Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Acid Sulfate Soil Management Plan

Proposed Mixed Use Development
42 Honeysuckle Drive, Newcastle

Prepared for
Doma Holdings (Honeysuckle) 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.

	Signature	Date
Author		22 November 2017
Reviewer		22 November 2017

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Report on Acid Sulfate Soil Management Plan
Proposed Mixed Use Development
42 Honeysuckle Drive, Newcastle

1. Introduction

This Acid Sulfate Soil Management Plan (ASSMP) has been prepared for the proposed nine storey mixed use development at 42 Honeysuckle Drive, Newcastle. The work was undertaken for Doma Holdings (Honeysuckle) Pty Ltd.

This ASSMP has been prepared to provide a framework for achieving environmental objectives to minimise the risk of harm to human health and the environment during and following the above mentioned works. This ASSMP provides the following:

- Acid sulfate soil (ASS) management strategies;
- Monitoring program for soil and water quality;
- Contingency procedures.

The management procedures outlined in this ASSMP are based on the results of Douglas Partners Pty Ltd (DP) 'Report on Contamination and Acid Sulfate Soil Assessment' (Ref 1) and 'Report on Geotechnical Investigation' (Ref 2) undertaken at the site in October 2017. The previous assessments included subsurface investigation, sampling and testing for the assessment of ASS conditions and monitoring of groundwater levels.

This ASSMP has been prepared with reference to the "Acid Sulfate Soils Manual" (Ref 3) published by the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC) and the "Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines" (Ref 4) published by the Queensland Acid Sulfate Soil Investigation Team (QASSIT).

2. Proposed Development

It is understood that development of the site will include:

- A nine storey mixed use building, with parking, serviced apartments and retail development on the ground floor, four storeys of parking and hotel rooms above the ground floor and an additional four storeys of residential apartments above the hotel;
- The ground floor level is proposed at approximately RL 2.5 AHD to RL 3.0 AHD (approximately 0.5 m to 1.5 m below existing site levels) which is marginally above existing street levels (i.e. no basement proposed). The far southern part of the site will require filling by up to 0.5 m to reach base slab level;
- Localised deeper excavations will be required for the five lift pits (an approximate invert level of RL1.5 AHD has been assumed);

- Localised deeper excavations to RL 0 AHD may be required for sub terrain fire tanks (subject to final design considerations);
- Footings will comprise a series of grouped concrete piles to depths in the order of 8.5 m below finished floor level (FFL). Pile caps are typically proposed to depths of 0.6 m below FFL;
- Landscape areas with some deep tree plantings are proposed around the perimeter of the proposed development.

Reference should be made to the architectural drawings provided in Appendix C showing the proposed development.

3. Site Description

The site is identified as Lot 22 DP1072217, 42 Honeysuckle Drive, Newcastle, New South Wales and is shown in Figure 1 below, and Drawing 1, in Appendix C.

The site is a trapezoidal shaped allotment situated at the western end of the Honeysuckle precinct and has a plan area of 3728 m^2. Current site levels range from about 2.1 m AHD to 3.8 m AHD. The site is bounded by the following land:

- Part Lot 23 (floodway) and Cottage Creek to the north-west;
- Honeysuckle Drive to the north-east;
- Hunter Water Corporation building to the south-east;
- Great Northern Railway Corridor (railway tracks have been recently demolished and removed) to the south-west.

The site is currently vacant, predominantly grassed and contains mounded fill. A fill mound covers the majority of the site footprint, which has raised site levels of 1.5 m to 2 m above the street level. The fill mound extends into the adjacent allotment to the west (Lot 23) and batters down to Cottage Creek;

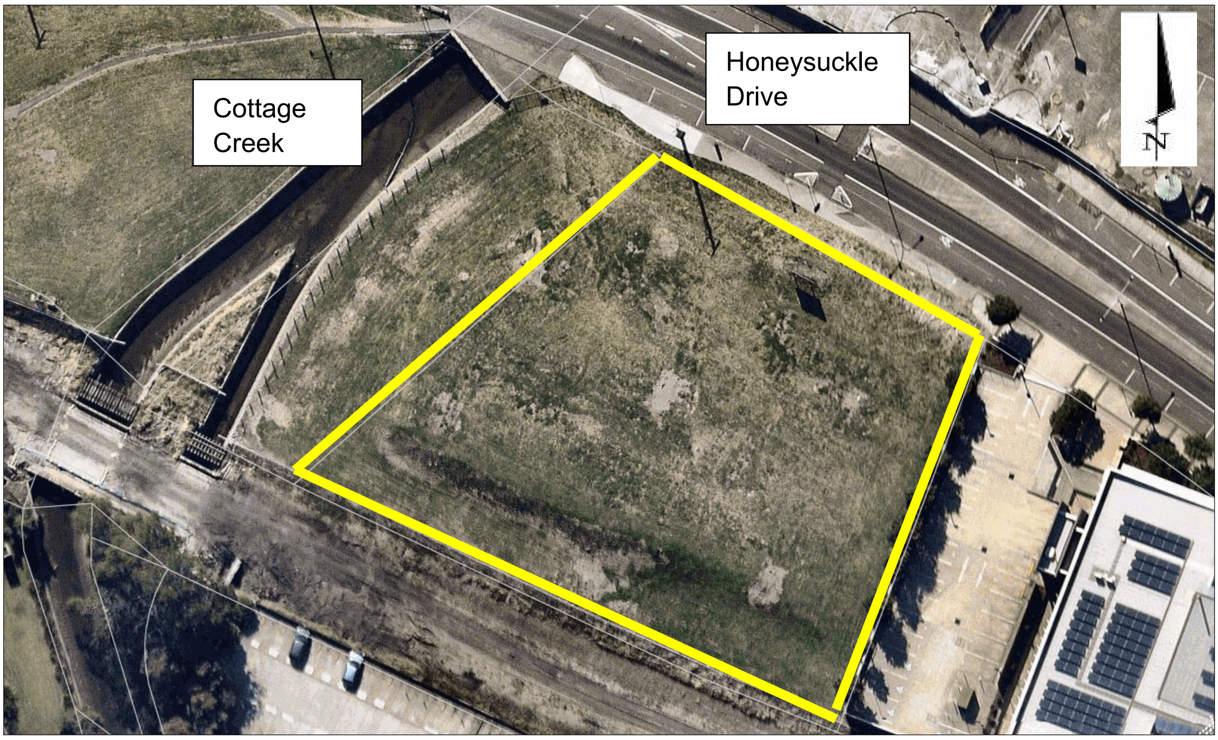


Figure 1: Aerial View of Site (yellow)

4. Regional Geology and Acid Sulfate Soil Risk Mapping

The 1:100,000 scale Newcastle Coalfield Regional Geology map (Sheet 9321, NSW Department of Mineral Resources, 1995) indicates that the site is underlain by Quaternary aged Alluvium comprising sand, silt, clay and gravel sediments deposited under water during a period of higher sea level. These alluvial deposits are underlain by rock of the Permian aged Newcastle Coal Measures, including sandstone, siltstone, tuff, conglomerate and coal.

The natural soils in this area are typically overlain by man-made fill materials to varying depths, related to reclamation, historical industrial usage and imported filling from nearby developments.

The 1:25,000 scale Acid Sulphate Soil Risk Map for Newcastle (Sheet 9232-S2, NSW Department of Land and Water Conservation, 1995) indicates that there is a high probability of acid sulfate soils (ASS) occurring between 1 m and 3 m below natural ground level at this site. The mapping is shown in Figure 2.

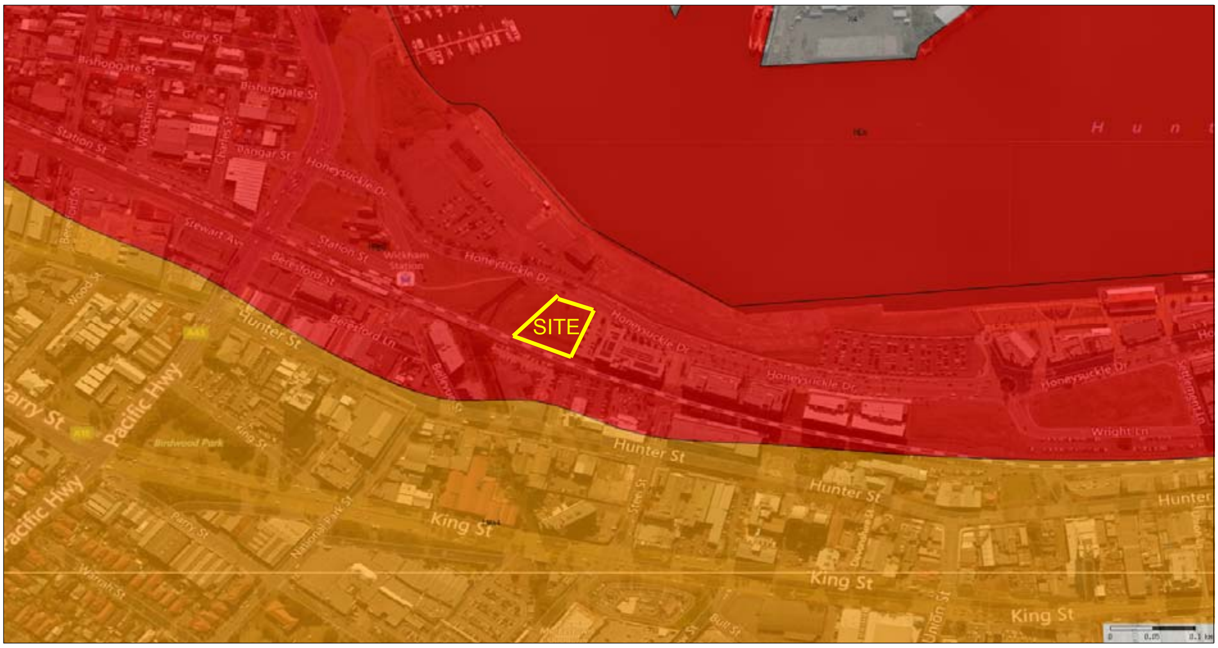


Figure 2: Acid Sulfate Risk Mapping (DLWC)

5. Previous Investigations

5.1 Introduction

A number of contamination, waste classification and geotechnical investigations have previously been conducted at the site. A summary of the pertinent findings of these reports is provided in Reference 1. In addition to these previous assessments, DP has recently completed a contamination and ASS assessment (Ref 1) and geotechnical assessment (Ref 2) at the site in October 2017 (Ref 1) for the currently proposed development. The ASS assessment comprised the following:

- Sampling from four boreholes across the site (201 to 204) to depths of up to 6.2 m;
- Installation of groundwater monitoring wells within three of the bores;
- Measurement of groundwater levels within the wells including data logging of groundwater levels within Bore 202;
- ASS screening tests and detailed ASS laboratory testing on selected soil samples to assess ASS conditions.

Approximate test locations are shown on Drawing 1, Appendix C.

The Newcastle foreshore area has been extensively modified by fill associated with land reclamation. It is understood that localised remediation of contaminated soils within upper fill materials has previously been undertaken at the site.

5.2 Geotechnical Subsurface Profile

A generalised geotechnical model of the sites subsurface conditions were provided in Ref 1 and 2. For the purposes of this ASSMP, the subsurface conditions encountered are summarised below:

FILLING:	Encountered in all bores/CPTs from the surface to 2.0 m / 4.0 m depth and generally comprised silty sands and sands with variable inclusions, including sandstone cobbles/boulders, gravels, ash, coal, shells and bricks.
SANDS:	Sands were encountered in all bores and CPTs beneath filling to depths of termination (bores) to 15.35 m (CPTs) and comprised upper loose to dense sands overlying ‘Upper’ loose to medium dense sand and ‘Central’ medium dense to dense sand.
UPPER CLAYS:	An upper layer of soft to firm clay / clayey sand and loose silty sand (‘weak alluvial’) was encountered in the majority of bores and all CPTs from 2.3 m to 4.5 m depth. The layer ranged in thickness from 0.3 m to 1.1 m where encountered.
LOWER CLAYS:	Stiff or better clays (‘lower clays’) were encountered in all CPTs from 12.9 m to 15.3 m depth to termination at depths of 16 m to 30 m.

The borehole logs and CPT plots are provided in Appendix B. The logs should be read in conjunction with the accompanying explanatory notes that define classification methods and terms used to describe the soils.

5.3 Groundwater Conditions

Free groundwater was encountered in the bores at depths ranging from 2.4 m to 3.0 m below existing ground levels during drilling. It should be noted that groundwater levels are affected by factors such as climatic conditions soil permeability and tidal fluctuations and will therefore vary with time.

Table 1 presents the groundwater parameters recorded at the time of well development on 7 September 2017.

Table 1: Field Measurements of Groundwater at Time of Well Development (7/09/2017)

Parameter (Units)	Bore / Well		
	201	202	203
Reduced Level of Well Collar (AHD)	3.736	3.687	2.480
Depth to Groundwater below Well Collar (m)	3.400	3.300	2.19
Depth to Groundwater below Ground Level (m)	3.447	3.36	2.23
Reduced Level of Groundwater (AHD)	0.336	0.387	0.290
PID Well Headspace (ppm)	<1	<1	<1
Thickness of free product (mm)	<1	<1	<1
pH	7.7	7.2	7.3
Electrical Conductivity (mS/cm)	0.39	0.66	0.36
Redox, Eh (mV)	-150	21	-80
Dissolved Oxygen (ppm)	5.0	6.8	6.0
Temperature (°C)	20.0	19.5	20.4
Turbidity (NTU)	400	450	250
Colour	Moderately turbid, grey/brown	Moderately turbid, grey/brown	Slightly turbid, brown

The results of groundwater field testing indicated the following:

- Groundwater is slightly basic to neutral (i.e. pH 7.2 to 7.7);
- Groundwater is fresh (i.e. EC 0.36 to 0.66 mS/cm);
- Oxidative to Reducing conditions were encountered (i.e. Redox potential -150 to 20);
- Generally a moderate oxygen content (i.e. DO 5.0 to 6.8 ppm) although this would be influenced by the development method;
- The results of PID screening on groundwater headspace suggest the absence of gross volatile hydrocarbon impacts (i.e. <1 ppm);
- Floating product was not detected visually or by the interface meter (i.e. <1 mm);

No observations of gross contamination (i.e. staining or odours) were observed within groundwater during drilling or during development of groundwater wells (refer Table 6 above).

Groundwater levels measured via a level logger installed within Well 202 over the period 14 September 2017 to 18 October 2017 are presented in Figure B1 in Appendix B. The plot shows the reduced water levels to AHD plotted against time and also the corresponding tide levels and rainfall (Nobby's Bureau of Meteorology Station), as well as manual gauging checks. The proposed bulk excavation and finished floor levels of the proposed development are also shown for comparison.

The results indicate the following:

- The water table during the monitoring period was typically around RL0.2 to RL0.7 based on selected CPT results and groundwater monitoring during September and October 2017, which is below the proposed floor level of 2.50 AHD, however, would be expected to be encountered in localised deeper excavations for tanks and possibly lift pits during construction, which will requiring dewatering.
- It should be noted that re-charge via rainfall during the few months prior to the investigation would have been limited due to lower than average rainfall;
- A subdued tidal response and time-lag was observed.

It is noted that during construction, while the ground is open to rainfall and runoff, there would likely be a more direct groundwater response to rainfall.

It should be noted that groundwater levels are affected by factors such as climatic conditions, soil permeability and tidal movements and will therefore vary with time.

5.4 Results of Acid Sulfate Testing

Selected soil samples of the filling and underlying natural soils were subject to ASS screening tests in DP's laboratory. Selected soil samples (35 in total) were tested for pH in distilled water and pH following oxidation in peroxide. Based on the screening test results, seven soil samples were sent to Envirolab Services Pty Ltd for detailed testing, comprising the Chromium suite. Table 2 presents the results of screening test results and detailed Chromium Suite testing.

Table 2: Results of Acid Sulfate Soil Tests

Sample ID	Sample Depth [a] (m)	Sample RL (AHD)	Sample Description	Screening Test Results				Laboratory Results							
				pH			Strength of Reaction [b]	pH$_{KCL}$	S$_{KCL}$	Scr %S	s-TAA %S	S$_{NAS}$ %S	s-ANC$_{BT}$ %S	Net Acidity^{c} %S	Exisiting and Potential Acidity %S
				pH$_{F}$	pH$_{FOX}$	pH$_{F}$ - pH$_{FOX}$									
201	1.5	2.3	Silty Sand Filling trace shells	7.2	7.0	0.2	4,H,F								
	2.3	1.5	Sand Filling trace shells	7.9	7.9	0.0	1								
	3.0	0.8	Sand Filling trace shells	8.0	7.9	0.1	1								
	3.5	0.3	Silty Sand Filling trace shells	7.9	7.9	0.0	1								
	4.0	-0.2	Sand trace shells	8.0	7.8	0.2	4,H,F	9.4	<0.005	<0.005	<0.01	<0.005	0.61	<0.005	<0.005
	4.5	-0.7	Clayey Sand trace shells	7.5	**1.7**	**5.8**	2,H								
	5.0	-1.2	Sand	7.7	5.9	**1.8**	2,H,F								
	5.5	-1.7	Sand trace shells	7.7	**2.1**	**5.6**	4,H								
	6.0	-2.2	Sand	7.7	**2.1**	**5.6**	2,H								
202	1.5	2.3	Sand Filling trace shells	7.8	4.8	**3.0**	1	9.6	<0.005	<0.005	<0.01	<0.005	0.33	<0.005	<0.005
	2.5	1.3	Sand Filling trace shells	8.0	6.4	**1.6**	1								
	3.0	0.8	Sand some shells	8.0	6.9	**1.1**	1	9.3	0.005	0.020	<0.01	<0.005	0.72	<0.005	0.020
	3.8	0.0	Clayey Sand some shells	7.6	**2.2**	**5.4**	4,F,H	6.7	0.020	0.550	<0.01	<0.005	0.18	0.43	0.550
	4.5	-0.8	Clayey Sand some shells	7.8	**1.9**	**5.9**	4,F,H								
	5.0	-1.3	Sand	7.8	**2.4**	**5.4**	4,F,H								
	5.5	-1.8	Sand	7.9	**2.0**	**5.9**	4,F,H	6.2	0.030	0.200	<0.01	<0.005	<0.05	0.20	0.200
	6.0	-2.3	Sand trace shells	8.0	**2.1**	**5.9**	1								
203	0.2	2.3	Silty Sand Filling trace shells	7.6	6.5	**1.1**	1,F	9.0	<0.005	0.006	<0.01	<0.005	0.40	<0.005	0.006
	1.0	1.5	Sand Filling trace shells	7.6	7.5	0.1	1								
	2.0	0.5	Sand Filling trace shells	7.7	7.7	0.0	1								
	2.5	0.0	Clayey Sand Filling trace shells	7.4	**3.0**	**4.4**	3,F,H								
	3.0	-0.5	Sand	7.3	**2.0**	**5.3**	4,F								
	3.5	-1.0	Clayey Sand	7.5	**1.8**	**5.7**	4,H,F								
	4.0	-1.5	Sand	7.6	**1.9**	**5.7**	3,F,H								
	4.5	-2.0	Sand trace shells	7.8	**2.4**	**5.4**	1								
	5.0	-2.5	Sand	7.6	**2.4**	**5.2**	1								
	5.5	-3.0	Sand	7.5	**2.2**	**5.3**	1								
	6.0	-3.5	Sand	7.6	**2.1**	**5.5**	1								
204	0.5	2.8	Silty Sand Filling trace shells	6.2	6.2	0.0	3,F								
	1.5	1.8	Sand Filling trace shells	7.9	7.6	0.3	1								
	2.5	0.8	Sand Filling trace shells	8.5	7.8	0.7	1								
	3.5	-0.3	Silty Sand Filling trace shells	6.6	**2.1**	**4.5**	1	6.5	0.024	0.220	<0.01	<0.005	0.07	0.18	0.220
	4.0	-0.8	Sand trace shells	6.6	**2.8**	**3.8**	2								
	5.0	-1.8	Sand	6.5	**2.8**	**3.7**	1								
	6.0	-2.8	Sand	6.6	**2.4**	**4.2**	1								
Guideline			Coarse sands, poorly buffered	<4^{d}	<3.5^{e}	≥1^{e}	-	Coarse sands, poorly buffered							0.01
			Coarse sands to loamy sands and peats					Coarse sands to loamy sands and peats							0.03
			Medium sandy loams to light clays					Medium sandy loams to light clays							0.06^{f}/0.03^{g}
			Fine medium to heavy clays & silty clays					Fine medium to heavy clays & silty clays							0.1^{f}/0.03^{g}

Notes to Table:

a Depth below ground surface

b Strength of Reaction

- 1 denotes no or slight reaction
- 2 denotes moderate reaction
- 3 denotes high reaction
- 4 denotes very vigorous reaction
- F denotes bubbling/frothy reaction indicative of organics
- H denotes heat generated

c Calculated by the laboratory based on the ABA equation in ASS Laboratory Methods Guidelines (Ref ?)

d For actual acid sulphate soils (ASS)

e Indicative value only for Potential Acid Sulphate Soils (PASS)

f QASSIT Action Criteria for disturbance of 1-1000 tonnes of material

g QASSIT Action Criteria for disturbance of more than 1000 tonnes of material

Bold results indicative of ASS

Shaded results indicate an exceedence of QASSIT action criteria (Ref ?)

pH$_{F}$ - Soil pH Test (1:5 soil:distilled w ater)

pH$_{FOX}$ - Soil Peroxide pH Test (1:4 soil:distilled w ater follow ing oxidation of soil w ith 30% hydrogen peroxide (H$_{2}$0$_{2}$))

*Laboratory methods used to quantify ANC are likely to overestimate environmental effectiveness

The results of detailed laboratory testing indicate the natural sands/clayey sands and silty sand fill below approximately RL0.2 are potential acid sulfate soils (PASS), and if disturbed during development, will require management in accordance with a site specific acid sulfate soil management plan (ASSMP) with reference to the ASSMAC guidelines (Ref 3).

6. Potential to Oxidise Acid Sulfate Soils

Based on the proposed development, the following activities may expose acid sulfate soils to oxidising conditions during construction:

- Localised excavations for construction including service trenches, lift pits / wells, subfloor tanks, which extend below approximately RL0.2;
- Installation of piles and subsequent generation of spoil at the surface;
- Localised dewatering of excavations, where required during the construction works;

The recommended management option for excavated ASS is neutralisation by full lime treatment and oxidation.

7. Management Strategy

7.1 Soil Treatment

Neutralisation of acid sulfate soils (ASS) should be undertaken in accordance with this ASSMP which has been prepared with reference to the ASSMAC (Ref 3) and QASSIT (Ref 4) guidelines. It will be necessary to prepare suitable treatment area(s) on site, as described below.

The treatment methodology applies to natural sands/clayey sands and silty sand fill below approximately RL0.2 at the site which is ASS. Where upper filling is intermixed with underlying ASS soils (e.g. spoil generation from pile installation), the materials should be considered as ASS.

The excavated ASS material or generated pile spoil should be segregated from non-ASS and contained within suitably bunded area(s) prepared as follows:

- Construct perimeter bunding around the treatment area(s) to prevent run-off or run-on (minimum height of 300 mm depending on the size of the treatment area and volume of material to be treated). If on-site soils are utilised for the bunding, they should also be lime treated at the rates as discussed below;
- Strip surface vegetation within area(s) to be used for treatment/stockpiling of ASS;
- Where sandy or highly permeable surface soils are present, place appropriate low permeability soils or low permeability membrane over the surface of the treatment area(s);
- Broadcast a guard layer of agricultural lime over the ground surface to be used for treatment/stockpiling (1 kg/m^2). Re-application of lime may be required if this guard layer is disturbed or removed during treatment of soils;
- Construct a catch drain/sump at the lowest point on the inside of the bund to collect run-off / leachate from the treatment area. The base of the sump should be inspected and must comprise low permeability (i.e. clayey) soils. If low permeability soils are not present the sump should be lined with a low permeability layer or membrane. The surface of the sump/catch drain should also be limed with 1 kg/m^2 of agricultural lime;
- Install appropriate erosion and sediment control measures for the perimeter of the treatment area(s).

It is noted that the above recommendations for the preparation of the treatment area rely on ASS treatment being conducted as soon as practical (i.e. within 4 hours of excavation for sandy soils and up to 24 hrs for clayey soils).

The location of the bunded area(s) should be selected in order to minimise the potential for impact on nearby sensitive receptors. Any leachate produced in the bunded area should be contained for monitoring and treatment (if required) as discussed below.

Suitable neutralising agents for actual acid sulfate or potential acid sulfate soils include agricultural lime ($CaCO_3$), calcined magnesia (MgO or $Mg(OH)_2$), and dolomite ($MgCO_3.CaCO_3$).

An assessment of the dosing rate for lime treatment can be calculated from the results of detailed laboratory testing, using the following equation, which includes a factor of safety.

Alkali Material Required (kg)

$$\textit{per unit volume of soil } (m^3) = \left(\frac{\%\,S \times 623.7}{19.98}\right) \times \frac{100}{ENV(\%)} \times D \times FOS$$

where: *%S = Existing & Potential Acidity (% S units);*
623.7 = % S to mol H^+/t;
19.98 = mol H^+/t to kg $CaCO_3/t$;
D = Bulk density of soil (t/m^3);
FOS = safety factor (usually 1.5);
ENV = Effective Neutralising Value (e.g. 80% for Grade 1 Agricultural lime).

Note: *The ENV is calculated based on the molecular weight, particle size and purity of the neutralising agent and should be assessed for proposed materials in accordance with ASSMAC (Ref 3).*

It is recommended that Grade 1 agricultural lime is used for the neutralisation of acid sulfate soils excavated during the construction.

The following liming/monitoring procedures for the treatment of ASS are recommended:

- All excavated ASS should be contained within the suitably bunded area(s) and kept moist to minimise oxidation, prior to treatment with lime. Progressive neutralisation will minimise the area required for bunding;
- Stockpiled natural sands/clayey sands and silty sand fill below approximately RL0.2 (i.e. ASS soil) should be limed initially at a rate of about 15 kg/tonne (i.e. ~27 kg/m^3) for sands / pile spoil and 30 kg/tonne (i.e. ~42 kg/m^3) for clays as soon as practicable following excavation. The above lime rate is recommended initially, and should be refined based on monitoring results as construction proceeds;
- The neutralising agent and acid sulfate soils should be thoroughly mixed and aerated using, for example, an agricultural lime spreader and excavator or rotary hoe. The soil should be treated in layers up to 300 mm thick to encourage aeration;

- The actual lime rate required will depend on the results of monitoring during neutralisation. Additional lime will be required if monitoring results indicate that appropriate neutralisation has not been achieved. Conversely the liming rate may decrease if monitoring suggests over-liming has occurred;
- Sampling and testing should be undertaken in accordance with Section 8.1 to verify the neutralisation treatment. The acceptance criteria are discussed in Section 8.2. Depending on the results of testing, reapplication of lime may be necessary to gain adequate neutralisation. Care should be taken to avoid over-liming of soils;
- Upon verification of treatment, the neutralised acid sulfate soils could be reused on site. The geotechnical suitability of the treated soils should be confirmed prior to reuse. Alternatively, treated ASS could be disposed at a licensed landfill following confirmation of the waste classification by an appropriate qualified consultant. It is noted that ASS must be appropriately neutralised prior to off-site landfill disposal in accordance with NSW EPA “Waste Classification Guidelines - Part 4: Acid Sulfate Soils” (Ref 5).

7.2 Neutralising Leachate

Leachate water collected from the bunded area(s) should be neutralised as necessary before disposal. Calcined magnesia (magnesium hydroxide, burnt magnesite, or magnesia) is the recommended neutralising agent as it produces a two-step reaction, which proceeds rapidly at acidic pH and slows down as higher pH is approached, and hence reduces the potential for over neutralisation to occur.

The amount of neutraliser required to be added to the leachate can be calculated from the following equation:

$$\text{Alkali Material Required (kg)} = \frac{M_{Alkali} \times 10^{-pH\ initial}}{2 \times 10^{3}} \times V$$

where: pH initial = initial pH of leachate

V = volume of leachate (litres)

M_{Alkali} = molecular weight of alkali material (g/mole)

Note: molecular weight of calcined magnesia (M_{MgO}) = 40 g/mole.

The alkali should be added to the leachate as slurry. Mixing of the slurry is best achieved using an agitator.

Notwithstanding regulatory authority requirements, the leachate should consider the water quality criteria presented in Section 8.2 prior to discharge.

Regular monitoring of leachate should be conducted as discussed in Section 8.1.2.

7.3 Dewatering

Options for the management/disposal of extracted groundwater during dewatering include the following:

- Re-injection of groundwater at a location away from the dewatered excavation;
- Overland discharge and infiltration, or infiltration from a detention basin;
- Disposal to sewer.

Dewatering activities should be conducted under the appropriate licence and regulatory requirements (i.e. NSW Office of Water, Council requirements).

The following procedure is recommended in order to minimise potential adverse impacts resulting from excavation and dewatering of acid sulfate soils during construction:

- Minimise the dewatering depth required for installation (i.e. as close as practicable to the invert level of the excavation);
- Minimise the time and volume of exposed acid sulfate soils (i.e. stage excavation and dewatering);
- If re-injection is proposed, periodic monitoring of reinjected water should be conducted to assess potential impacts from the dewatering process;
- For discharge/infiltration methods, extracted groundwater should be collected in a suitably sized multi stage sedimentation tank or on-site detention structures and neutralised as necessary prior to disposal;
- The extracted groundwater could then be discharged to a bunded area or constructed pond away from the dewatering site (i.e. re-injected or evaporation/infiltration) or discharged overland or to sewer, subject to regulatory requirements;
- The pH of the extracted water should be monitored prior to discharge. Neutralisation should be undertaken, as discussed below, if discharge water pH falls below natural background levels (re-injection/evaporation/infiltration) or outside regulatory requirements (sewer disposal);
- Dose the base of temporary excavations (i.e. pier holes, service trenches, lift wells etc.) at a rate of approximately 1 kg/m^2 of agricultural lime in order to counteract the generation of acidic leachate following groundwater recovery;
- Treat ASS excavated during construction as discussed in Section 7.1;
- Undertake monitoring as recommended in Section 8.

The following procedure is recommended for neutralising groundwater if required:

- The neutralising agent (e.g. agricultural lime or calcined magnesia) should be added as a slurry at the first stage of a multi-stage sedimentation tank or detention structure to allow the lime to mix with the extracted groundwater prior to discharge;
- The neutralising agent should be added at a constant rate during dewatering. The rate of dosing should be minimal initially and be monitored and adjusted based on the results of regular monitoring of the treated extracted groundwater.

8. Monitoring Strategies

8.1 Procedures

8.1.1 Soil Neutralisation / Management

It is recommended that the following inspections and monitoring be undertaken when excavating ASS materials (i.e. natural sands/clayey sands and silty sand fill below approximately RL0.2), based on guidelines presented in the ASSMAC (Ref 3) and QASSIT (Ref 4) manuals:

- Daily inspection of liming operations during initial excavation, to be reviewed following establishment of liming procedures;
- Sampling and testing after lime treatment (i.e. measurements of soil pH in distilled water and pH following oxidation with peroxide) should initially be undertaken at a frequency of at least one sample per 10 m^3 excavated soil to verify the neutralisation treatment. The frequency of testing could be reviewed as treatment progresses. A lower frequency of testing could be considered, subject to consistent results, soil conditions and treatment procedures;
- Analysis of one sample per 50 m^3 for Chromium Suite analysis by a NATA accredited laboratory to confirm appropriate neutralisation;
- Check testing should also be conducted on any natural soils encountered above RL0.2 during excavation works to confirm the absence of ASS as a precautionary measure.

8.1.2 Leachate Management

Leachate collected within the treatment bunded area(s) should be temporarily stored and neutralised as necessary. The pH of the leachate should be monitored daily and prior to discharge. The leachate could be discharged overland (i.e. re-injection evaporation/infiltration) or discharged to sewer, subject to regulatory requirements and licences.

Neutralisation should be undertaken if leachate water pH falls below natural background groundwater levels (evaporation/infiltration) or outside regulatory requirements (sewer discharge).

A contingency procedure should be in place to allow lime dosing and monitoring to confirm neutralisation prior to discharge.

8.1.3 Dewatering

Extracted groundwater should be temporarily stored, and neutralised as necessary. The pH of extracted water associated with areas of acid sulfate soils should be monitored twice daily (am, pm) prior to discharge. The groundwater could be reinjected, discharged overland (i.e. evaporation / infiltration) as discussed in Section 7.3, or discharged to sewer subject to regulatory requirements and licences.

Neutralisation should be undertaken if discharge water pH falls below natural background groundwater levels (re-injection/evaporation/infiltration) or outside regulatory requirements (sewer discharge). Current natural groundwater pH should be confirmed at the commencement of dewatering.

A contingency procedure should be in place to allow for lime dosing and monitoring confirming that neutralisation has been achieved prior to discharge.

Groundwater quality and dewatering discharge options should be confirmed prior to construction. Discharge / disposal should be conducted in accordance with regulatory and statutory requirements.

8.1.4 Surface Water Monitoring

A surface water monitoring program should be established due to the proximity of the site to receiving waters (i.e. Cottage Creek and Hunter River). The monitoring program should include pH and EC testing of surface waters upstream, downstream and adjacent to the site within Cottage Creek and the Hunter River.

Monitoring should be conducted at an initial daily frequency during construction. A reduced frequency could be conducted subject to consistent daily results and consistent construction activities.

The monitoring program should be developed prior to the commencement of construction with consideration to the staging of excavation and dewatering works.

8.1.5 Reporting

A record of treatment of acid sulfate soil and leachate should be maintained by the contractor and should include the following details:

- Date;
- Location;
- Time of excavation and reuse or disposal (i.e. time stockpile has been exposed);
- Neutralisation process undertaken;
- Lime rate utilised;
- Results of monitoring of soil, leachate, surface water and groundwater;
- Record of location, level placement and capping details where treated ASS has been re-used on-site.

A record of water monitoring and any treatment and discharge activities should also include the following:

- Background surface water pH and EC monitoring within Cottage Creek and the Hunter River, upstream and downstream of the site/discharge area;
- Daily monitoring at the point of discharge of any waters (i.e. on-site discharge point).

A record should also be maintained confirming contingency measures and additional treatment if undertaken. Monitoring should be commensurate with licencing and regulatory requirements.

A final report should be issued upon completion of the works presenting the monitoring regime and results to confirm that no adverse environmental impact has occurred during the works.

8.2 Acceptance Criteria

8.2.1 Water

Notwithstanding regulatory requirements, it is recommended that the pH of discharge waters from dewatering or leachate are within measured background groundwater pH levels, and that the ANZECC (2000) Guidelines for Fresh and Marine Water Quality (Ref 6) be considered before discharging any waters to the environment. The ANZECC (2000) guidelines trigger value range of pH 7.0 to pH 8.5 for estuarine environments is considered to be appropriate, rather than the marine or fresh water criteria, given the close proximity of the site to the Hunter River.

The background pH levels in groundwater should be confirmed prior to commencement of works.

8.2.2 Soil

Further treatment of soils may be required if monitoring of the material reveals any of the following properties:

- pH of soil in water is less than background values (to be confirmed at the commencement of works;
- pH of soil in water minus pH of soil in hydrogen peroxide is greater than 1 and pH in water is less than background values;
- pH of soil in hydrogen peroxide is greater than background (i.e. potential for over-liming).

Depending on the results of testing, reapplication of lime may be necessary to gain adequate neutralisation. Care should be taken to ensure over-liming does not occur.

The background pH levels in soils should be confirmed at the commencement of works.

9. Contingency Plan

Remedial action will be required if the standards or acceptance criteria outlined above are not being achieved. Remedial action shall comprise mixing of additional lime through the excavated material and neutralisation of leachate (if under-liming has occurred). If monitoring indicates that over-liming has occurred, additional ASS or leachate should be mixed with soils and leachate respectively to reduce pH to acceptable levels. The required mixing rate to treat the soil or leachate should be confirmed by on-site monitoring tests.

Where overland discharge or sewer discharge of extracted groundwater is proposed, a contingency plan should be in place to allow neutralisation and confirmation monitoring prior to discharge if pH levels are low or fall below natural background levels.

During periods of heavy or prolonged rainfall, stockpiling of acid sulfate soils should be appropriately contained/bunded to collect leachate for testing and neutralisation (if required) prior to disposal (see Section 7.2). Alternatively, temporary backfilling of acid sulfate soils could be undertaken to prevent the migration of leachate.

Sufficient lime should be stored on site during construction for the neutralisation of acid sulfate soils and contingency measures.

The development should be conducted with due regard to erosion and sediment controls to minimise potential impacts to nearby sensitive receptors.

Site development should be conducted in accordance with a site specific Construction Environmental Management Plan (CEMP). The CEMP should incorporate mitigation measures for soil and water management including those recommended for the management of ASS. Details should be provided in the CEMP by the contractor.

10. References

1. Douglas Partners Pty Ltd, 'Report on Contamination and Acid Sulfate Soil Assessment, Proposed Mixed Use Development, 42 Honeysuckle Drive, Newcastle', Project 91181.00, Report 91181.00.R.002.Rev0, October 2017.
2. Douglas Partners Pty Ltd, 'Report on Geotechnical Investigation, Proposed Mixed Use Development, 42 Honeysuckle Drive, Newcastle', Project 91181.00, Report 91181.00.R.001.Rev0, October 2017.
3. ASSMAC, "ASSMAC Acid Sulfate Soil Manual", New South Wales Acid Sulfate Soil Management Advisory Committee, August 1998.
4. Dear SE, Ahern CR, O'Brien LE, Dobos SK, McElnea AE, Moore NG and Watling KM, 'Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines v.4.0', Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government, June 2014.
5. NSW EPA "Waste Classification Guidelines, Part 4: Acid Sulfate Soils", Department of Environment and Climate Change, November 2014.
6. ANZECC (2000), 'Australian Water Quality Guidelines for Fresh and Marine Waters', November 2000.

11. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 42 Honeysuckle Drive, Newcastle with reference to DP's proposal dated 15 August 2017 and acceptance received from Mr Chris Farrington of Doma Holdings (Honeysuckle) Pty Ltd dated16 August 2017. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Doma Holdings (Honeysuckle) Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

This report must be read in conjunction with all of the attached 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.

Asbestos has been detected by observation and confirmed by laboratory analysis within filling at the surface of the site (likely to be associated with deeper fill materials brought to the surface through previous test pitting by others). Building demolition materials, such as concrete and brick were also identified in filling and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

Construction activities including the management, handling and disposal of soil / water, should be conducted in accordance with regulatory and statutory requirements.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

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

Please note that Part 5.6, Section 143 of the Protection of the Environment Operations (POEO) Act 1997 states that it is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that the waste is disposed of appropriately. DP accepts no liability for the unlawful disposal of waste materials from any site.

Douglas Partners Pty Ltd

Appendix A

About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Information on Cone Penetration Tests
Borehole Logs (201 to 204)
CPTs – 305, 306, 307, 308, 309A, 310A and 311
CPTu – 301A, 302, 303B and 304A

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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.

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.

Soil Descriptions

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

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

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

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

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

The proportions of secondary constituents of soils are described as:

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

Definitions of grading terms used are:

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

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Descriptions

Soil Origin

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

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

Transported soils may be further subdivided into:

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

Sampling Methods

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.

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

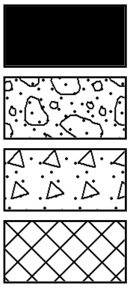
Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

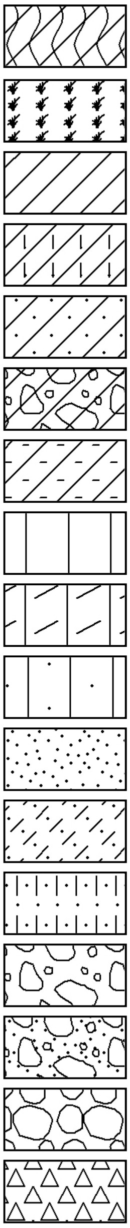
Graphic Symbols for Soil and Rock

General



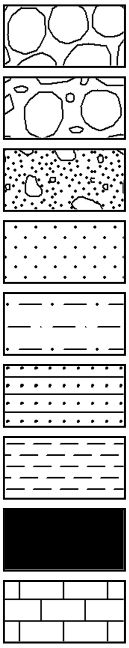
Asphalt
Road base
Concrete
Filling

Soils



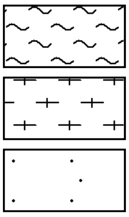
Topsoil
Peat
Clay
Silty clay
Sandy clay
Gravelly clay
Shaly clay
Silt
Clayey silt
Sandy silt
Sand
Clayey sand
Silty sand
Gravel
Sandy gravel
Cobbles, boulders
Talus

Sedimentary Rocks



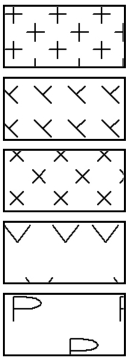
Boulder conglomerate
Conglomerate
Conglomeratic sandstone
Sandstone
Siltstone
Laminite
Mudstone, claystone, shale
Coal
Limestone

Metamorphic Rocks



Slate, phyllite, schist
Gneiss
Quartzite

Igneous Rocks



Granite
Dolerite, basalt, andesite
Dacite, epidote
Tuff, breccia
Porphyry

Cone Penetration Tests

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

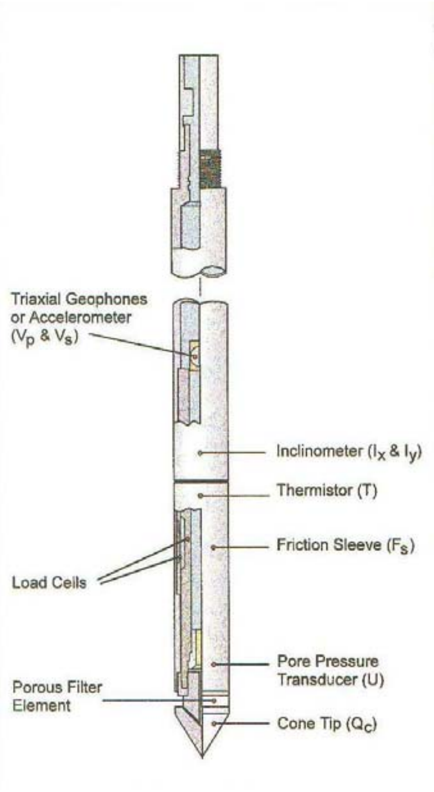


Figure 1: Cone Diagram

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)

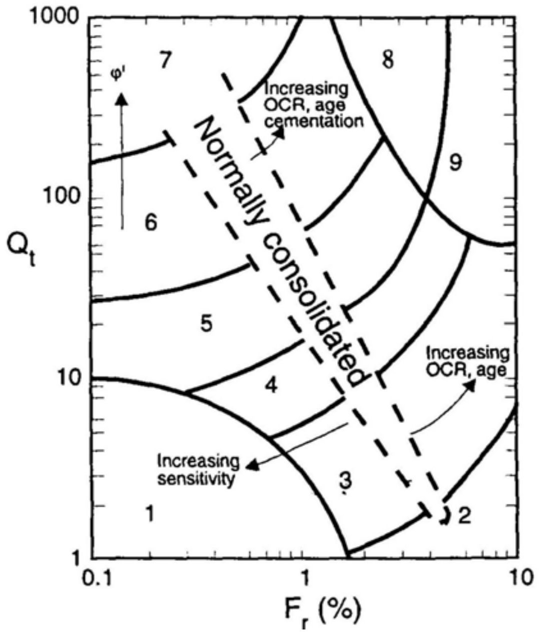


Figure 3: Soil Classification Chart

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.

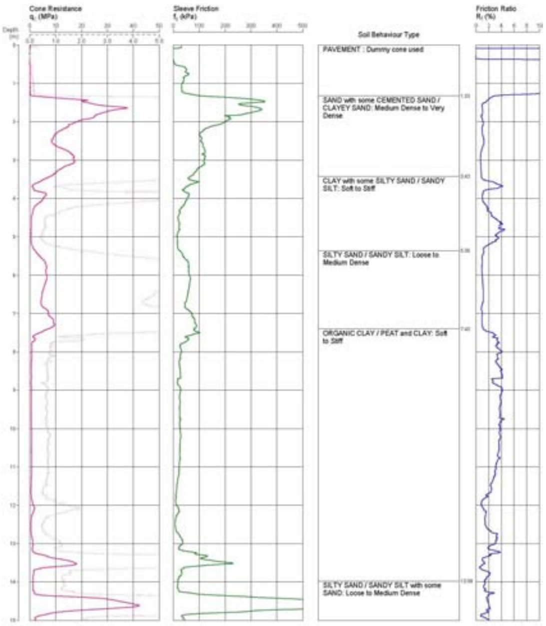


Figure 4: Sample Cone Plot

BOREHOLE LOG

CLIENT: The Doma Group
PROJECT: Proposed Mixed Use Development
LOCATION: 42 Honeysuckle Drive, Newcastle

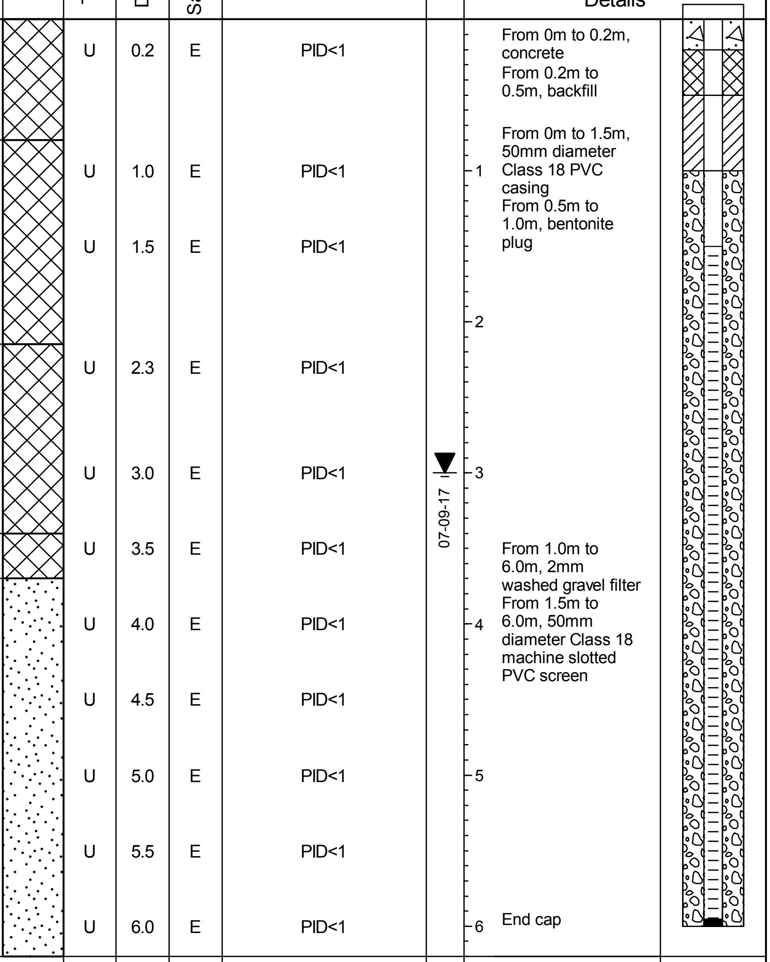
SURFACE LEVEL: 3.8 AHD
EASTING: 384371.2
NORTHING: 6356321.8
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 91181.00
DATE: 7/9/2017
SHEET 1 OF 1

Depth (m)	Description of Strata
0.0	FILLING - Generally comprising brown silty fine to medium grained sand filling, some rootlets, humid From 0.4m, trace to some subrounded gravels and trace ash gravel At 0.6m, sandstone cobble / boulder
0.8	FILLING - Generally comprising dark brown silty sand filling, trace ash gravel, coal and shell, damp
2.15	FILLING - Generally comprising pale grey, fine to medium grained sand filling, trace subrounded gravel up to 5mm and shell, damp At 3.0m, wet
3.4	FILLING - Generally comprising dark brown silty fine to coarse grained sand filling, trace to some subangular quarry and ash gravel up to 5mm in size, and trace shells, wet to saturated
3.7	SAND - Brown, fine to coarse grained sand, some silt, trace shells, wet to saturated From 3.8m to 4.7m, dark brown with clay From 4.5m, dark grey, trace shells
6.2	Bore discontinued at 6.2m, limit of investigation

Type	Depth	Sample	Results & Comments
U	0.2	E	PID<1
U	1.0	E	PID<1
U	1.5	E	PID<1
U	2.3	E	PID<1
U	3.0	E	PID<1
U	3.5	E	PID<1
U	4.0	E	PID<1
U	4.5	E	PID<1
U	5.0	E	PID<1
U	5.5	E	PID<1
U	6.0	E	PID<1

Water: ▼ 3.0 07-09-17



Well Construction Details:

From 0m to 0.2m, concrete
From 0.2m to 0.5m, backfill
From 0m to 1.5m, 50mm diameter Class 18 PVC casing
From 0.5m to 1.0m, bentonite plug
From 1.0m to 6.0m, 2mm washed gravel filter
From 1.5m to 6.0m, 50mm diameter Class 18 machine slotted PVC screen
End cap

RIG: Geoprobe 7822DT **DRILLER:** Tucker (Terratest) **LOGGED:** Depczynski **CASING:** Uncased
TYPE OF BORING: 60mm diameter Push tube
WATER OBSERVATIONS: Groundwater observed at ~3.0m during drilling
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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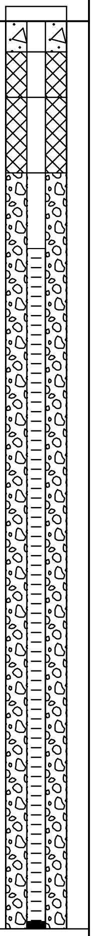
BOREHOLE LOG

CLIENT: The Doma Group
PROJECT: Proposed Mixed Use Development
LOCATION: 42 Honeysuckle Drive, Newcastle

SURFACE LEVEL: 3.7 AHD
EASTING: 384349.4
NORTHING: 6356318.3
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 91181.00
DATE: 7/9/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details
				Type	Depth	Sample	Results & Comments		
		FILLING - Generally comprising brown, fine to coarse grained silty sand filling, some rootlets and coal, trace subrounded gravel up to 15mm and shell, humid	▨	U	0.2	E	PID<1		From 0m to 0.2m, concrete From 0.2m to 0.5m, backfill
	0.4	FILLING - Generally comprising dark brown, fine to medium grained silty sand filling, trace quarry gravel up to 15mm, trace brick fragments, humid	▨	U	0.5	E	PID<1		
			▨	U	1.0	E	PID<1		From 0m to 1.5m, 50mm diameter Class 18 PVC casing From 0.5m to 1.0m, bentonite plug
	1.4	FILLING - Generally comprising pale grey, fine to coarse grained sand filling, trace shells, humid	▨	U	1.5	E	PID<1		
			▨	U	2.0	E	PID<1		
		From 2.8m, damp	▨	U	2.5	E	PID<1		
	2.9	SAND - Dark grey, fine to coarse grained sand, some fine shells, trace subrounded gravel up to 5mm, wet to saturated	⁘	U	3.0	E	PID<1	▼ 07-09-17	
		From 3.6m to 4m, clayey sand band	⁘	U	3.8	E	PID<1		From 1.0m to 6.0m, 2mm gravel filter From 1.5m to 6.0m, 50mm diameter Class 18 machine slotted PVC screen
		From 4m, trace wood (root)	⁘						
		From 4.4m to 4.7m, clayey sand band	⁘	U	4.5	E	PID<1		
			⁘	U	5.0	E	PID<1		
		From 5.7m, grey, trace shells	⁘	U	5.5	E	PID<1		
	6.0	Bore discontinued at 6.0m, limit of investigation		U	6.0	E	PID<1		End cap



RIG: Geoprobe 7822DT **DRILLER:** Terratest **LOGGED:** Depczynski **CASING:** Uncased
TYPE OF BORING: 60mm diameter Push tube
WATER OBSERVATIONS: Groundwater observed at ~3.0m during drilling
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The Doma Group
PROJECT: Proposed Mixed Use Development
LOCATION: 42 Honeysuckle Drive, Newcastle

SURFACE LEVEL: 2.5 AHD
EASTING: 384299.4
NORTHING: 6356307.2
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 91181.00
DATE: 7/9/2017
SHEET 1 OF 1

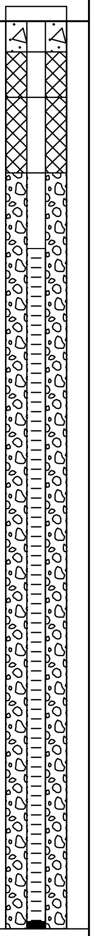
Depth (m)	Description of Strata
0.5	FILLING - Generally comprising brown silty, fine to medium grained sand filling, some rootlets, trace subangular to subrounded gravels (quarry and ash) up to 5mm in size and shells, humid
2.2	FILLING - Generally comprising grey, fine to coarse grained sand filling, some silt, trace shell fragments, humid From 0.7m, trace silt
2.95	FILLING - Generally comprising grey, fine to coarse grained sand filling, trace shell and subrounded gravel up to 10mm in size, damp From 2.4m to 2.8m, clayey sand (possibly natural), trace fine shell band, moderate hydrocarbon / organic odour, wet
6.0	SAND - Dark grey, fine to coarse grained sand, no odour, wet to saturated From 3.2m to 3.6m, clayey sand band From 4.2m to 4.4m, with subrounded gravel up to 10mm in size From 4.4m, fine to medium grained
	Bore discontinued at 6.0m, limit of investigation

Type	Depth	Sample	Results & Comments
U	0.2	E	PID <1
U	0.6	E	PID <1
U	1.0	E	PID <1
U	1.5	E	PID <1
U	2.0	E	PID=2
U	2.5	E	PID=2
U	3.0	E	PID=2
U	3.5	E	PID <1
U	4.0	E	PID <1
U	4.5	E	PID <1
U	5.0	E	PID <1
U	5.5	E	PID <1
U	6.0	E	PID <1

Water: ▼ 07-09-17

Well Construction Details

From 0m to 0.2m, concrete
From 0.2m to 0.5m, backfill
From 0m to 1.5m, 50mm diameter Class 18 PVC casing
From 0.5m to 1.0m, bentonite plug
From 1.0m to 6.0m, 2mm gravel filter
From 1.5m to 6.0m, 50mm diameter Class 18 machine slotted PVC screen
End cap



RIG: Geoprobe 7822DT **DRILLER:** Terratest **LOGGED:** Depczynski **CASING:** Uncased
TYPE OF BORING: 60mm diameter Push tube
WATER OBSERVATIONS: Groundwater observed at ~2.4m during drilling
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: The Doma Group
PROJECT: Proposed Mixed Use Development
LOCATION: 42 Honeysuckle Drive, Newcastle

SURFACE LEVEL: 3.2 AHD
EASTING: 384337.6
NORTHING: 6356344.6
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 91181.00
DATE: 7/9/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - Generally comprising brown silty fine to coarse grained sand filling, some subangular to subrounded gravel up to 30mm (including black ash), trace rootlets, shell	▨	U	0.2	E	PID<1		
				U	0.5	E	PID<1		
	0.7	FILLING - Generally comprising brown, fine to coarse grained sand filling, some silt and subrounded gravel up to 5mm in size, trace coal and shell fragments, humid	▨	U	1.0	E	PID<1		
				U	1.5	E	PID<1		
				U	2.0	E	PID<1		
		From 2.5m, moist From 2.7m, wet		U	2.5	E	PID<1		
	2.9	FILLING - Generally comprising brown silty, fine to coarse grained sand filling, trace shells, wet	▨	U	3.0	E	PID<1		
				U	3.5	E	PID<1		
	3.7	SAND - Brown, fine to coarse grained sand, some silt and trace shells, wet to saturated	⁘	U	4.0	E	PID<1		
				U	4.5	E	PID<1		
				U	5.0	E	PID<1		
				U	5.5	E	PID<1		
	6.0	Bore discontinued at 6.0m, limit of investigation		U	6.0	E	PID <1		

RIG: Geoprobe 7822DT **DRILLER:** Terratest **LOGGED:** Depczynski **CASING:** Uncased
TYPE OF BORING: 60mm diameter Push tube
WATER OBSERVATIONS: Groundwater observed at ~2.7m during drilling
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.7 AHD

COORDINATES: 384354E 6356330N

305

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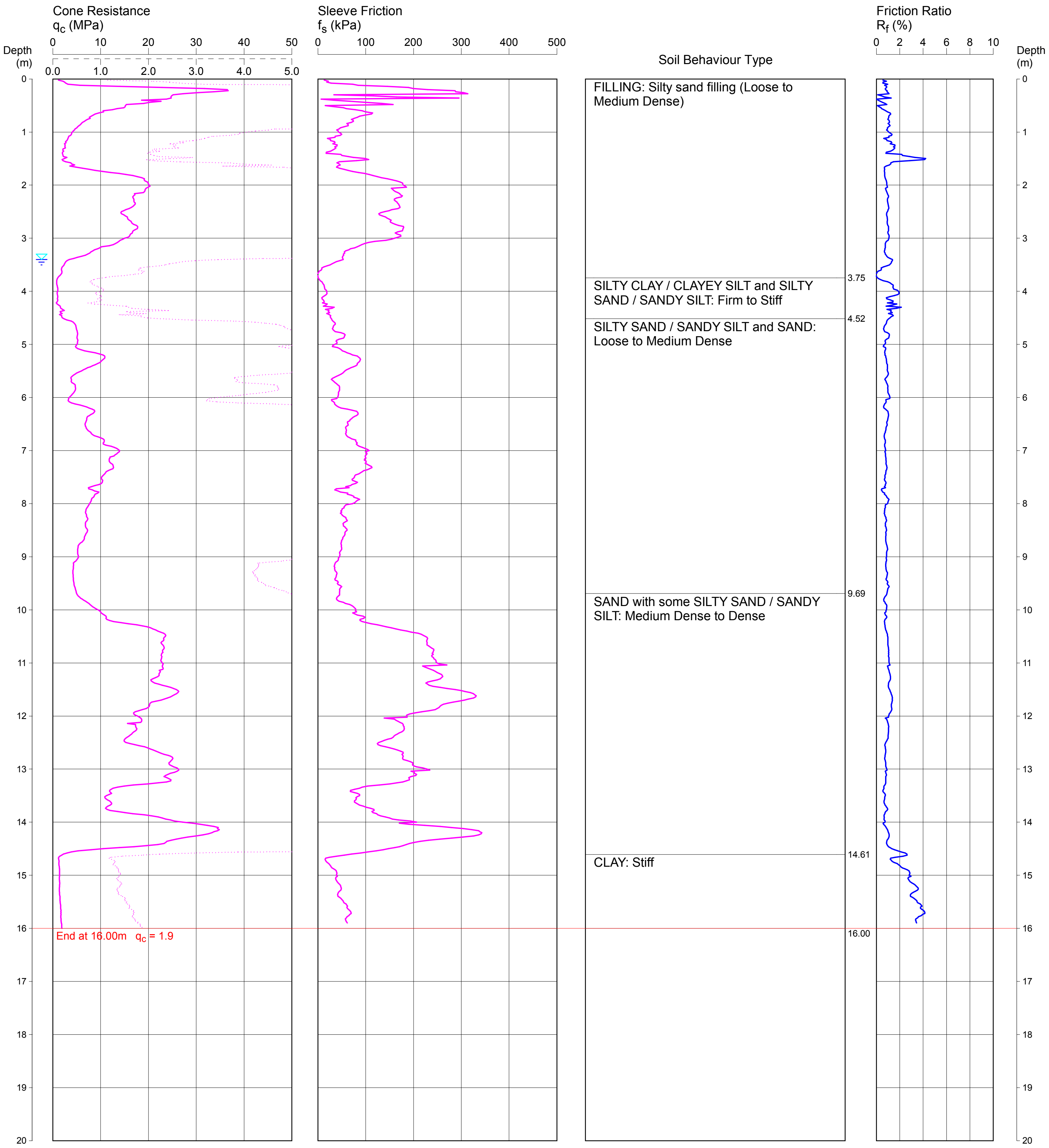
DATE 14/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET DEPTH
GROUNDWATER OBSERVED AT 3.4 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 3.40m depth (assumed)

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ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.9 AHD

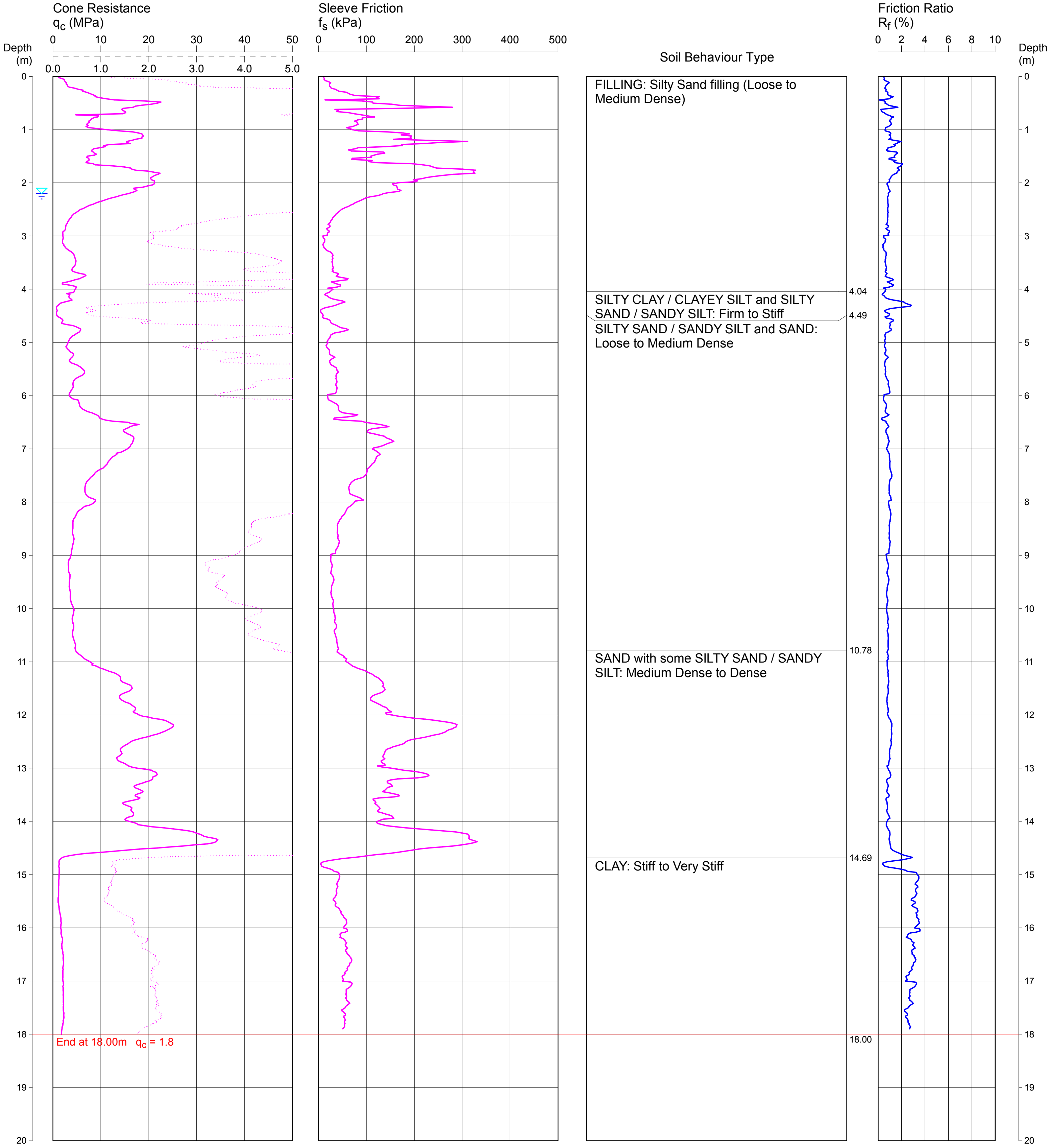
COORDINATES: 384356E 6356305N

306

Page 1 of 1

DATE 14/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET STRATA
HOLE COLLAPSE AT 2.2 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.20m depth (assumed)

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Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 2.2 AHD

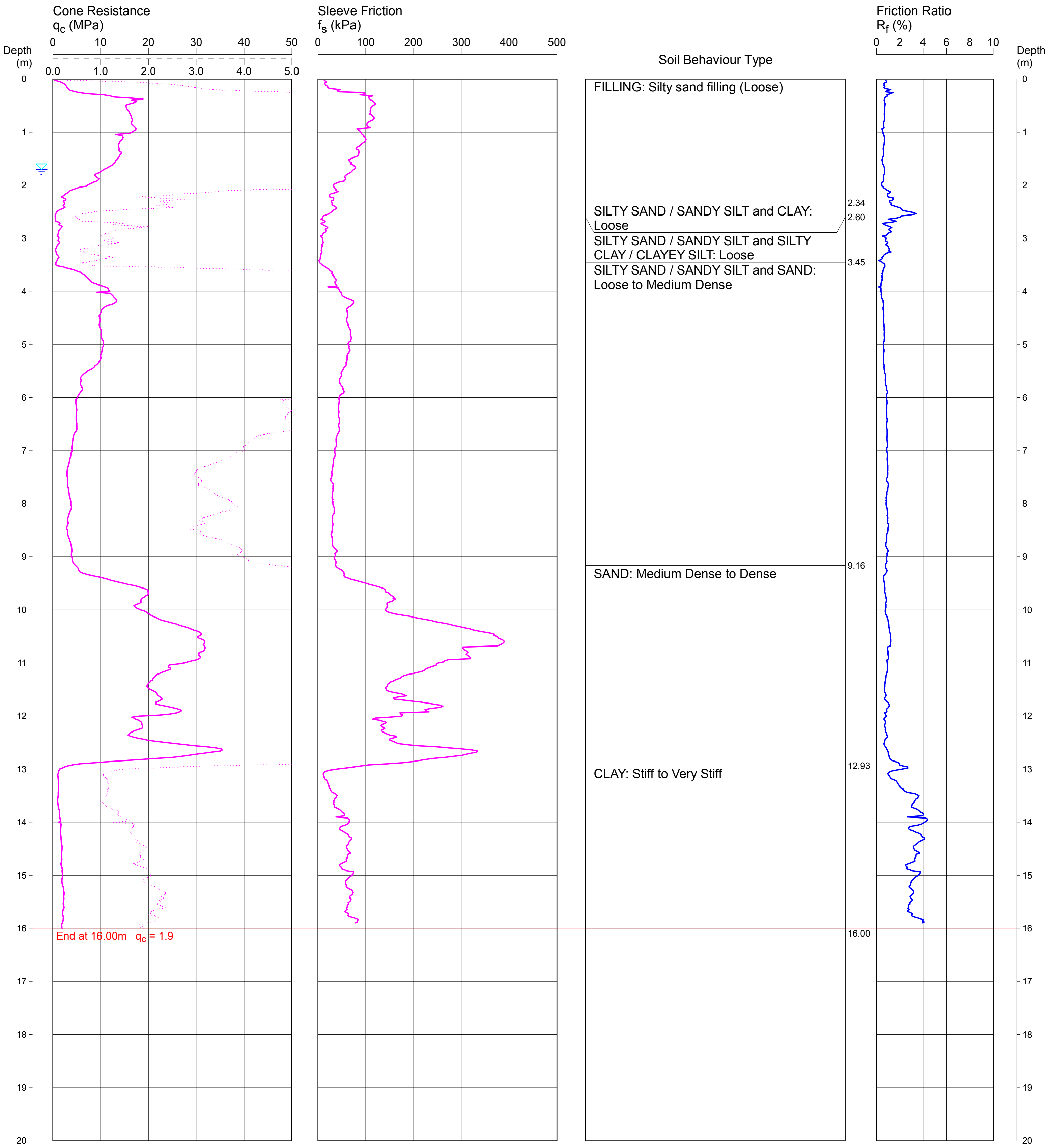
COORDINATES: 384394E 6356293N

307

Page 1 of 1

DATE 14/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET STRATA
GROUNDWATER OBSERVED AT 1.7 m AFTER WITHDRAWAL OF RODS

Water depth after test: 1.70m depth (measured)

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Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.8 AHD

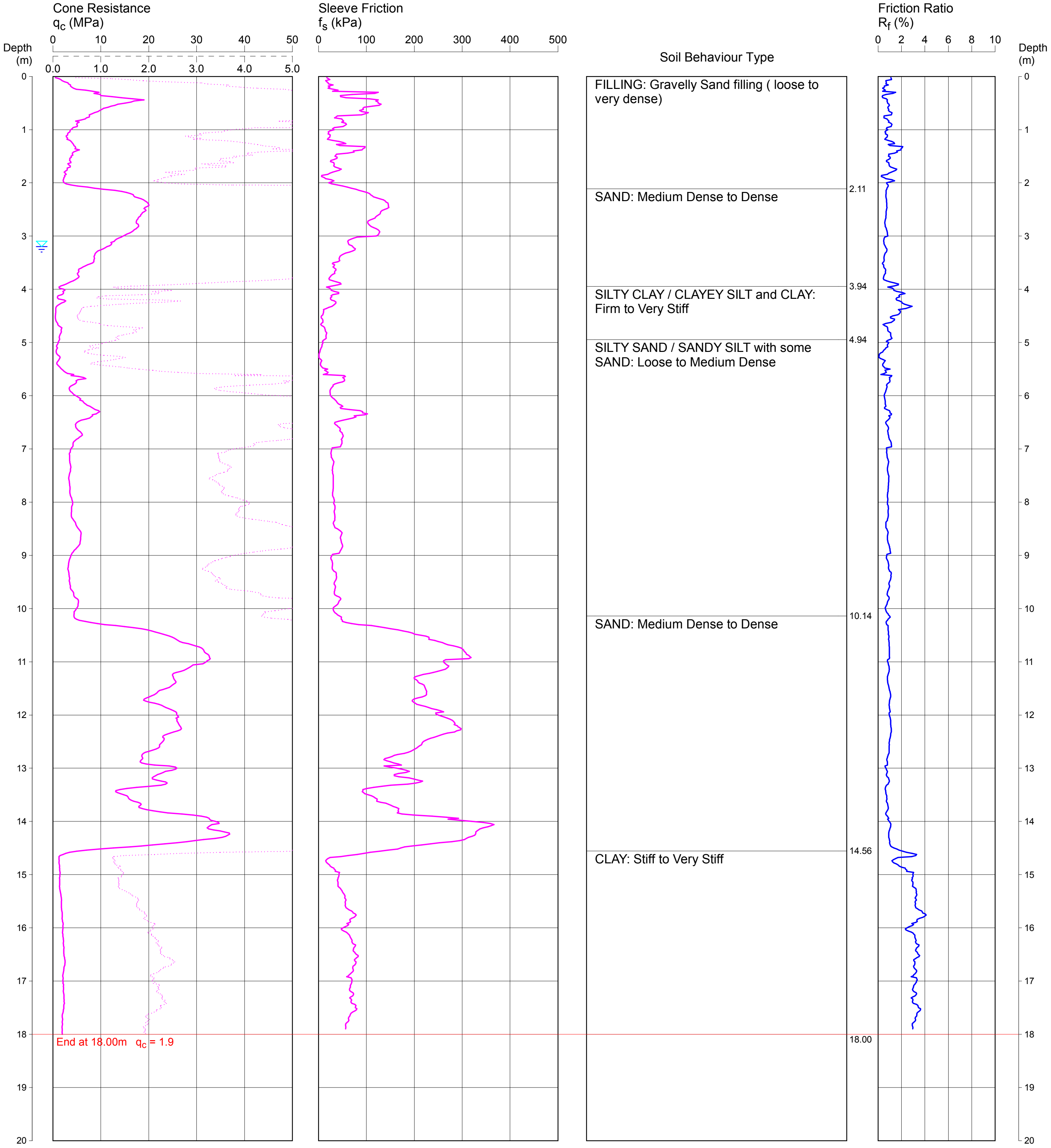
COORDINATES: 384335E 6356301N

308

Page 1 of 1

DATE 14/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET STRATA
HOLE COLLAPSE AT 3.2 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 3.20m depth (assumed)

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\308.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.6 AHD

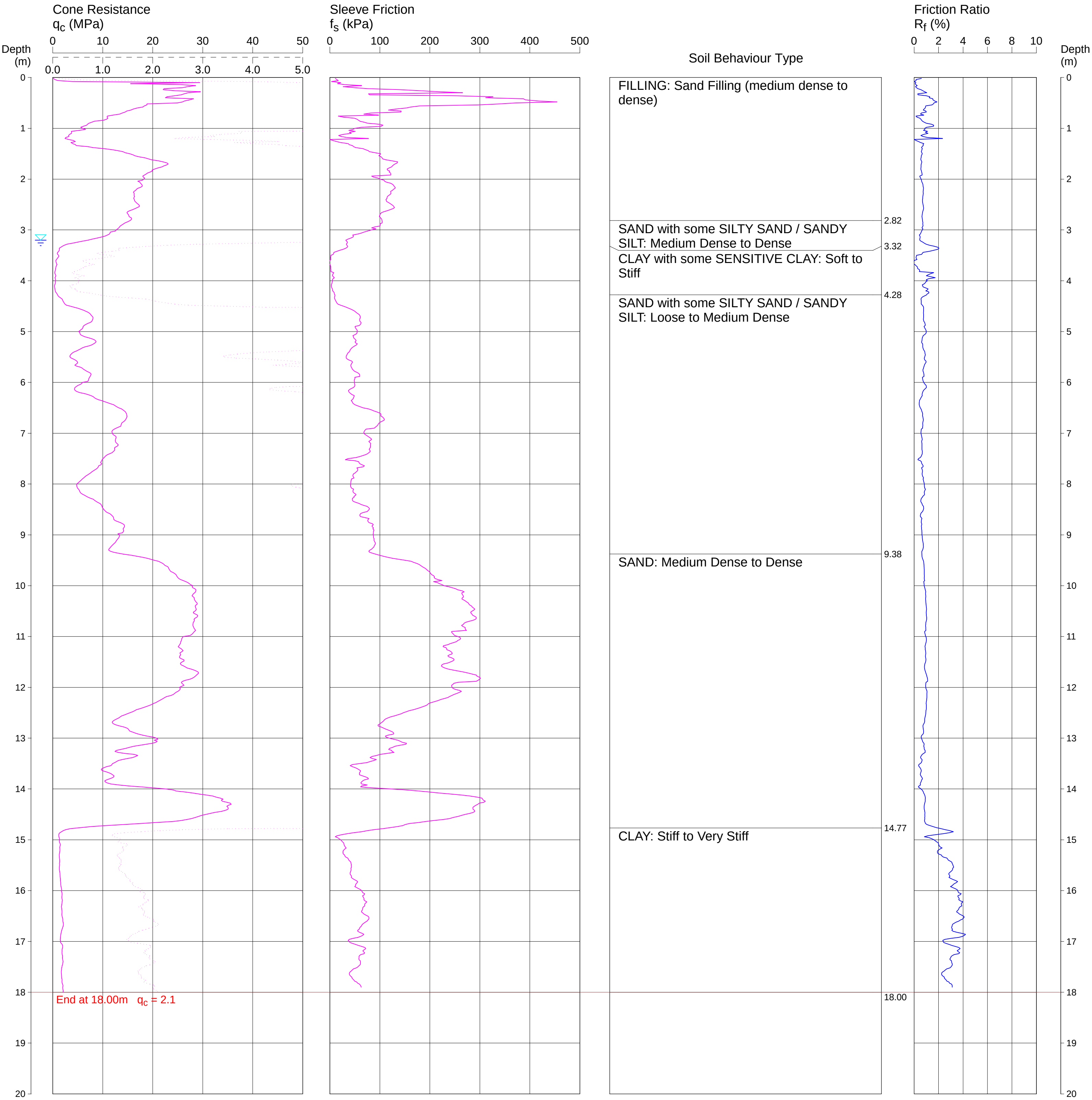
COORDINATES: 384340E 6356338N

309A

Page 1 of 1

DATE 14/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET STRATA
GROUNDWATER OBSERVED AT 3.2 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 3.20m depth (measured)

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\309A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE)

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.8 AHD

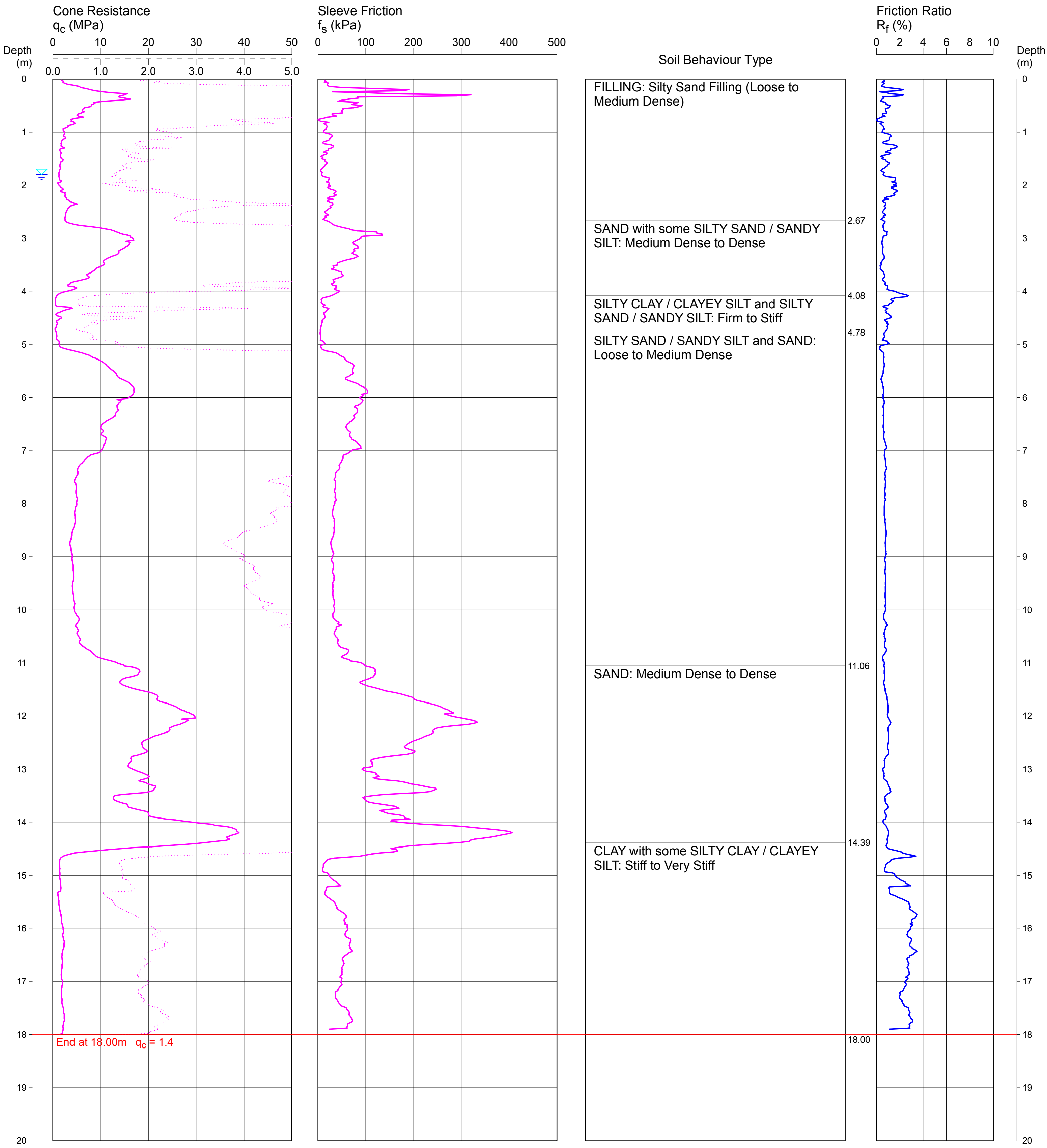
COORDINATES: 384343EE 6356302NN

310A

Page 1 of 1

DATE 14/09/2017

PROJECT No: 91181



FILLING: Silty Sand Filling (Loose to Medium Dense)

SAND with some SILTY SAND / SANDY SILT: Medium Dense to Dense

SILTY CLAY / CLAYEY SILT and SILTY SAND / SANDY SILT: Firm to Stiff

SILTY SAND / SANDY SILT and SAND: Loose to Medium Dense

SAND: Medium Dense to Dense

CLAY with some SILTY CLAY / CLAYEY SILT: Stiff to Very Stiff

REMARKS: TEST DISCONTINUED AT TARGET STRATA
HOLE COLLAPSE AT 1.8 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 1.80m depth (assumed)

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\310A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.8 AHD

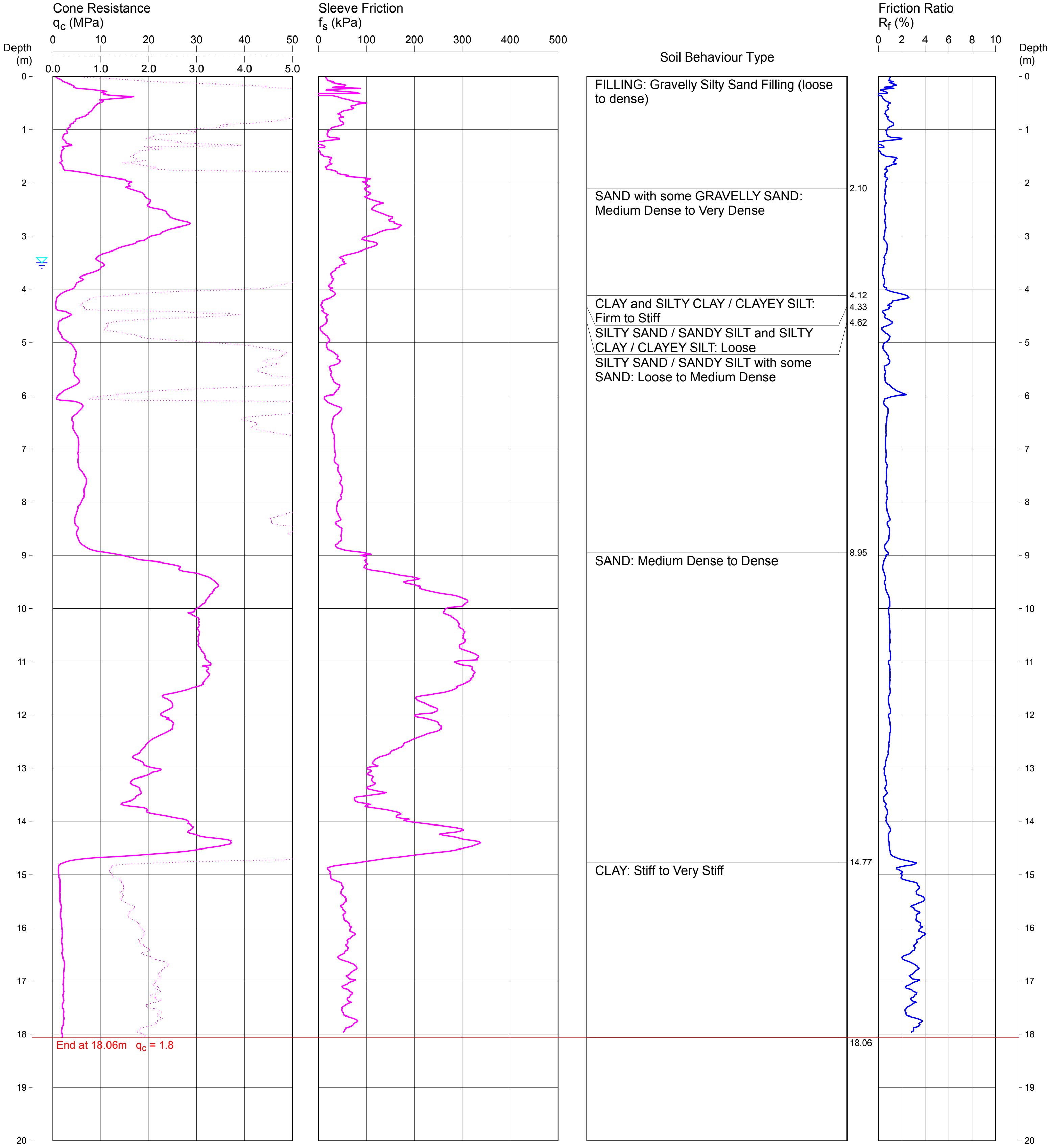
COORDINATES: 384349E 6356313N

311

Page 1 of 1

DATE 14/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET STRATA
GROUNDWATER OBSERVED AT 3.5 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 3.50m depth (measured)

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\311.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.8 AHD

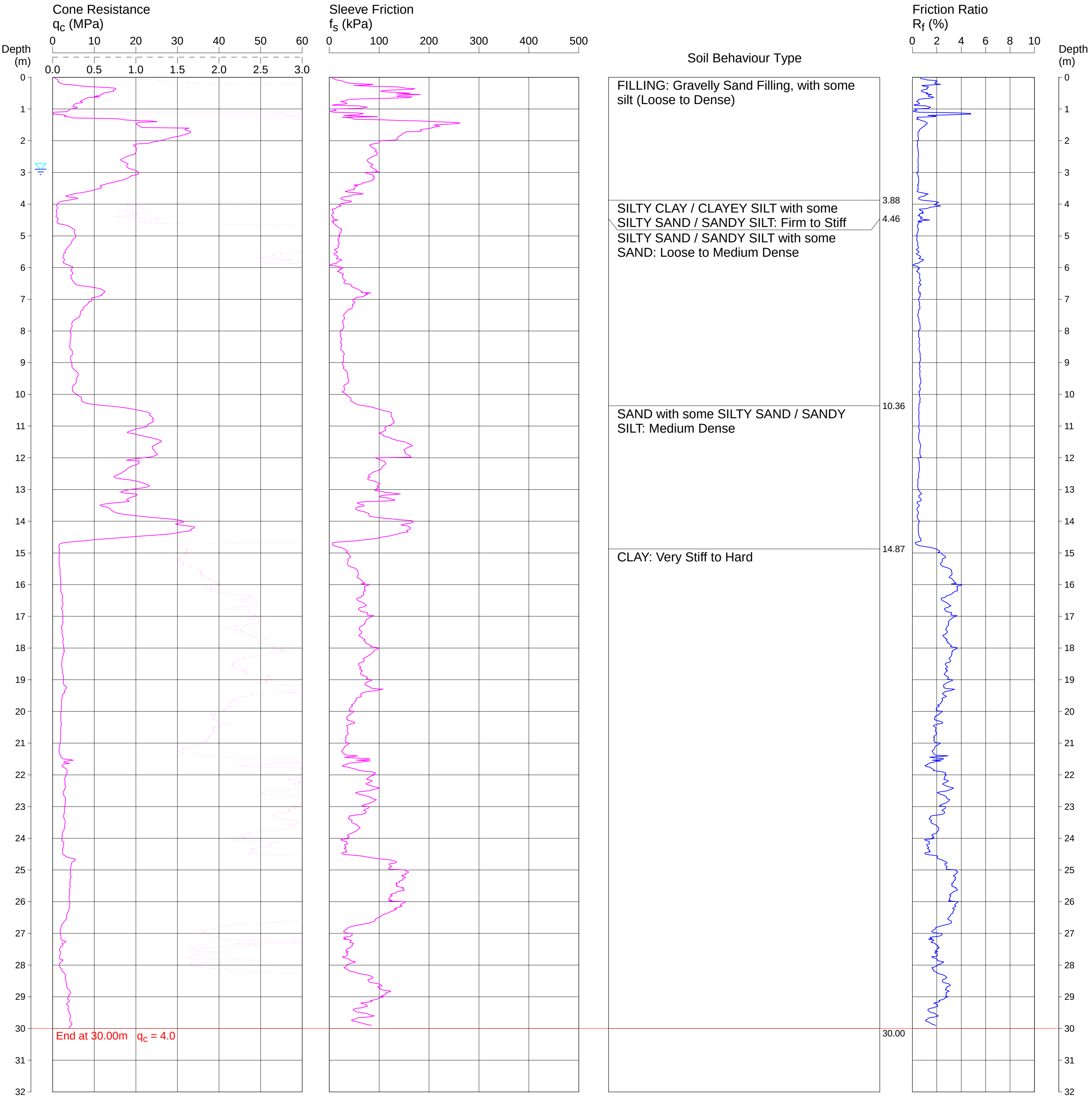
COORDINATES: 384347E 6356316N

301A

Page 1 of 1

DATE 13/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET DEPTH
HOLE COLLAPSE AT 2.9 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.90m depth (measured)

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\301A.CP5
Cone ID: 160917 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2
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Dissipation Test

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.8 AHD

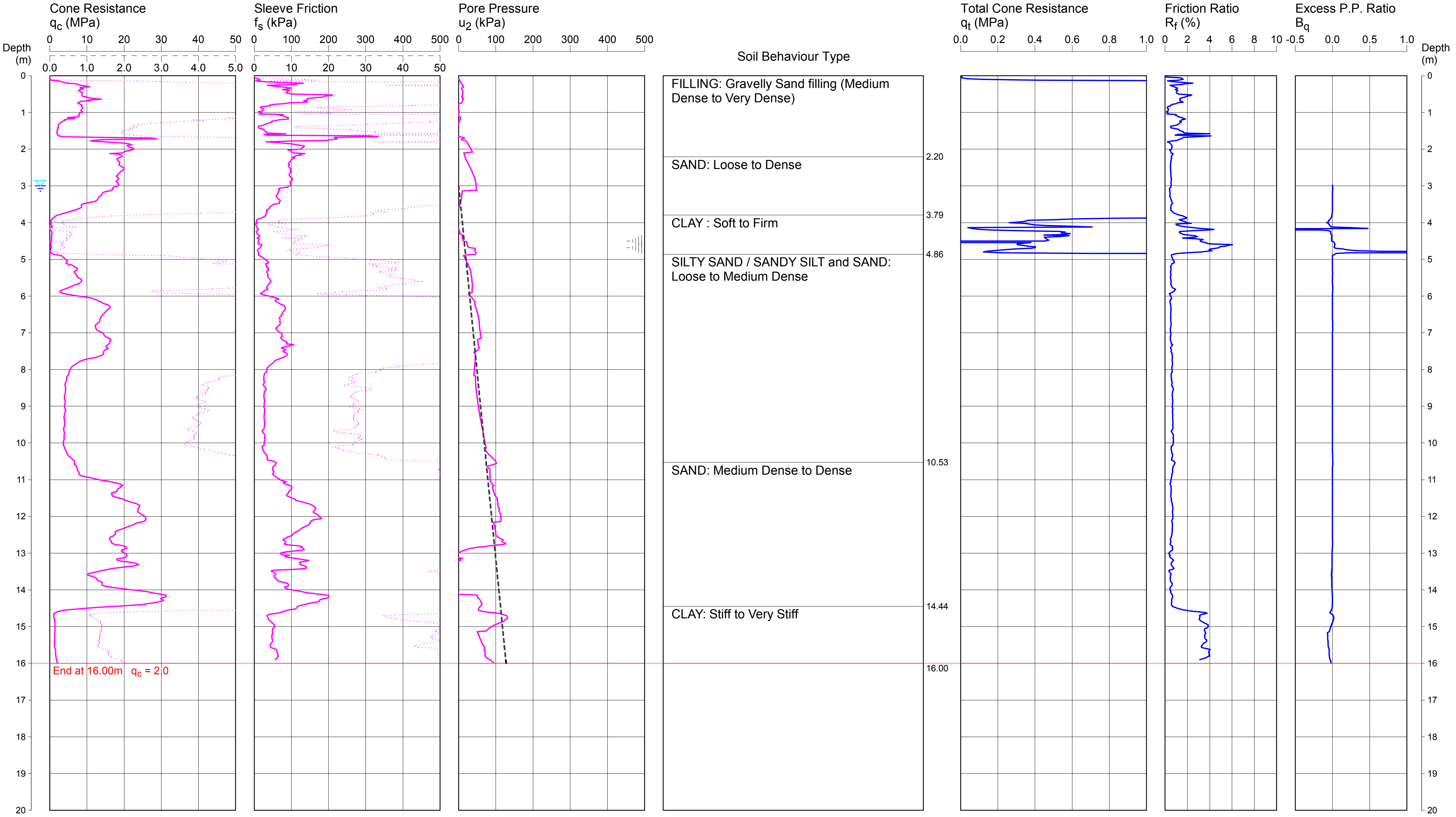
COORDINATES: 384631E 6356313N

302

Page 1 of 1

DATE 13/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET DEPTH
HOLE COLLAPSE AT 2.1 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 3.00m depth (assumed)

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\302.CP5
Cone ID: 120539 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2

-ııǁ Dissipation Test

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.9 AHD

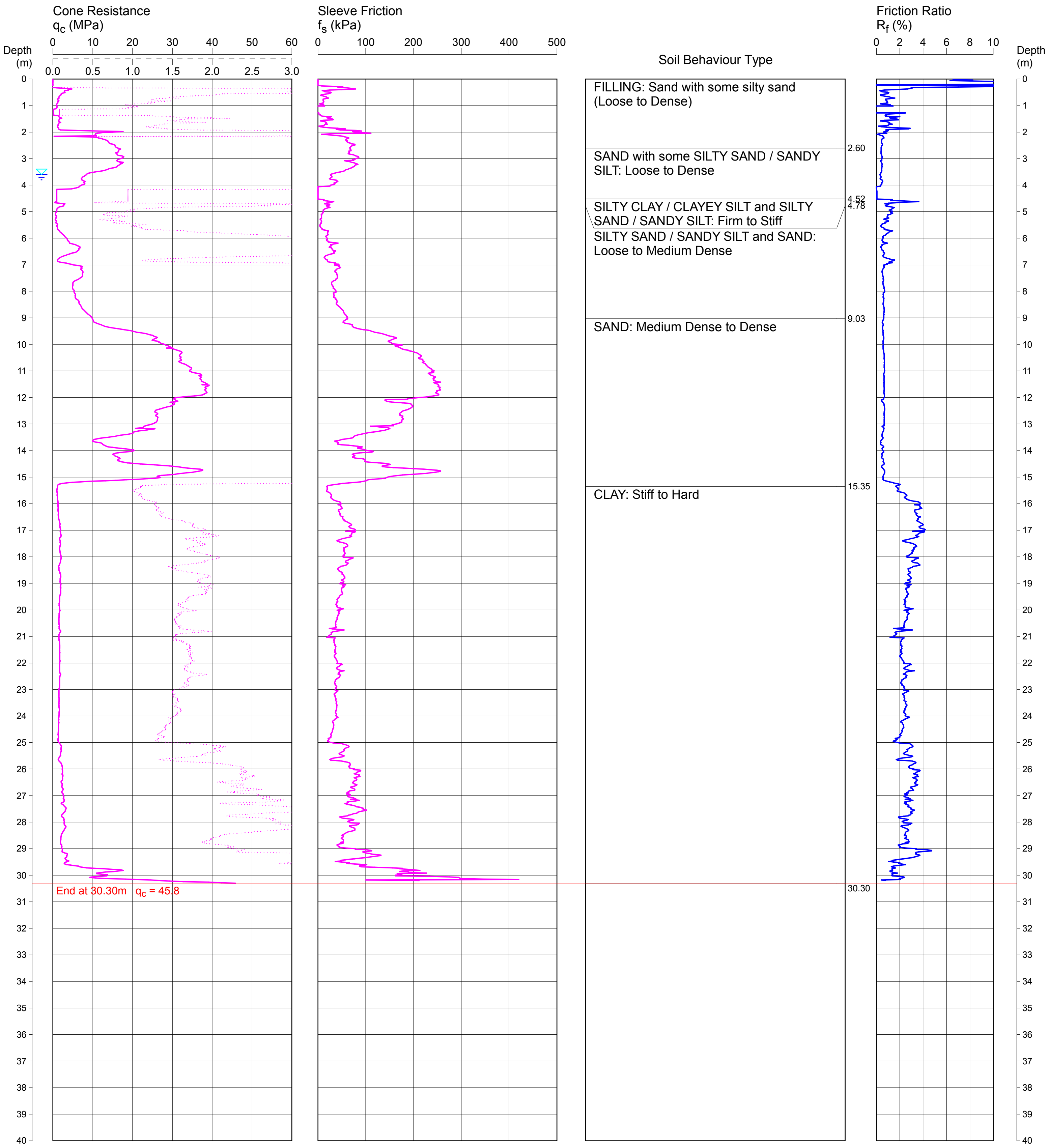
COORDINATES: 384310E 6356312N

303B

Page 1 of 1

DATE 13/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET DEPTH
GROUNDWATER OBSERVED AT 3.6 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 3.60m depth (measured)

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\303B.CP5
Cone ID: 120539 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2
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-·ı|| Dissipation Test

Douglas Partners
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CONE PENETRATION TEST

CLIENT: DOMA HOLDINGS (HONEYSUCKLE) PTY LTD

PROJECT: PROPOSED MIXES USE DEVELOPMENT

LOCATION: 42 HONEYSUCLE DRIVE, NEWCASTLE

REDUCED LEVEL: 3.8 AHD

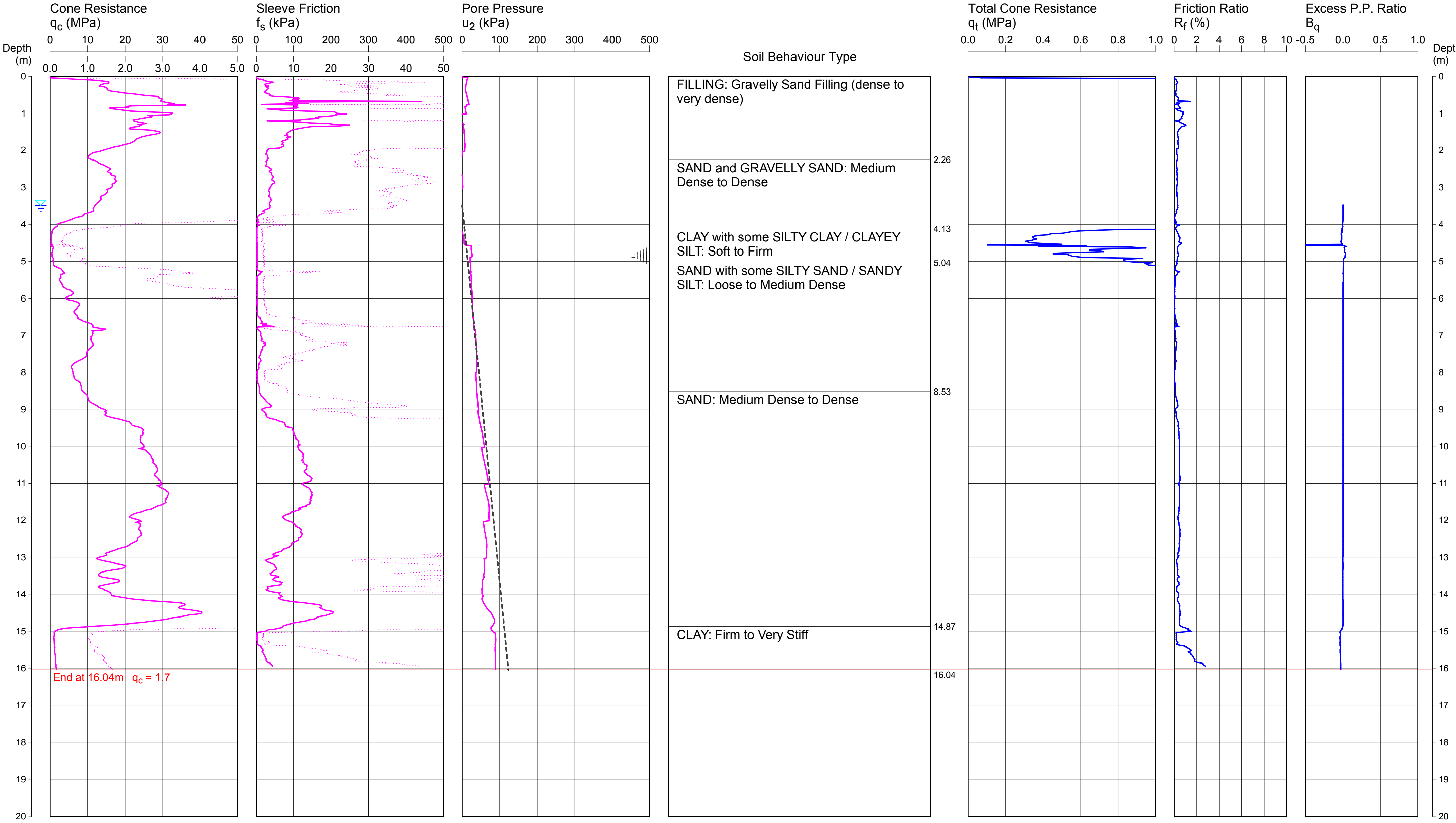
COORDINATES: 384335E 6356301N

304A

Page 1 of 1

DATE 13/09/2017

PROJECT No: 91181



REMARKS: TEST DISCONTINUED AT TARGET DEPTH
GROUNDWATER OBSERVED AT 3.5 m AFTER WITHDRAWAL OF RODS

File: P:\91181.00 - NEWCASTLE, 42 Honeysuckle Drive, Geo-Env\4.0 Field Work\cptS\91181.00 HONEYSUCKLE\91181.00 HONEYSUCKLE\304A.CP5

Cone ID: 160917 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2

-||| Dissipation Test

Water depth after test: 3.50m depth (measured)

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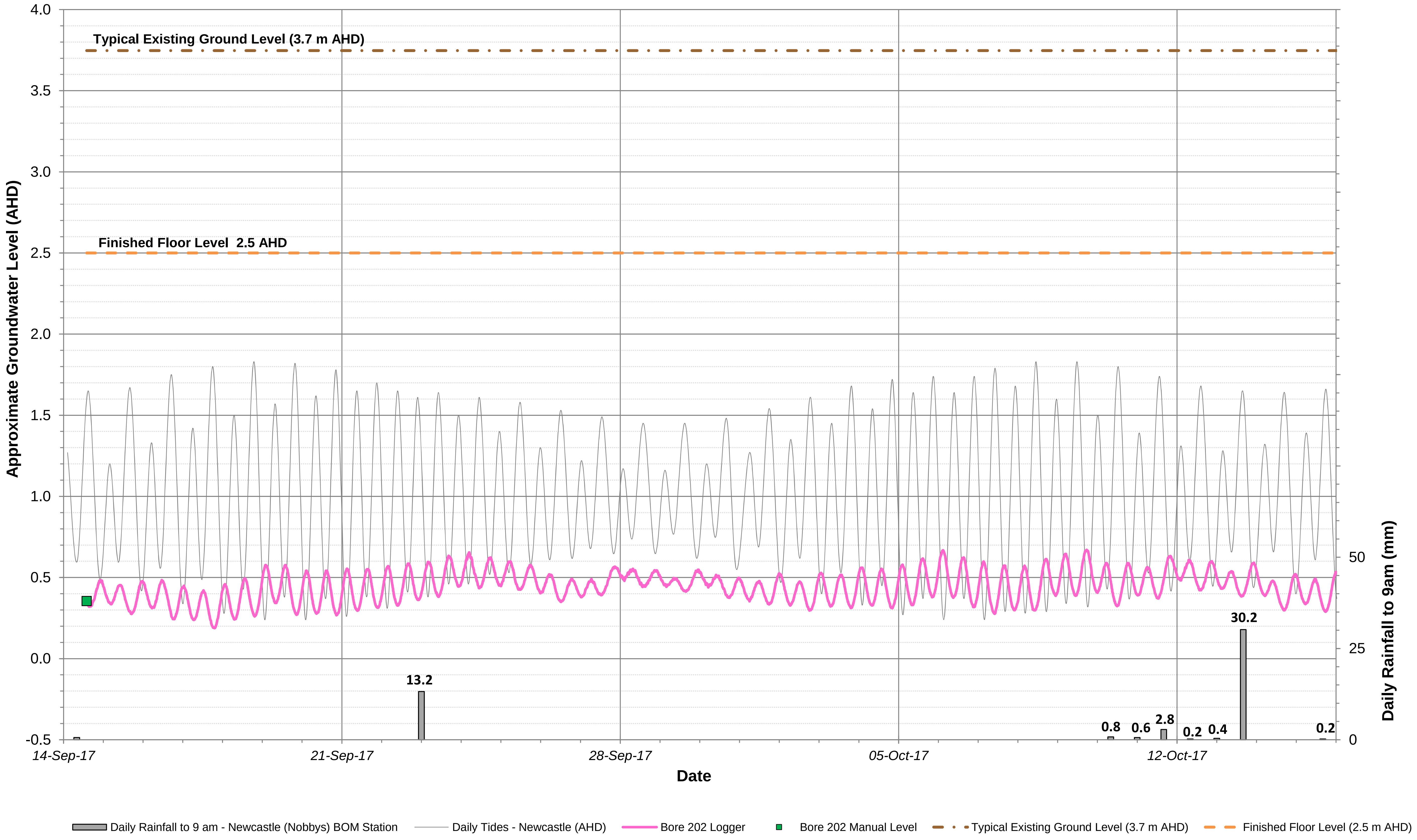
Appendix B

Figure B1 – Groundwater Pressure Head vs Rainfall



Douglas Partners
Geotechnics / Environment / Groundwater

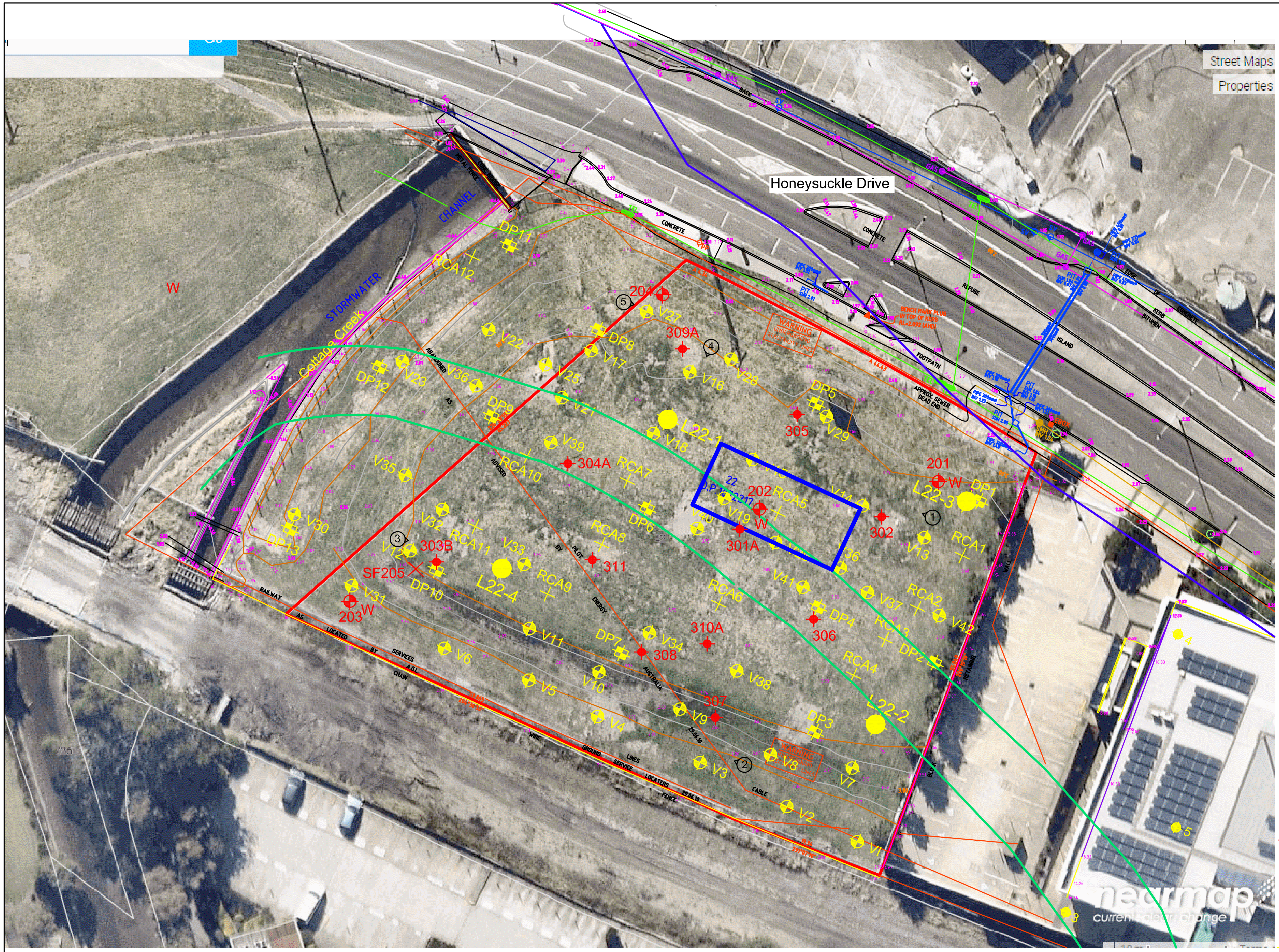
CLIENT: The Doma Group
OFFICE: Newcastle
DRAWN: LCD
SCALE: N/A
DATE: 19.10.17

TITLE: **Groundwater Pressure Head vs Rainfall**
Proposed Mixed Use Development
42 Honeysuckle Drive, Newcastle

PROJECT NO: 91181.00
FIGURE NO: B1
REVISION: Rev0

Appendix C

Drawing 1 – Test Location Plan
Drawings supplied by Client:
DWG: A03, 101 Rev A, titled “Ground Floor Plan”, dated 27.9.2017
DWG: SK1 Rev 2, titled “Inground Excavation Plan”, dated 31.10.2017



Locality Plan

NOTES

1. Drawing adapted from plan by de Witt Consulting, Ref 7768 dated 27.07.17, Nearmap Image dated 27.7.17 and plan by BatesSmart, Ref Ground Floor Plan s12109 dated 27.09.2017.
2. Current test locations are approximate only and were located using tape measurement from existing site features and hand held GPS.

0 5 10 15 20 30 40 50m

1:500 @ A3

LEGEND

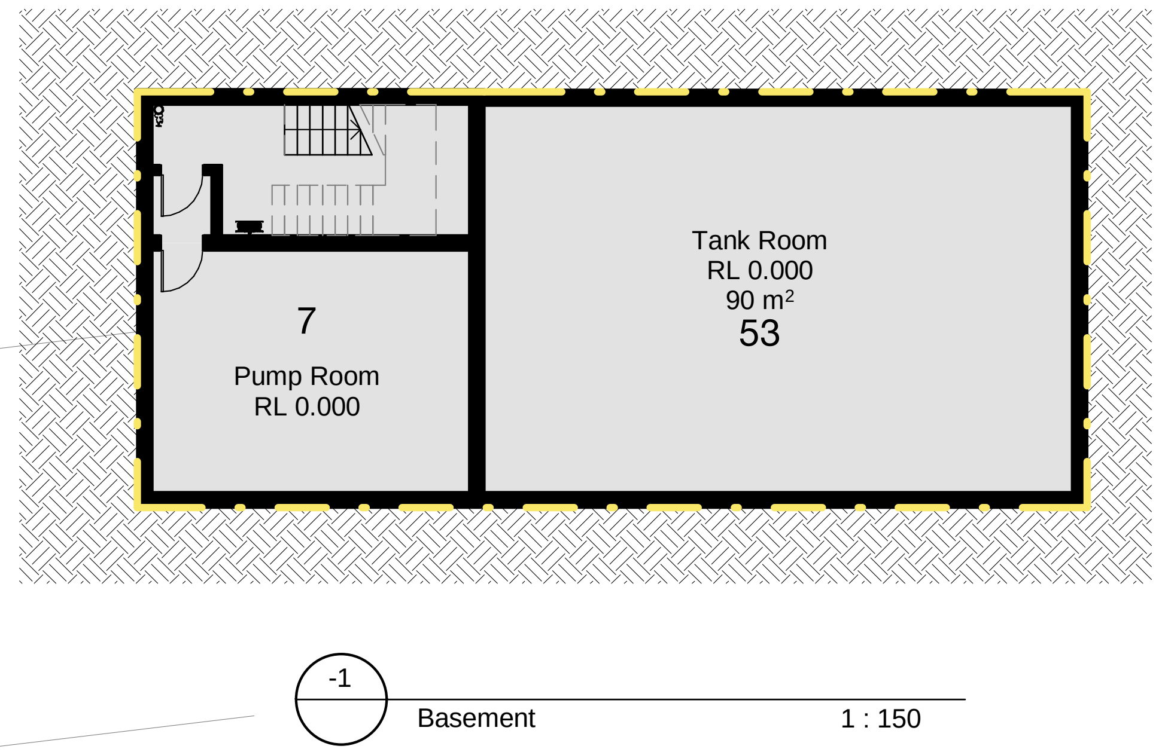
⊕	Borehole Location (current investigation)
W	Well Installed
✦	Cone Penetration Test Location (current investigation)
×	Surface Soil and Fibro Sample Location (current investigation)
✦	Previous Test Locations
🟩	Inferred Old Channel from Historical Photos
🟥	Site Boundary
⑩	Approximate Photo Location and Orientation
🟦	Proposed Pump / Tank Room

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: The Doma Group		TITLE:	**Test Location Plan**
OFFICE: Newcastle	DRAWN BY: PLH		**Proposed Mixed Use Development**
SCALE: As shown	DATE: 23.10.2017		**42 Honeysuckle Drive, Newcastle**

N

PROJECT No:	91181.00
DRAWING No:	1
REVISION:	D.002.Rev0



-1 Basement 1 : 150

LEGEND

1 Fire Hydrant 600x450mm
2 Fire Hose Reel 900x450mm
3 Fire Control Room 12sqm minimum
4 Exhaust Riser Above 1000x500mm
5 Hotel Fire Mimic (recessed in wall) 400x300mm
6 Cold Water Meter 3000x800x800
7 Subterrain fire tanks with pumps and pump controls
8 Kitchen Exhaust Riser 1200x850
9 Kitchen make-up riser 1200x850mm
10 Building Distribution Room 3600W x 2100D
11 Hydraulic Riser 850x600mm
12 Main Hotel Communications room 4600x3200mm
13 Building Distributor room 4000x1000mm
14 Fire Hydrant recess 450x700mm
15 Communications riser to above 300x150mm
16 Cold Water Pump room 4000x27000mm
17 Comms & Electrical Cupboard and Risers
18 Main Switchroom 6000x4000mm
19 Residential Fire Mimic panel 400x300mm
20 Chamber Substation 2800x5600mm
21 Gas Boundary Regulator 2000x1000x1300mm
22 Secondary Gas Main 1050 kPa
23 200 UPVC Water
24 150 UPVC Sewer
25 Subterrain Fire Pumps and Fire Tanks
26 Stairwell pressurisation shaft/fan room 2300x1900mm
27 Electrical distribution board servicing 650x500mm
28 Stairwell pressurisation shaft/fan room 2300x1900mm
29 Hydraulic riser 200x700mm
30 Electrical meter cupboard 1200x500mm
31 Communications riser below
32 Provide wall wetting sprinklers to louvers
33 Hotel communications riser 300x150mm
34 Hotel communications rack 1200x1200mm
35 Condenser plant for hotel common area
36 MSSB
37 Exhaust riser 1000x500mm
38 Stairwell pressurisation shaft/fan room 2200x650mm
39 Stairwell presurisation relief air riser 2000x1600mm
40 Electrical cable riser to above 1000x200mm
41 Condensers
42 Open Stairwell
43 Residential Storage Cages
44 Fire hydrant recess 700x450mm
45 Hot water riser 200x200mm
46 Hotel hot water plant 2200x3200mm
47 Residential hot water plant 2200x3200mm
48 Gas Boundary Regulator Below 222Wx1000Dx1300H
49 Fire Booster
50 Hotel Fire Mimic
51 Condensors
52 Electrical Distribution Board
53 Pump Room
54 Condenser plant for hotel common area
55 Carpark Electrical distrib. board with riser 800Wx500D
56 Refrigerant pipework riser 1050 x 1000
57 Two Condensers platforms for 52 condensers serving levels 5-8 apartments, 11400 x 6400

Revision	Date	Description	Initial	Checked
A	27/09/17	DA Draft	DOMA	BS

42 Honeysuckle Drive
42 Honeysuckle Drive, Newcastle

Ground Floor Plan

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Scale 1 : 150 @ A1 1:300 @ A3
Drawn MDJ Checked VG
Project no. s12109
Status DA
Plot Date 27/09/2017 6:06:15 PM
Plot File \\liv-vfp-01\home$\JDM\Documents\42HONEYSUCKLEDRIVE_BS_ARCH_DA_JDM.rvt
Drawing no. A03.101 Revision A

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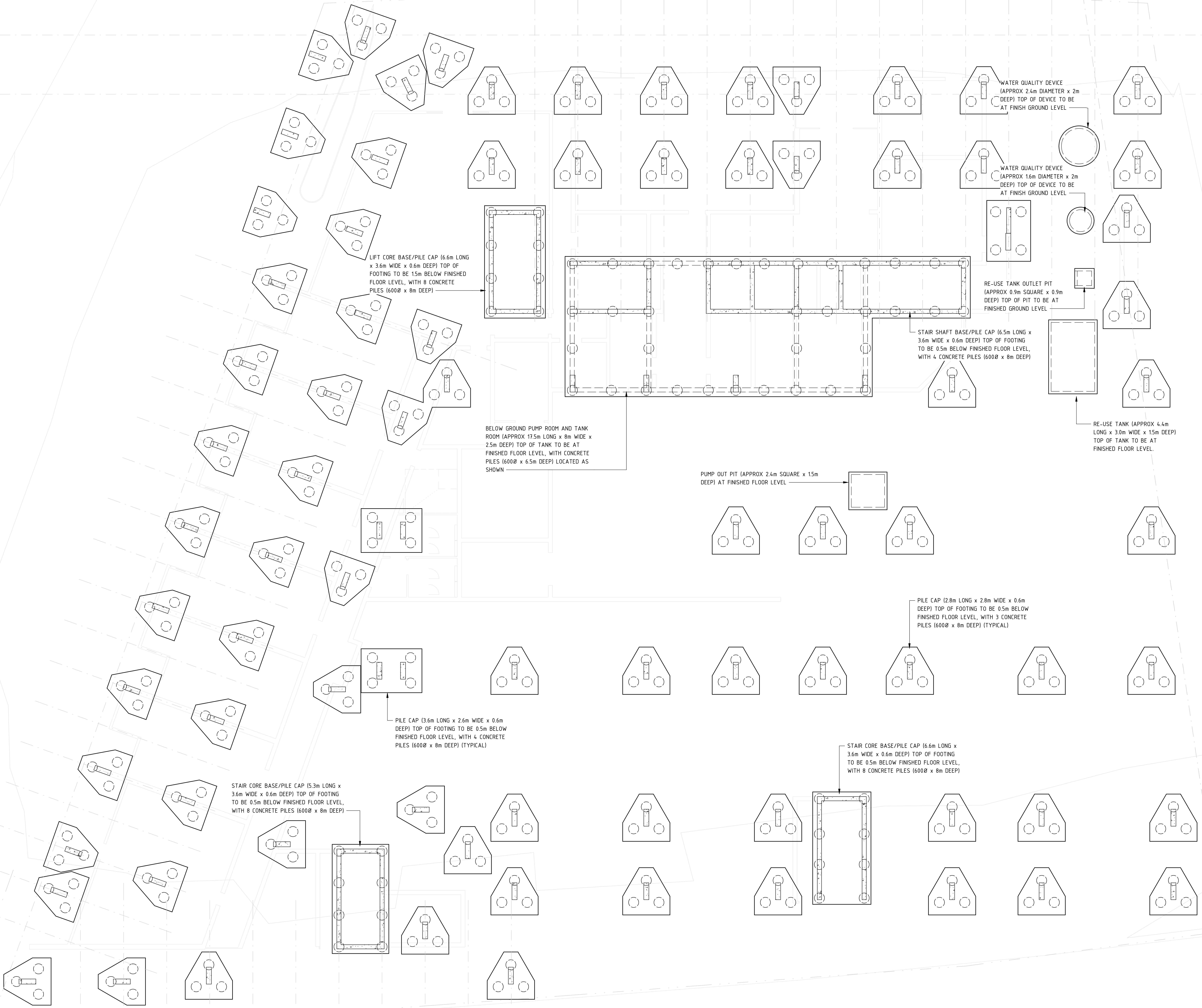
Bates Smart Pty Ltd ABN 70 004 999 400



DRAWN: D.BILLS
DESIGNED: N.PETHERBRIDGE
JOB MANAGER: N.PETHERBRIDGE
VERIFIER: -

NOT FOR CONSTRUCTION

REV	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	PRELIMINARY	D.B.		N.P.	16.10.17
2	PRELIMINARY	B.G.		N.P.	31.10.17

CLIENT
DOMA GROUP

DRAWINGS NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED

ARCHITECT
BATES SMART

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0 1000 2000 3000 4000 5000 PLAN

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PROJECT
42 HONEYSUCKLE DRIVE
COTTAGE CREEK PRECINCT
HONEYSUCKLE NEWCASTLE

DRAWING TITLE
STRUCTURAL DRAWING
INGROUND EXCAVATION
PLAN

JOB NUMBER
NL171278

DRAWING NUMBER
SK1

REVISION
2

DRAWING SHEET SIZE = B1