

17 February 2022

Job No: 64872#GE

eTrack No: 200040703

Highbrook Living Limited Att: Matt Doughney

RE: HIGHBROOK LIVING – GEOTECHNICAL APPRAISAL FOR PLAN CHANGE

1 INTRODUCTION

Highbrook Living Limited has engaged Babbage Consultants Ltd (Babbage) to provide a geotechnical assessment to support its Private Plan Change (PPC) Request to rezone land which forms part of the property at 8 Sparky Road Otara (the site) as high-density residential end use.

This geotechnical assessment is limited in scope to the area identified on the attached Site Plan. It is a preliminary geotechnical appraisal based on a desk study to inform the Private Plan Change Request and should be read in conjunction with the Applicability and Limitations as attached.

2 DESK STUDY

2.1 Site Description

The site is located in Otara and is bound by Highbrook Drive to the south-east, Tamaki River (estuary) to the north and the Southern Motorway to the west as shown in the site plan attached in Appendix A.

The plan change area ("the site") and surroundings are summarised below:

- The site forms part of the former Ōtāhuhu power station site.
- The site is located in the Light Industry Zone area in Ōtara. The residential area and town centre of Ōtara are to the south-east, and Highbrook Business Park is on the opposing side of Ōtara Creek to the north-east.
- The majority of the site is relatively flat at around 8mRL, with the exception of the slope from
 ~7mRL down to the shoreline along Tamaki River. This slope typically less than 45 degrees (1V:1H),
 however is locally as steep as ~56 degrees (1.5V:1H).
- There are some low points present on the site, including a pond in the northwest corner adjacent to State Highway 1 (SH1) which was used as an erosion and sediment pond during construction of Highbrook Drive and the widening of SH1.





2.2 Historic Aerial Photography

Historic aerial photography from AC Geomaps and Retrolensⁱ was reviewed as part of this assessment. Key changes to land use since 1940 include:

- 1958: Southern Motorway built across Curlew Bay to the west. Largely agricultural land.
- 1967-1969: Large liquid storage tanks under construction on north of site (likely associated with old power station). Stopbank built at edge of Curlew Bay adjacent Southern Motorway. Reclamation filling between stop bank and natural waterline beginning.
- 2003-2004: Removal of the liquid storage tanks.
- 2006: Construction of Highbrook Drive and widening of Southern Motorway in progress.

2.3 Published Geology

The geological mapⁱⁱ (see Figure 1) indicates the south and centre of the site is underlain by pumiceous deposits of the Puketoka Formation (tp), described as light-grey to orange-brown, pumiceous mud, sand and gravel, with muddy peat and lignite.

The north-eastern extent of the site is indicated to be underlain by lithic tuff of the Auckland Volcanic Field (avt), being thin graded beds of grey, mud- to sand-sized fragments of comminuted, country rock (mainly sandstone, mudstone, alluvium, micaceous sand) together with basalt and basanite fragments.

A small area of reclaimed land (hf) is present in the southwest corner, adjacent to the jetty.



Figure 1: Excerpt of the Auckland Urban Area Geology Map (1:50,000)





2.4 Nearby Investigation Data

The NZ Geotechnical Database^{III} contains several historic investigations carried out close to the site. These included machine-drilled boreholes, Cone Penetrometer Tests (CPTs) and test pits carried out in 2003-2004 for Highbrook Drive and the Southern Motorway widening (refer NZGD site plan below in Figure 2). The borehole logs considered in this assessment are attached to this letter.



Figure 2: Available data on the NZGD (accessed 10 December 2021)





3 SUMMARY OF ANTICIPATED GROUND CONDITIONS

Based on the findings from the desk study, ground conditions are expected to comprise clay, silt and sand of the Puketoka formation, overlain in part by tuff and other AVF deposits and/or surficial fill. The Puketoka formation is anticipated to comprised mostly stiff to hard clay and silt over the top 8-15m, with some loose to dense silty sand lenses. Competent Kaawa Formation sediments are expected between 15m and 22m below ground level. The lower lying reclamation area in the north-west corner of the site appears to comprise ~1.0m of well compacted aggregate separated from the underlying alluvium by a geotextile.

4 GEOTECHNICAL CONSIDERATIONS

4.1 Seismic Hazard

4.1.1 Seismic Subsoil Class

Based on the information available, the local geology, and our knowledge of the area, we consider that the site can be categorised as a 'shallow soil site' (Subsoil Class C) in accordance with NZS1170.0:2002 and NZS1170.5:2004.

4.1.2 Liquefaction Susceptibility

With respect to the liquefaction potential of the site, the anticipated ground conditions comprise predominantly stiff to hard cohesive material for the majority of the soil profile. Thin lenses of silty sand and sandy silt may be present which are more susceptible to liquefaction, however considering the relatively low peak ground accelerations associated with the design earthquake events, and the competent cohesive material present in the upper profile acting as a non-liquefiable 'crust', surface manifestation of liquefaction if considered highly unlikely.

Accordingly, liquefaction-induced ground damage during a ULS event for Importance Level 2 structures is assessed to be in the None to Minor category as defined by the Planning and Engineering Guidance for Potentially Liquefaction Prone Land (MBIE, 2017) document, and the site designated to have a Low Liquefaction Vulnerability. During an SLS event, the risk of liquefaction-induced ground damage is considered negligible.

Further assessment of the site's liquefaction susceptibility will be required during subsequent design stages.





4.2 Slope Stability

The majority of the site is flat, and therefore not considered susceptible to slope stability issues. However, development in close proximity to the northern slopes will require further consideration. Provisionally, a Building Restriction Line (BRL) set 10m back from the slope crest is recommended. It is understood that an esplanade reserve along the riverfront will be incorporated into future development plans, which will readily accommodate the setback zone.

A Building Restriction Line does not preclude development extending beyond; however, it would likely need to be accompanied by slope stabilization works such as in-ground retaining walls to ensure minimum factors of safety against instability as defined in the Auckland Council (2003) Code of Practice for Land Development and Subdivision are achieved.

The requirement for and position of the BRL will be assessed following quantitative stability analyses during subsequent design stages.

4.3 Coastal Erosion

Wave action is not expected in the Tamaki River, and therefore the risk of erosion affecting the proposed development is considered highly unlikely. Nevertheless, the proposed esplanade reserve and any requirements for a Building Restriction Line will ensure building platforms are not detrimentally affected by coastal erosion processes.

4.4 Building Foundations

Foundation selection will largely depend on structural loads. Medium- or high-rise structures are likely to require piling. Ground conditions are anticipated to be suitable for shallow foundations for smaller buildings (standalone or terraced housing) in general accordance with NZS 3604 or NZS 4229, subject to future investigation confirming the ground bearing capacity and soil reactivity class in line with AS 2870^{iv} and NZ Building Code Clause B1^v.

4.5 Earthworks

Ground conditions are expected to be suitable for cut material to be re-used as engineered fill. Further investigation and testing should be undertaken during design development to confirm material types, conditioning requirements (if any) and compaction criteria.





5 CLOSING

This assessment has been prepared for Highbrook Living Limited to support a Private Plan Change Request. In general, the site is considered geotechnically suitable for the new proposed land use.

Further geotechnical assessment and site-specific geotechnical investigations will be required to support resource and/or building consent application. Investigation locations should focus on any retaining walls and proposed building locations once a concept design is established.

Please contact Babbage Consultants Limited with any questions relating to this assessment.

Yours sincerely

Smith

Jordan Moll Geotechnical Engineering Manager

Babbage Consultants Ltd

Attachments: Applicability and Limitations Site Plan Borehole Logs (NZGD)





REFERENCES

- ⁱ Retrolens Aerial Photography, sourced from http://retrolens.nz and licensed by LINZ CC-BY 3.0 retrieved October 2021.
- ⁱⁱ Kermode, L.O. (1992): "Geology of the Auckland urban area". Scale 1:50,000. Institute of Geological & Nuclear Sciences geological map 2. 1 sheet + 63 p. IGNS Ltd: Lower Hutt.
- ^{III} NZ Geotechnical Database: https://www.nzgd.org.nz/, retrieved October 2021.
- ^{iv} AS 2870:2011 "Residential Slabs and Footings", 17 January 2011. Standards Australia: Sydney.
- ^v Ministry of Business, Innovation and Employment (2019): *Acceptable Solutions and Verification Methods for New Zealand Building Code Clause B1 Structure*. Amendment 19, 28 November 2019. MBIE: Wellington.





APPLICABILITY AND LIMITATIONS

This report has been prepared solely for the benefit of Highbrook Living Limited as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions. Where opinions or judgements are to be relied on they should be independently verified with appropriate legal advice.

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Babbage Consultants Limited.

Recommendations and opinions in this report are based on data from previous investigations undertaken by others as discussed within this report. The nature and continuity of subsoil conditions away from the boreholes are inferred; actual conditions may vary considerably from the assumed model.







Babbage Consultants Limited Level 4, 68 Beach Road, Auckland 1010 PO Box 2027, Shoriland Stroot Auckland 1140, Now Zealand T 09 379 9580 F 09 377 1170 E admin@babbage.co.nz www.babbage.co.nz

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CLIENT / PROJECT

Highbrook Private Plan Change

MAP TITLE

Map No 1. Site Plan

MAP REVISIONS 15/10/2021

Initial version by TT.

Legend

Highbrook Site Boundary

Contours Line (RL)

0.5

NOTES Aerial Images - LINZ Basemap

DISCLAIMER: This map/plan is not an engineering draft. This map/plan is illustrative only and all information should be independently verified on site before taking any action.

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MAP NO.

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BOREHOLE LOG

BOREHOLE No: BH3 Hole Location: Refer to Site Plan

SHEET....1 OF3

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BOREHOLE LOG

BOREHOLE No: BH3 Hole Location: Refer to Site Plan

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BOREHOLE LOG

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BOREHOLE LOG

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BOREHOLE LOG

BOREHOLE No: BH12 Hole Location: Refer to Site Plan

SHEET....2..... OF....3

ſ	PROJECT: Waiouru Per	nins	sula	to S	H1	Lin	٢				LOC	ATION	N: Ea	st Tama	ki/O)tahi	ihu			JOB No: 21061
	CO-ORDINATES m ¹	N									DRII	LL TYF	PE:	Edson I	MRA	1 260	0		но	LE STARTED: 10/10/03
	m	Е									DRII	LL ME	тнос): Rota	ry				HO	LE FINISHED: 13/10/03
	R.L. m										DRI	I FH	IID.	Water					LOC	GGED BY: L.A CHECKED: A.S
														11 Hear	1	ENG	SINE	ER	ING	DESCRIPTION
	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE WEATHERING	STRENGTH/DENSITY CLASSIFICATION	10 SHEAR STRENGTH		T SU STRENGTH	T 200 DEFECT SPACING	2000 (mm)	SOIL DESCRIPTION Soli type, mirror components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
	ESTUARINE	(%	ВЕ					-	<u>\\</u>	Pt	М	VSt						-
	SEDIMEN IS (PUKETOKA FORMATION)			100% 100	OB TUI	-	• 73/34kPa			- - - 11	1 × × × ×	ML		St						SILT, clayey, brown, organic stained.
139							• 102/46kPa					ML	-	VSt						SILT, slightly clayey, slightly sandy, green.
				100%	OB		• 130/50kPa			12-	× × ×									-grey with green.
				0%	В		• 194/104kPa			12 -										-grey with few organic flecks. 13-
				100	0		• 124/38kPa			15										-
				100%	OB		• 102/28kPa			14-										-with sandy pockets.
							• 110/32kPa					MH								-very clayey layer.
·)				100%	OB		• 119/32kPa			15-		SW ML								-very thin SAND layer. 15 – SILT, clayey, light green with few sandy pockets.
	KAAWA FORMATION			100%	OB		• UTP			16-	- * × - × × - × × - × ×	ML	-	Н						SILT, slightly sandy, grey, compact,
				%00	SPT		• UTP 21	6						H/VD						uncementedsandy with very thin clayey layers.
				100%	HQ3	-	32 20/70mm N>50			17-										17-
										18-										18-
			A STATEMENT	100%	HO3					19-	33333	نز د د د ده								-thin dark brown organic stained layer. -clayey with thin sandy layers.
			1897.7.	%0	SPT		32 50/140 N>100	mm		20										

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TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH12 Hole Location: Refer to Site Plan

SHEET.....³ OF³

	PROJECT: Waiouru P	enin	sula	a to i	SH1	Lin	ık				LOC	ATIO	N: Ea	st Tam	aki/	Ota	huh	u			JOB No: 21061
	CO-ORDINATES	nN									DRI	LTY	PE:	Edson	MR	A 2	260			HO	DLE STARTED: 10/10/03
		118									DRI	L ME	THOE): Rot	ary					HC DF	DLE FINISHED: 13/10/03 RILED BY: Prodrill Ltd
	DATUM	11									DRI	L FLI	JID:	Water						LC	DGGED BY: L.A CHECKED: A.S
	GEOLOGICAL															E١	١GI	NE	EF	NIN	G DESCRIPTION
	geological Unit, Generic Name, Origin, Mineral Composition.	FLUID LOSS	WATER	CORE RECOVERY	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	D. PTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE WEATHERING	STRENGTH/DENSITY CLASSIFICATION	T 20 SHEAR STRENGTH	100 (kPa)	Ts compressive	H 100 CINENCIA 1100 CMPa)		T 1000 UEFECI SPACING	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
() }	KAAWA PORMATION			100% 100%	HQ3 HQ3	والمعارية			00 000 00 000 000 000 000 000 000 000			IVIL,									-grey with layers of faint brown organic stain. 21 -
				-4.6-	Ţ		70/110		-	22 - -	3 3 3										22 -
			-		<u> </u>		N>100			23											END OF BOREHOLE AT 22.61m 32mm dia uPVC standpipe installed in base of hole 23 - 24 -
····										- - - 25 - -											25-
										- 26 - -											26 -
										27 28											27 -
								-													29 -
										30											



BOREHOLE LOG

BOREHOLE No: BH13 Hole Location: Refer to Site Plan

SHEET....1 OF 2

	PROJECT: Waiouru	Penir	nsula	a to	SHI	l Lin	k				LO	CATIO	N: E	ast Tai	ma	ki/C)tal	nuhu	ι		JOB No: 21061
	CO-ORDINATES	mN mF									DR	ILL TY	PE:	Edso	n N	ИRА	42	60		F	IOLE STARTED: 13/10/03
	R I	m									DR	ILL. ME	THO	D: Ro	otai	гy				H	IOLE FINISHED: 13/10/03
	DATUM	111									DR	LL FL	UID:	Wate	F					L L	OGGED BY: Prodrill Ltd
	GEOLOGICAL														-	E	EN	GIN	IEE	RIN	IG DESCRIPTION
	geological Unit, Generic Name, Origin, Mineral composition.	Storing Loss	VATER	ORE RECOVERY	AETHOD	asing	TESTS	AMPLES	·,μ. (π)	EPTH (m)	RAPHIC LOG	LASSIFICATION SYMBOL		TRENGTH/DENSITY LASSIFICATION		SHEAR SIRENGTH (kPa)		COMPRESSIVE STRENGTH	50 (MPa)	DEFECT SPACING	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour, ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filing.
	TOPSOIL	1	<u> </u>	80	B	Ť				<u> </u>	ان ک	OL	≥ o M	00	ŦĪ		Ť			100-	SILT, organic.
	FILL			100% 100%	OB WASH		• UTP • 102/46kPa			-	× × ×	3M/M		VD/V	St						SILT, gravelly, yellow with brick and concrete gravels to 0.3m.
	RECENT ALLUVIUM	_	13/10/03	100%	OB	•	• 18/6kPa		7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	1 — -	* °× , × °× , × ×	ML		VŚ							SILT, dark grey with dark brown stain,
				%0 %	TUBE					2 —	× × × × ×										-dark grey with pieces of decomposed wood. 2 ~
	ESTUARINE SEDIMENTS (PUKETOKA FORMATION)			00% 100	DB OB	•	106/52kPa			+	× × ×	ML		VSt St							SILT, clayey, grey.
				100% 1(OB	•	92/40kPa 98/50kPa	1		3-	× × × × × ×										
		· · · · · · · · · · · · · · · · · · ·		<u> 6</u> 100%	TUBE					4-	* * * _* × _ × _			VSt							-grey/green with minor organic stain.
				1009	OB	•	102/46kPa				× 3 × × × × × ×										
-)				100%	BO	•	108/44kPa	2		5-	** ** ** * * *										-organic stained.
				• 100%	TUBE					-, -, 6-,	× × × ×										6-
14 FUIX			1000	0% 100%	BE OB	•	121/39kPa	3				OL Pt									SILT, organic, dark brown. PEAT, amorphous, black, compressed.
99-1				0		•	133/62kPa			7-1-1-2	× ×	ML	-								SILT, clayey, organic stained with flecks of decomposed wood
			1000	1002	ALC UB	•	104/30kPa			8 1 × 1	1×3×1×3										-grey,
99 A A A A A A A A A A A A A A A A A A			10007	10070	GD		. 1010781 4				× × ×	ML	******								SILT, slightly sandy, grey/green.
	-		26	~		•	103/74kPa		!	9	.× × ×										9
NZGD	ID: BH 65561		1006		5	• 1	16/41kPa		1	 0	× ×	********									



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH13 Hole Location: Refer to Site Plan

SHEET....2 OF...2

PROJECT: Waiouru Peninsula to SHI Link LOCATION: East Tamaki/Otahuhu	JOB No: 21061
CO-ORDINATES mN DRILL TYPE: Edson MRA 260 HOLE STA	RTED: 13/10/03
BL m DRILL METHOD: Rotary DRILL S	ISHED: 13/10/03
DRILLE FLUID: Water LOGGED I	3Y: Prodrill Ltd 3Y: LA CHECKED: AS
GEOLOGICAL ENGINEERING DESC	RIPTION
	ESCRIPTION
ORIGIN, ORIGNN, ORIGIN, ORIGNN, ORIGNN	type, minor components, plasticity or icle size, colour.
	DESCRIPTION
	stance: Rock type, particle size, colour, minor components.
	ects: Type, inclination, thickness, roughness, filling.
ESTUARINE X ML M VSt III III III	
PUKETOKA	
• 132/44kPa	-
	. 11-
	-
	organic stained layer.
$ \left \begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	-
	een. 12 –
• 163/52kPa	-
	-
8 m • 122/38kPa - * *	-
	clayey, 13-
• 163/70kPa	-
	ey, very compact.
	-
$\begin{array}{ c c c } \hline & 26 & \hline & 7 \\ \hline & 25/90 \text{mm} & 15 - 4 \end{array}$	-
N>50	cemented.
	-
	r i
	- 16
	-
	-
	4
	17-
	-
]
$ ^{\Box} ^{\Xi} $	18 -
	-
	19 —
	-
	Ł
N>100 20	BORFHOLF AT 19 91

ę. P



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH14 Hole Location: Refer to Site Plan

SHEET. 1 OF 3

PROJECT Waiour	u Peninsula	to SH1 L	ink			LOCAT	ION	: East Tama	ki/01	tahuhu		JOB NO: 21061
	mN					DRILL	ТҮР	E: Edson l	/IRA	260	HOL	E STARTED: 14/10/03
	mE							FLIOD: Pota	n.	1	HOL	E FINISHED: 15/10/03
RI	m					URILL		HOD. Kota	. 9		DRI	LLED BY: Prodrill Ltd
DATUM						DRILL	FLU	ID: Water			LOG	GED BY: L.A CHECKED: A.S
GEOLOGICAL									E	INGINEER	NG	DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	UID LOSS ATER	DRE RECOVERY ETHOD	TESTS	AMPLES	.L. (m) ЕРТН (m)	RAPHIC LOG	LASSIFICATION SYMBOL	ADISTURE WEATHERING CONDITION WEATHERING STRENGTHUDENSITY SLASSIFICATION	SHEAR STRENGTH	COMPRESSIVE S COMPRESSIVE S STRENGTH (MPa) 200 C (MPa) 200 C C SPACING	1000 2000 2000	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
	E 3	Ŭ Ž (3	US I	<u>α</u> Δ	×	<u>ज</u> ्	<u>20</u> % 0	HH	┝╋┼┼┾┼┼┼┦┝╸	+++	SILT, organic.
FILL		% 100% B OB	• 124/46kPa		-	× _ 1 × _ 8 × _ 8	ИL	VSt				SILT, clayey, light brown and yellow with gravels to 25mm.
		0% 100 DB 0	• 135/96kPa		1-	× ~ 1 × – 1 × – 1	ML					SILT, clayey, dark yellow.
		40% 10 UBE C	• 111/52kPa	1	-							-slightly clayey, light grey and yellow.
ALLUVIUM (PUKETOKA	(1/03	Ť F			2	×		St				SILT, clayey, grey and yellow.
PORVICION	1 26/1	50% OB	• 70/38kPa	2		×× × ×						
		60% TUBE			-		SW	L				SAND, medium grained, grey.
		100% OB	• 80/26kPa		4 -							
ESTUARINE		100% TUBE		3		× × ×	ML ML	St				SILT, purniceous, light grey. SILT, clayey, grey.
SEDIMENTS (PUKETOKA FORMATION)		60% J OB J	• 86/28kPa		5 -							
					6-							
		100% OB	• 104/30kPa • 89/21kPa	a								
		100% TUBE	• 104/26kP	4 a	7.	× × ×						-with faint organic stain.
		100% OB	• 95/30kPa		. 8	3 × ×						
	2		• 111/30kP	a				VS				-organic stained with thin sandy layers.
		100% OB	• 101/28kP	a	9		Pt					PEAT, compressed, dark brown/black.
	2 4 4 9 A 10	100%	• 126/60kP	a 5								



TONKIN & TAYLOR LTD

BOREHOLE No: BH14 Hole Location: Refer to Site Plan

BOREHOLE LOG

SHEET....2.....OF....3.....

	PROJECT: Walouru Pe	enin	sula	to S	SHI	Lin	k				LOC	ATIO	N: Ea	st Tan	ıaki	/Ot	ahuh	u		JOB No: 21061
r	CO-ORDINATES n	nΝ									DRII	LTY	PE:	Edson	M	RA	260		Н	IOLE STARTED: 14/10/03
y .	n	пE									DRII	L ME	тног): Ro	tary				H	IOLE FINISHED: 15/10/03
	R.L. n	n									ויסח	1 61		Watar					D	ORILLED BY: Prodrill Ltd
'	GEOLOGICAL										UNI		JU.	Water		E	NGI	NE	ERIN	IG DESCRIPTION
	GEOLOGICAL UNIT',											ក្ខ័	RING		IGTH		۳	r.	SING	SOIL DESCRIPTION
	ORIGIN, MINERAL COMPOSITION.			۲								N SYME	VEATHE	YTIS≯ ⊼	STREN	(kPa)	PRESSI	(MPa)	ST SPAC	E particle size, colour.
		sso		COVE			TESTS	ю		Ê	9010	ICATIO	SN V	THIDEN	SHEAR		COM	0	DEFEC	ROCK DESCRIPTION Substance: Rock type, particle size, celour, minor companients.
			VATER	CORE R	AETHOD	CASING		SAMPLE	(E) L	DEPTH (BRAPHIC	CLASSIF	ILLIGNOC	STRENG	2%	858	-98	នទីខ្លួន	8 <u>%</u> 5	Defects; Type, inclination, thickness, roughness, filling.
	ESTUARINE SEDIMENTS				-		• 102/28kPa				×	ML	M	VSt						SILT, clayey, grey with organic stain.
	(PUKETOKA FORMATION)			%00	B					-										-
				Ä			• 132/52kPa			5 -5	< <	ML								SILT, slightly clayey, slightly sandy, grey/green.
<u>.</u> }										11-	-×-									11-
17 Y				%00	OB		• 121/60kPa				×									
				Ĩ	-		• 141/58kPa				č - X									
										12-,	× ×									-grey. 12-
				%00	BB		• 110/40kPa			-,	×- ×									
							• 118/36kPa			; ;	×.									
						****				13-5	- × 									13
				%00	BB		• 124/38kPa			-	,									
				1			• 118/42kPa				×									
										14-5	- ×									14 -
				%00	B		• 133/46kPa			دًـ د										-green.
r i							• 145/58kPa				×. 									
 •. }										15										-with flecks of decomposed wood.
1.,	KAAWA FORMATION			%00	g		• UTP			-	-x -x	ML		н						SIL1, sugnity sandy, grey, compact.
				-	_		• UTP				×	SW		vn						SAND slightly silty weakly cemented grey
				%0	SPT		30			16-	<	011		10						with white. 16-
				~	3		20/85mm N>100	6												-
				100	РН			7			«									-
	-							Í		17-	<									17-
											< [
				%00	ĝ															-with very thin clay layers.
				-	••••			ľ		18-	< ,									18 -
				%0	SPT		29			-										_
							20/70mm N>100			19 - ×	×	ML		Н						SILT, clayey, grey, weakly cemented.
	T T T T T T T T T T T T T T T T T T T			30%	<u>6</u> 3	-					_×									
				Ĭ	Hi					×X		sw								-faint, organic stain.
 N7	GD ID: BH 65562	<u> </u>								20 🗼	-×									BORELOG_TT 21061.003.GPJ 04/12/03



BOREHOLE LOG

BOREHOLE No: BH14 Hole Location: Refer to Site Plan

	PROJECT: Waiouru	ı Penir	ısula	a to a	SHI	Lini	k			LO	CATIO	N: Ea	ist Tar	naki/	Otah	uhu			JOB No: 21061]
	CO-ORDINATES	mN								DR	ILL TY	PE:	Edsor	1 MR	A 26	0		но	LE STARTED: 14/10/03	1
		mE								DR	ILL ME	THO	D: Ro	tary				HC	LE FINISHED: 15/10/03	Yeses
	R.L.	m								DR	ILL FL	UID:	Wate	r				LO	GGED BY: L.A CHECKED: A.S	
	GEOLOGICAL	Τ													EN	GINI	EEF		DESCRIPTION	1
	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN,	-									SYMBOL	EATHERING	sity	STRENGTH	KPa)	ENGTH ENGTH UDa)		mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.	
	MINERAL COMPOSITION.	ID LOSS	TER	RECOVER'	THOD	5NG	TESTS	APLES	(EL)	PTH (m) APHIC LOG	ASSIFICATION	ISTURE WD(TION	RENGTH/DEN	SHEAR		STR STR			ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, rouchness, filling.	
		<u> </u>	N.	0	ľ ME	Š		SA	8	8 6 ×	5	8	5 2	\$K1	₩28-4 ++++	~&#\$ 	28 3	828 111		-
			<u> </u>	8	SP.		21/150mm - 50/130mm					<u> </u>							END OF BORFHOLE AT 20 28m	
							N>100			-									END OF DOMENTOLS AT 20.20m	
																			32mm diameter UPVC standpipe installed in base of hole.	
	:								21	-									21 -	
										-										
									22	-									22 -	
																				_ _ 68
										1										-
										-										- 14
									23	-									23 -	
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			-						24										24 -	- New York
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TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH103 Hole Location: Refer to Site Plan

SHEET....1 OF3

	PROJECT: Waiourt	u Penin	sula	to S	HI	Link					LOC	ATIO	N: Ea	st Tama	aki/	Ota	huhu				JOB No: 21061.010	
	CO-ORDINATES	40.00	im i	1							DRI		PE:	Barge l	Moi	inte	d		ł	10	LE STARTED: 09/10/03	
	RI	40.00	m m	3							DRI	LL ME	THOD): Rota	ary					10)R	LE FINISHED: 09/10/03 ILLED BY: Prodrill (Dave)	
	DATUM	1.00									DRI	LL FLI	JID:	Water					ι	.00	GGED BY: D.L.R CHECKED:	
	GEOLOGICAL		1	ΠT					T				0				IGIN	IEE	RII	NG		
	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	D LOSS	TER	RE RECOVERY	Нор	sing	TESTS	APLES	(W)	тн (ш)	APHIC LOG	SSIFICATION SYMBOL	ISTURE WEATHERIN	RENGTH/DENSITY ASSIFICATION	SHEAR STRENGTH	(KPa)	COMPRESSIVE STRENGTH	(MPa)	DEFECT SPACING	(mm) 8	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, rouchness fillion	
		13	W	Ö	M	Š		SAM	2	0	- 65 	ਹੋ ਨੁਧ	Q D W D	53	2145	388. H 		貿	88 ++	≌≋ ††	CLAY soft saturated highly plastic dark	
	ESTUARINE MUD ESTUARINE SEDIMENTS PUKETOKA FORMATION			100% 100%	OB OB	********	• UTP		- - - - -	- - - 1	×	ML		3 H							<u>prev, many shells and shell fragments.</u> SILT, slightly clayey, hard, dark greenish grey, thinly bedded.	
(\ldots)				%0	SPT		20		-	-	jХ										-	
		- AND - A					22 8 for 40mm N>50		L.			SP		D							SAND, fine, saturated, light greenish grey, weakly cemented.	
				53%	HQ3					2-											- becomes medium grained. 2-	
									-	•		СН	-	H							CLAY, hard, dark grey.	(assessed)
										3-											- Joint 70°,Planar, Smooth, Tight	
				100%	HQ3				- 	4		Pt									Grades over 100mm to PEAT, silty, saturated, moderately plastic, dark brown. 4	
											× × × × ×	ML									SILT, slightly sandy, hard, dark brownish grey with few shiny speckles. - becomes sandy and dark greenish grey with shiny speckles. 5 –	
)				100%	HQ3				-	, , ,	× × × × × ×	,									-	
									5	6-	× × × × × ×										6-	
				100%	HQ3				- - 6	- 7 -	× × × × ×										7-	
									-		×	SP	1	D							SAND, fine to medium, saturated, dark grey with few shiny speckles.	Given
									ŀ			CH	-	н			-				CLAY, silty, hard, saturated, highly plastic,	
				90%	HQ3				-7	8-								******			dark grey. 8 -	Contraction of
					[-		-*	SP		D							SAND, fine to medium, saturated, dark greenish grey with shiny speckles and shell	
		·		0%0	SPT		4 7 28 N=35			9 -											1 naginenis urvagnou. 9-	and a company
										10											POPELOG TT 21661 010 GPI 04/12/0]

NZGD ID: BH_65570



BOREHOLE LOG

BOREHOLE No: BH103 Hole Location: Refer to Site Plan

SHEET....².... OF....³....

	PROJECT: Waiouru P	enin	sula	to S	HI	Linl	ς				LOC	ATIO	N: Ea	st Tam	aki/O	tah	uhu			JOB No: 21061.010
	CO-ORDINATES 4	0.00	mN	[DRIL	.L TYI	PE:	Barge I	Moun	ted			HC	DLE STARTED: 09/10/03
	4 RL 1	0.00 g	n me								DRIL	L ME	THOD	: Rota	ıry				DF	RILLED BY: Prodrill (Dave)
	DATUM										DRIL	L FLI	JID:	Water	F	10.10			LC	OGGED BY: D.L.R CHECKED:
2 2.	GEOLOGICAL										1		U				JIN	EE		
	GEOLOGICAL UNIT, GENERIC NAME,											MBOL	HERIN	~	ENGT		STH	_	PACING	Soil become non Soil type, minor components, plasticity or particle size, colour.
	ORIGIN, MINERAL COMPOSITION.			ERY			TESTS				m	ION SY	WEAT	ENSIT	AR STF (kPa		STREN	(WP8	rect Si (mm	ROCK DESCRIPTION
		SSO		RECOV	0			Es		Ē	ic ro(IFICAT	URE /	IGTH/D	Ч Ч Ч	{	5			Substance: Rock type, particle size, colour, minor components.
		1 OIN	NATER	CORE	METHO	CASING		SAMPL	R.L. (m	DEPTH	GRAPH	CLASS	MOIST	STREN	5K85	8	^w 88	8 <u>8</u>	8 ⁸⁸²⁸	Detects: Lype, inclination, thickness, roughness, filling.
1.			-	100%	Ê	_						61.6	N CINE	10		Π		Ш		SANDSTONE madium moderately
	KAAWA FORMATION								-	-		SM	WIW	۷D						weathered, extremely weak, dark grey with
				%(PT		50 for 130m	m	-	-	, , , , , , , , , , , , , , ,									fragments throughout, moderately thinly
Π					_		N>100			11 -										11-
			ĺ	,	~					-	· · · ·				-					-Joint 65°, Curved, Rough, Tight.
74				100%	Ĥ		RQD = 100	%	F	-										
									11	- 17										12
									- 11	-	· · · · ·									-
									F	-										
				95%	HQ3		RQD = 85%		Ē	-										-Joint40°, Planar, Rough, Partly open
									-12	13 —										(0.5mm) 13-
									F	-										- very weak.
-									-	-										
									13	- 14										14
				00%	HQ3		RQD = 100	%	-	-										
				1					-	-										
U									-	-										- 15
-)										15 -		CL	HW	H						MUDSTONE, highly weathered, extremely weak to hard, light grey.
\mathbb{N}^{\vee}									-	-			MW	VD						SANDSTONE, as 10.2m, but medium to
				%0	ĮQ3		RQD = 90%		-	-										coarse grained.
Π				00						16-										16 -
									-											
									-				SW							- weak and slignity weathered.
U									-			-								- shells no longer present. 17-
				%0	5		ROD = 90%		-10			-								-
				101	H				-											
kar									F											- Joint25°, slightly curved, Rough, Tight.
				-					-17	18-										- Joint75°, Curved), Rough, Open (0.6mm) 18
			min						F			:								- Joint 30°, Slightly Curved, Rough, Tight
			40 1/	1%	3		ROD = 70°		-			i tri stati								- Joint 60°, Slightly Curved, Rough, Open (0.6mm)
				8	Ĕ		1.20 - 703	ľ	-18	19-										- artesian water flowing at 40 l/min
94220									F		· · · ·	:								- Joint 65°, Slightly Curved , Rough, Tight.
				-	-															
U							******	*****	-	20	-									-

NZGD ID: BH_65570

BORELOG_TT 21061.010.GPJ 04/12/03



BOREHOLE LOG

BOREHOLE No: BH103 Hole Location: Refer to Site Plan

SHEET....³ OF...³

	PROJECT: Waiour	u Pe	min	sula	a to	SH	1 L	ink					LOC	OITAC	N: Ea	ist T	ama	ki/(Ota	huł	ıu			JOB No: 21061.010
	CO-ORDINATES	40 40).00) 00	m]	N R								DRI	LL TY	PE:	Bar	ge N	lou	nte	d			H	OLE STARTED: 09/10/03
	R.L.	1.	00 1	m	-								DRI	LL ME	ETHO): I	Rotai	ry					DF	OLE FINISHED: 09/10/03 RILLED BY: Prodrill (Dave)
	DATUM												DRI	LL FL	VID;	Wa	ter						LC	OGGED BY: D.L.R CHECKED:
	GEOLOGICAL			_	1	1	—	1		<u> </u>	I	·			1 45	1			EN	IGI	INE	Ef	RIN	G DESCRIPTION
	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.		FLUID LOSS	WATER	CORE RECOVERY	METHOD	CASING		TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		STRENGTH/DENSITY	CLASSIFICATION	T SK SHEAK STRENGTH	200 (KFE)	TS COMPRESSIVE	100 SIKENGIH 100 (MPa)	20	1 200 UEFECT SPACING	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filing.
					%06	HO3		R	QD = 90%		-	•		area a a a a a a a a a a a a a a a a a a										
												21	-											END OF BOREHOLE AT 21m 2
								-				22 -			-									2
											- - 	- 23												
												-												
										-		24 — - -												2
							-				- 	25												2
										-	- 	- 26 — -												2
											- - 													2
											- 	28												2
		*****															1940-00 -00-00-00-00-00-00-00-00-00-00-00-0							
												29 —												2
L												30												

Contraction of the second s



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH104 Hole Location: Refer to Site Plan

SHEET. 1 OF 3

	PROJECT: Waiouru I	Penir	nsul	a to	SHI	t Li	nk				LO	CATIO	N: Ea	st Tan	aki/O	ahuhu		JOB No: 21061.010
	CO-ORDINATES	60.00	0 ml	N							DR	LL TY	PE:	Edson	MRA	260	нс	DLE STARTED: 09/10/03
	6	50.00) ml	Ξ							npi		TUA) Do	-		HC	DLE FINISHED: 10/10/03
	R.L.	1.00	m								DR			J. KO	агу		DF	RILLED BY: Prodrill (Ant)
<u> </u>											DR	LL FL	UID:	Water			LO	GGED BY: D.L.R CHECKED:
	GEOLOGICAL	╺┼╌	1	1	<u> </u>	r—	1	1	1			T			5	NGINE	ERINO	G DESCRIPTION
	GEOLOGICAL UNIT, GENERIC NAME,		ĺ						-			ğ	RING		GTH	۳ 2	S Z	SOIL DESCRIPTION
	ORIGIN,											SYME	ATHE	È	rren a)	Pa)	SPAC E	Soil type, minor components, plasticity or particle size, colour,
	MINERAL COMPOSITION.		ļ	VER			TESTS				ø	NOL	ME	DENS	AR S' (Ki	STRE (M	Ë ECT	ROCK DESCRIPTION
		COSS		RECO	g	6		ES ES		Ê		FICA	BRUNDI	GTH/	ЯHS ВНS	8. 0	DEF DEF	Substance: Rock type, particle size, colour, minor components.
.			ATEF	ORE I	ETHO	ASING		MPL	Ē	FTH	HGAS	ASSI	LISIC	REN			.88	Defects: Type, inclination, thickness, roughness, filing
	Engineered FILL	Ē	5	Ó	N	0	· · · · · · · · · · · · · · · · · · ·	ŝ		ä		ਹ GW	žŏ W	ਓ ਹੱ TP		1-∞8855#	8428	GPAVEL fine come coord and wet do b
				80%	ВO				ŀ	-	, <i>°</i> ,	011		**				greyish brown.
									F	-	000							-
				%0	g				ŀ	-	000							-
				®.	_				L	,_]	, 0 0							-
	ESTUARINE/ALLUVIA	ΨL I		%	щ					-	×	MH		VSt				SILT, minor coarse sand, very stiff, wet
	SEDIMENTS -			8	0				ŀ	-	ĸŢ.							highly plastic, light greyish green.
	FORMATION								ŀ	-		SP		L				SAND, very fine, wet, light grey with
					_			ĺ	ŀ	4								orangey brown streaks, thinly bedded.
				70%	Ö			ļ	1	2		MH	S	VSt				SILT, slightly sandy, very stiff, saturated 2
						ĺ			-	-	¢,							highly plastic, dark grey with minor shell
							• 49/13kPa		-	ļ		CH		St				CLAY, silty, stiff, saturated, highly plastic.
									F]	•		ĺ					dark grey.
				%00	B		• 57/11kPa		2	3	<u> </u>							3
				Ξ	Ŭ				-	-[÷							
							• 57/11kPa		-	-f		ĺ	İ					La construction de la constructi
İ							<i>5</i> 11		_	ť	x	SW	ŀ	D				SAND, coarse, silty, dark grey with rare
				%	щ				-	1		ML	+	H				light greenish grey pebbles.
				ŏ.	9					4	x	[SIL1, sandy, hard, moderately plastic, dark 4 – greyish green, thinly bedded.
and a second second second second second second second second second second second second second second second		i I	ļ						_	<u>}</u>	×							1
				%	£		10		-	_	Л		Ì					
				0	S		19		-	-	\sim							_
first in			ſ				20 N=39		4	5 - [*	×							5 -
									-	- ×	×			1				-
				600	Ŷ			ŀ	-	-[×	×							-
						•			-	-Â	- : - X							- becomes very sandy.
									- 5	6 İ×	×							-
							-		-J -			SW		D				SAND, fine, very silty, saturated, light
		ſ					[->								minor carbonaceous laminations,
									-									_
				479	Î	•	ĺ	ŀ	-	-6								-
								-	6	7-X								7-
								ŀ	-	×								-
	***		╞	+	_			F		-1-		Dt						
				ĺ],	÷ 	· ·						blackish brown.
									7	8		MH	-	VSt				SILT, sandy, very stiff, saturated highly
			è	\$18	3			-		×	×							plastic, light brownish grey, rare
*Gamiji				리	Ľ			-		×	×							carbonaceous particles.
and a second								ŀ		-×	×	ML						SILT, very sandy, very stiff, saturated,
								ł		-×:	×							moderately plastic, light greenish grey with shiny speckles.
			F		-		Ì	╞	8	9 – [×] .	×							9
								f		-(^. .×	×							low plasticity
			.				-			×	×							- iow prasility.
			000		2			-		×	×							
NZGD ID	: BH_65571									10 x	î							BORELOC TE ALACLAVA ORY ALACA



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH104 Hole Location: Refer to Site Plan

SHEET....2 OF....3

	PROJECT: Waiouru P	enin	sula	to	SH1	Lin	k				LOC	CATIO	N: Ea	st Tam	aki/(Otah	սհս			JOB No: 21061.010
	CO-ORDINATES 6	0.00	mN	ł							DRI	LL ΤΥ	PE:	Edson	MR.	A26	0		Н	DLE STARTED: 09/10/03
		0.00									DRI	LL ME	THO): Rota	ary				HC DE	DLE FINISHED: 10/10/03
	DATUM	.001	111								DRI	LL FL	UID:	Water					LC	DGGED BY: D.L.R. CHECKED:
	GEOLOGICAL															EN	GINI	EEI	RING	G DESCRIPTION
	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	SSOT DIA	WATER	CORE RECOVERY	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		STRENGTH/DENSITY CLASSIFICATION	25 SHEAR STRENGTH	100 (Xf*d) 200	5 COMPRESSIVE 20 STRENGTH 100 (MPa)	250 (mm a)	250 DEFECT SPACING 1000 (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
	ESTUARINE/ALLUVIA SEDIMENTS - PUKETOKA FORMATION								-	-	* * * * * *	ML	S	VSt						
0		and a second second second second second second second second second second second second second second second		100%	HQ3						× × × × × ×	MH								- high plasticity.
				100%	ндз					12	× × × ×									- slightly sandy.
					-					13	× × × × ×	MH		H						13 – SILT, clayey, hard, saturated, highly plastic, light bluish grey with shiny speckles.
	KAAWA FORMATION			100%	HQ3					14 - -	×	СН								CLAY, hard, saturated, highly plastic, dark grey, thinly bedded, minor carbonaceous laminations.
				0%	Q3					15 — - -		-								15-
				10	H				- 	- 16 — - -										16-
				100%	HQ3					17										
									- 		******	ML	MW							SILTSTONE, moderately weathered, extremely weak, dark grey, few carbonaceous laminations. 18
			WE SUMMER	. 100%	HQ3						********									- Joint 70°, Planar, Smooth, Tight. 19 - 19.6m - sandy - Joint30°, Planar, Rough, Tight.
			-						-	20	* * * * * * *									- Joint40°, Planar, Smooth, Tight. BORELOG TT 21061.010.GPJ 04/12/03



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TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH104 Hole Location: Refer to Site Plan

CO-ORDINATES 6.08 molt PL 100 m PL 100 m PLM 100 m ORDINATES 00 mit PLM 100 m ORDINATES 00 mit ORDINATES		PROJECT: Waiour	ru Per	าเกรเ	ıla to	o SH	II Lii	nk				LOC	CATIO	N: Ea	st Tan	naki/C)tah	uhu	1		JOB No: 21061.010
ALL LOW ID DRUL RETHOD: Ready MOLE FUNDER: DATUM DATUM DRUL FUND Water LOGGED DY: Drobit (LWP) CECOLA MF, mage: now software, decords, wet, decords,		CO-ORDINATES	60.	.00 r	nN							DRI	LL TY	PE:	Edsor	MRA	260	0		F	HOLE STARTED: 09/10/03
PLLM DUDLE DF DLL DF DLT DF DLL DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF DLT DF<			60.	.00 r	nE							DRI	LL ME	THOE): Ro	tary				H	HOLE FINISHED: 10/10/03
TEED COLOGIN Construction Construction<		R.L.	1.0	10 m								DRI		ימוו	Water					L I	
EXCLUSION LIFE: ORDER ALLS: CONTROL MER. TENT TENT <td></td> <td>GEOLOGICAL</td> <td></td> <td>510.</td> <td>mutor</td> <td></td> <td>ENG</td> <td>GIN</td> <td>IEE</td> <td>RIN</td> <td>NG DESCRIPTION</td>		GEOLOGICAL												510.	mutor		ENG	GIN	IEE	RIN	NG DESCRIPTION
OFFICE: DM: INSURT COPORTION Instrume (b) (b) (b) (b) (b) (b) (b) (b) (b) (b)		GEOLOGICAL UNIT,				T								0 Z		Ŧ	Τ			U	SOIL DESCRIPTION
MMR. Market Conversions. Version Big Big Big Big Big Big Big Big Big Big		GENERIC NAME,											IOĐW,	HERI		ENG	- Her	SSIVE	_	ACIN	Soil type, minor components, plasticity or particle size, colour
B Cons B B Cons B Cons B Cons Cons <thcons< th=""> <thcons< th=""></thcons<></thcons<>		ORIGIN, MINERAL COMPOSITION.			N			TENTO					N SV	WEAT	LISN X	R STR (kPa)		RENC	(MPa	01 SF	
Image: Second				SS	100	Š		IESIS			e	Pog	CATIC	ų K	CATIC	HEAS	1	200		DEFE	Substance: Rock type, particle size, colour,
Image: Second				<u>9</u>			ON N		IPLES	Ê	n HT	OHIC	SSIFI	STUR	ENG SSIFI	ľ				-	Defects: Type, Inclination, thickness,
- vmy vmk - vmy vmk				2	Š Ž	3 5	8 S		NA NA	R.L	E C	GR	CLA CLA	NO NO	F J	288	8	۳88 ۱۱۱	88 ₩	នន៍ទ័	장종 roughness, filling. 같은 것
25 26- 25 26- 27 28- 27 28- 27 28- 27 28- 28 29- 28 2					200	ŝ				-	-	XX	ML	MW	H						
20 21 20 21 -very weak. very weak. -lost 50', Sightly Curved, Smooth, Tigla. 21 21 NP-10 21 22 22 21 21 22 23 21 21 21 21 22 23 21 21 21 21 22 23 23 23 23 23 24 -23 24 24 24 -24 25 -24 25 25 25 -25 26 -24 25 26 26 -25 26 -24 25 26 26 -24 25 -25 26 26 26 -27 28 -26 27 28 28 28 -27 28 -28 29 29 29 29 -28 29 -28 29 29 29 29 29					2	2 F	1			_	-	x x x x									
30 fix 00mm -20 21 -20 21 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>***</td> <td></td> <td>-</td> <td>-</td> <td>× × × ×</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>- very weak.</td>								***		-	-	× × × ×									- very weak.
Image: Second second										-	-	\sim									- Joint 50°, Slightly Curved, Smooth, Tight.
			_		100		년 카	50 for 90m	n		21	\square					╨		+++		21-
								N>100		-	-]									
					Ì					-	-										-
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-22 23- -23 24- -23 24- -24 25- -25										_	-										
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			1000							-23											
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									┝		29-										29
									ŀ		T				*						
ZGD ID: BH 65571				-]										
ZGD ID: BH 65571									Ē]										
		3H 65571									30										BORRI OG TT 21061 010 GPI 04/12/03



BOREHOLE LOG

BOREHOLE No: BH105 Hole Location: Refer to Site Plan

SHEET....1 OF2

	PROJECT: Waiour	a Peninsu	la to i	SHI	Link	-				LO	CATIO	N: E	ast Tan	nak	i/Ot	ahuh	u		JOB No: 21061,010
	CO-ORDINATES	80.00 m	N							DR	ILL TY	PE:	Barge	e M	ount	ted		Н	OLE STARTED: 10/10/03
	D1	80.00 m	E							DR	ILL ME	THO	D: Ro	tary	Ý			Н	OLE FINISHED: 10/10/03
	DATUM	1.00 m								DR	LL FL	UID:	Water	-				D	RILLED BY: Prodrill (Dave)
	GEOLOGICAL											0.0.	(Tuto)		E	NGI	NEE	RIN	IG DESCRIPTION
	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	UID LOSS ATER	DRE RECOVERY	ETHOD	SN SS	STS	MPLES	- (ш)	111 (m)	APHIC LOG	ASSIFICATION SYMBOL	DISTURE WEATHERING	RENGTH/DENSITY ASSIFICATION	SHEAR STRENGTH	(kPa)	COMPRESSIVE STRENGTH	(MPa)	DEFECT SPACING	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness,
	ESTUARINE MUD	_ ⊑ ≥	8	ž	ข้		¥8	RI	<u>е</u> С	18	5 CT	¥ 8 €	5 5	2X 	3828 		;≊≋ †††	8 8₿	CTAY yory cog schurded medanti [
	ESTILARINE		%0	OB	-			-											plastic, dark grey, some shell layers.
	SEDIMENTS (PUKETOKA FORMATION)		100%	OB				0	1-		IVIL	vv	V 30 H						SIL1, Sandy, very stiff to hard, wet, moderate plasticity, light greenish grey with minor dark greenish grey mottles, thinly bedded.
			100%	OB				 -1	2-	- X - X - X	SW		MD						SAND, fine, silty, wet, light greenish grey.
								- - -		× × × × ×	ML		VSt/H						- minor fine gravel.
			100%	OB	• 181/3	3kPa			3		СН								grey, very thinly bedded. 3- CLAY, slightly silty, very stiff, wet, highly plastic, light bluish grey.
					• 156/3	9kPa			4 -	× - , × - , × - ,									
			100%	OB					- - 5		Pt								- minor carbonaceous laminations.
in the				-					-	× × × ×	MH								brown/black. SILT, clayey, very stiff, wet, highly plastic, light greyish brown, minor carbonaceous particles
			100%	OB	• UTP		-	5	6-	× × × × × × ×	sw	-	MD						SAND, silty, wet, light greenish grey with 6 -
					• 89/33	kPa		6	- 7- -	× × × × × × × ×	MH		St						SILT, stiff to very stiff, wet, highly plastic, 7- light greenish grey with shiny speckles.
			100%	GB	• 116/1	BkPa		7	-	× × × × × ×			VSt						
					- 121/2	2K1'8		~/	8 – - -	× × × × × ×									- becomes sandy.
	KAAWA FORMATION		100%	a				-8	- 9	× ×	MH SW	S	MD						SILT, clayey, very stiff, saturated, highly plastic, light grey. SAND, fine to medium, silty, dark greyish green, minor shell fragments.
			0% SPT	1 10	28 22 for	45mm	-		10	· · · · · · · · · · · · · · · · · · ·	1	мw	VD						SANDSTONE, medium, moderately weathered, very weak to weak, dark green with red and white flecks. Thin dark grey

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TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH105 Hole Location: Refer to Site Plan

SHEET....² OF...²

	PROJECT: Waiouru Pe	enin	isula	to	SH1	Lin	k				LOC	ATIO	N: Ea	st Tam	aki/(Otal	huhi	1			JOB No: 21061.010
	CO-ORDINATES 80	0.00) ml	1							DRI		PE:	Barge	Mou	inte	d		۱	-10	LE STARTED: 10/10/03
2001	80	0.00) mE	3							DRI	LL ME	THO): Rot	агу				1	-10	LE FINISHED: 10/10/03
	R.L. 1.	.00	m								DRI		(IID)	Water	-				1	ж Ю	ILLED BY: Prodrill (Dave)
1999 (A)	GEOLOGICAL	1											010.	Trater.		EN	IGI	1EE	RI	NG	DESCRIPTION
	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.			ERY			TESTS					ON SYMBOL	WEATHERING	ENSITY ON	R STRENGTH	(kPa)	MPRESSIVE TRENGTH	(MPa)	ECT SPACING	(mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour, ROCK DESCRIPTION
		-UID LOSS	ATER	ORE RECOV	ETHOD	ASING		AMPLES	(Ē) 구	EPTH (m)	RAPHIC LOG	LASSIFICATI		TRENGTH/D	SHE	88	00	88	Se DEFI	88	Substance: Rock type, particle size, colour, minor components. Defects: Type, Incilnation, thickness, roughness, filling.
	KAAWA FORMATION		5	Ó	Σ	Ŭ	N>100	0)	œ			<u> </u>	S 0 MW	o o VD				++			beds with red and white flecks, beds
				80%	НQ3		RQD = 0			-											oriented at many different angles up to 40°. - 10 - 11m - recovered as medium gravel.
									- 	- 11 -			SW								- dark grey with red, white and black flecks. - 11 - 14m - many defects present. Orientations include 40°, 30°, 70°, 80°, all Slightly Curved, Rough, Open (0.6mm)
				%06	HQ3		RQD = 20		_ 11	- 12											- Joint 70°, Slightly Curved, Rough, Tight. - 12 - 14m - some coarse sand sized white
									~ ~ ~	-										~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	and pinky grey grains. - minor fine gravel sized pebbles. - Joint 80°, Slightly Curved, Rough, Open (1mm) - vein of calcite, 75°, curved, 2mm thick.
				100%	HQ3		RQD = 0			13 - - -											13
									-	-											
									13-	-14								Ħ			END OF BOREHOLE AT 14m
										-											Piezometer installed. See sheet BH105P.
										- 15											
									- 	 16 											- 16 — -
									- 	- - 17 —											
									-												- - - - 18
									- 1 1	-			-								-
										- 19 											- 19 - -
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BORELOG_TT 21061.010.GPJ 04/12/03

`	÷.		21	54'	2	/-/	25	591	О				20	576111	64	708	24
			Morito	_	-	PROJE	CT	Otahuh	nu C P	ower	Station			HOLE No.	DH-OC	2	
	¢,		S INICI ILCO			FEATL	RE	Found	ations	; L	OCATION	Hellaby Roa	ad CO-OR	DINATES	N 69210	0 E 3	08587
		LOG	OF DRILLHOLE	·		ANGLE	FRO				90°	DIRECTIO	ON N/A	R.L.C	OLLAR	8.63	3m
	DE: WEA DEFI (bedi STR	SCRIPTION C ATHERING, RELATIN ECT TYPE, LITHOLI ding, folliation, minel ATIGRAPHIC UNIT	DF CORE VE STRENGTH, COLOUR, NAME, DGICAL FEATURES aalogy, comment etc.),	ROCK	STRENGTH	TEST RESULT	CORE LOSS/ LIFT %	DEPTH m	GRAPHIC LOG		DEFECT (UOINTS, BED CRUSH ZONE attitude, spacin SOIL DES	DESCRIPTION DING, SEAMS, SHAT S, FOLIATION, SCHI IG, continuity, roughn CRIPTION	ITER, SHEAR AND STOSITY- ess. infilling, etc.)	PIE	ZOMETER	DRILL WATER LOSS %	DRILLING
			SPT	MS- HM	NW M	3	0 - 100	2		(cm) 820	(consistency, r grading, group	elative density, water symbol etc.}	content, plasticity,			0-100	
		Fill Fill/ Reworke	ed Ash						8 8 9		Orange b some vold diam. to white, r some CL/	rown, CLAYEY canic GRAVEL mottled greyish AY, firm to stiff,	SILT, moist, f clasts up to 1 SANDY SILT non-plastic, r	firm, Omm noist			HQTT
			1/2/1			N=3					some thin Brown, da	i, brown organi ark orange SIL	c zones, plast	ic Jor			SPT
	E	Fill - dredgin estuarine sa fragments, s (wire, concre material, wo	ig, some nd and shell some inorganic sle slabs) 1/2/3 ody material			N ∞5		3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			CLAY inclusion of the second s	fine to medium	nm, shell frag	ments			SPT
								4 11 5			dense, m brown SIL	oist, loose, soft T inclusions slab	t to firm, minor				
		Tauranga G	roup Alluvium								Tube San	nple					Shelby
			1/1/2) N=3					Dark grey occasiona Light grey organic	/, SILT, some f al GRAVEL cla /, greenish SAI	ine SAND, sts 15mm, firn NDY SILT, slig	n Jhtly			SPT HQTT
		Peaty SILT						7			Dark brow firm, zone Poor Rec Tube San	wn CLAYEY SI e of peaty SILT overy nple	LT, organic, s	oft to			Shelby
	Group		0/1/5			N=6		8 1 1			Grey SIL woody ma	T to fine SAND aterial, mica	, moist, firm to	stiff,			SPT
	auranga (Peaty SILT					4	911			becomes some coa Tube San	peaty SILT, so arse SAND nple	oft, wet, plastic	· ·			HQTT
		Peaty SILT							ά. Ψ.		Dark grey organic S firm to stil	y, banded dark IILT, thinly bed ff, some mica s	brown, peaty, ded, moist, pla specks	astic, -			HQTT
T 17/10/01			1/2/5			N=7			· · · · · · · · · · · · · · · · · · ·			CANDY	-				SPT HQTT
0G.GD		i	0/2/3			N=5			* * * * * * * * * * * * * * *		becomes	light grey CLA	S YEY SILT, wit	th -			SPT
NHUHUC.GPJ TONY L	DRI DRI STA	ILLER Drillwell ARTED 0/1/01	WEATHERING UW - Unweathered SW - Slightly weathered MW - Moderately weathered HW - Highly weathered CW - Completely weathered RW - Residualty weathered		VS S MW W W EW	FELA RELA Strong Moderate Moderate Weak Very wea Extremet	I IVE STF 19 Ily strong Ily weak k r weak	LI TH	× x k		PIEZOMETER L DRILL CUTTIN BENTONITE SI FILTER PACK SLOTTED SCR	<u>Egend</u> GS Eal IEEN	PROJECT 25.1 LOGGED BP DATE 10/1 TRACED BP	20 02C /01	DRILLING OB 10 NOTT - H HOTT - H POTT - PI SPT - S T PERC - PC	METHOE METHOE Ormop O Triple T O Triple T O Triple T tandard F est Proussion	D en Barrel Tube Tube Penetration (air) Drilling
IYS DRILLHOLE OTA	FIN 1 DRI T	IISHED 10/2/01 ILL Tractor	EXPLANATION SPTs bag sampled Push Tube Samples at 5.2 • 5.7m 9.2 • 9.7m UCS Sample at 21.7 • 21.9m		-	~				VA 50/ UT SU Ssi Zsi	NE SHEAR ST 15 peak/remoul P - unable to pe OW - sunk undo - Sandstone - Sittstone	RENGTH TEST Ided anetrate er own weight	CHECKED TND LENGTH 23m CORE BOXES 5		RC • Ri Shelby - Tu Pilcon Miniat DR No. Factor.	everse Cil ibe Samp ure Sheer V Blade N	rculation Ma Vane Io.
ð١	1		H, O levels 12	/10 🤿	- 5		6 C					1	anadi 1	ur Z	NZGS Guide	Gaongat pë line.	

				+	•	P	ROJE	CT	Otahuhu C	Power	Station		HOLE No.	DH-OC	2	
	9		GEORGE STREET, NEWM			F	EATU	RE	Foundation	s L(OCATION Hellaby F	load CO-ORI	DINATES	N 692100	0 E 3	08587
		LOG	OF DRILL	.HOLE		A	NGLE	FRO	M HORIZONT	AL	90° DIREC	TION N/A	R.L.C	COLLAR	8.6	3m
	DE: WEA DEF (bed STR	SCRIPTION C ATHEAING, RELATIV ECT TYPE, UTHOLI Iding, tolliation, miner Iding, tolliation, miner IdingRaphic UNIT	OF CORE /E STRENGTH, COLOU CG(CAL FEATURES ralogy, coment etc.),	UR, NAME, SPT	-sw ROCK -kw WEATHERING -sc Del ATNJE	-WW STRENGTH	TEST RESULT	CORE LOSS/ LIFT %	DEPTH m DEPTH m DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DEPTH C DE C DE C DE C DE C DEC DE	+ to 2) + to 2) + to 2) - t	DEFECT DESCRIPTI (JOINTS, BEDDING, SEAMS, S CRUSH ZONES, FOLIATION, S attitude, spacing, continuity, rox SOIL DESCRIPTION (consistency, relative density, v grading, group symbol etc.)	ON INATTER, SHEAR AND SCHISTOSITY- Ighnese, infilling, etc.) vater content, plasticity,	PI	EZOMETER 	DRILL WATER LOSS %	DRILLING
		Tauranga Gi	roup Alluvium						13 13 13 13 13 13 13 13 13 13 13 13 13 1		organic inclusions, st Dark grey, banded da organic SILT, thinly b firm to stiff, some mic	iff Irk brown, peaty, edded, moist, pla a specks	stic,			HQTT
		HW Tamaki Greenish gre and fine SAf thinly to moo	SANDSTONE, by SILTSTONE, NDSTONE, derately thinly	4/6/10			N=16		14-1		Greenish grey, fine to stiff, mica, some deco	medium SAND, omposed rootlets	very			SPT HQTT
		carbonaceo	us material	2/4/5			N=9		15 		becomes atternating medium SAND layers subhorizontal	SILT and fine to , thinly bedded,				SPT
				2/2/4			N=6				SILT beds become m stiff to hard possible bioturbation SAND	oderately thin, ve infilled with coars	ry e			SPT
	Istone	SW/MW Tar Sandstone, S SILTSTONE	naki SANDY with brown								Greenish blue SAND SAND, thinly bedded banding	Y SILT, occasiona , some brown org	al fine anic			натт
	Tamaki Sand	fine SANDS beds, very w SW Coarse very weak to	TONE in thin yeak SANDSTONE, weak, some	20/52			N>50		18		Dark grey, coarse SA cemented, massive	ND, homogenous	s, well			SPT HQTT
		brittle zones	ak	19/50			N>50		20							SPT HQTT
				22/39			N>50		21-							SPT HQTT
		SILTSTONE	, weak	18/50			N>50		22		SILT bed, thin, subho	rizontal				SPT
0G.GDT 17/10/01									24							
HUHUC.GPJ TONY LI	DR/ D STA	I ILLER Drittwell ARTED 0/1/01	WEATH UW - Unweathered SW - Siightiy weathe MW - Moderately we HW - Highly weather CW - Completely we RW - Residually wea	IERING athered ed athered athered		VS - V S - S HS - N W - N W - V W - E	RELA /ery strong /oderate /oderate Veak /ary wea Extremely	I I I I I I I I I I I I I I I I I I I	I T		PIEZOMETER LEGEND DRILL CUTTINGS BENTONITE SEAL FILTER PACK SLOTTED SCREEN	PROJECT 25.12 LOGGED BP DATE 10/1/ TRACED BP	0 02C	DRILLING I OB - 10 NOTT - NO HOTT - HO POTT - PO SPT - St Te PERC - Pe	METHOD Omm Op D Triple T D Triple T D Triple T D Triple T andard F est rcussion	en Barrel ube ube vbe enetration (air) Drillind
ONYS DRILLHOLE OTAL	FIN DRI T	ISHED 0/2/01 ILL ractor	EXPLANATION SPTs bag sample Push Tube Samp 5.2 - 5.7m 7.7 - 8.2m 9.2 - 9.7m UCS Sample at 21.7 - 21.9m	l bd les at						VAI 50/ UTI SU/ Sst Zst	NE SHEAR STRENGTH TES 15 peak/remoulded 2 - unable to penetrate DW - sunk under own weight - Sandstone - Siltstone	CORE BOXES 5	of 2	RC - Re Shelby - Tul Pilcon Miniatu DR No, Factor, Vane Shear S NZGS Guiden	verse Cil be Samp Ire Shear \ Blade N Blade N	culation le fane o.