

9 June 2023

GBar Properties Limited 33 Coles Crescent Papakura Auckland 2110

Attn: Sanjay Bangs (Woods)

Site Soakage Testing - 9, 33, 49 Heights Road, Pukekohe Auckland

(Our Reference: 21253.000.001_03)

1 Introduction

ENGEO Limited was requested by GBar Properties Limited to undertake infiltration testing at 9, 33, 49 Heights Road, Pukekohe (herein referred to as the site). The purpose of that testing was to determine the soakage rate of the native soils to determine the feasibility of two conceptual stormwater treatment devices via soakage to ground. This work has been carried out in accordance with our signed agreement dated 25 May 2023 (ref: P21253.000.001_01).

Our scope of works does not include the design of the proposed soakage device(s) and the regulations thereof and is limited to provision of soakage rates obtained from the site specific testing.

2 Soakage Investigation

2.1 General

ENGEO attended site on 29 May 2023 to drill four 100 mm diameter auger holes (SKG 01, SKG 02, SKG 03 and SKG 04) to facilitate soakage testing. The borehole locations are presented on the Soakage Testing Plan (Appendix 1). Boreholes SKG01 and SKG04 were drilled to 2.2 m below ground level (m bgl) and boreholes SKG 02 and SKG 03 were drilled to 2.0 m bgl. At the conclusion of drilling all borehole locations were filled with water to ground surface to pre-soak the ground prior to infiltration testing.

All borehole logs have been prepared in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005) and full borehole logs are presented in Appendix 2).



2.2 Summary of Borehole Findings

Borehole findings are summarised as follows:

• Topsoil was encountered at all borehole locations to depths between 0.2 and 0.5 m bgl.

A 100 mm thick buried topsoil layer was encountered at borehole SKG01 at a depth of 1.1 m underlying existing fill material.

- Existing fill material was encountered underlying the topsoil in boreholes SKG01, SKG03 and SKG04 extending to depth up to 1.2 m bgl. The fill generally comprised clayey silt with variable sand and gravel fractions. Shear strength results obtained within the fill ranged between 87 and 191 kPa indicating a stiff to very stiff soil.
- Native South Auckland Volcanic Field deposits were encountered at all borehole locations underlying the topsoil and existing fill. The material typically comprised on inorganic, silt / clay soil. Vane shear strengths recorded in the native soils ranged from 167 to greater than 230 kPa, indicating a very stiff to hard soil.
- Standing groundwater was not encountered at any borehole location following the completion of drilling.

2.3 Soakage Testing

Falling head percolation tests were completed at the site on 30 May 2023. The soakage tests and results presented in this report were carried out in accordance with 'Stormwater Soakage and Groundwater Recharge in the Auckland Region' Guideline Document 2021/007 version 1 (GD07).

To limit the infiltration testing to the natural South Auckland Volcanic Field soils, where existing fill and topsoil was encountered, these soils were cased off through the use of solid UPVC casing during testing.

The closest rainfall station to the site is situated at Whangamaire Culvert, located approximately 5 km to the east of the site. Data from this rainfall station indicated that the rainfall recorded for the month of May 2023 showed the third highest rainfall month recorded since 2020, and therefore, the groundwater conditions on-site at the time of our testing is considered to be representative of the winter (worst-case) groundwater. The rainfall graph for the site is shown in Figure 1.





Figure 1: Rainfall at Whangamaire Culvert rainfall station

The percolation test results were used to analyse the hand auger holes capacity for soakage using Worksheet 1 of GD07 attached. An additional analysis of the completed soakage test results was done in accordance with Section 9.0.2 of Building Code E1/VM1. Both sets of results are shown in Table 1 and the calculations thereof in Appendix 3. The area available for soakage in each of the drilled hand auger holes was used in the analysis of the infiltration results (the total area of each hole excluding the cased off area), are presented in Table 1. From professional experience, the result from soakage tests and the associated lithology (silts and clayey silts), seems to be with what is expected from the underlying geology.

Soak Hole ID	ak Test Hole Hole Adopted Ground e ID Duration Width Depth Depth ter Lev		Groundwa	Percolation Rate (L/min/m ²)			
	(min)	(m)	(m)	(excluding cased of area) (m)	(m bgl)	Tested Rate	Factored Rate
SKG 01	240	0.1	2.2	1.0	NE ¹	0.04 ¹ (5.8 mm/hr) ²	0.03 ¹ (4.1 mm/hr) ²
SKG 02	240	0.1	2.0	1.6	1.04	0.01 ¹ (5.5 mm/hr) ²	0.01 ¹ (4.0 mm/hr) ²
SKG 03	240	0.1	2.0	1.1	NE ¹	0.09 ¹ (8.0 mm/hr) ²	0.06 ¹ (5.7 mm/hr) ²
SKG 04	240	01	2.2	1.0	NE ¹	0.25 ¹ (10 mm/hr) ²	0.18 ¹ (7.1 mm/hr) ²

Table 1: Summary of Soakage Test Results

NE = Not Encountered

1- Soakage Rate as determined through GD07

2- Soakage rate as determined by Section 9.0.2 of Building Code E1/VM1.



The following Factors of Safety (FoS) has been used to analyse the soakage capacity of the soil in accordance with GD07:

- For consequence of failure consequence (F_(c)) level 1 (FoS of 1) has been used based on the assumption that: the secondary flow path complies with the Stormwater Code of Practice; pre-treatment will be present; and access for maintenance will be easy, frequency of maintenance will be high, and a maintenance plan will be implemented.
- For testing uncertainty (F_(u)), Quality Level 2 (FoS of 1.4) has been used based on the assumption that: the soakage tests were undertaken at the locations of the proposed soakage device; the tests were undertaken during a time period which coincides with high rainfall.

The factor of safety used for the site relies upon assumptions made with regards to the type of soakage device that is going to be installed, the location thereof and quality of data gathered during the testing. Should these assumptions not be satisfied then a new factor of safety needs to be assigned.

The maximum unfactored infiltration rate was observed at SKG 04 which has an infiltration rate of 0.25 L/min/ m^2 (10mm/hr). The unfactored infiltration rates recorded in the rest of the hand auger holes was less than 8 mm/hr when unfactored.

3 Conclusion

The maximum unfactored infiltration rate was observed at SKG 04 which recorded an infiltration rate of 0.25 L/min/m² (10mm/hr). The unfactored infiltration rates recorded in the rest of the auger hole locations were less than 8 mm/hr.

It should, however, be noted that lateral variations in soil properties and permeabilities can occur, hence the soakage rates that were determined in this report can only be considered for the immediate vicinity of respective holes.



4 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, GBar Properties Limited, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by

Louwrens Le Roux Geologist / Hydrogeologist

Report reviewed by

Dustin Tookey, CMEngNZ (CPEng) Associate Geotechnical Engineer



5 References

Auckland Council GIS Viewer < http://maps.aucklandcouncil.govt.nz/aucklandcouncilviewer/>.

Stormwater Soakage and Groundwater Recharge in the Auckland Region' Guideline Document 2021/007 version 1 (GD07).

Environmental Auckland Rainfall data <

https://environmentauckland.org.nz/Data/DataSet/Chart/Location/649940/DataSet/Rainfall/Continuo us/Interval/Latest>





APPENDIX 1

Testing Plan





Legend

ENGEO Soakage Borehole (May 2023)



ENGEO Hand Auger Borehole (December 2022)

Hydrology

Rivers and Permanent Streams

- Open Watercourse
- Overland Flow Paths 3ha to 100ha (25,000)
- Overland Flow Paths 1ha to 3ha (25,000)
- Overland Flow Paths 1ha to 3ha (15,000)
- Overland Flow Paths 4000m2 to 1ha -(8,000)
- Overland Flow Paths 2000m2 to 4000m2 (5,000) ----
- Site Boundary

Contours

- Contours 50m



Produced by Datanest.earth

Title: Soakage Testing Plan

Client: GBar Prope		
Project: 9, 33, 49 Heights Road, Pukekohe	Drawn: LL	Appendix No.: 1 Size: A3
Date: 06-06-2023	Checked: DT	
Proj No.: 21253.000.001	Scale: 1:1500	Version: 1.0



APPENDIX 2

Borehole Records





			NGEO	LOG OF HAND AUGER SKG02															
	Ge	eoteo), 33 Puk 2	chnical Investigation 8, 49 Heights Road kekohe, Auckland 21133.000.001	Cli Client F D Hole De Hole Diame	Client : GBar Properties Limited Shear Vane No : 1413 Client Ref. : 21133.000.001 Logged By : JM/AK Date : 29/05/2023 Reviewed By : Hole Depth : 2 m Latitude : -37.1769852 Hole Diameter : 50 mm Longitude : 174.8962977						ane No: 1413 ged By: JM/AK ved By: atitude: -37.1769852 gitude: 174.8962977								
Depth (m BGL)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol		Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks							
-	TOPSOIL	OL	TOPSOIL.	² SOIL.							181/75								
- 0.5 - -			SILT with minor clay and trace fine brownish orange. Low plasticity.	r clay and trace fine sand; je. Low plasticity. es with minor fine to medium						e sand; co medium			- - - -51	- - 51 -				188/80	
- - 1.0—		ML	1.0 m - Becomes with some fine to	o coarse sand.	sand.	-		М	VSt	169/55									
-	SAVF					-					186/51								
- 1.5 - -			Clayey SILT with trace fine sand; o Low plasticity.	brange brown.						VSt	167/116								
-	-	ML	1.9 m - Becomes with red streaks.				50			Н	211/116								
2.0— - -			End of Hole Depth: 2 m Termination Condition: met target	depth				1	<u> </u>	1	230+								
Hand Auger met target depth at 2 m depth . Coordinates and elevation data estimated from Auckland Council GeoMaps. Standing groundwater was not encountered.																			

	Ge	eoteo 9, 33 Puk 2	chnical Investigation 49 Heights Road ekohe, Auckland 21133.000.001	CI Client Hole De Hole Diam	Client : GBar Properties Limited Shear Vane No : 1413 Client Ref. : 21133.000.001 Logged By : JM/AK Date : 29/05/2023 Reviewed By : Hole Depth : 2 m Latitude : -37.1760619 Hole Diameter : 50 mm Longitude : 174.8983003						
Depth (m BGL)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
		ML	TOPSOIL.			للمناطعة وتجريبهم وتعارضهم والم			N/A	68/27	
0.5		ML	[FILL] SILT with minor clay and tra coarse gravel; brownish orange wit red and dark brown streaks. Low p Gravel is sub-angular to angular.	ace fine to th occasional plasticity.		-44			н	UTP	
1.0-	-	ML	SILT with some fine to medium sa orange with occasional dark brown red streaks. Low plasticity.	nd; brownish nottles and	××××		L	м	н	- 230+	
	-	ML	Clayey SILT with some fine to mee orange brown. Low plasticity.	dium sand;		-			VSt	- 191/85	
1.5	SAVF		SILT with some clay and minor fine sand; brownish orange with red mo plasticity.	e to medium ottles. Low		-				211/85	
	-	ML				-			Н	UTP	
2.0 End of Hole Depth: 2 m Termination Condition: met target depth UTP											
2.0 End of Hole Depth: 2 m Termination Condition: met target depth Hand Auger met target depth at 2 m depth . Coordinates and elevation data estimated from Auckland Council GeoMaps.											

			NGEO	LOG OF HAND AUGER SKG04							
	Ge	eoteo), 33 Puk 2	chnical Investigation 49 Heights Road kekohe, Auckland 21133.000.001	Cli Client F D Hole De Hole Diame	ent : 0 Ref. : 2 Pate : 2 pth : 2 Ster : 5	Bar Pi 1133.0 9/05/2 .2 m 0 mm	ropei)00.(023	rties L 001	imited	Shear Va Loge Review La Lon	ane No: 1413 ged By: AK/JM ved By: atitude: -37.1759722 gitude: 174.8984488
Depth (m BGL)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Notes/Remarks
-	TOPSOIL	OL	TOPSOIL						N/A	78/32	
0.5 -			[FILL] Clayey SILT with minor fine trace fine to coarse gravel; greyish orange intermixed. Low plasticity.	sand and brown and		× × ×				87/36	
- - 1.0—		ML				-44		М	St-H	UTP	
- - 1.5 -		ML	Clayey SILT; red with occasional w and dark brown mottles. Low plast	hite streaks city.		× - -			Н	230+	
-	SAVF	ML	Clayey SILT; red with occasional w and dark brown mottles. Low plast	hite streaks city.		-			VSt	155/66	
2.0			End of Hole Depth: 2.2 m			-43				133/63	
-	I ermination Condition: met target depth										
Ha Co Sta SA	Hand Auger met target depth at 2.2 m depth . UTP = Unable to Penetrate Coordinates and elevation data estimated from Auckland Council GeoMaps. Standing groundwater was not encountered. N/A = Not Applicable SAVF = South Auckland Volcanic Field.										



APPENDIX 3

Soakage Test Results



Appendix B1.1 Worksheet 1: Falling Head (Variable Head) Percolation Test (pg. 1/2)

Proiect	Number:	212	253	Date:	30/05/2023	}	Time:	9:30:00 AM
Site	Address:	9, 33, 49	Heights R	oad.Pukekohe			-	
Bo	orehole #	SK(G 01	Test # 1	of total	1	tests	Test by:
F	Position v:			Position v:	ortotal	•	mRI ·	
Otho	vr borobole	as within in	ofluonco d	istanco (tost simult	anoously):			
Une		55 WILLIII II	inuence u					
1. Attach t	1. Attach the following (tick once attached)							
	V	Log of hole	e showing o	lepth, rock type & moi	isture			
	V	Graph of V	Vater Leve	against Time				
	V	Site Plan S	Showing loc	ation of hole(s)				
2. Genera	l Informati	on						
	Depth of bo	orehole H .	1	m	If casing is	required.		
	Diameter	of bore D	0.1	m	in eacing io	Depth	of casing.	m
	Pre-test	GW level :		m (bpal)		Diameter	of casing:	m
				(299)		Diamotor	or oading.	
3. Test Lo	g		-low4l-					
	Internet	Water	depth		Internet			
Minutes	Interval	(m b	opgl)	Level Drop Over				Notes
	(x; min)	Start of	End of	Interval (y; m)	(y/)	x)		
0	0			0	0.0	0		
0	0	0.00	0.00	0 000	0.0	00		
1	1	0.00	0.01	0.000	0.00)00)50		
2	1	0.01	0.01	0.005	0.00)50)50		
J	1	0.01	0.02	0.005	0.00)50)50		
- 4 - 5	1	0.02	0.02	0.003	0.00)25		
10	5	0.02	0.02	0.003	0.00	05		
15	5	0.02	0.05	0.000	0.00)30		
20	5	0.05	0.07	0.015	0.00)30		
30	10	0.07	0.09	0.020	0.00)20		
45	15	0.09	0.12	0.015	0.00)10		
60	15	0.12	0.14	0.030	0.00)20		
90	30	0.14	0.19	0.025	0.00	008		
122.5	32.5	0.19	0.22	0.045	0.00)14		
148.5	26	0.22	0.25	0.035	0.00)13		
179	30.5	0.25	0.28	0.030	0.00)10		
210	31	0.28	0.31	0.030	0.00	010		
240	30	0.31	0.33	0.030	0.00)10		
							ļ	
							L	
					1			



Appendix B1.1	Worksheet 1: Falling	Head	(Variable Head)) Percolation	Test (pg. 2/2	2)



Worksheet 1: Falling Head (Variable Head) Percolation Test (graph)

Appendix B1.1 Worksheet 1: Falling Head (Variable Head) Percolation Test (pg. 1/2)

Project	Number:	212	253	Date:	30/05/2023		Time:	9:30:00) AM
Site	Address:	9 33 49	Heights R	oad Pukekohe					
Br	rehole #	SK(3 02	Test #: 1	of total	1	tests	Test by:	11
	Desition v:	0110	5 02	Position v:		•	mRI ·	1001 by.	
0tha	vsilion X.	oc within ir	ofluoneo d	istanco (tost simultr			1111XL.		
Une			inuence u						
1. Attach t	the followi	ng (tick or	nce attache	ed)					
	V	Log of hole	e showing o	depth, rock type & moi	sture				
	V	Graph of V	Vater Leve	l against Time					
	V	Site Plan S	Showing loc	cation of hole(s)					
2. General	l Informati	on							
	Depth of bo	orehole H .	16	m	If casing is requ	uired [.]			
	Diameter	of bore D	0.1	m	in outsing to requ	Depth	of casing.	m	ı
	Pre-test	GW level :	1	m (bpal)	Dia	ameter	of casing:	n	1
			•	(0099)			or odding.	···	
3. Test Lo	g		-low-th-						
	Internel	Water	depth						
Minutes		(m b	opgl)	Level Drop Over	Interval Grad	lient		Notes	
	(x; min)	Start of	End of	interval (y; m)	(y/x)				
0	0			0	0.00				
0	0	0.00	0.00	0 000	0.00				
1	1	0.00	0.01	0.000	0.0000				
2	1	0.01	0.03	0.010	0.0100				
3	1	0.03	0.04	0.020	0.0200				
- - 5	1	0.04	0.05	0.010	0.0100				
10	5	0.00	0.00	0.000	0.0030				
15	5	0.11	0.15	0.050	0.0100				
20	5	0.15	0.19	0.045	0.0090				
30	10	0.19	0.25	0.035	0.0035				
46.5	16.5	0.25	0.33	0.065	0.0039				
60	13.5	0.33	0.38	0.080	0.0059				
90	30	0.38	0.46	0.050	0.0017				
120	30	0.46	0.51	0.080	0.0027				
151.5	31.5	0.51	0.54	0.050	0.0016				
180	28.5	0.54	0.57	0.030	0.0011				
212.5	32.5	0.57	0.59	0.030	0.0009				
240	27.5	0.59	0.60	0.015	0.0005				

Project Number: 212	53	Date:		30/05/2023	3	Time:	9:30:00) AM	
Site Address: 9, 33, 49	Heights R	oad,Puke	kohe			_			
Borehole #: SKC	6 02	Test #:	1	of total	1	tests	Test by:	LL	
1. Minimum Gradient ¹					N				
Minimum Gradient ²	=	y x	-		Vater depth (m)				
	=	0.0005	m/min						
d	=	1.01	m		0 Time (r	nin)			
2. Percolation Rate									
Percola	ion Rate ³	$= P_{(total)} =$	D x grad	dient x 1000 1 x d	=	0.01	L/min/m ²		
Soaka	ge Rate ^{3b}	=	min.	δ Depth δ Time	=	5.5	mm/hr		
FoS for consequence	of failure ⁴	$= F_{(c)} =$	1	_					
FoS for testing un	certainty ⁵	$= F_{(u)} =$	1.4						
Total Facto	r of Safety	F _{(to}	$_{tal)} = F_{(c)} \times$	F _(u) =	1.4				
Factored Percol	ation Rate		P _(factored)	$= \frac{P_{(total)}}{F_{(total)}}$	=	0.01	L/min/m ²		
Factored	Rate Rate		P _(factored)	$= \frac{P_{(total)}}{F_{(total)}}$	- =	4.0	L/min/m ²		
Additional Comments:									
Name of Test Operator:				LM Le Roux	x				
Qualification		DC							
Qualification.		D.3		eology		_			
Signature									
Date:		30/05/2023	3						
Notes: ¹ m hoal - ~	otres halo	w present	around lo	رما					
2 lowest area	lient is rea	wired This	will norm	ally he the la	st two poir	nts If the ra	te of change	during	
the test has repeated	s not stabi	lised for at	least the l	ast three me	asuremen	its, then the	e test shall be	uning	
³ d = distanc	e in m bet	ween the m	nidpoint of	the last two	readings a	and the bas	se of the borel	hole	
^{3b} Calcualted	l in accord	ance with N	VZBC E1/	VM1					
⁴ See Sectio ⁵ See Sectio	 ⁴ See Section B.4.0 Table 5 for factors of safety. ⁵ See Section B.4.0 Table 6 for factors of safety. 								

Appendix B1.1 Worksheet 1: Falling Head (Variable Head) Percolation Test (pg. 2/2)



Worksheet 1: Falling Head (Variable Head) Percolation Test (graph)

Appendix B1.1 Worksheet 1: Falling Head (Variable Head) Percolation Test (pg. 1/2)

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM Site Address: 9, 33, 49 Heights Road,Pukekohe Test #: 1 of total 1 tests Test by: LL Position x: Position y: mRL: mRL: mRL:										
Site Address: 9, 33, 49 Heights Road,Pukekohe Borehole #: SKG 03 Test #: 1 of total 1 tests Test by: LL Position x: Position y: mRL: mRL	Project	Number:	212	253	Date:	30/05/2023	}	Time:	9:30:00 AM	
Borehole #: SKG 03 Test #: 1 of total 1 tests Test by: LL Position x:	Site	Address:	9. 33. 49	Heights R	oad.Pukekohe			_		
Position x: Position y: mRL: Other boreholes within influence distance (test simultaneously);	Bo	orehole #	SKO	3 03	Test # 1	of total	1	tests	Test by:	
Other boreholes within influence distance (lest simultaneously): Intra- 1. Attach the following (tick once attached)	F	Position x:			Position v	ortotal		mRI ·		
In Attack the following (ick once attacked) v Log of hole showing depth, rock type & moisture v Graph of Water Level against Time v Site Plan Showing location of hole(s) If casing is required: Diameter of bore, bit of the showing location of hole(s) If casing is required: Diameter of bore, bit of the showing location of hole(s) It casing is required: Diameter of bore, bit of the showing location of hole(s) It casing is required: Diameter of bore, interval (y; m) It casing is required: Diameter of bore, interval (y; m) It casing is required:	Othe	osition X.	as within in	ofluence d	istance (test simulta	aneously).				
1. Attach the following (tick once attached) v Graph of Water Level against Time v Site Plan Showing location of hole(s) 2. General Information Depth of borshole, H: 1.1 Diameter of bore, D: 0.1 m Depth of casing: m Diameter of bore, D: 0.1 m Depth of casing: m m 3. Test Log Water depth Level Drop Over interval (y; m) Interval Gradient (y/x) Notes 11 0.00 0.00 0.000 0.000 0.000 0.000 2 1 0.02 0.000 0.000 0.000 0.000 2 1 0.02 0.000 0.000 0.000 0.000 3 1 0.03 0.05 0.015 0.0150	Ound									
V Cog of hole showing depth, rack type & moisture V Graph of Water Level against Time Depth of borehole, H. 1.1 m Depth of casing:m Depth of borehole, H. 0.1 m Depth of casing:m Pre-test GW level : m m (bpgl) Depth of casing:m 3. Test Log m Interval (y; min) Interval (y; min) Notes (x; min) Start of End of interval (y; m) Interval (y; m) Interval (y; m) Notes 1 0.00 0.00 0.00 0.000 0.000 0.000 1 1 0.00 0.00 0.015 0.0150	1. Attach t	the followi	ng (tick or	nce attache	ed)					
V Graph of Water Level against Time V Site Plan Showing location of hole(s) 2. General Information Depth of borehole, H; 1.1 m Depth of casing; m Diameter of bore, D; 0.1 m Depth of casing; m m 3. Test Log m (bggl) Level Drop Over interval (y; m) Interval Gradient (y/x) Notes 1 1 0.00 0.00 0 0.00 0.00 2 1 0.02 0.03 0.015 0.0150		V	Log of hole	e showing o	depth, rock type & mo	isture				
v Site Plan Showing location of hole(s) 2. General Information Depth of borehole, H: 1.1 m If casing is required: Diameter of bore, D: Depth of orasing: m Depth of casing: m Depth of casing: m Main test of the state of the		V	Graph of V	Vater Leve	l against Time					
Seneral Information Depth of borehole, H: 1.1 m (bgg) If casing is required: Diameter of borehole, H: 0.1 m (bgg) Start of interval Colspan="2">Colspan="2">Colspan="2">Colspan="2" Minutes Mater of borehole, H: (bgg) Diameter of casing: m Notes Name of casing: m Name of casing: m Nater of casing: <th colsp<="" td=""><td></td><td>V</td><td>Site Plan S</td><td>Showing loc</td><td>cation of hole(s)</td><td></td><td></td><td></td><td></td></th>	<td></td> <td>V</td> <td>Site Plan S</td> <td>Showing loc</td> <td>cation of hole(s)</td> <td></td> <td></td> <td></td> <td></td>		V	Site Plan S	Showing loc	cation of hole(s)				
Depth of borehole, H: 1.1 m If casing is required: Diameter of bore, D: 0.1 m Depth of casing: m m S: Tere-test GW level: m (bggl) Diameter of casing: m m Minutes Interval Water depth Level Drop Over Interval Gradient Notes 0 0 0.00 0.00 0.00 0.00 0.00 1 1 0.00 0.00 0.000 0.000 0.000 2 1 0.02 0.03 0.015 0.0150	2. Genera	I Informati	on							
Diameter of bore, D: 0.1 m Depth of casing: m Pre-test GW level: m (bpgl) Diameter of casing: m 3. Test Log Start of End of interval Interval (x; min) End of 0 Interval 0 Notes 0 0 0.00 0.00 0 0.00 Notes 1 1 0.00 0.02 0.000 0.000 0.000 2 1 0.02 0.03 0.015 0.0150		Depth of bo	orehole, H :	1.1	m	If casing is	required:			
Detects GW level : m (bpgl) Diameter of casing: m 3. Test Log Minutes Interval (x; min) Water deth interval (m b-pgl) Level Drop Over interval (y; m) Interval Gradient (y/x) Notes 0 0.00 0.00 0.00 0.00 0.00 0.00 1 1 0.00 0.00 0.000 0.000 0.000 2 1 0.02 0.033 0.015 0.0150 0.0150 3 1 0.03 0.05 0.015 0.0150 0.0150 3 1 0.06 0.07 0.015 0.0150 0.0150 10 5 0.07 0.13 0.010 0.0020 0.065 15 5 0.17 0.23 0.045 0.0065 0.0110 21.5 6.5 0.17 0.23 0.045 0.0065 0.0022 30 0.54 0.62 0.100 0.0033 0.001 0.0027 120 30 <td></td> <td>Diameter</td> <td>of bore, D:</td> <td>0.1</td> <td>m</td> <td>0</td> <td>Depth</td> <td>of casing:</td> <td>m</td>		Diameter	of bore, D:	0.1	m	0	Depth	of casing:	m	
S. Test Log Water depth (m bpg!) Level Drop Over interval Interval Gradient (y/x) Notes 0 0 0.00 0.00 0 0.00 0.00 0.00 2 1 0.02 0.03 0.015 0.0150		Pre-test	GW level :		m (bpgl)		Diameter	of casing:	m	
Notes Water very (x; min) Water very (m b-pd) Level Drop Over interval (y; m) Interval Gradient (y/x) Notes 0 0 0.00 0.00 0 0.000 0.000 0.000 1 1 0.00 0.00 0.000 0.000 0.000 2 1 0.02 0.03 0.015 0.0150	3 Test Lo	a								
Ninutes Interval (x; min) (m bog) interval interval (x; min) Level Drop Over interval (y; m) Interval Gradient (y/x) Notes 0 0 0.00 0 0.00 0 0.00 1 1 0.00 0.00 0 0.000 0.000 2 1 0.02 0.03 0.015 0.0150 0.0150 3 1 0.05 0.06 0.015 0.0150 0.0150 4 1 0.05 0.06 0.015 0.0150 0.0150 5 1 0.06 0.07 0.015 0.0150 0.0150 10 5 0.07 0.13 0.010 0.0020 0.0151 115 5 0.13 0.17 0.023 0.044 0.0055 0.0065 30 8.5 0.23 0.29 0.055 0.0065 0.0022 0.0016 210 30 0.67 0.71 0.055 0.0018 0.0016 0.0016 0.0016	5. TEST LO	Э 	Water	depth						
Minutes K; min interval Start of interval End of interval interval (y; m) Motes 0 0 0.00 0.00 0 0.00 0.00 1 1 0.02 0.00 0.00 0.000 0.000 2 1 0.02 0.03 0.015 0.0150 0.0150 3 1 0.03 0.06 0.015 0.0150 0.0150 4 1 0.05 0.06 0.015 0.0150 0.0150 5 1 0.06 0.07 0.015 0.0150 0.0150 10 5 0.07 0.13 0.010 0.0020 0.0051 11 5 0.17 0.023 0.045 0.0069 0.0010 15 5 0.17 0.23 0.044 0.085 0.0057 150 30 0.62 0.67 0.086 0.0022 0.00110 120 30 0.54 0.62 0.67 0.0085		Interval	(m h	nal)	l evel Drop Over	Interval (Gradient			
(a) (b) (b) (b) (b) 0 0 0.00 0.00 0 0.00 1 1 0.00 0.02 0.000 0.000 2 1 0.02 0.000 0.000 0.000 3 1 0.02 0.03 0.015 0.0150 3 1 0.02 0.06 0.015 0.0150 4 1 0.05 0.06 0.015 0.0150 10 5 0.07 0.13 0.010 0.0020 15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0065 30 8.5 0.23 0.29 0.055 0.0065 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 <	Minutes	(x·min)	Start of	Fnd of	interval (v·m)	(v/	x)		Notes	
0 0 0.00 0.00 0 0.00 1 1 0.00 0.02 0.000 0.0000 2 1 0.02 0.03 0.015 0.0150 3 1 0.03 0.05 0.015 0.0150 4 1 0.05 0.06 0.015 0.0150 4 1 0.05 0.06 0.015 0.0150 5 1 0.06 0.07 0.015 0.0150 10 5 0.07 0.13 0.010 0.0020 1 5 5 0.13 0.17 0.025 0.0110 1 21.5 6.5 0.17 0.23 0.045 0.0065 1 30 8.5 0.23 0.29 0.355 0.0065 1 45 15 0.37 0.44 0.085 0.0022 1 120 30 0.54 0.62 0.1010 0.0033 1 <td></td> <td>(^,)</td> <td>interval</td> <td>Interval</td> <td></td> <td>(Jr.</td> <td>~/</td> <td></td> <td></td>		(^,)	interval	Interval		(Jr.	~/			
1 1 0.00 0.02 0.000 0.0000 2 1 0.02 0.03 0.015 0.0150 3 1 0.03 0.05 0.015 0.0150 4 1 0.06 0.07 0.015 0.0150 5 1 0.06 0.07 0.015 0.0150 10 5 0.07 0.13 0.010 0.0020 15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.055 0.0065 45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.64 0.62 0.100 0.0033 150 30 0.67 0.71 0.055 0.0018 210 30 0.67 0.78	0	0	0.00	0.00	0	0.0)0			
2 1 0.02 0.03 0.015 0.0150 3 1 0.03 0.05 0.015 0.0150 4 1 0.05 0.06 0.015 0.0150 5 1 0.06 0.07 0.015 0.0150 10 5 0.07 0.13 0.010 0.0020 15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.64 0.662 0.0022 100 150 30 0.62 0.100 0.0033 101 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.78 0.035 0.0012 10 10 <th10< th=""> <</th10<>	1	1	0.00	0.02	0.000	0.00)00			
3 1 0.03 0.05 0.015 0.0150 4 1 0.05 0.06 0.015 0.0150 5 1 0.06 0.07 0.015 0.0150 10 5 0.07 0.13 0.010 0.0020 15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.055 0.0069 30 8.5 0.23 0.29 0.055 0.0069 30 8.5 0.23 0.29 0.055 0.0069 30 8.5 0.23 0.29 0.055 0.0067 90 30 0.44 0.085 0.0022 100 120 30 0.62 0.100 0.0033 1002 120 30 0.67 0.71 0.055 0.0018 1002 210 30 0.75	2	1	0.02	0.03	0.015	0.01	50			
4 1 0.05 0.06 0.015 0.0150 5 1 0.06 0.07 0.015 0.0150 10 5 0.07 0.13 0.010 0.0020 15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.055 0.0065 45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0012 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0012 190 10 10 10 10	3	1	0.03	0.05	0.015	0.01	50			
5 1 0.06 0.07 0.015 0.0150 10 5 0.07 0.13 0.010 0.0020 15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.055 0.0065 45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.44 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0012 180 30 0.67 0.78 0.035 0.0012 10 10 10 10 10 10 10 150 10 10 <td< td=""><td>4</td><td>1</td><td>0.05</td><td>0.06</td><td>0.015</td><td>0.01</td><td>50</td><td></td><td></td></td<>	4	1	0.05	0.06	0.015	0.01	50			
10 5 0.07 0.13 0.010 0.0020 15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.055 0.0065 45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.44 0.62 0.100 0.0033 120 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 240 240 24	5	1	0.06	0.07	0.015	0.01	50			
15 5 0.13 0.17 0.055 0.0110 21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.055 0.0065 45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.54 0.62 0.100 0.0033 120 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.012 240 1 1 1 1 </td <td>10</td> <td>5</td> <td>0.07</td> <td>0.13</td> <td>0.010</td> <td>0.00</td> <td>)20</td> <td></td> <td></td>	10	5	0.07	0.13	0.010	0.00)20			
21.5 6.5 0.17 0.23 0.045 0.0069 30 8.5 0.23 0.29 0.055 0.0065 45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.44 0.54 0.065 0.0022 120 30 0.64 0.62 0.100 0.0033 150 30 0.67 0.71 0.055 0.0018 210 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0013 240 30 0.75 0.78 0.035 0.0012 1 1 1 1 1 1 1 240 30 0.75 0.78 0.035 0.0012 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 240 30 0.75 <td< td=""><td>15</td><td>5</td><td>0.13</td><td>0.17</td><td>0.055</td><td>0.01</td><td>10</td><td></td><td></td></td<>	15	5	0.13	0.17	0.055	0.01	10			
30 8.5 0.23 0.29 0.055 0.0065 45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.44 0.54 0.065 0.0022 120 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 100 100 100 100 100 100 240 30 0.75 0.78 0.035 0.0012 100 101 100 100 100 100 100 100 102 100 100 100 100 100 100 1030	21.5	6.5	0.17	0.23	0.045	0.00)69			
45 15 0.29 0.37 0.060 0.0040 60 15 0.37 0.44 0.085 0.0057 90 30 0.44 0.54 0.065 0.0022 120 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 1.50 1.50	30	8.5	0.23	0.29	0.055	0.00)65			
60 15 0.37 0.44 0.085 0.0057 90 30 0.44 0.54 0.065 0.0022 120 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.75 0.78 0.035 0.0013 240 30 0.75 0.78 0.035 0.0012 0 0 0.055 0.0012 0.0012 0.0012 0 0 0.75 0.78 0.035 0.0012 0.0012 0 0 0.012 0.0012 0.0012 0.0012 0.0012 0.0012 0 0 0 0.0012 0.0012 0.0012 0.0012 0.0012 0 0 0 0 0.0012 0.0012 0.0012 0.0012 0.0012 0 0 0 0 0.0012 0.0012 0.0012 0.0012 0.0012 0.0012<	45	15	0.29	0.37	0.060	0.00	040			
90 30 0.44 0.54 0.065 0.0022 120 30 0.54 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.71 0.75 0.040 0.0013 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 240 240 240 240 240 240 30 30 30 30<	60	15	0.37	0.44	0.085	0.00)57			
120 30 0.34 0.62 0.100 0.0033 150 30 0.62 0.67 0.080 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.71 0.75 0.040 0.0013 240 30 0.75 0.78 0.035 0.0012 400 30 0.75 0.78 0.035 0.0012 400 30 0.75 0.78 0.035 0.0012 400 30 0.75 0.78 0.035 0.0012 400 30 0.75 0.78 0.035 0.0012 400 1 1 1 1 1 1 400 1 1 1 1 1 1 401 1 1 1 1 1 1 401 1 1 1 1 1 1 401 1 1 1 1 1 1 401 1 1 1	90	30	0.44	0.54	0.065	0.00)22			
130 30 0.62 0.67 0.030 0.0027 180 30 0.67 0.71 0.055 0.0018 210 30 0.71 0.75 0.040 0.0013 240 30 0.75 0.78 0.035 0.0012 4 - - - - - 5 - - - - - 6 - - - - - 7 - - - - - 6 - - - - - 7 - - - - - 6 - - - - - 7 - - - - - - 7 - - - - - - - 7 - - - - - - - 8 - - - - - - - -	120	30	0.54	0.62	0.100	0.00	033			
100 30 0.07 0.71 0.035 0.0013 240 30 0.75 0.78 0.035 0.0012 4 4 4 4 4 4 5 1 1 1 1 1 6 1 1 1 1 1 6 1 1 1 1 1 7 1 1 1 1 1 6 1 1 1 1 1 7 1 1 1 1 1 1 7 1 1 1 1 1 1 7 1 1 1 1 1 1 8 1 1 1 1 1 1 1 9 1	130	30	0.62	0.07	0.060	0.00)18			
240 30 0.75 0.78 0.035 0.0012 240 30 0.75 0.78 0.035 0.0012 240 20 20 20 20 20 20 240 30 0.75 0.78 0.035 0.0012 20 240 20 20 20 20 20 20 20 240 20 20 20 20 20 20 20 20 240 20 20 20 20 20 20 20 20 240 20 <td>210</td> <td>30</td> <td>0.07</td> <td>0.75</td> <td>0.033</td> <td>0.00</td> <td>)13</td> <td></td> <td></td>	210	30	0.07	0.75	0.033	0.00)13			
Image: Solution of the state of the sta	240	30	0.75	0.78	0.040	0.00)12			
Image: section of the section of th			0110	0.1.0	0.000	0.00				
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Image: select										
						 				

Project Number:	21253	5	Date:		30/05/2023	3	Time:	9:30:00) AM
Site Address: 9, 3	3, 49 He	ights R	oad,Puke	kohe					
Borehole #:	SKG 0	3	Test #:	1	of total	1	tests	Test by:	LL
1. Minimum Gradient ¹						1			
Minimum Grad	ient ²	= •	y x	-		Vater depth (m)			
		=	0.0012	m/min					
	d	=	0.3375	m		0 Time (n	nin)		
2. Percolation Rate									
P	ercolatior	n Rate ³	$= P_{(total)} =$	D x grad	dient x 1000 4 x d	=	0.09	L/min/m ²	
	Soakage	Rate ^{3b}	=	min.	δ Depth δ Time	=	8.0	mm/hr	
FoS for consequ	uence of f	ailure 4	$= F_{(c)} =$	1					
FoS for test	ting unce	rtainty 5	= F _(u) =	1.4					
Total	Factor of	f Safety	F _{(to}	$_{tal)} = F_{(c)}$	F _(u) =	1.4			
Factored	Percolatio	on Rate		P _(factored)	$= \frac{P_{(total)}}{F_{(total)}}$	=	0.06	L/min/m ²	
Fac	ctored Ra	te Rate		P _(factored)	$= \frac{P_{(total)}}{F_{(total)}}$	- =	5.7	L/min/m ²	
Additional Comments:									
Name of Test Ope	arator:					v			
Name of rest ope						^			
Qualific	ation:		B.S	c Hydroge	eology				
Sigr	ature								
	Date:		30/05/2023	3					
1									
Notes: ' m bp	ogl = metr	es belov	w present	ground lev	/el				
² lowe	st gradier	nt is requ ot stabili	uired. This	will norm	ally be the lat	st two poir	nts. If the ra	te of change	during
repe	ated	u sianii	seu iui al	ieast the		asuleillell			
3 d = c	distance i	n m betv	veen the n	nidpoint o	the last two	readings a	and the bas	se of the borel	nole
^{3b} Cal	cualted in	accorda	ance with I	VZBC E1/	VM1	<u>9</u> -			
⁴ See	Section E	3.4.0 Tal	ble 5 for fa	ctors of s	afety.				
⁵ See Section B.4.0 Table 6 for factors of safety.									

Appendix B1.1 Worksheet 1: Falling Head (Variable Head) Percolation Test (pg. 2/2)



Worksheet 1: Falling Head (Variable Head) Percolation Test (graph)

Appendix B1.1 Worksheet 1: Falling Head (Variable Head) Percolation Test (pg. 1/2)

Project	Number:	212	253	Date:	30/05/2023		Time:	9:30:00 AM
Site	Address:	9 33 49	Heights R	oad Pukekohe				
Br	rehole #	SK(3 04		of total	1	tests	Test by:
	$\frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{j=1}^$	0110	504	Position v:		•	mRI ·	
Otho	vr borobole	se within ir	ofluonco d	istanco (tost simult				
Une		55 WILLIII II	inuence u		aneousiy).			
1. Attach	the followi	ng (tick or	nce attache	ed)				
	V	Log of hole	e showing o	depth, rock type & mo	isture			
	V	Graph of V	Vater Leve	l against Time				
	V	Site Plan S	Showing loc	cation of hole(s)				
2. Genera	l Informati	on						
	Depth of bo	orehole. H:	1	m	If casing is	reauired:		
	Diameter	of bore. D:	0.1	m	J	Depth	of casina:	m
	Pre-test	GW level :		m (bpgl)		Diameter	of casing:	m
2 Testis								
S. TEST LO	9	Mator	donth					
	Interval	water		Level Drop Over	Interval	Inadiont		
Minutes	(v: min)	(III L Start of	ppgi) End of					Notes
	(x, mm)	interval	Interval	intervar (y, iii)	(y/	^)		
0	0			0	0.0)()		
1	1	0.00	0.04	0,000	0.00	000		
2	1	0.04	0.07	0.040	0.04	00		
3	1	0.07	0.10	0.030	0.03	300		
4	1	0.10	0.12	0.030	0.03	300		
5	1	0.12	0.15	0.020	0.02	200		
10	5	0.15	0.23	0.025	0.00)50		
15	5	0.23	0.29	0.080	0.01	60		
20	5	0.29	0.34	0.060	0.01	20		
30	10	0.34	0.41	0.050	0.00)50		
45	15	0.41	0.48	0.070	0.00)47		
60	15	0.48	0.54	0.070	0.00)47		
90	30	0.54	0.63	0.060	0.00)20		
120	30	0.63	0.70	0.095	0.00)32		
150	30	0.70	0.76	0.070	0.00)23		
210	30	0.76	0.81	0.060	0.00	17		
210	30	0.01	0.00	0.030	0.00	117		
240	- 30	0.05	0.00	0.040	0.00	/15		

Project Number: 21	oject Number: 21253 Date:			30/05/2023		Time:	Time: 9:30:00 AM	
Site Address: 9, 33, 49	Heights R	oad,Puke	kohe			_		
Borehole #: SK	G 04	Test #:	1	_of total	1	tests	Test by:	LL
1. Minimum Gradient ¹					N			
Minimum Gradient ²	=	y x	-		later depth (m)			
	=	0.0013	m/min		5			
(= k	0.135	m		0 Time (n	nin)		
2. Percolation Rate								
Percol	ation Rate ³	$= P_{(total)} =$	D x grad	lient x 1000 x d	=	0.25	L/min/m ²	
Soak	age Rate ^{3b}	=	min.	δ Depth δ Time	=	10.0	mm/hr	
FoS for consequence	e of failure 4	$= F_{(c)} =$	1					
FoS for testing u	ncertainty 5	$= F_{(u)} =$	1.4					
Total Fact	or of Safety	F _{(to}	$\mathbf{F}_{(c)} = \mathbf{F}_{(c)} \mathbf{x}$	F _(u) =	1.4			
Factored Perce	plation Rate		$P_{(factored)}$	$= \frac{P_{(total)}}{F_{(total)}}$	=	0.18	L/min/m ²	
Factored Rate Rate			P _(factored)	$= \frac{P_{(total)}}{F_{(total)}}$	- =	7.1	L/min/m ²	
Additional Comments:								
Name of Test Operator	:			LM Le Roux	x			
Qualification		BS	c Hydroge	ology				
		2.0	e : .j e g .			_		
Signature)							
Date	:	30/05/2023	3					
N								
Notes: m bpgl = metres below present ground level								
² lowest gradient is required. This will normally be the last two points. If the rate of change during the test has not stabilised for at least the last three measurements, then the test shall be repeated								
3 d = distance in m between the midpoint of the last two readings and the base of the borehole								
^{3b} Calcualted in accordance with NZBC E1/VM1								
⁴ See Sect	on B.4.0 Ta	ble 5 for fa	ctors of s	afety.				
⁵ See Section B.4.0 Table 6 for factors of safety.								

Appendix B1.1 Worksheet 1: Falling Head (Variable Head) Percolation Test (pg. 2/2)



Worksheet 1: Falling Head (Variable Head) Percolation Test (graph)