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Report
Geotechnical Investigation
Lot 200 Edison Circuit, Forrestdale WA

Client:
Auspan Group

Reference:GI294224PG _Rev0
Date: 14 September 2024



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Quality Information

Document Report - Geotechnical Investigation
Lot 200 Edison Circuit, Forrestdale WA

Project Ref GI294224PG _Rev0

Date 14 September 2024

Prepared for Auspan Group

Revision History

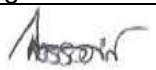
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				Name/Position	Signature
0	14/09/2024	Client Review	HA	Mohammad Amzad Hossain Sr Geotechnical Engineer	

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1.0 INTRODUCTION

Perth Geotechnics (PG) was engaged by Mr. Mick Imberti on behalf of Auspan Group to undertake a geotechnical site investigation for a proposed warehouse at Lot 200 Edison Circuit, Forrestdale WA (the site).

The site location map is shown in Figure 1.



Figure 1. Site Location Map (Source: Google Maps)

The objectives of the investigation were to obtain information on the sub-surface conditions to classify the site in accordance to the definitions provided in Australian Standard AS2870 – 2011 and to provide recommendations on strength and stiffness parameters, bearing capacity, subgrade's CBR, earthworks and stormwater drainage system for the site.

Field works were conducted on 29 August and 02 September 2024. Weather condition on the day of field investigation was fine and sunny.

The scope of the investigation did not include compaction control, wind force calculations or classifications, slope stability checking and environmental issues.

This report has to read or implement in full. No partial implementation of this report is allowed.

2.0 PROPOSED DEVELOPMENT

The proposed development at the site will be a single-story warehouse and an office+showroom building. Proposed areas of the workshop will be 1,301 m^2, washdown will be 500 m^2 and the office+showroom building will be 400 m^2. There will be carpark (LV and HV parking), driveway, loading hardstand area #1 and hardstand #2 and landscaping.

The buildings are understood to be supported on shallow strip, pad and raft footings.

3.0 SCOPE AND OBJECTIVES

The scope and objectives of the investigation are as follows:

- Undertaking 2 Electric Friction Cone Penetrometer Tests (CPTs) to a target depth of 6 m or refusal. Two CPTs test were undertaken with a piezocone to assess the pore pressure profile and depth to the groundwater table.
- Drilling of 10 hand auger Bore Holes (BHs) across the proposed development site to a target depth of 2.2 m, refusal or hole collapse, whichever was encountered first.
- Conducting of 10 Perth Sand Penetrometer (PSP) tests alongside the BHs up to a depth of 1.05 m or refusal.
- Undertaking 2 Field Permeability Tests (FPT) using a Guelph Permeameter constant head method.
- Submit a factual report on findings to classify the site in accordance with the Australian Standard AS2870 – 2011.
- Sub-soil class (AS1170.4-2007), earthquake parameters.
- Subsurface conditions in the significant foundation zone.
- Description of groundwater conditions.
- Geotechnical design/strength parameters.
- Site preparation recommendations during construction (AS 3798-2007).
- Provide recommendations on bearing capacity, CBR, earthworks and stormwater drainage.

4.0 SITE CONDITIONS

4.1 Site Setting & Surface Conditions

The site was observed to be a vacant land during the time of investigation. Site surface was covered with grass, weeds and white-grey sand. The site is bounded by Edison Circuit and commercial properties to the south, a drainage basin to the south-west, Tonkin Hwy to the west and Ranford Road to the east. The eastern side of the site is found water-logged and water ponding at the time of site inspection. There are small to medium size trees at western to northern side of the site. The site level was found to be gently sloped downward from west to east. Average site surface level was indicated to be 23.66 m AHD along the western side and 23.4 m AHD to the eastern side (Ref. Department of Water online database). Difference in elevation was approximately 0.26 m.

Site photos taken during the field investigation are shown in **Appendix D**.

4.2 Site Geology

A review of Environmental Geological Western Australia survey Map of Armadale 1:50,000 (part sheets 2033 I and 2133 IV) revealed that the site is consisted of Sand (S_8 and S_{10}) white to pale grey, yellow at depth, fine to medium grained, moderately sorted, subangular to subrounded, minor heavy minerals, over sandy clay to clayey sand of the Guilford formation, of eolian origin.

Environmental Geological map of Armadale also revealed that the site soil has high permeability, Low corrosion potential, medium slope stability, low shrink-swell potential, medium to high bearing capacity. High water table, thin veneer so foundation properties governed by underlying Guildford formation lithologies.

4.3 Groundwater Information

Groundwater table encountered all of the boreholes between depth of 0.2 m and 1.4 m below ground level (bgl).

A review of the 'Online Perth Groundwater Atlas' of the Department of Water was carried out for the site. 'Perth Groundwater Atlas' revealed that the site has a natural ground level that varied between 23.4 m AHD and 23.66 m AHD. Annual average maximum groundwater table is at 20.57 m AHD as per 2019 data.

That means,

- Estimated average groundwater depth is between 2.83 m and 3.09 m bgl.

5.0 FIELD INVESTIGATION

5.1 General

The geotechnical site investigation was undertaken on 29 August and 02 September 2024 in the full-time presence of a geotechnical engineer from PG. The geotechnical site investigation comprised of:

- 2 x CPT Tests (CPTU01 and CPTU02),
- 10 x Bore Holes (BH1 to BH10),
- 10 x Perth Sand Penetrometer Tests (PSP1 to PSP10)
- 2 x Field Permeability Tests (FPT1 and FPT2).

Test location plan is shown in **Appendix A**.

5.2 Electric Friction Cone Penetrometer Test

The Electric Friction Cone Penetrometer Test (CPT) was undertaken by Probe Drill using a 22t truck+7t track rig up to the target depth of 6 m or refusal. The investigation was carried out in accordance with AS 1289.6.5.1-1999.

CPT test generally interprets profile and type of soil, subsurface strength and stiffness parameters along the probing depth in accordance with Robertson et. al. (1986).

The results of the test are presented in **Appendix C** as plots of Cone Tip Resistance (qc), Sleeve Friction (fs), Friction Ratio (Rf = fs/qc x 100%) versus depth.

CPTU01 and CPTU02 were terminated at a depth of 4.1 m and 4.2 m respectively due to CPT probe refusal on hard strata. After each probing, the probe hole was dipped by a weighted measuring tape with the intention to directly measure the depth of groundwater table. Groundwater was encountered at all CPTs to the depth between 0.9 m and 1.4 m below ground level.

5.3 Bore Hole Logs

Ten Bore Holes (BH1 to BH10) were conducted across the site by using a handheld mechanical auger. During BH drilling, the spoil was stockpiled adjacent to the test location. The subsurface profiles exposed in the test holes were logged in accordance with AS1726 and were photographed to provide a visual record of subsurface conditions encountered. Following these activities, each test location was progressively backfilled in the reverse order of excavation works.

Similar soil profile as described below was encountered in all BHs:

- **SAND (SP)** - fine to medium grained, black, dark grey, grey, pale grey, white, dry to wet, loose to dense, to the termination depth of 2.2 m.

Groundwater table encountered all of the boreholes between depth of 0.2 m and 1.4 m below ground level (bgl). Boreholes BH4 & BH6 – BH10 were terminated at the target depth of 2.2 m. However, BH1, BH2, BH3 & BH5 were started collapsing at a depth of 1.6 m, 1.8 m, 2.0 m and 2.0 m depth respectively under groundwater.

Logs and photographs of the BHs are presented in **Appendix B** and **Appendix D**, respectively

5.4 Perth Sand Penetrometers (PSP) Test

Ten Perth Sand Penetrometer tests (PSP1 to PSP10) were conducted adjacent to borehole locations. All PSP tests were conducted to a depth of 1.05 m. The tests were conducted in accordance with test method AS1289.6.3.2, Ref. Table 6.4.6.2 HB 160-2006. PSP tests revealed that the site was in loose to dense condition.

The PSP test certificates are attached to this report in **Appendix B**.

5.5 Field Permeability Test

Two (2) Field permeability tests (FPT1 and FPT2) were conducted by using Guelph permeameter as per ASTM D 5126 – 90 method. The tests were conducted at a depth of 1.2 m below ground level. The Guelph Permeameter is a constant head device that operates on the Mariotte siphon principle. It provides a straightforward way of determining the field saturated hydraulic conductivity, matrix flux potential and the soil sorptivity in the field.

Permeability tests reports are presented in **Appendix B** and summary are presented in **Table 1**.

Table 1. Summary of Field Permeability Test Results

Permeability Test ID	Test Depth (m)	Soil Description	Average Permeability Rate	
			cm/sec	m/day
FPT1	1.2	Sand (wet)	9.9×10^{-4}	0.86
FPT2	1.2	Sand (wet)	1.6×10^{-3}	1.4

It should be noted that the tests were done on the surficial soil layer. The coefficient of permeability or hydraulic conductivity of the site is between 0.086 m/day and 1.4 m/day.

6.0 LABORATORY TEST

6.1 General

As the classification and behaviour of the Bassendean Sand (underlying top formation of the site) are known to the industry, no laboratory tests were undertaken for this project.

7.0 ENGINEERING CONSIDERATIONS AND RECOMMENDATIONS

7.1 Inferred Subsurface Conditions

A generalised subsurface profile was inferred from the site investigation and described as follows:

- **SAND (SP)/ Silty SAND (SM)** - fine to medium grained, black, dark grey, grey, pale grey, white, dry to wet, to the termination depth of 4.2 m, with the following densities:

  - 0.0 – 2.5 m = Loose to Medium dense
  - 2.5 – 4.2 m = Dense to very dense

7.2 Groundwater

Groundwater table encountered all of the boreholes between depth of 0.2 m and 1.4 m below ground level (bgl). Perth Groundwater Atlas revealed that the average groundwater depth is between 2.83 m and 3.09 m bgl.

Eastern side of the site is found mostly water-logged and water ponding. The concerned area needs to be raised (minimum 500mm), and the construction should be undertaken in summertime, otherwise dewatering will be required at the time of construction.

7.3 Geotechnical Design Parameters

Geotechnical design parameters for the site were inferred on the basis of the site investigation data and are presented in **Table 2**.

Table 2. Inferred Geotechnical Design Parameters for the Current Site Conditions

Depth (m, bgl)	Layer Description	Soil Parameters					k (m/day)
		ϕ' (deg.)	c_u / c' (kN/m^2)	γ (kN/m^3)	E' (MPa)	ν'	
0 – 2.5	Sand (SP)/Silty Sand (SM) Loose to Medium dense	32	-/-	18	10	0.3	0.86 to 1.4
2.5 – 4.2	Sand (SP)/Silty Sand (SM) Dense to very dense	36	-/-	19	50	0.3	

Notes: ϕ' = Effective friction angle, c_u = Undrained shear strength, c' = Drained cohesion, γ = Bulk density, E' = Drained Elastic Modulus, ν' = Poisson's Ratio, k = Coefficient of Permeability.

7.4 Geotechnical Design Parameters for Retaining Structures

Earth pressure parameters for the design of retaining structures are presented in **Table 3**. These parameters should be considered as preliminary.

Table 3. Geotechnical Design Parameters for Retaining Structures

Material type	γ (kN/m^3)	ϕ' (degrees)	Cohesion c' (kPa)	K_0	Wall friction, $\delta = 0^o$	
					K_a	K_p
Loose to medium dense in situ sand	17	30	0	0.50	0.33	3.00
Dense Sand or Compacted Sand Fill	18	34	0	0.44	0.28	3.54

Notes: γ = Bulk unit weight, ϕ'= Effective friction angle, K_0 = Coefficient of earth pressure at rest, K_a = Coefficient of drained active earth pressure, K_p = Coefficient of drained passive earth pressure.

Earth pressure coefficients are provided for the condition of zero friction between the wall and the soil. The retaining wall designer should make an independent assessment of the parameters appropriate to the construction method used, including alternative values of wall friction. A level surface behind the wall has been assumed (i.e., β = 0).

Compaction plant can augment the lateral earth pressure acting on retaining walls. Hand operated compaction equipment is recommended within 2 m of any retaining walls to minimise compaction pressures.

It is important to note that some ground movement is to be expected behind any soil retaining system. This must be taken into account by the retaining wall designer.

7.5 Site Classification

Based on the subsurface and surrounding site condition during the investigation, the site is classified with a Site Classification of **'P'** in accordance with the definitions provided in Australian Standard AS2870 -2011. The site classification **'P'** is due to only the current loose condition of the site.

The site can be reclassified to **'A'** classification, by conducting following earthwork remediation measures and site preparation at (Section 7.7.3). The characteristic of surface movement is zero in accordance with the definitions provided in Australian Standard AS2870 -2011.

It should be noted that AS 2870 is applicable to residential structures up to double storey, and light industrial and commercial buildings if they are similar to houses in size, loading and superstructure.

7.6 Earthquake Design Factor

Australian Standard AS1170.4-2007 outlines the design criteria required for a structure in consideration of the risk of being subjected to earthquake loads. Earthquake design factors are summarised in **Table 4**.

Table 4. Earthquake Design Factors

Factor/Class	Value/Name	Ref. AS1170.4- 2007
Hazard Factor (z)	0.09	Figure3.2 (D)
Site sub-soil class	**Class C_e** – Shallow Soil	Section 4 Clause 4.1

7.7 Earthworks

7.7.1 Suitability of Excavated Materials for use as Fill

In situ sands are considered to be suitable for reuse as structural fill material.

7.7.2 Structural Fill

Suitable materials for structural fill shall be a clean sand fill. The fill material at compaction should comprise sand that is free from oversized material (i.e., material > 75 mm in any dimension), contains less than 5% fines (material passing 0.075 mm sieve), and free from foreign material, organic material or other deleterious material. It should also be free from industrial waste, solid waste, or construction and demolition debris.

7.7.3 Site Preparation - Earthworks

Earthworks should be carried out in general accordance with the Australian Standard AS 3798-2007 “Guidelines on Earthworks for Commercial and Residential Developments”. The following are general guidelines to be followed during preparation of the site areas within the proposed development footprints:

- Remove and grub all root masses and tree stumps, if any.
- Remove or screen off any, cobbles and boulders, paved materials, demolition debris, green waste, weeds/grass, organic matter or other deleterious material from topsoil.
- Compact /proof roll the exposed surface with required number of passes (a minimum of 10 passes) of a heavy vibratory roller to make the underlying layer into a dense state, i.e., to 95% of MMDD in accordance with AS1289.5.2.1. Add moisture as needed during the compaction.
- The loose soil is required to be compacted/ improved to a dense state. If compaction effort is applied on the surface only, the soil layer will not be compacted to the full depth. In such case, we recommend that box out approximately 1000 mm top layer existing sandy materials and stockpile at any corner of the site. Then compact that depth to bring the site to dense condition. Proof compaction must not be attempted if the exposed ground is saturated, or groundwater is at excavation level. Then backfill the site by using site soil/ clean sand and compact to bring to the design level. Site soil can be use only after screening off.
- We recommend to raise the site **500mm** from current ground level using the imported sand. Place the sand material in lifts not exceeding 300 mm in loose thickness and compact the lift using a vibratory compactor to 95% of its modified maximum dry density in accordance with AS1289.5.2.1. The material at compaction should be moisture conditioned within -1% to +2% of its optimum moisture content. Follow the same procedure of lift and compaction up to the design finished ground level.
- Subgrade (or backfill lifts/layers) at driveway, hardstand, loading/unloading pad, access road areas shall be compacted to 98% of MMDD in accordance with AS1289.5.2.1. Add moisture as needed during the compaction.
- Undertake necessary excavation to the required depth for the proposed shallow foundation, raft, pad and strip footing or pile cap. Temporary excavation up to 1 m depth can be conducted with a maximum dry slope angle of 1V: 1.5H. It is highly recommended to undertake a series of PSP tests at each footing base to ensure that the ground beneath the footing, at least to 1 m depth, does not comprise loose sands or other deleterious, clay or weak materials. Hand held compactor can be used if the base ground is not in dense state.
- Care will need to be taken when compacting in the vicinity of existing structures to avoid damage from excessive vibrations.
- For site maintenance, it is recommended to follow the CSIRO publication “Guide to Home Owners on Foundation Maintenance and Footing Performance” in Building Technology File Number 18. This document provides important information on the implications of plumbing, property maintenance, site classification on foundation design, drainage and performance expectations.

It is recommended that a competent geotechnical engineer supervises the site activities to ensure that all demolition debris have been adequately removed from the area and that site is safely excavated and adequately backfilled and compacted as per the procedures described above.

7.8 Bearing Capacity

If the earthworks as described in Section 7.7.3 are undertaken prior to the construction, ground will have sufficient bearing capacity to support the proposed pad and strip foundations at the design ground level. As discussed in Section 7.7.3, all footing bases should be improved to a dense state, to a minimum depth of 1 m below the footing excavation level.

The allowable bearing pressures are estimated (**Table 5**) to limit settlements to less than or equal to 20 mm and provide a minimum factor of safety of 2.0 against general bearing capacity failure. These bearing pressures do not consider eccentric and inclined loading conditions and interaction effects (i.e., loadings from adjacent foundations). Furthermore, the calculations assume that the areas beneath the pad, raft and strip foundations have been compacted to a density ratio of 95% modified compaction, MMDD, and are founded at least 0.5 m below final ground grading levels.

Table 5. Allowable Bearing Pressures for Typical Strip and Pad Footings

Embedment Depth (m)	Footing Type	Footing Width (m)	Allowable Bearing Pressure (kPa)	Estimated Settlement (mm)
0.5	Strip	0.5	100	20
		1	150	20
		1.5	180	20
1.0	Strip	0.5	120	20
		1	160	20
		1.5	200	20
0.5	Pad	1	180	20
		2	220	20
		3	220	20
		4	220	20
1.0	Pad	1	200	20
		2	250	20
		3	250	20
		4	250	20

Note: Differential settlement is approximately half of the total settlement value.

Differential settlements between adjacent isolated footings subjected to similar loadings are anticipated to be approximately half of the total settlement value. It should be noted that where isolated footings are subject to significantly different loadings, differential settlement between these footings may exceed acceptable limits. Settlements should be checked in detail where such instances arise.

7.10 California Bearing Ratio (CBR)

The subgrade of the carpark, driveway, hardstand, loading bay, access road areas shall be prepared as per the general guidelines set out in Section 7.7.3 and compacted to a density ratio of **98% MMDD**.

Based on the sandy material onsite, a design CBR value of 12% can be considered for this project.

7.11 Excavatability

The medium dense to dense state of the in-situ sandy soils suggests that the materials should be excavatable with a standard earthmoving equipment (e.g., 10 tonne excavator).

7.12 Cut and Fill Batters

Temporary excavation up to 1 m depth can be conducted with a maximum dry slope angle of 1V: 1.5H. Cut and fill batters above groundwater table will generally be stable at 1V: 2H. Intermediate benches have to be created if excavation is deeper than 1 m.

7.13 Stormwater Drainage

The site investigation revealed that the site comprises of sand up to the investigation depth. Groundwater table encountered all of the boreholes between depth of 0.2 m and 1.4 m below ground level. It was found from field permeability test that the coefficient of permeability or hydraulic conductivity of the site varied from 0.86 to 1.4 m/day.

The recommended measure for the disposal of stormwater should be combination of onsite and offsite of the property or to the council drain by site-specific drainage design. The drainage designer has to consider the current groundwater table that may be raised up in the heavy rainfall winter. The drainage system has to fulfil the requirements of the City of Armadale.

8.0 LIMITATION OF USE

The ground is a product of continuing natural and man-made processes and therefore exhibits characteristics and properties which vary from place to place and can change with time. Geotechnical site investigation involves gathering and assimilating limited facts about these characteristics and properties in order to better understand or predict the behaviour of the ground at a particular site under certain conditions.

This site investigation has been carried out by inspection, using a limited amount of CPT, sampling, testing or other means of investigation. Achieving a full coverage of the site to ensure all variations is not practical and is seldom done due to cost constraints as well as the impracticality.

It should be noted that the subsurface conditions encountered by the limited number of field tests as part of this geotechnical site investigation represents the ground conditions at the locations where the samples were taken and where tests have been undertaken and as such are an extremely small proportion of the site to be developed.

The facts reported in this document are directly relevant only to the ground at the place where, and time when, the investigation was carried out and are believed to be reported accurately. Given the limited number of field and laboratory testing carried out with respect to the overall site area, variations between investigation locations are likely and ground conditions different to those presented in this report may be present within the subject site area. The risk associated with this variability and the impact it will have on the proposed development should be carefully considered.

The level of geotechnical investigation that has been completed to date is considered appropriate for the project objectives. If the above-mentioned client, its subcontractors, agents or employees use this factual information for any other purpose for which it was not intended, then the client, its subcontractors, agents or employees does so at their own risk and Perth Geotechnics will not and cannot accept liability in respect of the advice, whether under law of contract, tort or otherwise.

Any interpretation or recommendation given in this report is based on judgement and experience and not on greater knowledge of the facts reported. Perth Geotechnics does not represent that the information or interpretation contained in this report addresses completely the existing features, subsurface conditions or ground behaviour at the subject site.

9.0 REFERENCES

- Australian Standard AS1170.4-2007, “Earthquake Actions in Australia”.
- Australian/New Zealand Standard AS/NZS 1547-2012, “On-site Domestic Wastewater Management”.
- Australian Standard AS 1726-1993 "Geotechnical Site Investigations".
- Australian Standard AS 2870-2011, "Residential Slabs and Footings".
- Australian Standard AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments".
- Bowles JE (2013), Foundation Analysis and Design, 5th edition, McGraw Hill London
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- Geological Survey of Western Australia. Geological map of Armadale 1:50,000 (Sheet 2034 II and Part of 2034 III and 2134 III)
- Institute of Municipal Engineering Australia, WA Division Inc (1998), Local Government Guidelines for Subdivisional Development
- Perth Groundwater Atlas online version, https://maps.water.wa.gov.au/#/webmap/gwm, Department of Environment, WA.
- Robertson. P.K., Campanella, R.G., Gillespie, D., and Greig, J., (1986), “Use of Piezometer Cone data”, In-Situ’86 Use of In-situ testing in Geotechnical Engineering, GSP 6, ASCE, Reston, VA, Specialty Publication, pp 1263-1280.
- Standards Australia, Hand Book HB 160-2006 "Soil Testing".

Perth Geotechnics

APPENDIX – A

SITE PLAN AND SITE LAYOUT PLAN



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Project: Geotechnical Investigation **Location:** Lot 200 Edison Circuit, Forrestdale WA		**Site Plan:** Bore Hole (BH), Cone Penetration Testing (CPT), Perth Sand Penetrometer (PSP) and Field Permeability Test (FPT) Locations
Client: Auspan Group		
Reference: GI294224PG	**Scale:** N.T.S.	**Drawing No:** 294224_Rev0
Date: 12/09/2024	**Drawn By:** MH	



DATA					
SITE AREA	18 632 SQM	DRAINAGE		LV CARPARKING	
WORKSHOP	1 301 SQM	CALC'S ON 1/100 YR STORM / 24 HR PERIOD		REQUIREMENT	
WASHDOWN	500 SQM				
WORKSHOP MEZZ	108 SQM	IMPERVIOUS AREA APPROX	15 536 sqm	OFFICE	
CANOPY (10m)	990 SQM	DRAINAGE REQ'D (x 0.015)	234 m^3	1 x BAY PER 100sqm NLA	4 x BAYS
OFFICE	400 SQM				
		DRAINAGE BASIN # 1 366m^3		WORKSHOP	
HARDSTAND # 1	7 737 SQM	DRAINAGE BASIN # 2 177m^3		2 x BAYS PER 100sqm NLA	
HARDSTAND # 2	4 190 SQM	DRAINAGE BASIN # 3 82m^3		OR 1 x BAY PER EMPLOYEE	17 x BAYS
HARDSTAND # 3	1 092 SQM				
BITUMEN	696 SQM	TOTAL CAPACITY	625m^3	TOTAL BAYS	21 x BAYS
LANDSCAPING	1 237 SQM				

10 0 10 20 30 Metres

SCALE 1 : 500

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No.	Description	Date
A	DRAFT ISSUE	24.05.01
B	TEST FIT DESIGN CONCEPT ISSUE	24.05.14
C	CLIENT REVISIONS	24.08.02
D	CLIENT REVISIONS	24.08.14

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PROQUIP RENTAL - SALES

PROJECT: PROPOSED NEW OFFICE / WORKSHOP

ADDRESS: LOT 200 EDISON CIRCUIT FORRESTDALE

DRAWING: SITE PLAN

CLIENT: PROQUIP

SCALE: 1 : 500 @ A1

DATE: MAY 24

DESIGNED: SF

DRAWN: SF

PROJECT NUMBER: TK3257

REVISION: D

DRAWING NUMBER: SK001

Perth Geotechnics

APPENDIX – B

BORE HOLE LOGS, PSP & FIELD PERMEABILITY TEST CERTIFICATES

BORE HOLE LOG

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH1
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 207	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 387	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
	0.2	▽			SP		**SAND**- fine to medium grained, black, dark grey, grey groundwater was encountered	M-W	L	
	0.3						changes colour to grey, dark grey, pale grey			
	0.5							W	L	
1.0								W	L	
	1.2						changes colour to pale grey, white			
	1.5							W		
	1.6						**Terminated at a depth of 1.6 m due to borehole collapsing under groundwater**			
2.0										
3.0										
4.0										
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ = **Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

BORE HOLE LOG

Perth Geotechnics
ABN: 74 660 182 061
Tel: 08 6396 2675; M: 0430 130 677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH2
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 242	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 365	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, dark grey, grey	M-W	MD	
	0.5						changes colour to pale grey, white	W	L	
	0.6	▽					groundwater was encountered			
1.0								W	L	
	1.5							W		
	1.8						**Terminated at a depth of 1.8 m due to borehole collapsing under groundwater**			
2.0										
3.0										
4.0										
5.0										

Remarks:

Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH3
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 202	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 368	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, dark grey, grey	M	MD	
	0.5						changes colour to pale grey, white	M-W	L	
	0.65	▽					groundwater was encountered			
1.0								W	L	
	1.5							W		
2.0										
							Terminated at a depth of 2.0 m due to borehole collapsing under groundwater			
3.0										
4.0										
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

BORE HOLE LOG

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH4
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 202	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 326	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, dark grey, grey	M	MD	
	0.5							M	MD	
1.0								M-W	MD	
	1.1	▽					groundwater was encountered			
	1.5						changes colour to pale grey, white	W		
2.0										
	2.2						**Terminated at the target depth of 2.2 m**			
3.0										
4.0										
5.0										

Remarks:

Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

BORE HOLE LOG

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH5
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 160	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 351	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, black, dark grey, grey	M	MD	
	0.5						changes colour to pale grey, white	M-W	L	
	0.7	▽					groundwater was encountered			
1.0								W	L	
	1.5							W		
2.0										
							Terminated at a depth of 2.0 m due to borehole collapsing under groundwater			
3.0										
4.0										
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH6
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 164	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 325	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, dark grey, grey	M	MD	
	0.3						changes colour to pale grey, white			
	0.5							M-W	MD	
1.0								W	MD	
	1.3	▽					groundwater was encountered			
	1.5							W		
2.0										
	2.2						**Terminated at the target depth of 2.2 m**			
3.0										
4.0										
5.0										

Remarks:

Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH7
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 136	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 348	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, grey, pale grey, white	M	L	
	0.5							M	MD	
1.0								M-W	MD	
	1.2	▽					groundwater was encountered			
	1.5							W		
2.0								W		
	2.2						**Terminated at the target depth of 2.2 m**			
3.0										
4.0										
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense
VS = Very Soft
F = Firm
St = Stiff
VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH8
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 177	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 294	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, dark grey, grey	M	MD	
	0.5							M	D	
	0.7						changes colour to pale grey, white			
1.0								M-W	MD	
	1.2	▽					groundwater was encountered			
	1.5							W		
2.0								W		
	2.2						**Terminated at the target depth of 2.2 m**			
3.0										
4.0										
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense
VS = Very Soft
F = Firm
St = Stiff
VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH9
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 120	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 325	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, dark grey, grey	M	L	
	0.3						changes colour to pale grey, white			
	0.5							M-W	MD	
1.0								W	MD	
	1.4	▽					groundwater was encountered			
	1.5							W		
2.0										
	2.2						**Terminated at the target depth of 2.2 m**			
3.0										
4.0										
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

BORE HOLE LOG

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Reference:	GI294224PG	**Client:**	Auspan Group
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH10
Location:	Lot 200 Edison Circuit, Forrestdale WA	**Date Commenced:**	29/08/2024
Easting:	50 402 125	**Equipment Type**	Handheld Machine Auger
Northing:	6 444 266	**Logged By:**	HA
Sampling Type:	B - Bulk Sample	**Checked By:**	MH

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SP		**SAND**- fine to medium grained, dark grey, grey	M	D	
	0.3						changes colour to pale grey, white			
	0.5							M	D	
1.0								M-W	D	
	1.3	▽					groundwater was encountered			
	1.5							W		
2.0								W		
	2.2						**Terminated at the target depth of 2.2 m**			
3.0										
4.0										
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
▽ **= Water Table**

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

VS = Very Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

PERTH SAND PENETROMETER (PSP)
TEST CERTIFICATE

Perth Geotechnics
ABN: 74 660 182 061

AS 1289.6.3.2

Correlation of Sand Density - Table 6.4.6.2 HB 160-2006

Client	Auspan Group	Project	Geotechnical Investigation
Reference	GI1294224PG	Location	Lot 200 Edison Circuit, Forrestdale WA
Date Tested	29/08/2024	Tested By	MH/HA

References:	PSP01	PSP02	PSP03	PSP04	PSP05	PSP06
Depth below ground level test commenced	**Penetration Resistance - Blows/300mm**					
0-150	Set	Set	Set	Set	Set	Set
150 - 450	5	6	6	6	6	6
450 - 750	5	5	5	7	5	7
750 - 1050	5	5	5	7	5	7
Depth below ground level test commenced	**Density Classification**					
0-150	-	-	-	-	-	-
150 - 450	L	MD	MD	MD	MD	MD
450 - 750	L	L	L	MD	L	MD
750 - 1050	L	L	L	MD	L	MD

Remarks:

VD=Very Dense	D=Dense	MD=Medium Dense	L=Loose	VL=Very Loose
> 15	8 - 15	6 - 8	2 - 6	≤ 2

PERTH SAND PENETROMETER (PSP)
TEST CERTIFICATE

Perth Geotechnics
ABN: 74 660 182 061

AS 1289.6.3.2

Correlation of Sand Density - Table 6.4.6.2 HB 160-2006

Client	Auspan Group	Project	Geotechnical Investigation
Reference	GI1294224PG	Location	Lot 200 Edison Circuit, Forrestdale WA
Date Tested	29/08/2024	Tested By	MH/HA

References:	PSP07	PSP08	PSP09	PSP10	PSP11	PSP12
Depth below ground level test commenced	**Penetration Resistance - Blows/300mm**					
0-150	Set	Set	Set	Set		
150 - 450	5	7	5	8		
450 - 750	6	8	6	9		
750 - 1050	6	6	7	10		
Depth below ground level test commenced	**Density Classification**					
0-150	-	-	-	-		
150 - 450	L	MD	L	D		
450 - 750	MD	D	MD	D		
750 - 1050	MD	MD	MD	D		

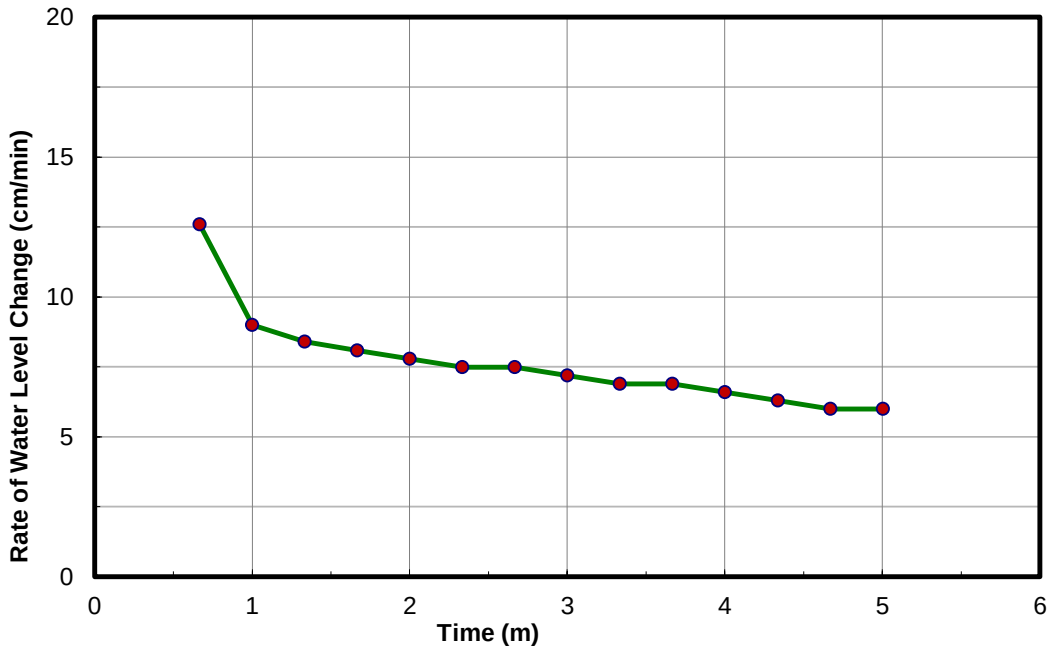
Remarks:

VD=Very Dense	D=Dense	MD=Medium Dense	L=Loose	VL=Very Loose
> 15	8 - 15	6 - 8	2 - 6	≤ 2

PERTH GEOTECHNICS

Test ID	FPT1	Reference	GI294224PG
Project	Permeability Test	Client	Auspan Group
Location	Lot 200 Edison Circuit, Forrestdale WA	Soil Type	Sand (wet)
Co-ordinates	Easting: 50 402 228 Northing: 6 444 374	Test Depth	1.2 m below ground level
Instrument Name	Guelph Permeameter	Date Tested	29/08/2024

PERMEABILITY TEST CERTIFICATES
(ASTM D 5126-90)



Water Hydraulic conductivity K_{fs}: **9.9E-04** **cm/sec**

8.6E-01 **m/day**

Tested By: *Mohammad Amzad Hossain*

Date: 14/09/2024

Perth Geotechnics

Tel: 08 6396 2675; M: 0430 130 677

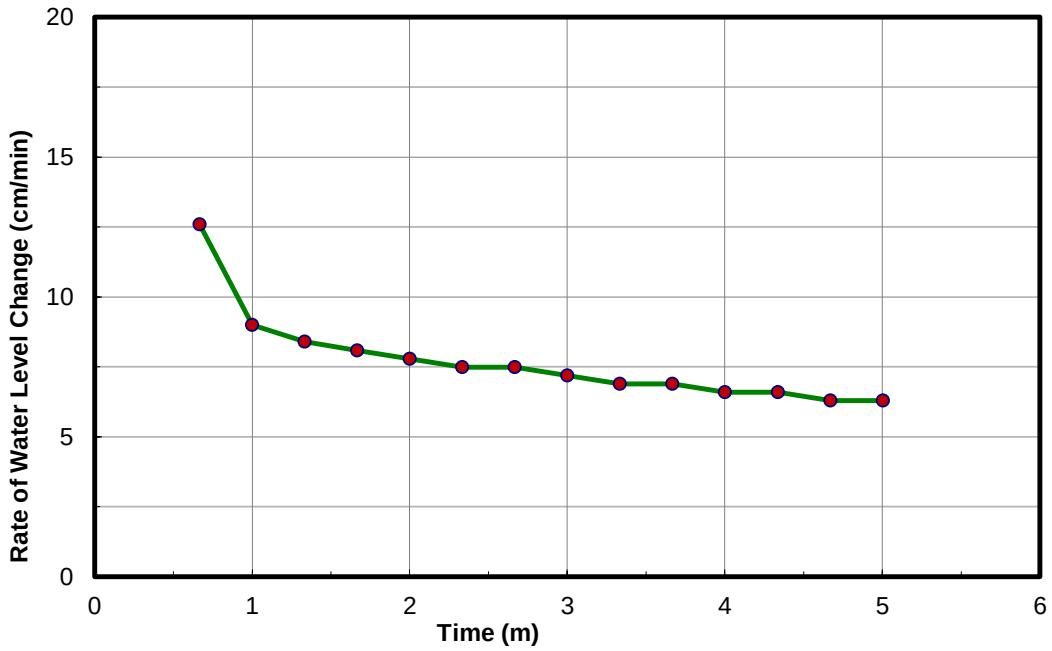
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PERTH GEOTECHNICS

Test ID	FPT2	Reference	GI294224PG
Project	Permeability Test	Client	Auspan Group
Location	Lot 200 Edison Circuit, Forrestdale WA	Soil Type	Sand (wet)
Co-ordinates	Easting: 50 402 151 Northing: 6 444 287	Test Depth	1.2 m below ground level
Instrument Name	Guelph Permeameter	Date Tested	29/08/2024

PERMEABILITY TEST CERTIFICATES
(ASTM D 5126-90)



Water Hydraulic conductivity K_{fs}: **1.6E-03** **cm/sec**

1.4E+00 **m/day**

Tested By: *Mohammad Amzad Hossain* Date: 14/09/2024

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APPENDIX – C

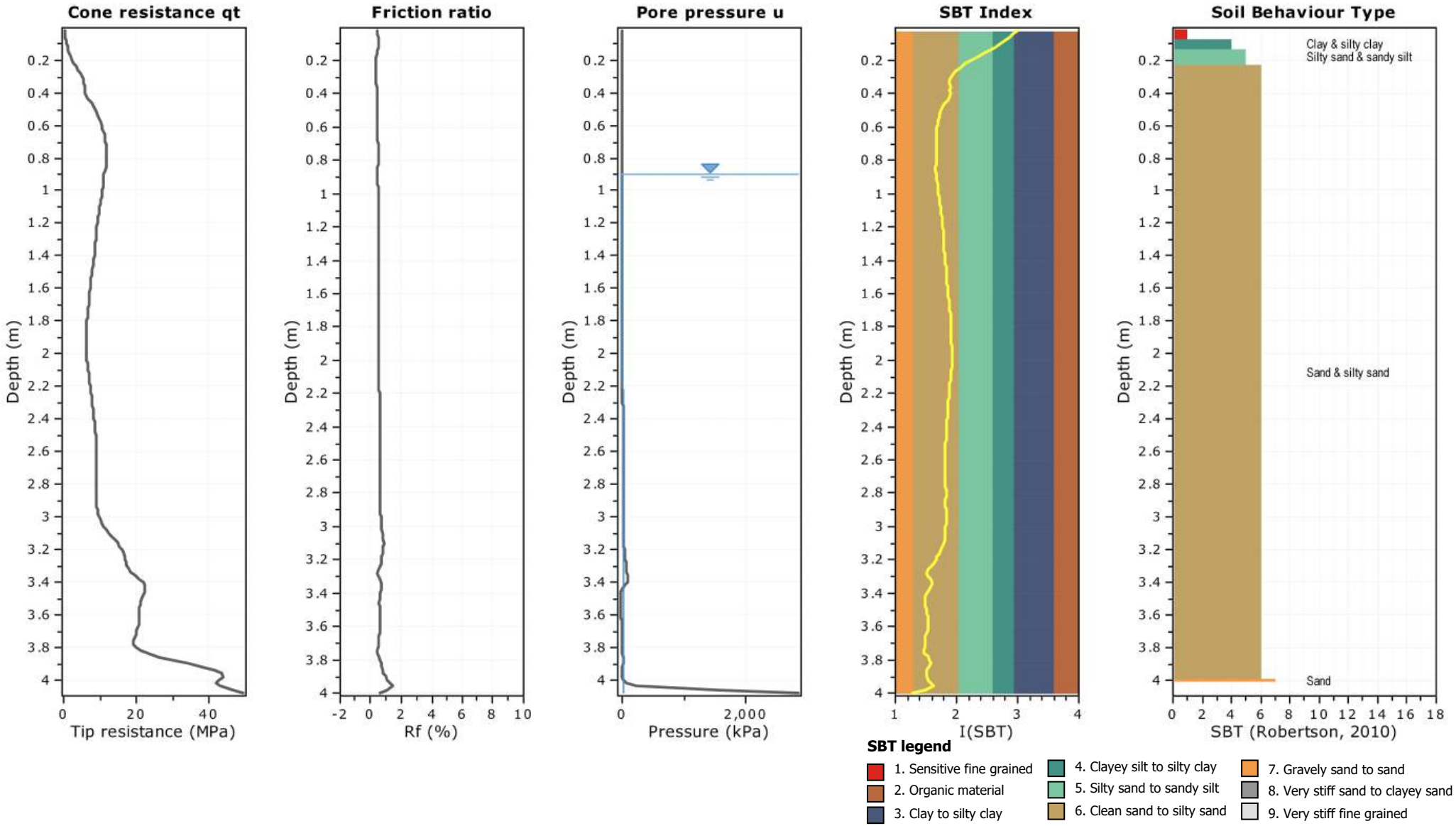
CPT TRACES & INTERPRETATION

Perth Georgetechnics

19 Silkie Link, Southern River, WA 6110
www.perthgeotechnics.com.au

Project: **Geotechnical Investigation**
Location: **Lot 200 Edison Circuit, Forrestdale**

CPTU01
Total depth: 4.08 m, Date: 2/09/2024

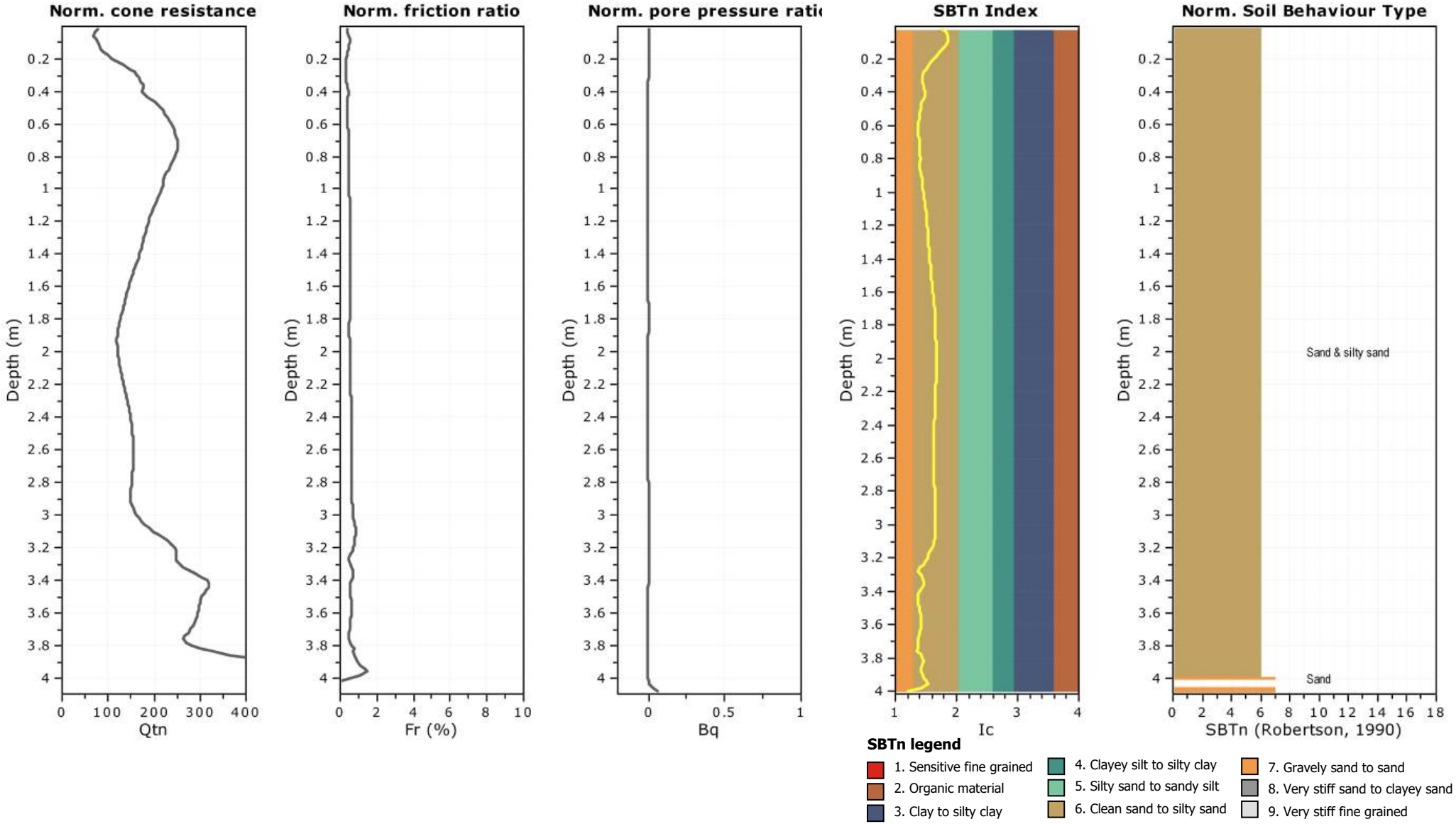


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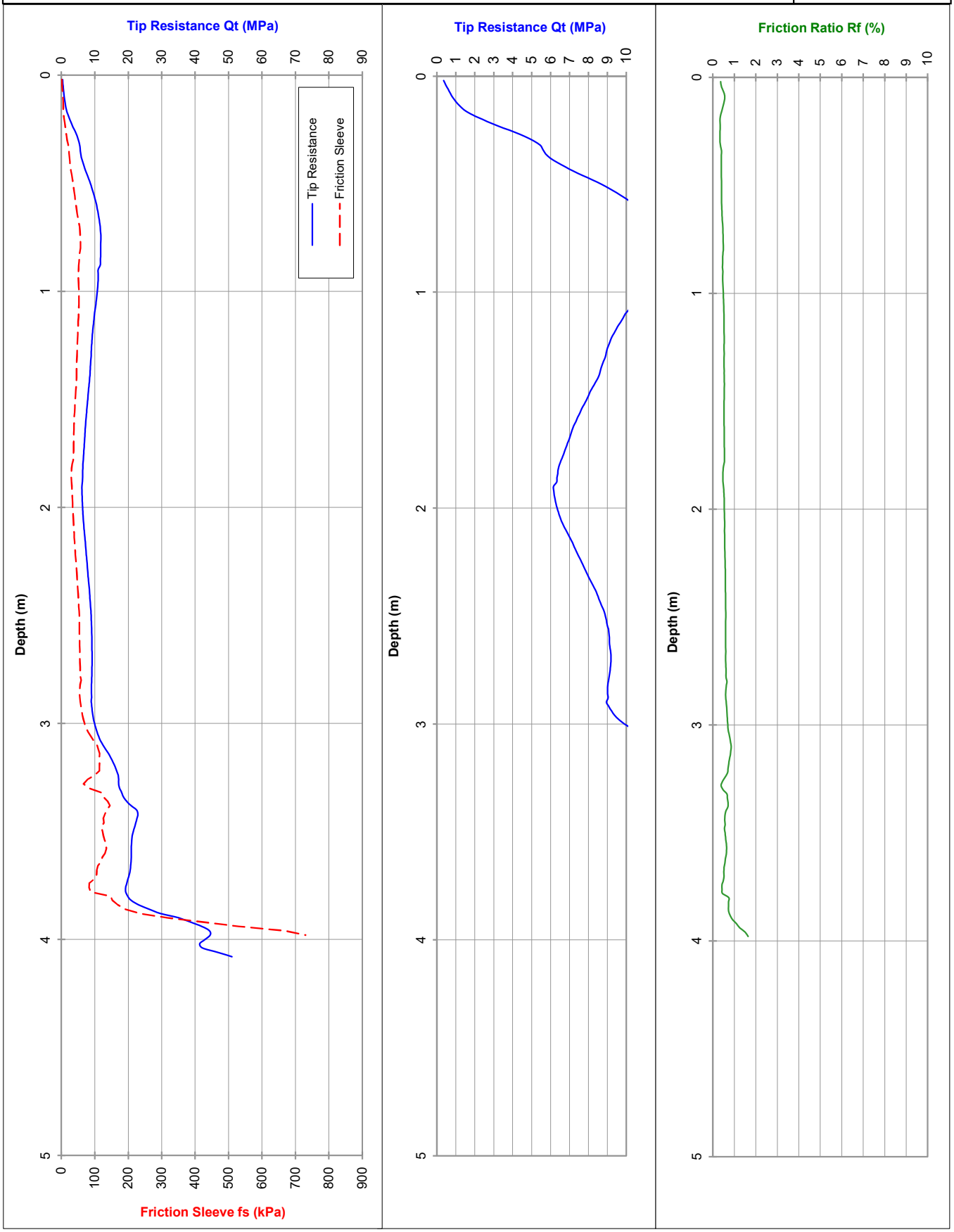
Project: **Geotechnical Investigation**
Location: **Lot 200 Edison Circuit, Forrestdale**

CPTU01
Total depth: 4.08 m, Date: 2/09/2024



ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Perth Geotechnics	Job No.: GI294224PG	Probe I.D
PROJECT: Geotechnical Investigation	RL (m):	**CPTU 01**
LOCATION: Lot 200 Edison Circuit, Forrestdale	Co-ords:	02-Sep-24



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 0.9

Dummy probe to (m):

Refusal: Max PP

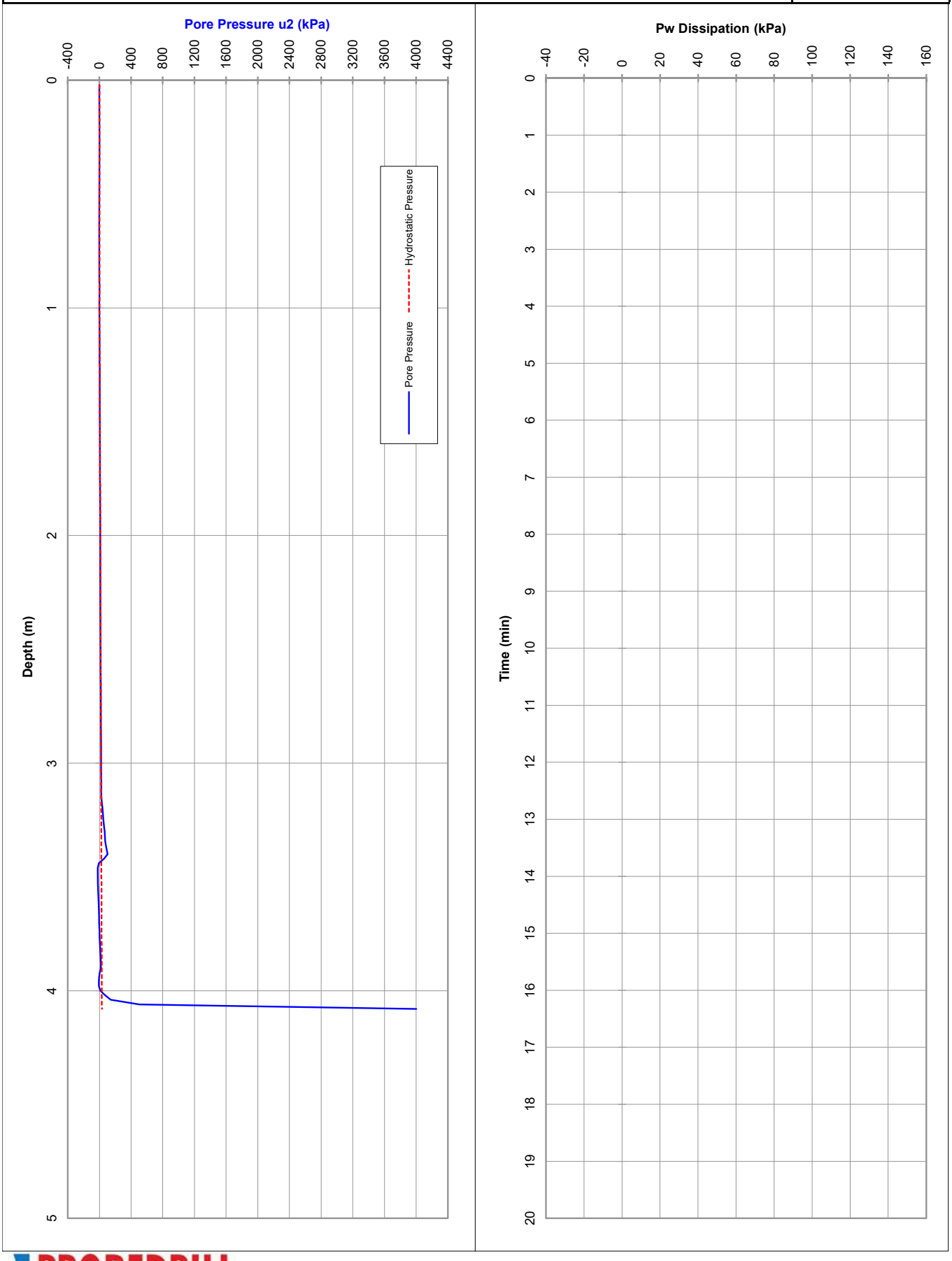
Cone I.D.: EC14

File: PG0182TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Perth Geotechnics	Job No.: GI294224PG	Probe I.D
PROJECT: Geotechnical Investigation	RL (m):	**CPTU 1**
LOCATION: Lot 200 Edison Circuit, Forrestdale	Co-ords:	02-Sep-24



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

Approx. Water (m): 0.9

File: PG0182TT.txt

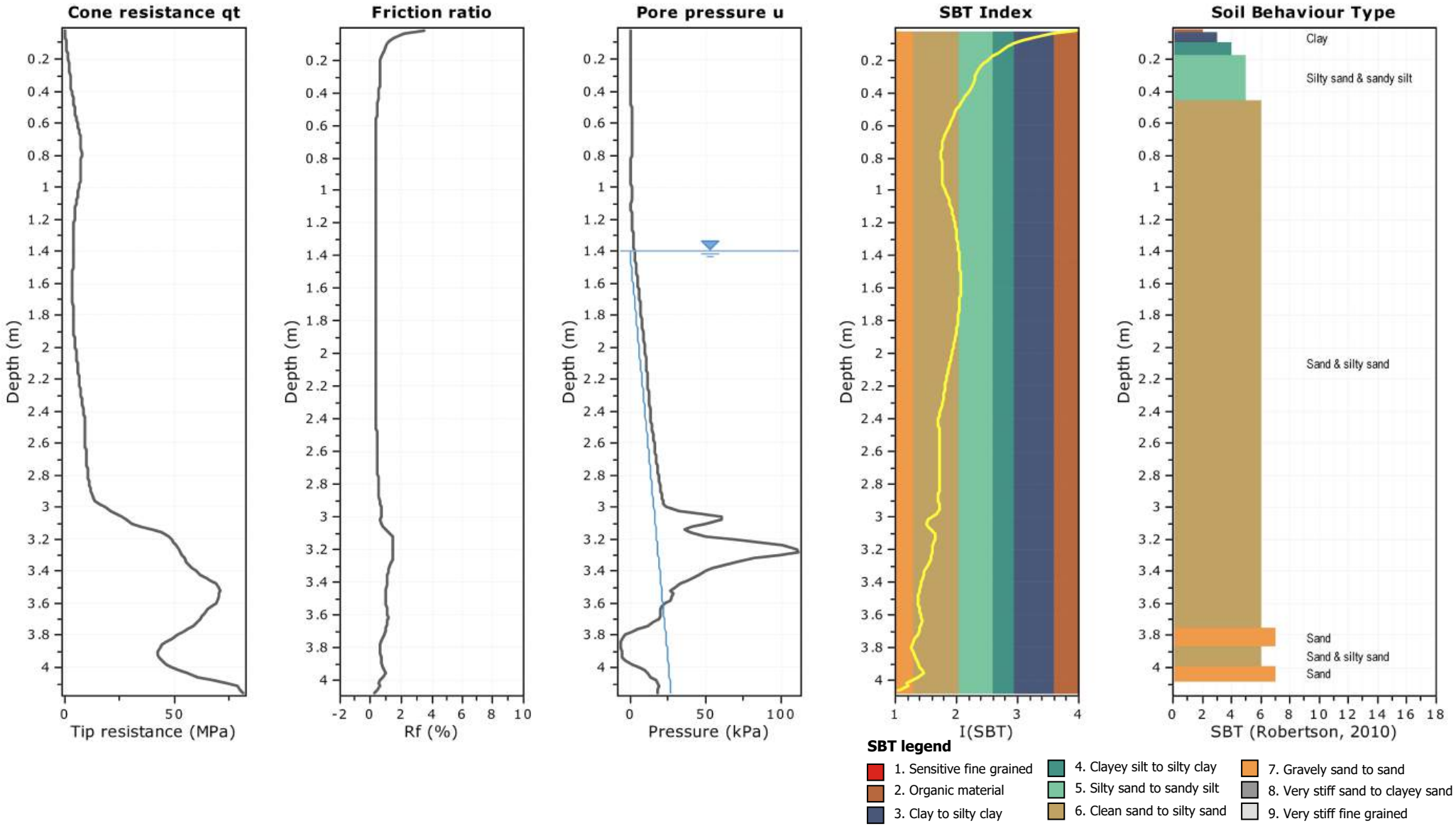
Rig type: 7-22t Track-Truck

Perth Georgetechnics

19 Silkie Link, Southern River, WA 6110
www.perthgeotechnics.com.au

Project: **Geotechnical Investigation**
Location: **Lot 200 Edison Circuit, Forrestdale**

CPTU02
Total depth: 4.16 m, Date: 2/09/2024

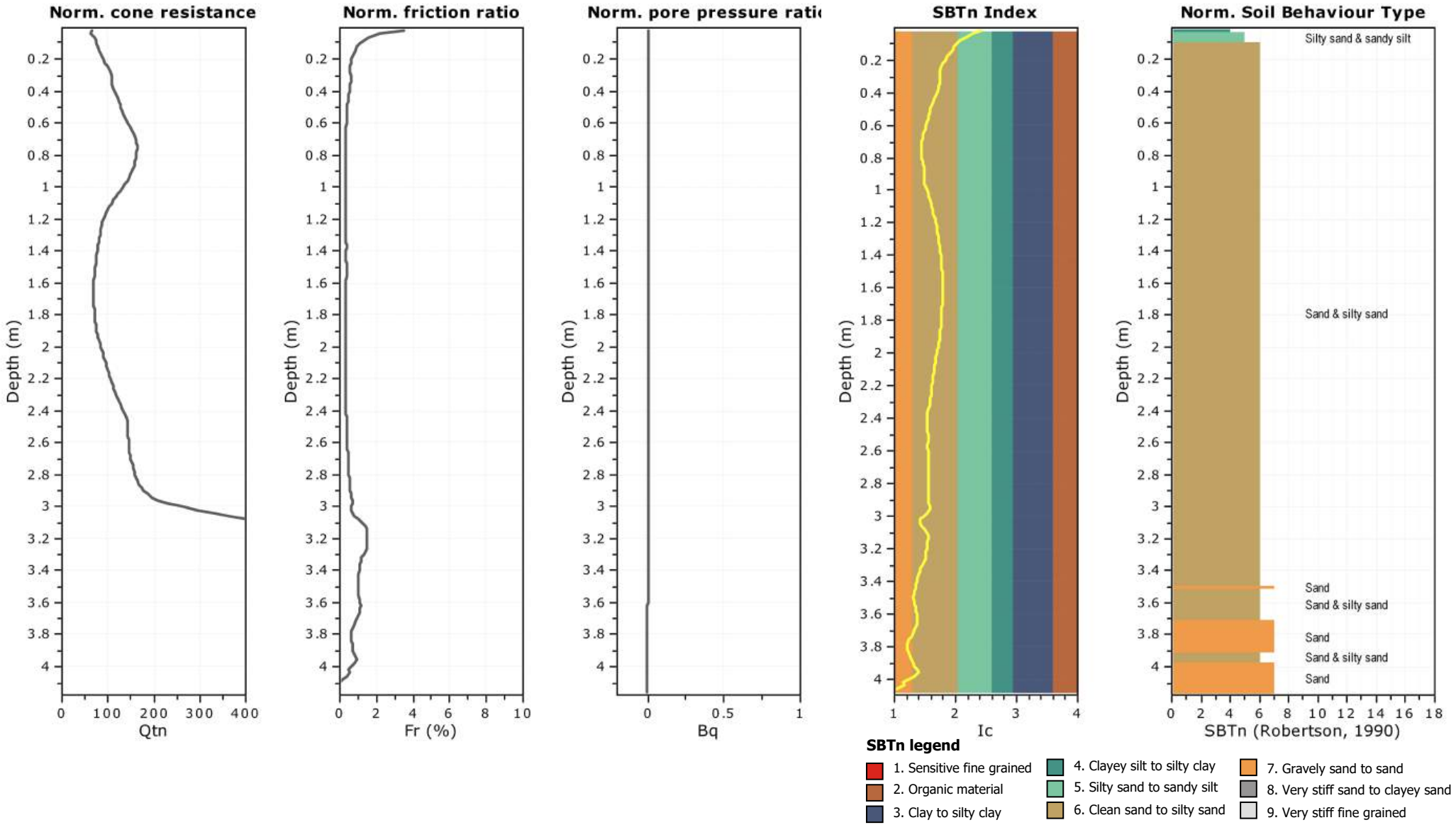


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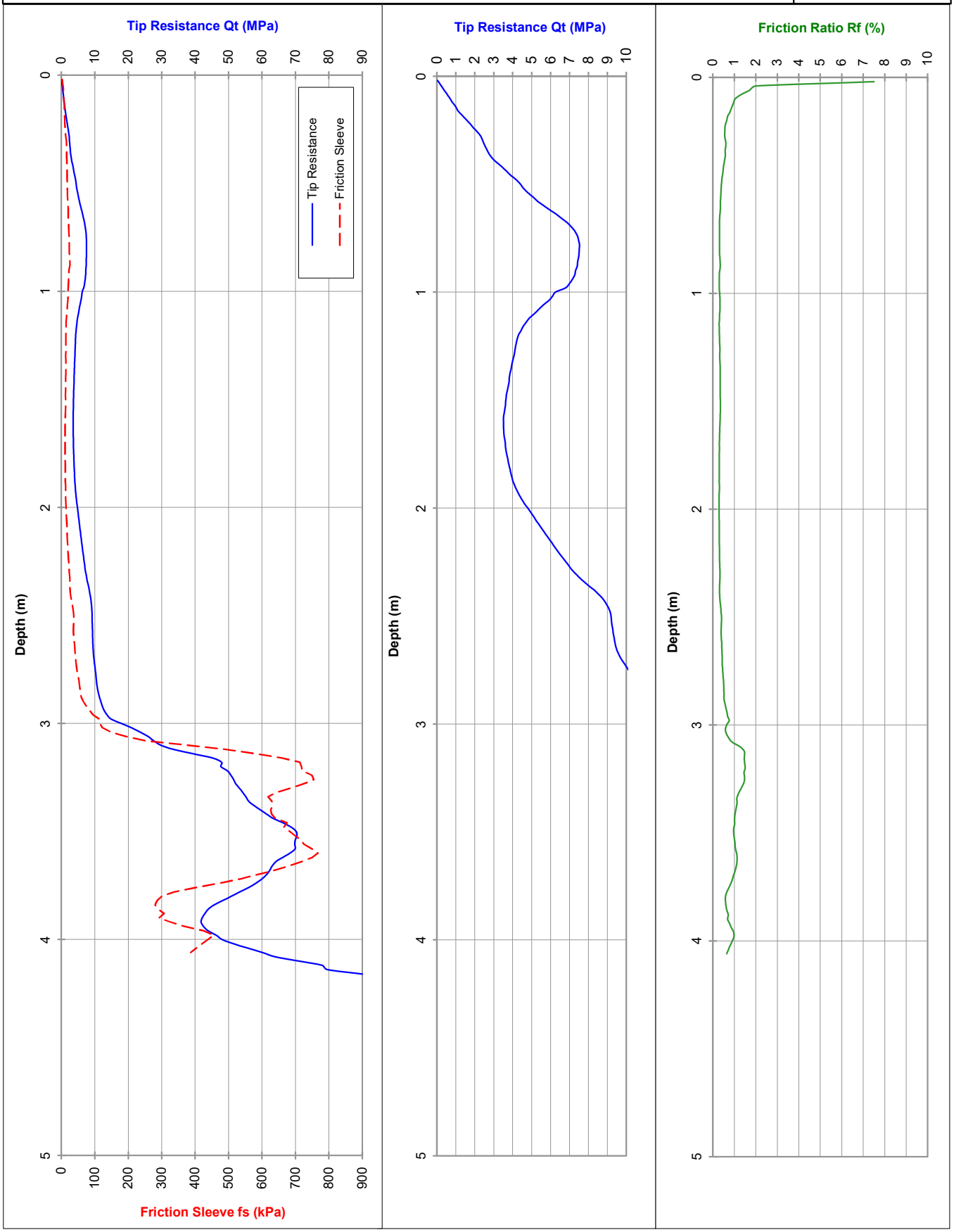
Project: **Geotechnical Investigation**
Location: **Lot 200 Edison Circuit, Forrestdale**

CPTU02
Total depth: 4.16 m, Date: 2/09/2024



ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Perth Geotechnics	Job No.: GI294224PG	Probe I.D
PROJECT: Geotechnical Investigation	RL (m):	**CPTU 02**
LOCATION: Lot 200 Edison Circuit, Forrestdale	Co-ords:	02-Sep-24



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.4

Dummy probe to (m):

Refusal: 90 MPa

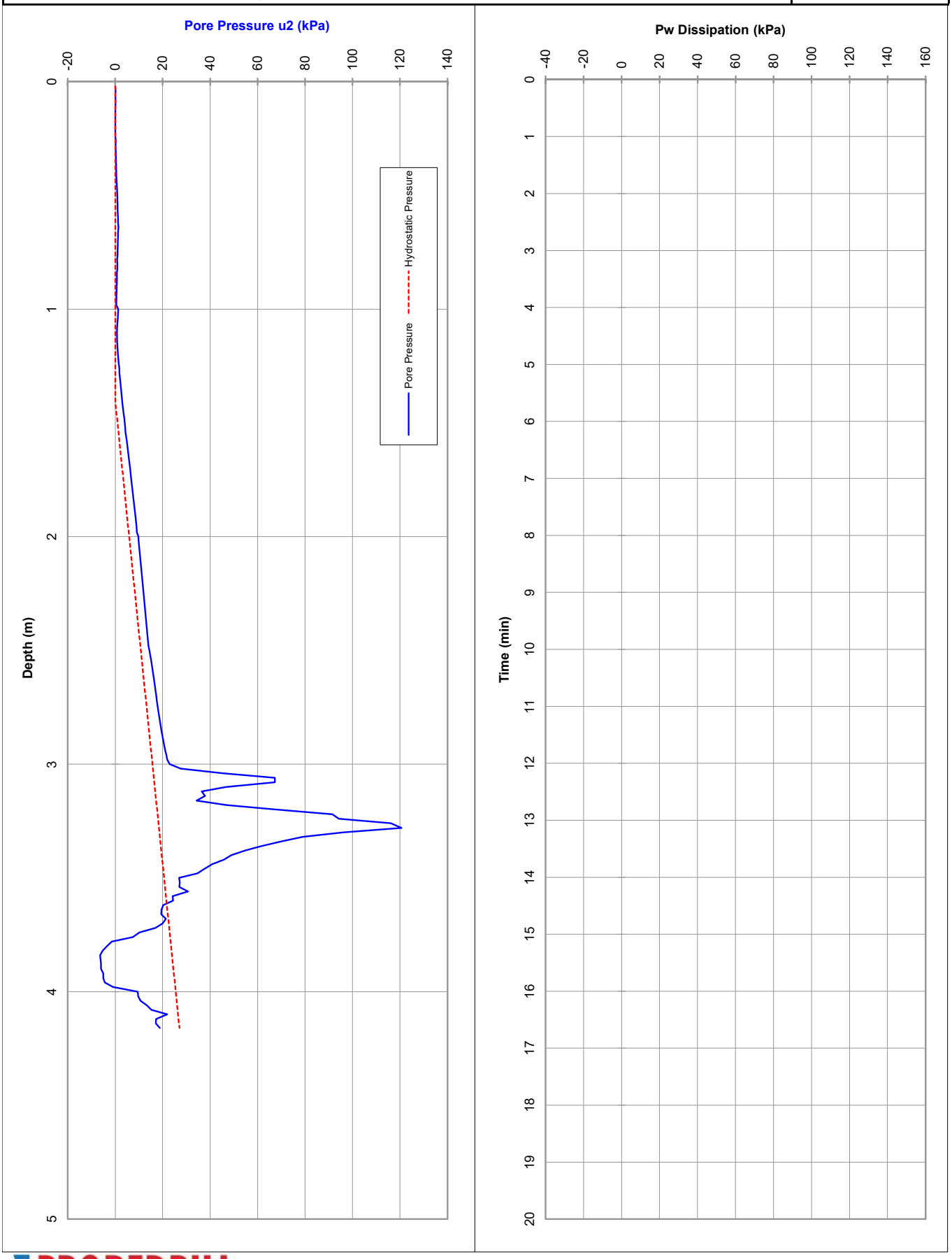
Cone I.D.: EC17

File: PG0183TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Perth Geotechnics	Job No.: GI294224PG	Probe I.D
PROJECT: Geotechnical Investigation	RL (m):	**CPTU 02**
LOCATION: Lot 200 Edison Circuit, Forrestdale	Co-ords:	02-Sep-24



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

Approx. Water (m): 1.4

File: PG0183TT.txt

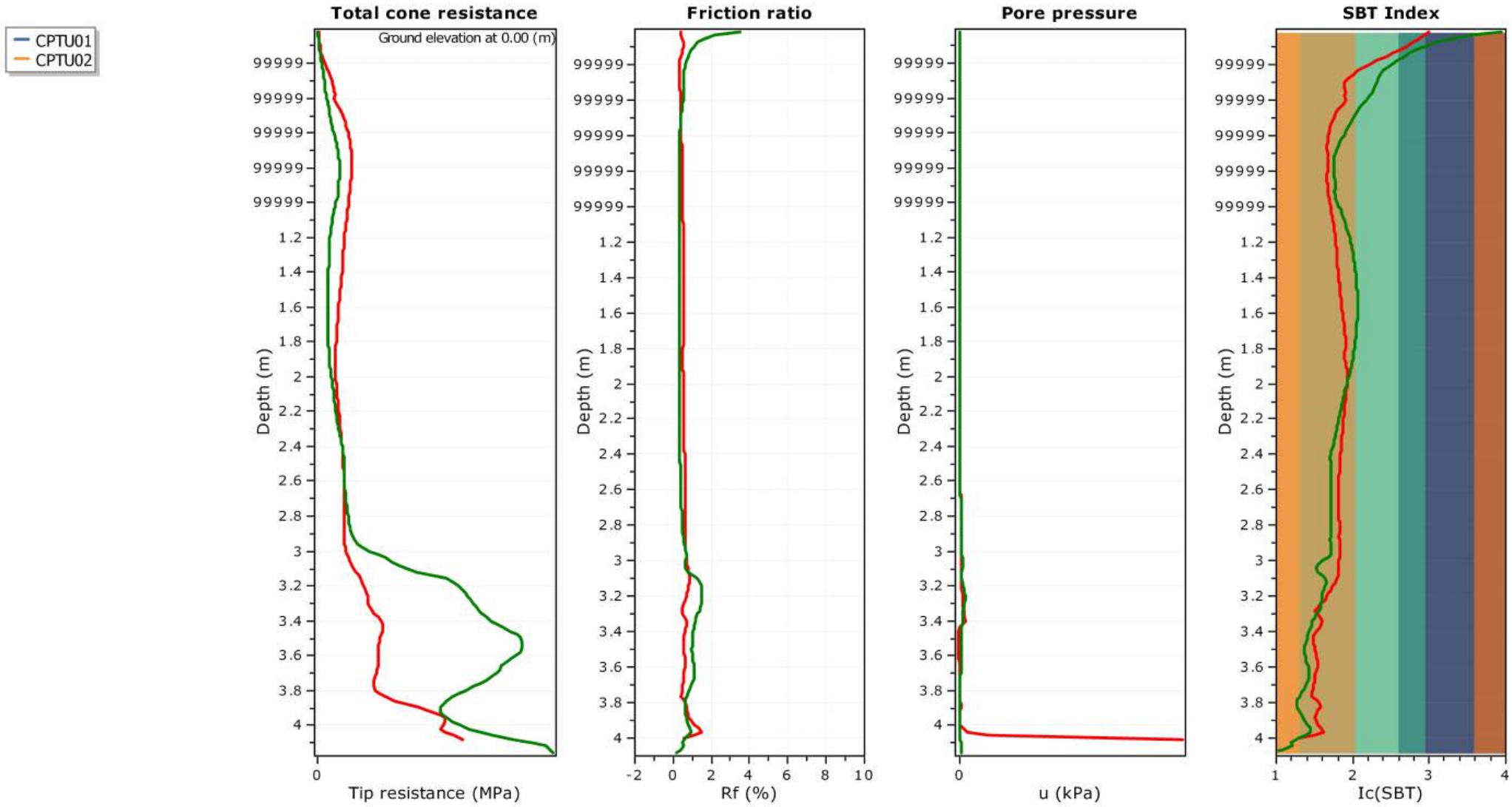
Rig type: 7-22t Track-Truck

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Project: **Geotechnical Investigation**
Location: **Lot 200 Edison Circuit, Forrestdale**

Overlay basic interpretation plots

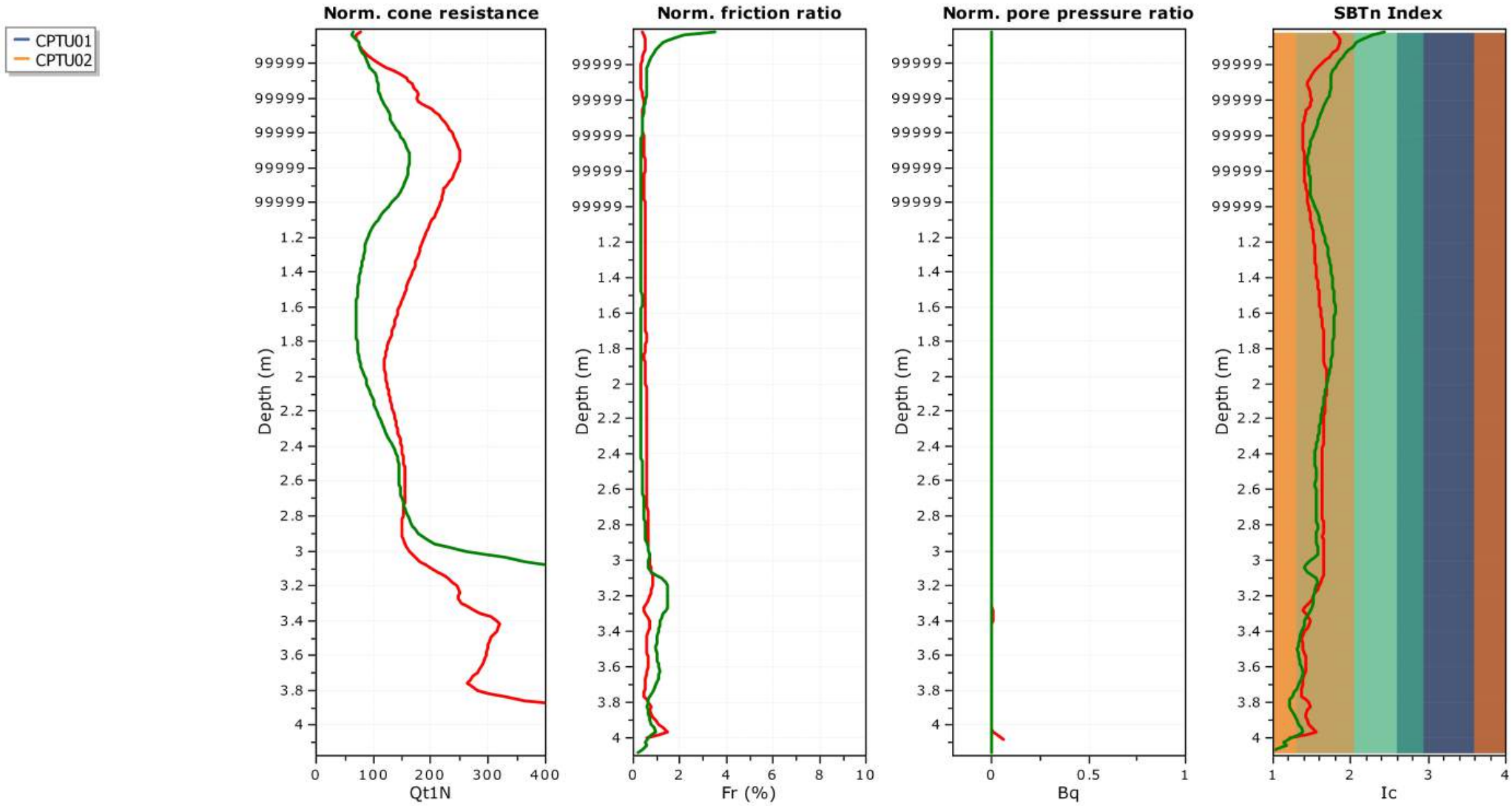


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Project: **Geotechnical Investigation**
Location: **Lot 200 Edison Circuit, Forrestdale**

Normalized basic plots



ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Perth Geotechnics

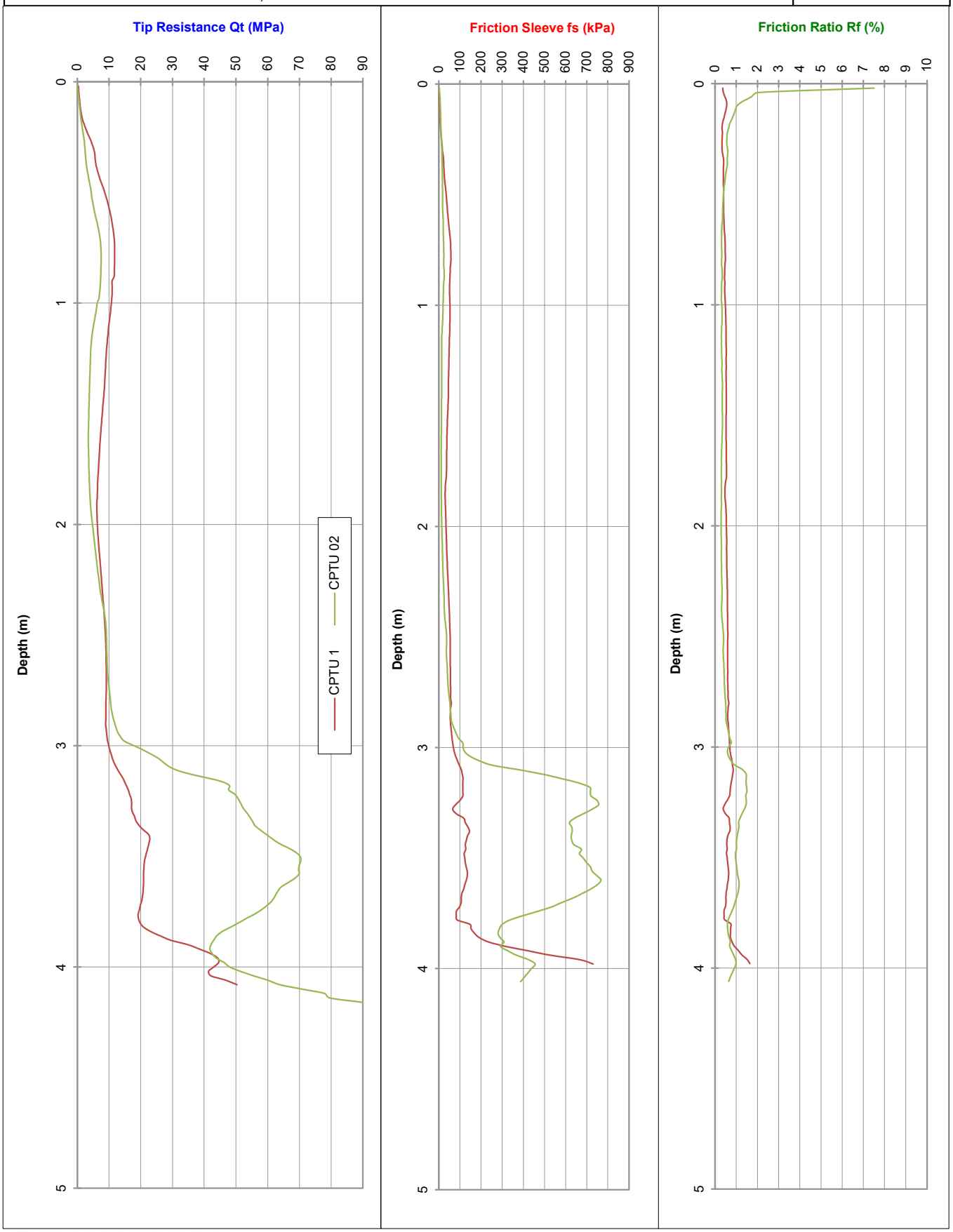
Job No.: GI294224PG

PROJECT: Geotechnical Investigation

Date/s: 2-Sep-2024

LOCATION: Lot 200 Edison Circuit, Forrestdale

ALL DATA



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999
and IRTP 2001 for friction reducer

Rig Type: 22t truck (Track-Truck)

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APPENDIX – D

SITE PHOTOGRAPH

Perth Geotechnics
ABN: 74 660 182 061
Tel: 08 6396 2675; M: 0430 130 677
PO Box 165, Gosnells WA 6990
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Photo 01: Site is looking from northern-east side



Photo 02: Site is looking from southern side Edison Circuit, Forrestdale WA

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Photo 03: Water-logged area at northern side of the site



Photo 04: Site is looking from western side

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Photo 05: Conducting Cone Penetration Test at CPTU01 location



Photo 06: Conducting Cone Penetration Test at CPT02 location

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Photo 07: Subsurface probing by auger at Bore Hole BH2 location



Photo 08: Soil from Bore Hole BH2 location, groundwater was encountered 0.6 mbgl

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Photo 09: Soil from Bore Hole BH6 location



Photo 10: Soil from Bore Hole BH9 location