These documents must be retained on site. Inspections may not be carried out if they are not.

TETRA TECH COFFEY

6, 7 & 8 Johnston Grove

Geotechnical Assessment

Palmer and Cook Developments

Reference: 773-WLGGE287885

18 January 2022

6, 7 & 8 JOHNSTON GROVE

Geotechnical Assessment

Report reference number: 773-WLGGE287885

18 January 2022

PREPARED FOR

Palmer and Cook Developments
c/- Moore Design
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PREPARED BY

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QUALITY INFORMATION

Revision history

Revision	Description	Date	Author	Reviewer	Approver
v1	Geotechnical Investigation and Assessment	18/01/2022	C.Hemi/ S.Martin	K-W. Ho	A. Hutchinson

Distribution

Report Status	No. of copies	Format	Distributed to	Date
v1	1	PDF	Cameron Moore	18/01/2022

Restriction on Disclosure and Use of Data

Please refer to the attached Limitations 'Important Information about your Tetra Tech Coffey report'

Template #

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APPENDICES

1. INTRODUCTION

Tetra Tech Coffey (NZ) Ltd has been engaged for a geotechnical assessment for a planned housing development at 6, 7 & 8 Johnston Grove, Taita. The three existing sites have a combined land area of 3,180m^2. A townhouse development comprising 20 two-storey timber framed townhouses is proposed. The existing semi-detached unit at 6 Johnston Grove will remain.

This geotechnical report summarises the results of our site investigation and geotechnical assessment including recommendations for suitable foundations.

2. SCOPE OF WORK

Our scope of work includes:

- Desktop Study of available information such as maps, New Zealand Geotechnical Database (NZGD), internal Coffey data
- Site Investigation comprising 6 Hand Augers to refusal with Dynamic Cone Penetrometer (DCP) probes and shear vane testing as appropriate. The test locations are shown in attached plan. We have allowed for underground service locate.
- Assessment and reporting comprising:
    - Ground model
    - Soil bearing capacity
    - Commentary on liquefaction risk
    - Site soil class to NZS1170.5
    - Confirm whether site meets NZS3604 ‘Good Ground’
    - Commentary on suitable foundation options and design values
    - Geological map showing any variations in conditions
    - Any other pertinent geotechnical issues

3. RECEIVED INFORMATION

We have received the following information from Palmer and Cook Developments

- 6,7&8 Johnston Grove, Taita, Lower Hutt “Site Plan”, Moore Designs, dated 13/01/2021, Sheet No. CD01
- 6,7&8 Johnston Grove, Taita, Lower Hutt “New Floor Plans”, Moore Designs, dated 13/01/2021, Sheet No. CD02

4. SITE DETAILS

4.1 GENERAL

The site is located in a residential setting in the northern part of Taita. The site is near flat with a slight slope up to the south. The site is at 24m elevation above sea level[1]. The Eastern Hutt hills are ~300m to the east.

[1] Hutt City Council Webmap Viewer https://maps.huttcity.govt.nz/Html5Viewer2101/Index.html?viewer=HCC.HuttView&run=Load_Aerials date accessed 11/01/2022

The High /Eastern Hutt Walkway runs along the southern boundary and the Hutt Railway line is ~50m to the east of the site. The site comprises three properties:

- 6 Johnston Grove: single-story semi-detached dwelling with a grass back lawn. A foundation slab is left from an existing building that was in the back lawn.
- 7 Johnston Grove: two-story dwelling with a swimming pool in the back lawn, and a semi-demolished building is in the south-eastern corner.
- 8 Johnston Grove: single dwelling with an extension, grass lawns that surround the house, and another foundation slab of an existing building.

4.2 GEOLOGICAL CONTEXT

The geology of the site is shown on the 1:50 000 scale Geology of Wellington Map[2] to be Holocene Alluvium (fa) comprising gravel and silt. Wellington Belt Greywacke rock is mapped ~300m to the east[2].

5. EXISTING INFORMATION

5.1 GWRC MAPS

A review of the Greater Wellington Regional Council's (GWRC) Hazard Maps[3]. Table 1 below shows the classified risk for 6,7&8 Johnston Grove.

Table 1: Earthquake related hazards at 6,7&8 Johnston Grove

Earthquake Relating Hazard	Risk Level
Combined Hazard	Moderate
Liquefaction	Low
Ground Shaking	Low to Moderate
Slope Failure	Low
Tsunami Evacuation Zone	None

5.2 GNS ACTIVE FAULTS

The GNS Active Faults Map[4] shows the site is located approximately 650m west of the Wellington Fault. The Wellington Fault is a dextral normal fault, with a high slip rate and moderate single event displacement and recurrence interval of approximately 900 years[5].

5.3 NEW ZEALAND GEOTECHNICAL DATABASE (NZGD)

A review of the New Zealand Geotechnical Database (NZGD)[6] show there has been previous shallow geotechnical investigations at 3 & 4 Johnston Grove. This comprised six Hand Augers and Dynamic Cone Penetrometers (DCPs) 40m to 80m east and north-east of the site.

[2] Begg, J.G. & Mazengarb, C., 1996. Geology of the Wellington Area, scale 1:50 000. Institute of Geological and Nuclear Sciences geological map 22. 1 sheet+128p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Science Limited.
[3] GWRC Web Map Viewer - https://mapping.gw.govt.nz/GW/GWpublicMap_Mobile/#
[4] *GNS – Surface Traces of Onshore Active Faults at a scale of 1:250,000. https://data.gns.cri.nz/af/*
[5] Morgenstern & Van Dissen, "Active Fault Mapping and Fault Avoidance Zones for Wellington City" GNS Science Consultancy Report 2020/57 dated May 2021
[6] NZGD - https://www.nzgd.org.nz/

The hand augers achieved depths of 0.7-2.1m depth terminating due to gravel obstruction. DCPs achieved 1.0-2.5m depth. These logs indicate a ground model consisting of ~200mm of topsoil overlying alluvium. Alluvial soils were typically 500 to 900mm thick firm to hard silt overlying sandy gravel/gravelly sand at 1.1 to 1.9m depth.

The nearest deep investigation data available is two boreholes ~185m and ~220m east of the site. These boreholes achieved depths of 10.4m and 15m depth and encountered sandy silt/silty sand to 2.7/3.7m depth underlain by gravel dominate soil to termination depth. Groundwater was not encountered in either of these boreholes.

A map showing the location of these investigations is in Appendix A.

5.4 RECORDED EARTHQUAKE MOVEMENTS

Strong motion stations throughout the Wellington region recorded ground motions during the 2016 Kaikoura earthquake. A selection of these recorded peak ground accelerations (PGAs Horizontal) as well as the site subsoil class are shown in Table 2 below.

Table 2: Horizontal PGAs recorded during the 2016 Kaikoura earthquake.

Site	Location	Distance from Site	PGA	Subsoil Class
TAIS	Taita Central School	1km SW	0.16g	Class D
HSSS	Lower Hutt Haywards Substation	3km N	0.077g	Class C

6. SITE INVESTIGATION

The site investigation was undertaken on the 9th of November 2021 and included six hand augers with in-situ shear vane testing, and six dynamic cone penetrometers (DCPs). Hand augers refused on gravel at 0.7m and 1.6m depth.

Hand augers were logged by a Tetra Tech Coffey geo-professional in general accordance with the New Zealand Geotechnical Society (NZGS) Guidelines[7].

Refer to Figure 1 for Site Investigation Plan. Engineering logs are provided in Appendix B.

[7] NZ Geotechnical Society Inc., December 2005 Field Descriptions of Soil and Rock: Guidelines for the field classification and description of soil and rock for engineering purposes.

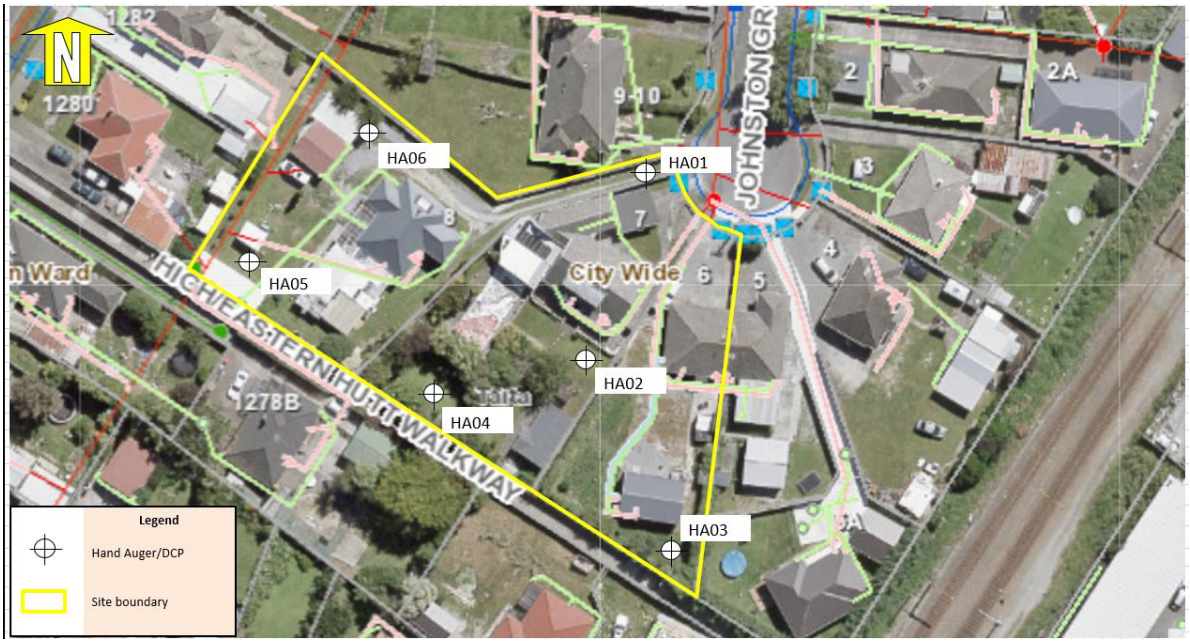

Figure 1: Site investigation Plan

7. GROUND MODEL

We have developed a ground model for the site largely based on the site-specific geotechnical investigation and supplemented with the NZGD data. Generally, the subsoil profile comprises ~100mm of topsoil underlain by alluvial soils consisting of silt and sand. The top of the gravel unit is inferred from the testing refusal on gravel. Gravel fill 0.15m thick was encountered in HA06 in the north-west of the site

As is typical in alluvial soils, the thickness and depth of material units varies across the site. In particular, the gravel layer (Alluvium 3) was typically encountered at a depth of 0.65m to 0.8m except for HA01 which this was noted at 1.6m depth.

Table 3 below presents a summary of the ground model for the site.

Table 3: Ground Model for 6,7&8 Johnston Grove

Material Unit	Top Depth (mbgl#)	Thickness (m)	Description	Consistency	DCP blows/100mm	Shear Vane (kPa)
Topsoil/Fill	0.0	0.1-0.2	Topsoil SILT Fill: GRAVEL	-	1-8	-
Alluvium 1	0.1/0.2	0.25-0.65	SILT: non-plastic to low plastic, trace fine sand, trace gravel	Firm to very stiff	1-12	56-176
Alluvium 2*	0.4/0.8	0.15-0.8	SAND: fine to coarse, minor gravel, trace silt	Loose to medium dense	1-12	-
Alluvium 3	0.7/1.6	10+	GRAVEL: silty and sandy to minor silt and sand. Possible silt or sand lenses	Medium dense to very dense	3-20+	-

* Not encountered in HA04 and HA05
# metres below ground level

7.1 GROUNDWATER

No groundwater was encountered during the site investigation or available in nearby publicly available investigations.

Based off groundwater contours in the Lower Hutt Aquifer Model (GWRC, 2014[8]) where groundwater is shown at ~16.0m above mean sea level i.e ~8.0m below existing ground surface. This is consistent with the contour levels from Hutt City Council (HCC)[9] which shows the Hutt River is ~16m, 8m elevation lower than the ground level at Johnston Grove. A previous investigation carried out by Tetra Tech Coffey indicated groundwater at a depth of 8.5mbgl at Pomare Station, 730m north of Johnston Grove.

A design groundwater level of 8mbgl is recommended for this site.

7.2 GEOTECHNICAL DESIGN PARAMETERS

Geotechnical design parameters are provided in Table 4 based on our in-situ testing and experience of similar materials in the region.

Table 4: Geotechnical Design Parameters for 6,7&8 Johnston Grove.

Material unit	Top Depth (m)	Unit Weight, γ (kN/m^3)	Effective Friction Angle, Ø' (°)	Effective Cohesion, c' (kPa)	Shear Strength, S_u (kPa)	E', Youngs Modulus (MPa)
Alluvium 1: SILT	0.1/0.2	18	28	5	75	20
Alluvium 2: SAND	0.4/0.8	18	30	0	-	25
Alluvium 3: GRAVEL	0.7/1.6	20	36	0	-	60

8. GEOTECHNICAL ASSESMENT

8.1 SITE SUBSOIL CLASS

The site is mapped as Site Class C – shallow soil site by Boon et al., (2010)[10]. The site is assumed to be Site Class C – Shallow Soil based on this and in accordance with site investigation and desk study.

8.2 GROUND MOTION PARAMETERS

The latest update of the New Zealand Geotechnical Society (NZGS) Practice Module 1 (rev1)[11] has provided updated design peak ground acceleration (PGA) values for geotechnical analysis. The design PGAs for SLS and ULS loading conditions for an importance level 2 structure are summarised in Table 5.

[8] GWRC (June 2014) Lower Hutt Aquifer Model Revision (HAM3): Sustainable Management of the Waiwhetu Aquifer
[9] Hutt City Council Webmap Viewer https://maps.huttcity.govt.nz/Html5Viewer2101/Index.html?viewer=HCC.HuttView&run=Load_Aerials date accessed 11/01/2022
[10] Boon et al., (2010) GNS Science Consultancy Report *It's our fault, geological and geotechnical characterisation and site class revision of the Lower Hutt*
[11] NZGS practise module - https://www.building.govt.nz/assets/Uploads/building-code-compliance/b-stability/b1-structure/geotechnical-guidelines/geotech-module-1.pdf

Table 5: Summary of PGA and Magnitude Values for the Wellington Region

Loading	Return Period	Effective Magnitude (Mw)	PGA (g)
SLS1	1/25 Years	6.5	0.13
ULS	1/500 Years	7.7	0.68

8.3 LIQUEFACTION ASSESSMENT

Liquefaction at the site is considered to be very low risk due to the depth to groundwater (8mbgl) and the medium dense to very dense gravel dominant soils below the groundwater table.

8.4 SOIL BEARING CAPACITY

The site does not meet the definition of 'good ground' according to NZS3604 due to the presence of the sand layer (Alluvium 2) in the upper metre. The estimated ultimate bearing capacity (UBC) of the upper profile (Alluvium 1 and 2) is 200kPa.

The UBC of the underlying gravel layer (Alluvium 3) typically below 1m depth can be taken as 400kPa. A geotechnical reduction factor of 0.5 and 0.6 in the static and seismic design cases should be used.

8.5 FOUNDATION RECOMMENDATIONS

8.5.1 Shallow Foundations

We consider that the site is suitable for an enhanced foundation solution in line with those recommended as TC2 Options 1-4 (MBIE, 2012)[12].

If this is selected, we consider that waffle slabs could be specifically designed to be founded on soil which are confirmed to have 200kPa UBC during construction. To confirm the UBC, we recommend that we are engaged to inspect the subgrade once topsoil has been stripped and subgrade is proof rolled with a 10 tonne static weight roller. This will reduce the risk of unnecessary over excavation and associated backfilling costs. While most of the subgrade would provide 200kPa, we recommend making some allowance for excavation of any localised soft areas to 1.0m and backfilled with engineered fill material. Note that a geotextile separator is required over the subgrade to separate the fine grained natural subgrade from any engineered fill material.

Some surficial fill to 0.15m depth was observed in the north-west of the site. This should be removed when the site is stripped.

8.5.2 Deep Foundations

A piled foundation is also suitable for this development. The medium dense to very dense gravel (Alluvium 3) encountered from between 0.7 and 1.6m depth would be a suitable founding layer.

The ultimate end bearing capacity of this layer for driven piles can be taken as 400kPa. A reduction factor of 0.5 is recommended.

[12] MBIE (December 2012) Repairing and rebuilding houses affected by the Canterbury earthquakes Part A Version 3

9. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are made:

- The site typically comprises topsoil underlain by weaker silt and sands with more competent medium dense to very dense gravel layer below 700mm to 1600mm depth.
- The groundwater at the site is anticipated to be at ~8mbgl
- The site is Site Class C based on NZS1170.5
- Liquefaction risk is assessed as very low due to the deep water table
- The ultimate bearing capacity of 200kPa is available in the upper 1 to 2m depth.

The following recommendations are made:

- The following foundation solutions are suitable for the proposed development:
    - Waffle slab founded at 200mm depth or other shallow enhanced foundations which are in line with those recommended as TC2 Options 1-4.
    - Piled foundations founded on the medium dense to very dense gravel layer at 1 to 2m depth.
- Confirmation of the ground conditions and ultimate bearing capacity is recommended at construction. This should include an inspection of the subgrade once topsoil and fill are stripped and site proof rolled with a static 10 tonne roller.
- Some excavation and replacement of isolated soft spots is anticipated.

TETRA TECH COFFEY

IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY REPORT

As a client of Tetra Tech Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Tetra Tech Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Tetra Tech Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Tetra Tech Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Tetra Tech Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Tetra Tech Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Tetra Tech Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Tetra Tech Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Tetra Tech Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Tetra Tech Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Tetra Tech Coffey to work with other project design professionals who are affected by the report. Have Tetra Tech Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Tetra Tech Coffey for information relating to geoenvironmental issues.

Rely on Tetra Tech Coffey for additional assistance

Tetra Tech Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Tetra Tech Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Tetra Tech Coffey to other parties but are included to identify where Tetra Tech Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Tetra Tech Coffey closely and do not hesitate to ask any questions you may have.

APPENDIX A: FIGURES

BC220531

Legend

- NZGD Hand augers/DCPs
- NZGD Borehole
- Borehole (Coffey, 2019)

BUILDING CONSENT GRANTED 22/03/2022

HUTT CITY COUNCIL

TETRA TECH COFFEY	CLIENT:	PROJECT: 773-WLGGE287885	DESIGNED: SM	FIGURE TITLE:	Existing Investigation Locations
	Palmer and Cook Developments	DATE: 14/01/2022	DRAWN: SM	FIGURE NO:	A-1
	PROJECT TITLE:	REVISION: Final	CHECKED: AH	NOTES:	Image Source: Google Earth
	6, 7 & 8 Johnston Grove, Taita	SCALE: NTS	STATUS: v1		

HUTT CITY TE AWA KAIRANGI

APPENDIX B: INVESTIGATION LOGS

BC220531

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	**HA01**
sheet:	1 of 1
project no.	**773-WLGGE287885**
client:	**Palmer and Cook Developments**
date started:	**09 Nov 2021**
principal:	**-**
date completed:	**09 Nov 2021**
project:	**Geotechnical Assessment**
logged by:	**C.Dutil**
location:	**6, 7 & 8 Johnston Grove, Taita, Lower Hutt**
checked by:	**S. Martin**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.: -

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 485

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10 12	structure and additional observations
HA, N		Not Encountered			0.0		ML	**TOPSOIL: SILT**: non plastic to low plasticity, dark brown, trace rootlets, trace sand, trace gravels.	W				**TOPSOIL**
							ML	**SILT**: low plasticity, brown, minor sand.		VSt			**ALLUVIUM**
					0.5			0.7 m: sand increase to some			⊕ ⊙		VS 114/ 25 kPa
											⊕ ⊙		VS 106/ 25 kPa
					1.0		SP	**SAND**: fine - coarse grained, brown, minor silt.		L			
					1.5				M				
								Hand Auger HA01 terminated at 1.6 m Refusal on gravel				1000 mm	
					2.0								
					2.5								

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

BUILDING CONSENT GRANTED 22/06/2022 HUTT CITY COUNCIL

HUTT CITY TE AWA KAIRANGI

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BC220531

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	**HA02**
sheet:	1 of 1
project no.	**773-WLGGE287885**
client:	***Palmer and Cook Developments***
date started:	**09 Nov 2021**
principal:	**-**
date completed:	**09 Nov 2021**
project:	***Geotechnical Assessment***
logged by:	**C.Hemi**
location:	***6, 7 & 8 Johnston Grove, Taita, Lower Hutt***
checked by:	**S. Martin**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.: -

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 484

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) remoulded ⊕ peak ⊙ 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10 12	structure and additional observations
HA N		Not Encountered			0.0		ML	**TOPSOIL: SILT**: non plastic - low plasticity, dark brown, minor rootlets, trace fine sand.	D				**TOPSOIL**
							ML	**SILT**: non plastic - low plasticity, brown, trace fine sand, trace gravel; medium to coarse, sub-angular to sub-rounded.		VSt	⊕ ⊙		**ALLUVIUM** VS 176/ 93 kPa
					0.5			0.5 m: organic wood					
							SP	**SAND**: fine grained, brown, trace gravel; fine to coarse, sub-angular to sub-rounded.	M	L			
								Hand Auger HA02 terminated at 0.7 m Refusal on gravel					
					1.0								
					1.5								
					2.0								
					2.5								

CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP JOHNSTON GROVE.GPJ <<DrawingFile>> 18/01/2022 09:22

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BUILDING CONSENT GRANTED 22/06/2022 HUTT CITY COUNCIL

HUTT CITY TE AWA KAIRANGI

BC220531

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	**HA03**
sheet:	1 of 1
project no.	**773-WLGGE287885**
client:	***Palmer and Cook Developments***
date started:	**09 Nov 2021**
principal:	**-**
date completed:	**09 Nov 2021**
project:	***Geotechnical Assessment***
logged by:	**C.Hemi**
location:	***6, 7 & 8 Johnston Grove, Taita, Lower Hutt***
checked by:	**S. Martin**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.: -

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10 12	structure and additional observations
HA, N		Not Encountered			0.0		ML	**TOPSOIL: SILT**: non plastic - low plasticity, dark brown, trace fine sand, trace rootlets.	D				**TOPSOIL**
							ML	**SILT**: non plastic - low plasticity, brown, trace fine sand.	D to M	St	⊕		**ALLUVIUM** VS 56/ 31 kPa
					0.5		SP	**SAND**: fine grained, brown, minor gravel; coarse, sub-rounded, trace silt.	M	L D			
								Hand Auger HA03 terminated at 0.65 m Refusal on gravel					
					1.0								
					1.5								
					2.0								
					2.5								

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
HA hand auger

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

BUILDING CONSENT
GRANTED
22/06/2022
HUTT CITY COUNCIL
HUTT CITY TE AWA KAIRANGI

BC220531

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	**HA04**
sheet:	1 of 1
project no.	**773-WLGGE287885**
client:	**Palmer and Cook Developments**
date started:	**09 Nov 2021**
principal:	**-**
date completed:	**09 Nov 2021**
project:	**Geotechnical Assessment**
logged by:	**C.Hemi**
location:	**6, 7 & 8 Johnston Grove, Taita, Lower Hutt**
checked by:	**S. Martin**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.: -

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 484

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10 12	structure and additional observations
HA N		Not Encountered			0.0		ML	**TOPSOIL: SILT**: non plastic - low plasticity, dark brown, minor rootlets, trace fine sand.	D				**TOPSOIL**
							ML	**SILT**: non plastic - low plasticity, brown, trace gravel; medium, sub-rounded, trace fine sand, trace rootlets.	M	St	⊕ ⊙		**ALLUVIUM**
					0.5								VS 98/ 37 kPa
								0.65 m: gravels; fine to coarse, sub-rounded			⊕ ⊙		VS 81/ 26 kPa
								Hand Auger HA04 terminated at 0.7 m Refusal on gravel					VS UTP
					1.0								
					1.5								
					2.0								
					2.5								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

BC220531

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	**HA05**
sheet:	1 of 1
project no.	**773-WLGGE287885**
client:	**Palmer and Cook Developments**
date started:	**09 Nov 2021**
principal:	**-**
date completed:	**09 Nov 2021**
project:	**Geotechnical Assessment**
logged by:	**C.Dutil**
location:	**6, 7 & 8 Johnston Grove, Taita, Lower Hutt**
checked by:	**S. Martin**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.: -

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) ⊕ remoulded ⊙ peak (50 100 150 200)	DCP (blows/ 100 mm) (2 4 6 8 10 12)	structure and additional observations
HA — N		Not Encountered			0.0		ML	**TOPSOIL: SILT**: non plastic - low plasticity, dark brown, trace coal fragments, trace gravels, trace rootlets.	M				**TOPSOIL**
							ML	**SILT**: low plasticity, brown, minor fine to coarse sand, trace gravel; fine to coarse, round to sub-round, gravels up to 30mm.		St			**ALLUVIUM**
					0.5			0.6 m: gravels increasing to some					
								Hand Auger HA05 terminated at 0.7 m Refusal on gravel					
					1.0								
					1.5								
					2.0								
					2.5								

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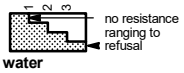
method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

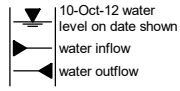
* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration



water



samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

BC220531

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	**HA06**
sheet:	1 of 1
project no.	**773-WLGGE287885**
client:	***Palmer and Cook Developments***
date started:	**09 Nov 2021**
principal:	**-**
date completed:	**09 Nov 2021**
project:	***Geotechnical Assessment***
logged by:	**C.Dutil**
location:	***6, 7 & 8 Johnston Grove, Taita, Lower Hutt***
checked by:	**S. Martin**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.: -

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) remoulded ⊕ peak ⊙ 50 100 150 200	DCP (blows/100 mm) 2 4 6 8 10 12	structure and additional observations
HA N		Not Encountered			0.0		GP	**FILL: GRAVEL**: medium - coarse grained, poorly graded, sub-angular, grey, some silt.	M				**FILL**
							ML	**SILT**: low plasticity, brown, minor sand.		F - St			**ALLUVIUM**
					0.5		SP	**SAND**: medium - coarse grained, brown-grey, minor gravel; medium to coarse, sub-rounded.		L			
										D			
					1.0			Hand Auger HA06 terminated at 0.8 m Refusal on gravel				20/13 mm	
					1.5								
					2.0								
					2.5								

method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
HA hand auger

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

BUILDING CONSENT GRANTED 22/06/2022 HUTT CITY COUNCIL

HUTT CITY TE AWA KAIRANGI

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TETRA TECH COFFEY

Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are broadly described in accordance with the Unified Soil Classification System (UCS) as shown in the table on Sheet 2. However, there are some departures from this and reference should be made to the New Zealand Geotechnical Society 'Field Description of Soil and Rock' 2005 for clarification.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		60 mm to 200 mm
Gravel	coarse	20 mm to 60 mm
	medium	6 mm to 20 mm
	fine	2 mm to 6 mm
Sand	coarse	600 μm to 2 mm
	medium	200 μm to 600 μm
	fine	60 μm to 200 μm

MOISTURE CONDITION

Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	Easily exudes between fingers when squeezed.
Soft	12 - 25	Easily indented by fingers.
Firm	25 - 50	Indented by strong finger pressure & can be indented by thumb pressure.
Stiff	50 - 100	Cannot be indented by thumb pressure.
Very Stiff	100 - 200	Can be indented by thumb nail.
Hard	200 - 500	Difficult to indent by thumb nail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)	SPT N-value (Blows / 300mm)
Very loose	Less than 15	Less than 4
Loose	15 - 35	4 - 10
Medium Dense	35 - 65	10 - 30
Dense	65 - 85	30 - 50
Very Dense	Greater than 85	Greater than 50

MINOR COMPONENTS

FRACTION	TERM	% OF SOIL MASS	EXAMPLE
Major	(...) [UPPER CASE]	≥ 50 [major constituent]	GRAVEL
Subordinate	(...)y [lower case]	20 - 50	Sandy
Minor	with some... with minor...	12 - 20 5 - 12	with some sand with minor sand
	with trace of (or slightly) ...	< 5	with trace of sand (slightly sandy)

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS	
Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TRANSPORTED SOILS	
Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

TETRA TECH COFFEY

Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)							USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 60 mm is larger than 0.06 mm	(A 0.06 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.36 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 60 mm is smaller than 0.05 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
		SILTS & CLAYS Liquid limit less than 50	**DRY STRENGTH**	**DILATANCY**	**TOUGHNESS**			
			None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				Pt	PEAT

• Low plasticity – Liquid Limit w_L less than 35%. • Medium plasticity – w_L between 35% and 50%. • High plasticity – w_L greater than 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter.	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.