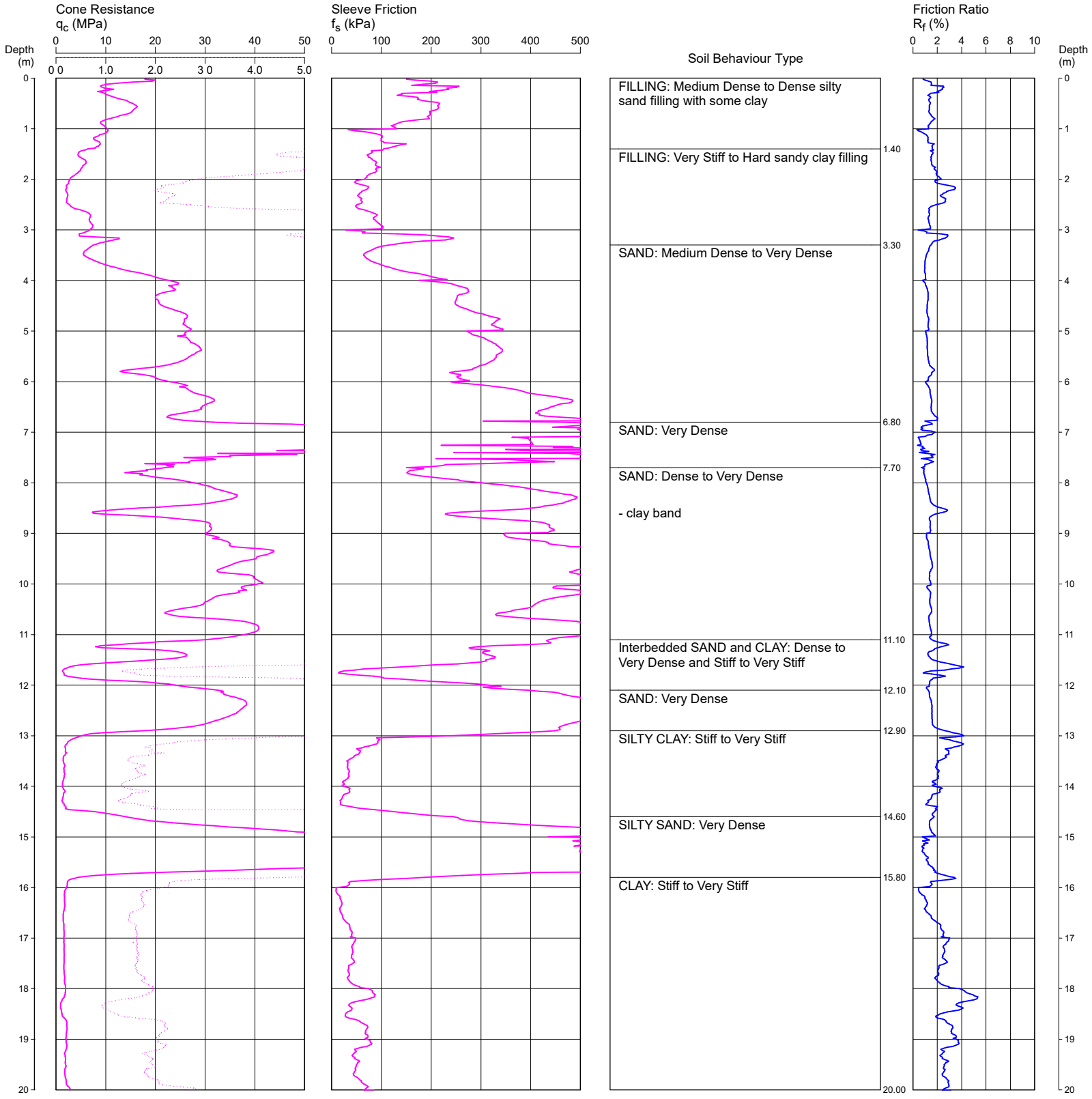
REDUCED LEVEL 20.3

COORDINATES 334449E 6246459N

CPT123

DATE 21/12/2015

PROJECT No 73743.02



REMARKS HOLE COLLAPSE MEASURED AT 5 0M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT123.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

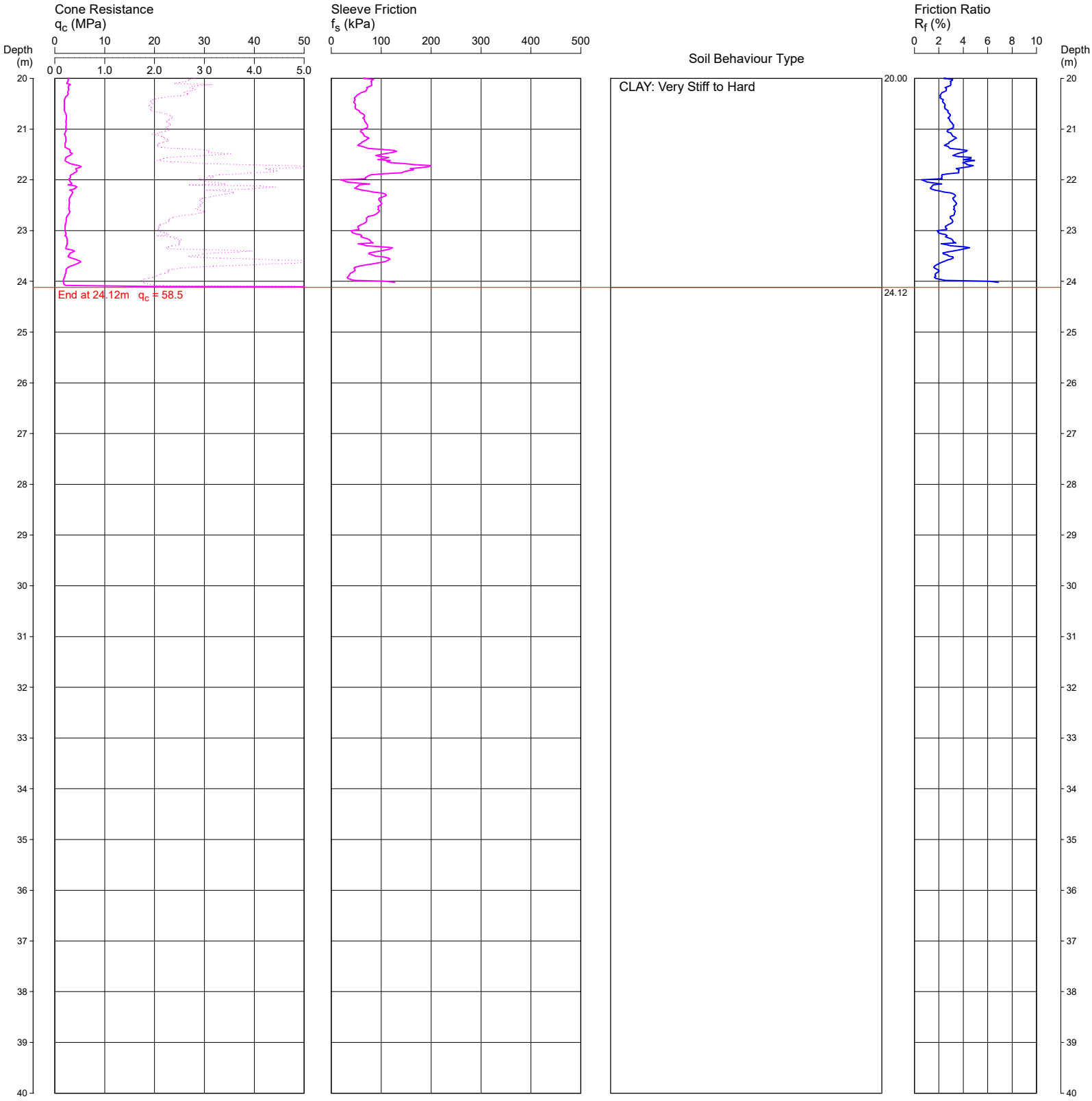
REDUCED LEVEL 20.3

COORDINATES 334449E 6246459N

CPT123

DATE 21/12/2015

PROJECT No 73743.02



REMARKS HOLE COLLAPSE MEASURED AT 5 0M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT123.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

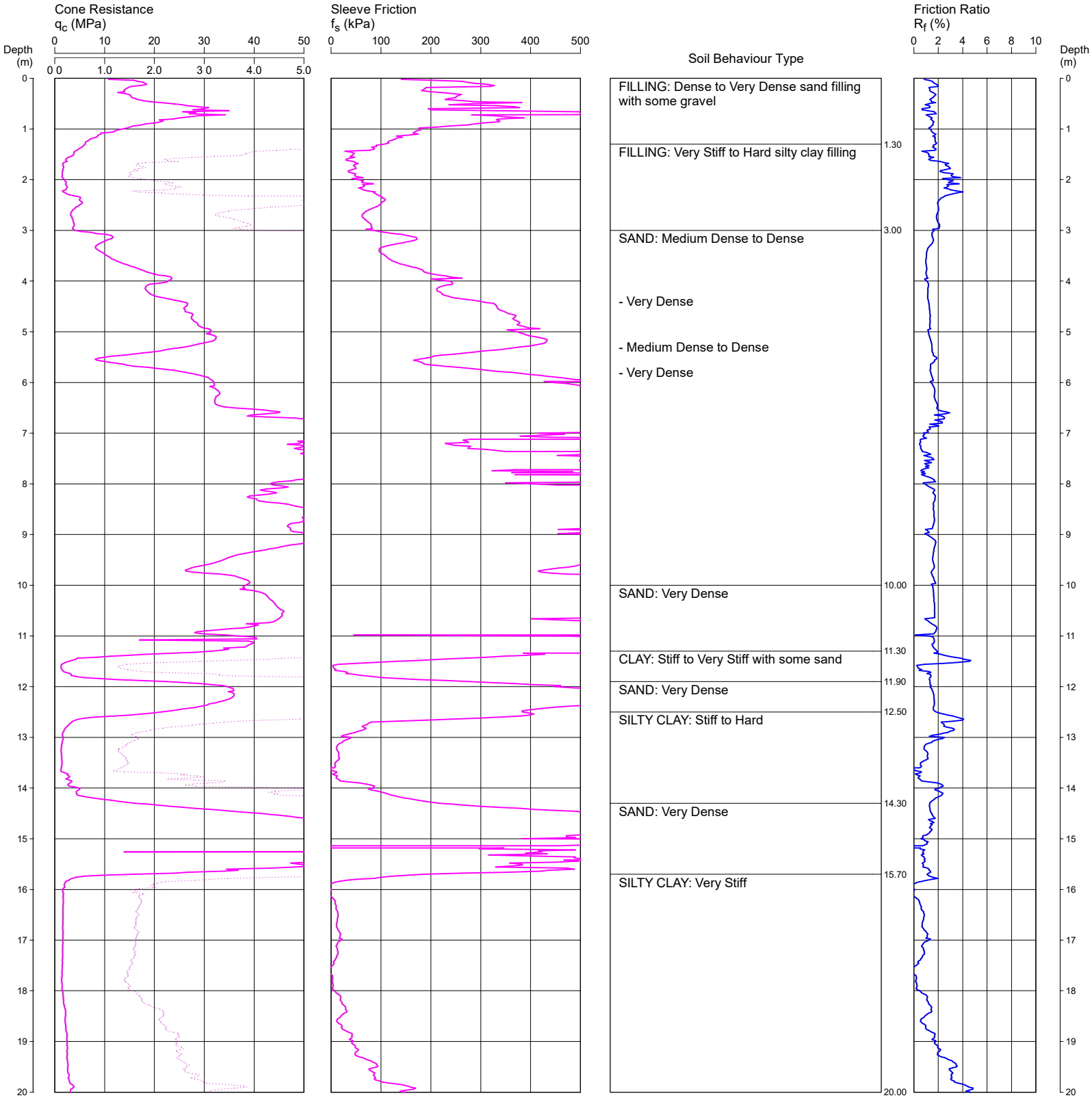
REDUCED LEVEL 19.9

COORDINATES 334454E 6246424N

CPT124

DATE 22/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 4.9M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT124.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

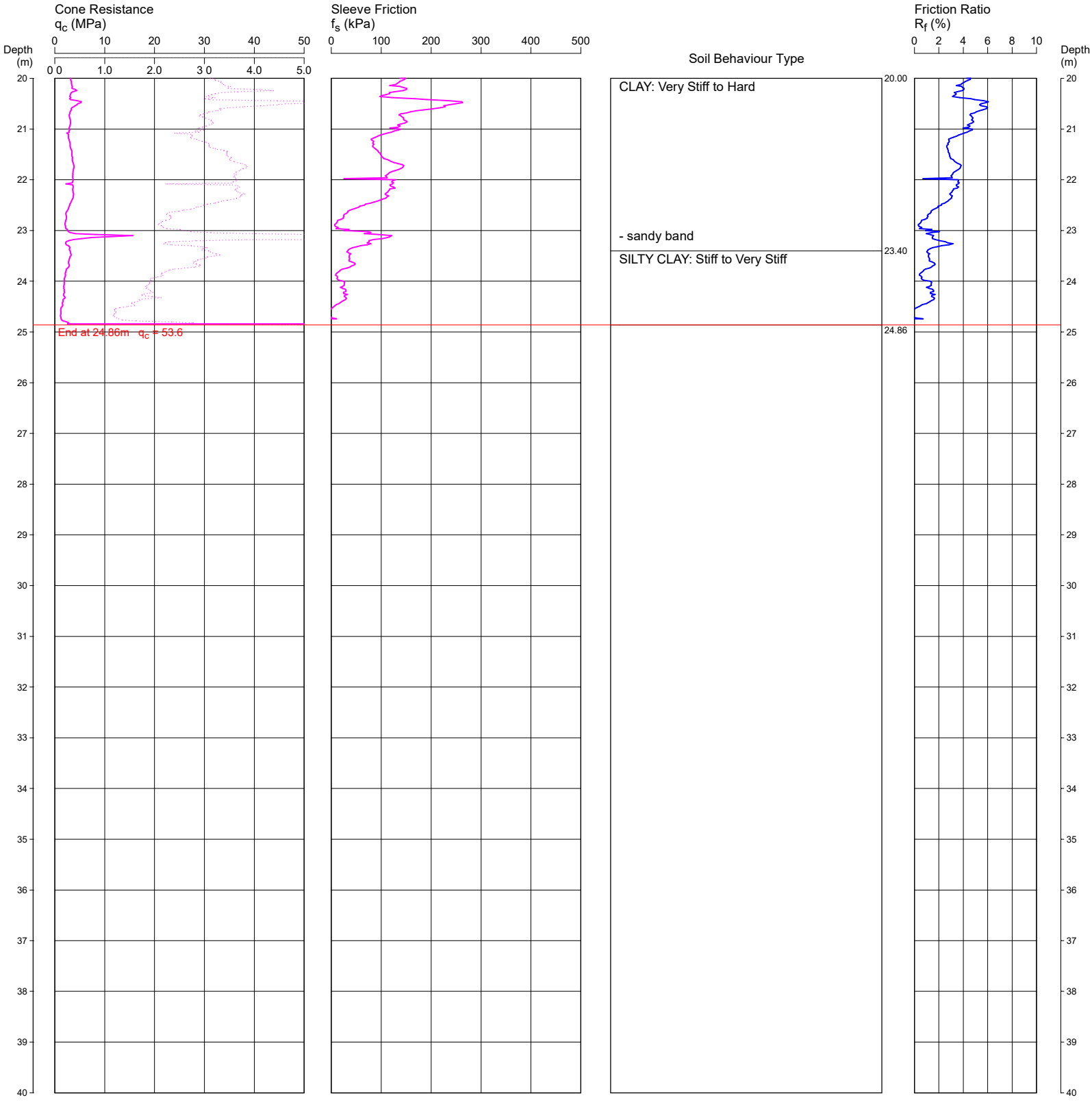
REDUCED LEVEL 19.9

COORDINATES 334454E 6246424N

CPT124

DATE 22/12/2015

PROJECT No 73743.02



REMARKS GROUNDWATER MEASURED AT 4.9M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT124.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

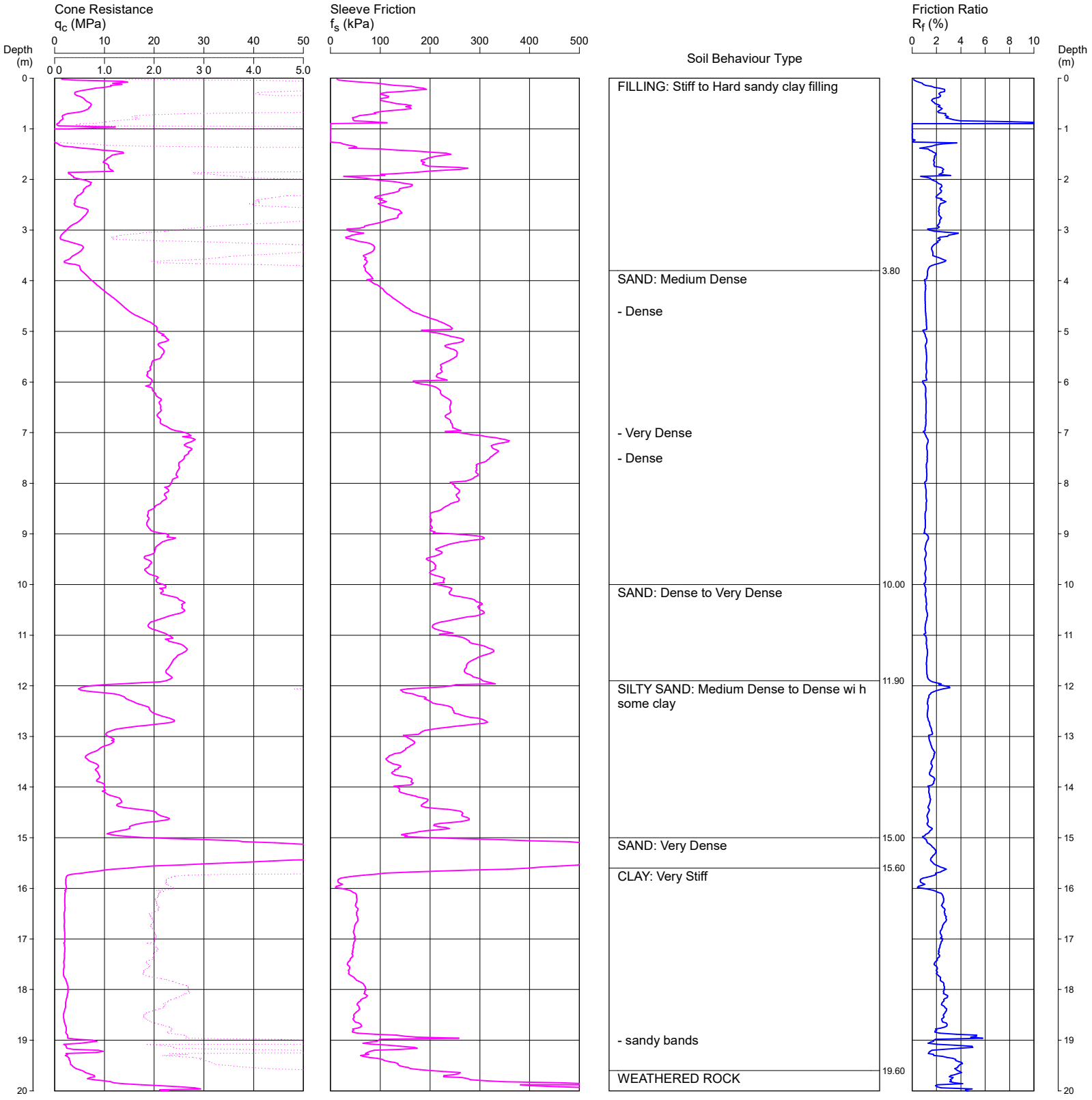
REDUCED LEVEL 20.2

COORDINATES 334404E 6246435N

CPT126

DATE 21/12/2015

PROJECT No 73743.02



REMARKS DUMMY CONE FROM 1.0M TO 1 5M DEPTH. HOLE COLLAPSE MEASURED AT 6.0M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT126.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

REDUCED LEVEL 20.2

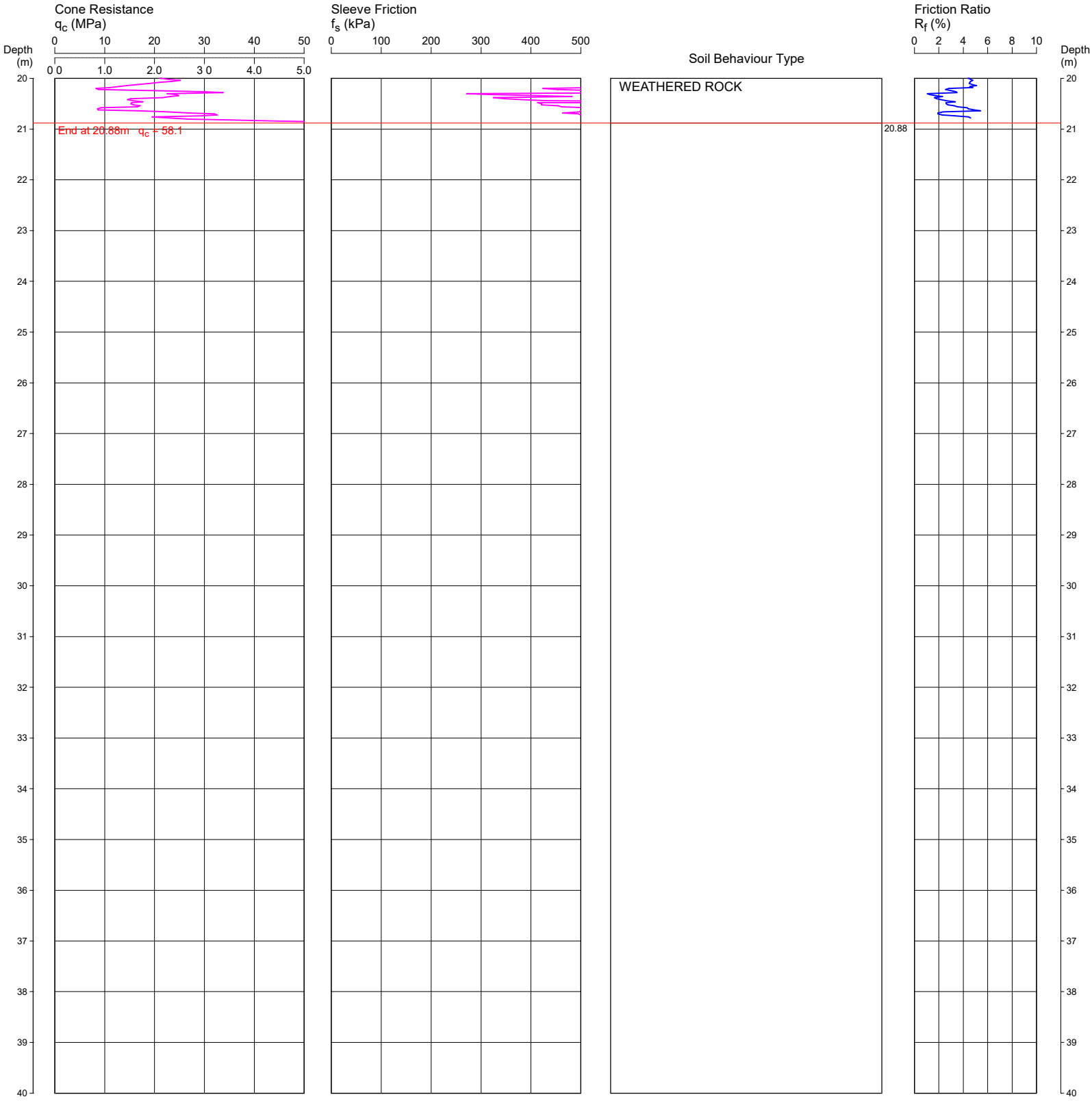
COORDINATES 334404E 6246435N

CPT126

Page 2 of 2

DATE 21/12/2015

PROJECT No 73743.02



REMARKS DUMMY CONE FROM 1.0M TO 1 5M DEPTH. HOLE COLLAPSE MEASURED AT 6.0M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT126.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

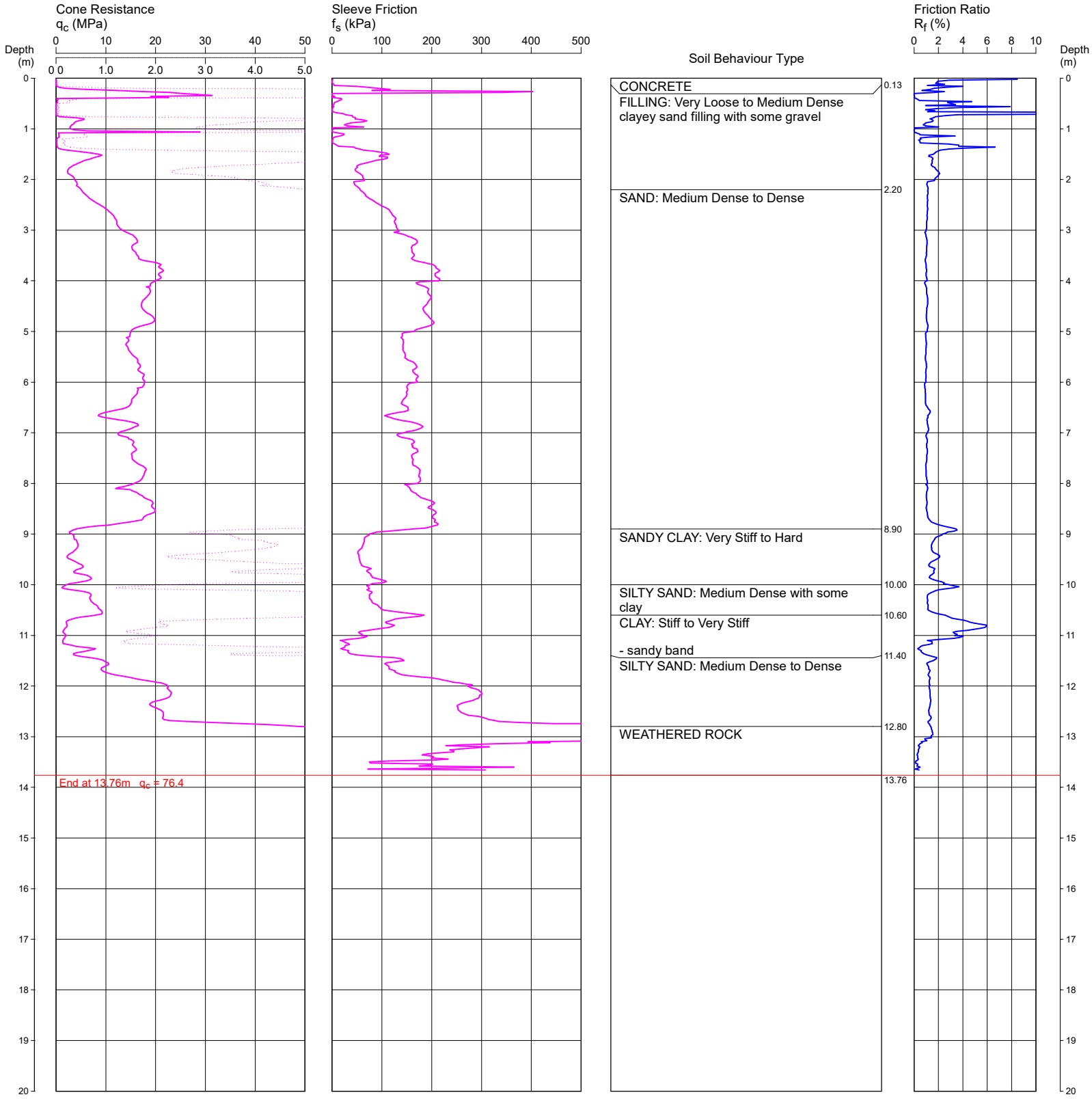
REDUCED LEVEL 18.5

COORDINATES 334425E 6246410N

CPT127

DATE 17/12/2015

PROJECT No 73743.02



REMARKS DUMMY CONE FROM 0.38M TO 0.8M AND 1.06M TO 1.5M DEPTHS.
CONCRETE DEPTH 130MM. GROUNDWATER MEASURED AT 4.6M DEPTH AFTER REMOVAL OF RODS.

File R:\72000-73999\73743.02 ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT127.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

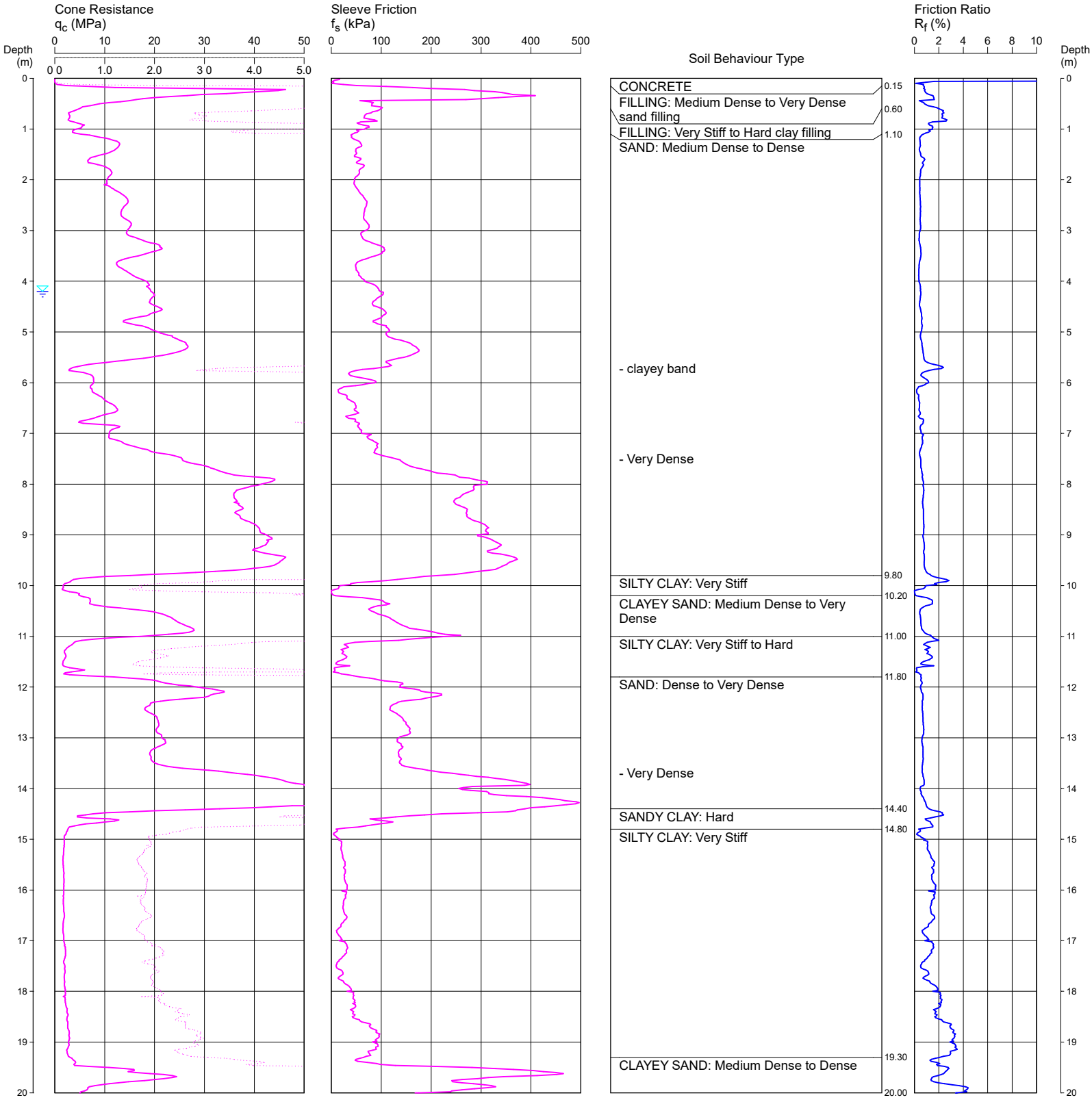
REDUCED LEVEL 18.5

COORDINATES 334378E 6246405N

CPT130

DATE 11/01/2016

PROJECT No 73743.02



REMARKS CONCETE DEPTH 150MM. GROUNDWATER MEASURED AT 4.2M DEPTH AFTER REMOVAL OF RODS.

Water depth after test **4.20m depth (assumed)**

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT130.CP5

Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

REDUCED LEVEL 18.5

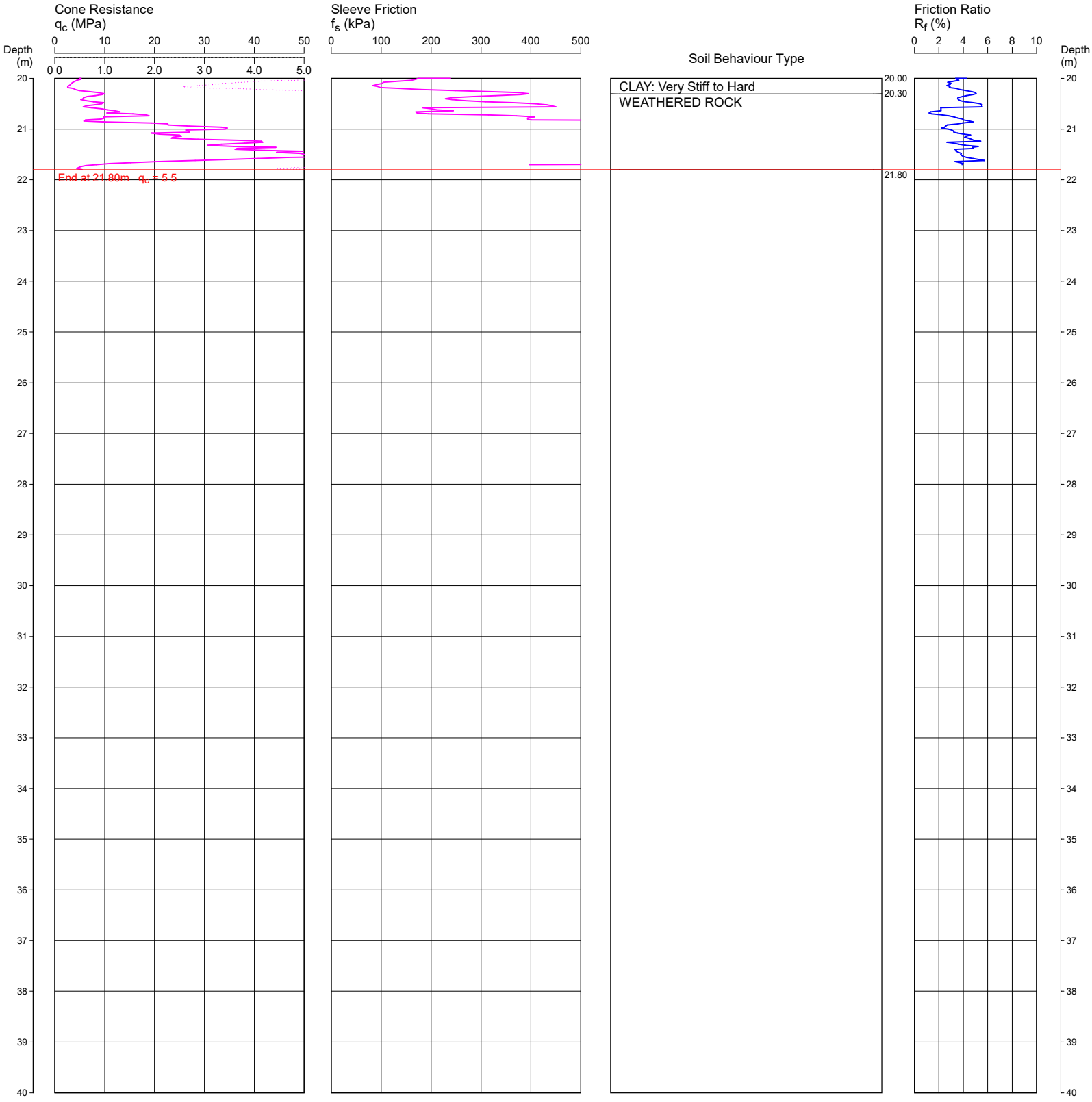
COORDINATES 334378E 6246405N

CPT130

Page 2 of 2

DATE 11/01/2016

PROJECT No 73743.02



REMARKS CONCETE DEPTH 150MM. GROUNDWATER MEASURED AT 4.2M DEPTH AFTER REMOVAL OF RODS.

Water depth after test **4.20m depth (assumed)**

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT130.CP5

Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

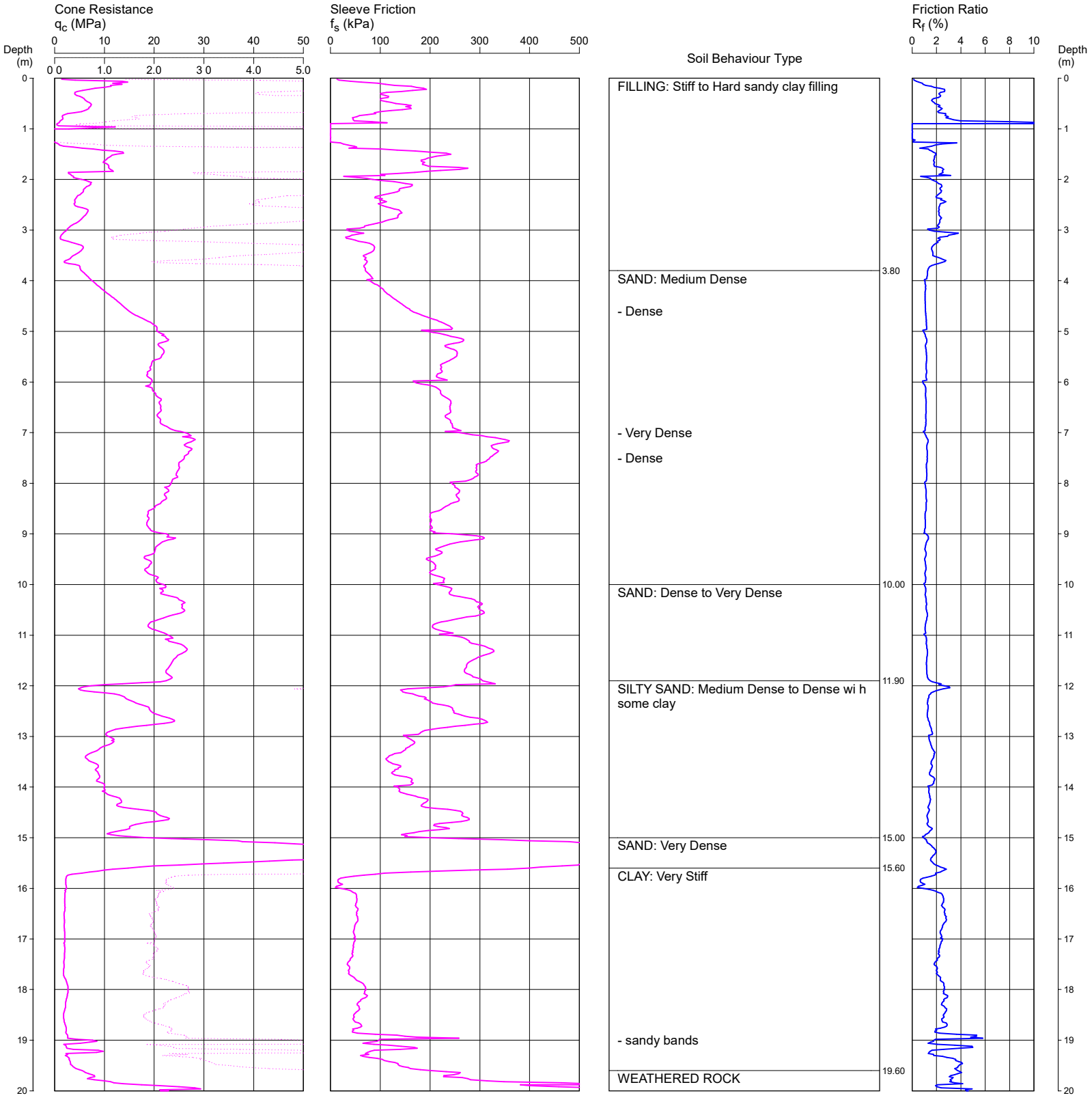
REDUCED LEVEL 20.2

COORDINATES 334404E 6246435N

CPT126

DATE 21/12/2015

PROJECT No 73743.02



REMARKS DUMMY CONE FROM 1.0M TO 1 5M DEPTH. HOLE COLLAPSE MEASURED AT 6.0M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT126.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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CONE PENETRATION TEST

CLIENT CITY OF SYDNEY COUNC L

PROJECT GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION JOYNTON AVENUE, ZETLAND

REDUCED LEVEL 20.2

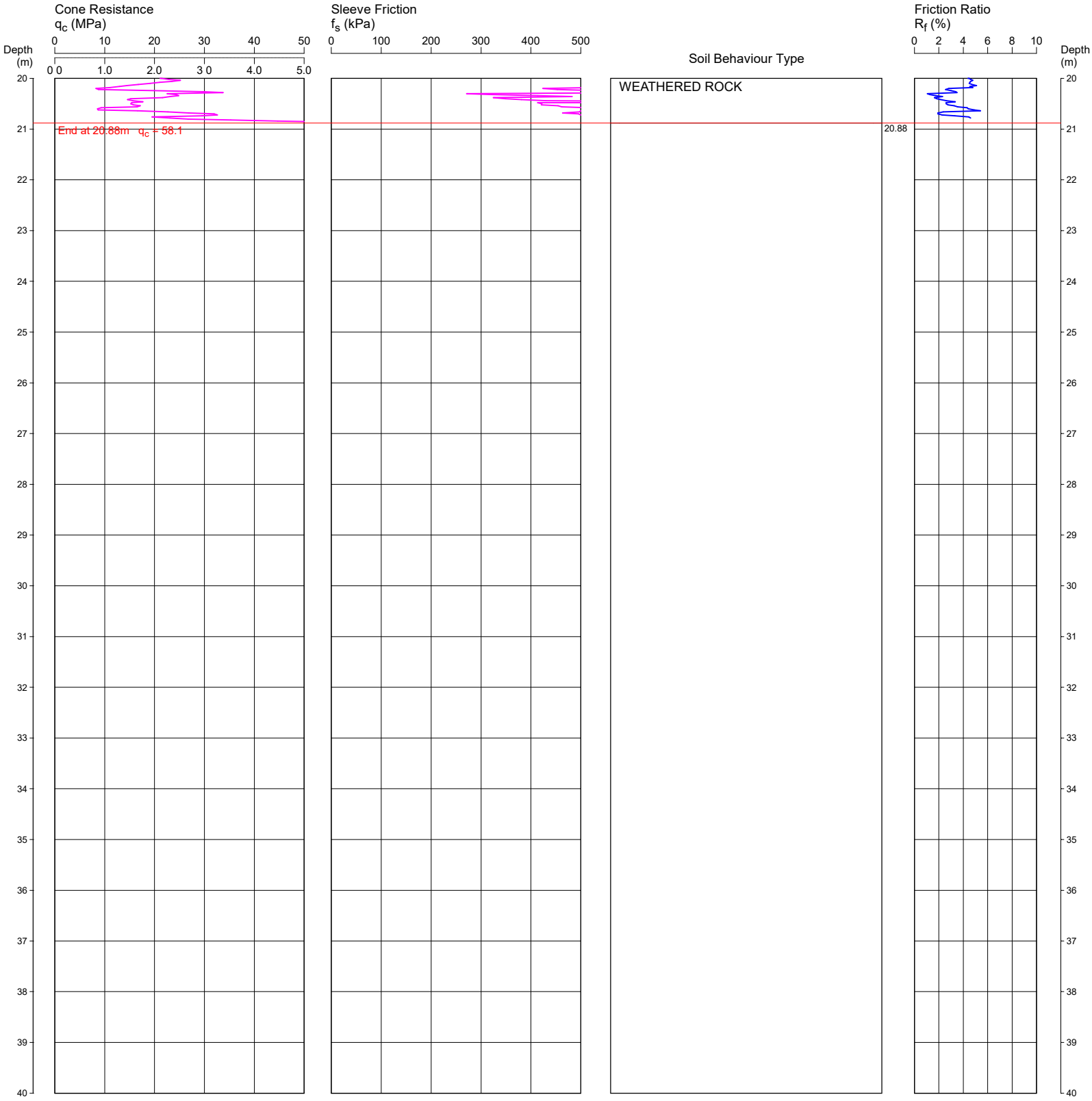
COORDINATES 334404E 6246435N

CPT126

Page 2 of 2

DATE 21/12/2015

PROJECT No 73743.02



REMARKS DUMMY CONE FROM 1.0M TO 1 5M DEPTH. HOLE COLLAPSE MEASURED AT 6.0M DEPTH AFTER REMOVAL OF RODS.

File C:\Users\atha.kapitanof\Documents\73743 06 Zetland\Previous CPT Results\CPT126.CP5
Cone ID 120630 **Type** I-CFXY-10

ConePlot Version 5 9 2

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