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.

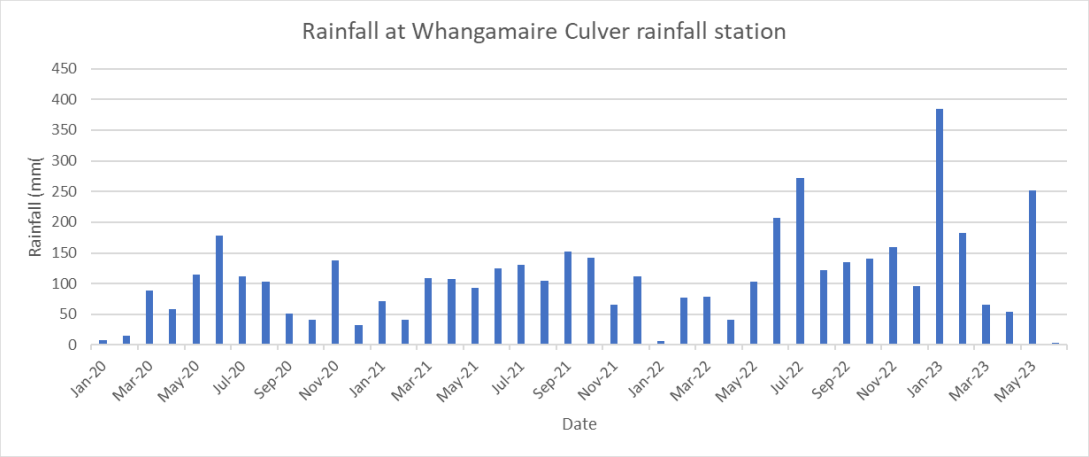
2.3 Soakage Testing

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.

Table 1: Summary of Soakage Test Results

Soak Hole ID	Test Duration (min)	Hole Width (m)	Hole Depth (m)	Adopted Depth (excluding cased of area) (m)	Groundwater Level (m bgl)	Percolation Rate (L/min/m^2)	
						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]

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/m^2 (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.

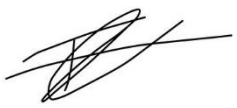
We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

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/Continuous/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

0 25 m 50 m

ENGEO

Produced by **Datanest.earth**

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

APPENDIX 2

Borehole Records

LOG OF HAND AUGER SKG01

Geotechnical Investigation
9, 33, 49 Heights Road
Pukekohe, Auckland
21133.000.001

Client : GBar Properties Limited
Client Ref. : 21133.000.001
Date : 29/05/2023
Hole Depth : 2.2 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : AK/JM
Reviewed By : HP
Latitude : -37.1765505
Longitude : 174.8959222

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
	TS	OL	TOPSOIL.					N/A		
0.5	FILL	ML	[FILL] Clayey SILT with minor fine to medium sand, trace 1-2mm rootlets and fine gravel; brown with orange and dark grey mottles. Low plasticity.		48			VSt	191/94 188/60	
1.0	BTS	OL	BURIED TOPSOIL.				M	N/A	157/51	
	SAVF	ML	Clayey SILT with trace 1-2mm rootlets; orange brown. Low plasticity.		47			VSt-H	160/55 205/102 167/85	
2.0			End of Hole Depth: 2.2 m Termination Condition: met target depth						188/116	

Hand auger met target depth at 2.2 m depth .
Coordinates and elevation data estimated from Auckland Council GeoMaps.
Standing groundwater was not encountered.
N/A = Not Applicable; TS = Topsoil

BTS = Buried Topsoil
SAVF = South Auckland Volcanic Field.

GEOTECH HAND AUGER - NO SCALA SOAKAGE HA'S GINT.GPJ NZ DATA TEMPLATE 2.GDT 6/7/23

LOG OF HAND AUGER SKG02

Geotechnical Investigation
9, 33, 49 Heights Road
Pukekohe, Auckland
21133.000.001

Client : GBar Properties Limited
Client Ref. : 21133.000.001
Date : 29/05/2023
Hole Depth : 2 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : JM/AK
Reviewed By :
Latitude : -37.1769852
Longitude : 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.					N/A	181/75	
0.5	SAVF	ML	SILT with minor clay and trace fine sand; brownish orange. Low plasticity.						188/80	
			0.7 m - Becomes with minor fine to medium sand		51			VSt	169/55	
1.0			1.0 m - Becomes with some fine to coarse sand.				M		186/51	
1.5		ML	Clayey SILT with trace fine sand; orange brown. Low plasticity.		50			VSt	167/116	
			1.9 m - Becomes with red streaks.					H	211/116	
2.0			End of Hole Depth: 2 m Termination Condition: met target depth						230+	

Hand Auger met target depth at 2 m depth .
Coordinates and elevation data estimated from Auckland Council GeoMaps.
Standing groundwater was not encountered.
SAVF = South Auckland Volcanic Field.

LOG OF HAND AUGER SKG03

Geotechnical Investigation
9, 33, 49 Heights Road
Pukekohe, Auckland
21133.000.001

Client : GBar Properties Limited
Client Ref. : 21133.000.001
Date : 29/05/2023
Hole Depth : 2 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : JM/AK
Reviewed By :
Latitude : -37.1760619
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
	TOPSOIL	ML	TOPSOIL.					N/A	68/27	
0.5	FILL	ML	[FILL] SILT with minor clay and trace fine to coarse gravel; brownish orange with occasional red and dark brown streaks. Low plasticity. Gravel is sub-angular to angular.					H	UTP	
1.0	SAVF	ML	SILT with some fine to medium sand; brownish orange with occasional dark brown mottles and red streaks. Low plasticity.		44		M	H	230+	
		ML	Clayey SILT with some fine to medium sand; orange brown. Low plasticity.					VSt	191/85	
1.5		ML	SILT with some clay and minor fine to medium sand; brownish orange with red mottles. Low plasticity.					H	211/85	
2.0			End of Hole Depth: 2 m Termination Condition: met target depth		43				UTP	

Hand Auger met target depth at 2 m depth .
UTP = Unable to Penetrate
Coordinates and elevation data estimated from Auckland Council GeoMaps.
Standing groundwater was not encountered.
SAVF = South Auckland Volcanic Field.

LOG OF HAND AUGER SKG04

Geotechnical Investigation
9, 33, 49 Heights Road
Pukekohe, Auckland
21133.000.001

Client : GBar Properties Limited
Client Ref. : 21133.000.001
Date : 29/05/2023
Hole Depth : 2.2 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : AK/JM
Reviewed By :
Latitude : -37.1759722
Longitude : 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	ML	[FILL] Clayey SILT with minor fine sand and trace fine to coarse gravel; greyish brown and orange intermixed. Low plasticity.					St-H	87/36 UTP	
1.0					44		M			
	SAVF	ML	Clayey SILT; red with occasional white streaks and dark brown mottles. Low plasticity.					H	230+	
1.5		ML	Clayey SILT; red with occasional white streaks and dark brown mottles. Low plasticity.					VSt	230+ 155/66	
2.0					43				133/63	
			End of Hole Depth: 2.2 m Termination Condition: met target depth							

Hand Auger met target depth at 2.2 m depth .
Coordinates and elevation data estimated from Auckland Council GeoMaps.
Standing groundwater was not encountered.
SAVF = South Auckland Volcanic Field.

UTP = Unable to Penetrate
N/A = Not Applicable

GEOTECH HAND AUGER - NO SCALA SOAKAGE HA'S GINT.GPJ NZ DATA TEMPLATE 2.GDT 6/7/23

APPENDIX 3

Soakage Test Results

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

Borehole #: SKG 01 Test #: 1 of total 1 tests Test by: LL

Position x: Position y: mRL:

Other boreholes within influence distance (test simultaneously):

1. Attach the following (tick once attached)

√	Log of hole showing depth, rock type & moisture
√	Graph of Water Level against Time
√	Site Plan Showing location of hole(s)

2. General Information

Depth of borehole, **H**: 1 m

Diameter of bore, **D**: 0.1 m

Pre-test GW level : m (bpgl)

If casing is required:

Depth of casing: m

Diameter of casing: m

3. Test Log

Minutes	Interval (x; min)	Water depth (m bpgl)		Level Drop Over interval (y; m)	Interval Gradient (y/x)	Notes
		Start of interval	End of Interval			
0	0	0.00	0.00	0	0.00	
1	1	0.00	0.01	0.000	0.0000	
2	1	0.01	0.01	0.005	0.0050	
3	1	0.01	0.02	0.005	0.0050	
4	1	0.02	0.02	0.005	0.0050	
5	1	0.02	0.02	0.003	0.0025	
10	5	0.02	0.04	0.003	0.0005	
15	5	0.04	0.05	0.015	0.0030	
20	5	0.05	0.07	0.015	0.0030	
30	10	0.07	0.09	0.020	0.0020	
45	15	0.09	0.12	0.015	0.0010	
60	15	0.12	0.14	0.030	0.0020	
90	30	0.14	0.19	0.025	0.0008	
122.5	32.5	0.19	0.22	0.045	0.0014	
148.5	26	0.22	0.25	0.035	0.0013	
179	30.5	0.25	0.28	0.030	0.0010	
210	31	0.28	0.31	0.030	0.0010	
240	30	0.31	0.33	0.030	0.0010	

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

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

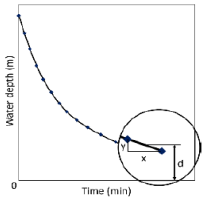
Borehole #: SKG 01 Test #: 1 of total 1 tests Test by: LL

1. Minimum Gradient [1]

Minimum Gradient [2] = $\frac{y}{x}$

= 0.0010 m/min

d = 0.68 m



2. Percolation Rate

Percolation Rate [3] $= P_{(total)} = \frac{D \times gradient \times 1000}{4 \times d}$ = 0.04 L/min/m^2

Soakage Rate [3b] = min. $\frac{\delta \text{ Depth}}{\delta \text{ Time}}$ = 5.8 mm/hr

FoS for consequence of failure [4] $= F_{(c)}$ = 1

FoS for testing uncertainty [5] $= F_{(u)}$ = 1.4

Total Factor of Safety $F_{(total)} = F_{(c)} \times F_{(u)}$ = 1.4

Factored Percolation Rate $P_{(factored)} = \frac{P_{(total)}}{F_{(total)}}$ = **0.03 L/min/m^2**

Factored Rate Rate $P_{(factored)} = \frac{P_{(total)}}{F_{(total)}}$ = **4.1 L/min/m^2**

Additional Comments:

Name of Test Operator: LM Le Roux

Qualification: B.Sc Hydrogeology

Signature

Date: 30/05/2023

Notes: [1] 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 Section B.4.0 Table 5 for factors of safety.

[5] See Section B.4.0 Table 6 for factors of safety.

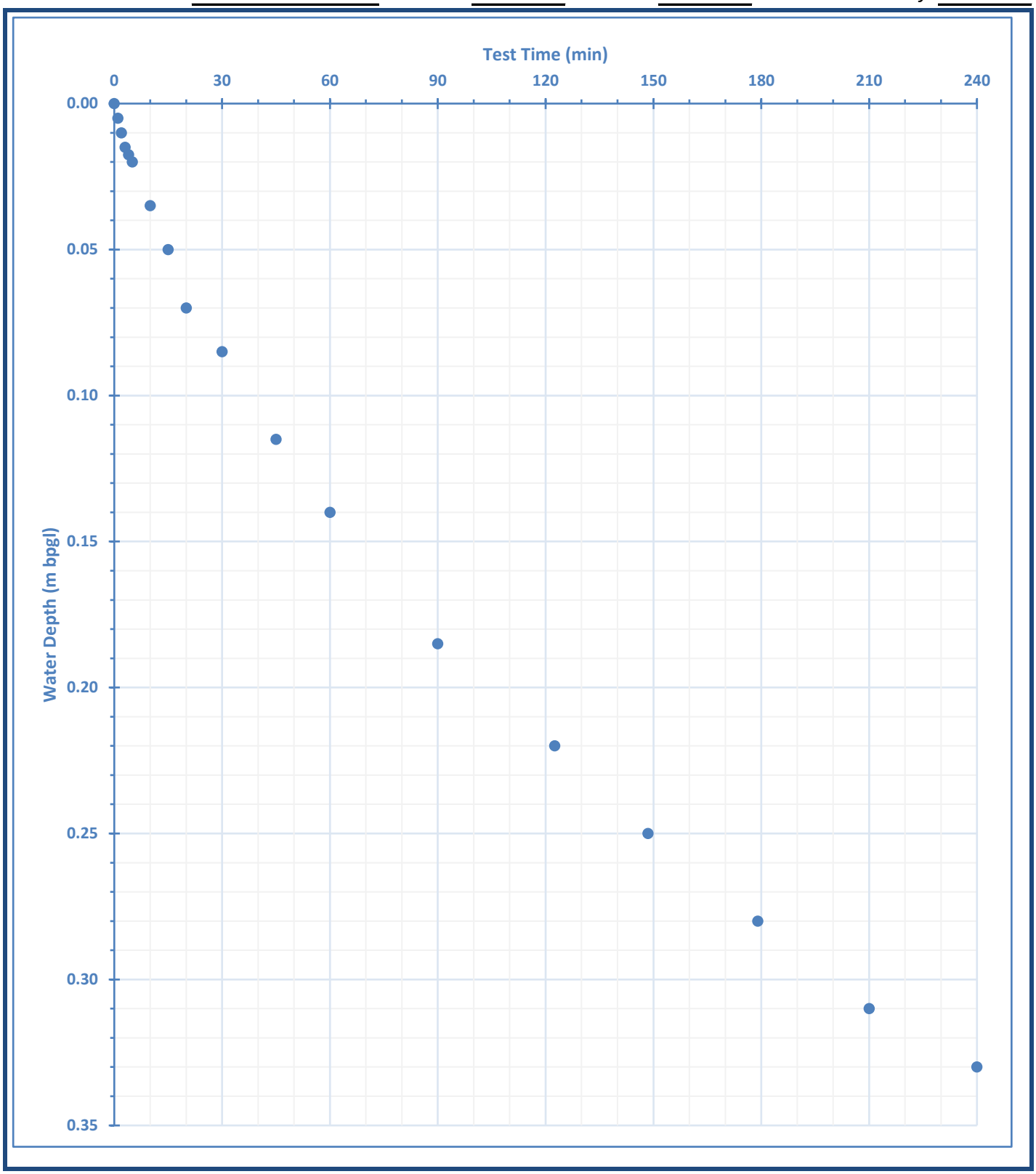
Worksheet 1: Falling Head (Variable Head) Percolation Test (graph)

[redacted]

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

Borehole #: SKG 01 Test #: 1 of total 1 tests Test by: LL



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

Borehole #: SKG 02 Test #: 1 of total 1 tests Test by: LL

Position x: Position y: mRL:

Other boreholes within influence distance (test simultaneously):

1. Attach the following (tick once attached)

√	Log of hole showing depth, rock type & moisture
√	Graph of Water Level against Time
√	Site Plan Showing location of hole(s)

2. General Information

Depth of borehole, **H**: 1.6 m

Diameter of bore, **D**: 0.1 m

Pre-test GW level : 1 m (bpgl)

If casing is required:

Depth of casing: m

Diameter of casing: m

3. Test Log

Minutes	Interval (x; min)	Water depth (m bpgl)		Level Drop Over interval (y; m)	Interval Gradient (y/x)	Notes
		Start of interval	End of Interval			
0	0	0.00	0.00	0	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	
4	1	0.04	0.05	0.010	0.0100	
5	1	0.05	0.06	0.005	0.0050	
10	5	0.06	0.11	0.010	0.0020	
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	

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

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

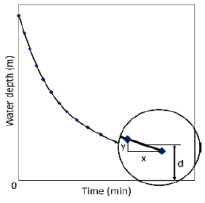
Borehole #: SKG 02 Test #: 1 of total 1 tests Test by: LL

1. Minimum Gradient [1]

Minimum Gradient [2] = $\frac{y}{x}$

= 0.0005 m/min

d = 1.01 m



2. Percolation Rate

Percolation Rate [3] $= P_{(total)} = \frac{D \times gradient \times 1000}{4 \times d}$ = 0.01 L/min/m^2

Soakage Rate [3b] = min. $\frac{\delta \text{ Depth}}{\delta \text{ Time}}$ = 5.5 mm/hr

FoS for consequence of failure [4] $= F_{(c)}$ = 1

FoS for testing uncertainty [5] $= F_{(u)}$ = 1.4

Total Factor of Safety $F_{(total)} = F_{(c)} \times F_{(u)}$ = 1.4

Factored Percolation 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

Qualification: B.Sc Hydrogeology

Signature

Date: 30/05/2023

Notes: [1] 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 Section B.4.0 Table 5 for factors of safety.

[5] See Section B.4.0 Table 6 for factors of safety.

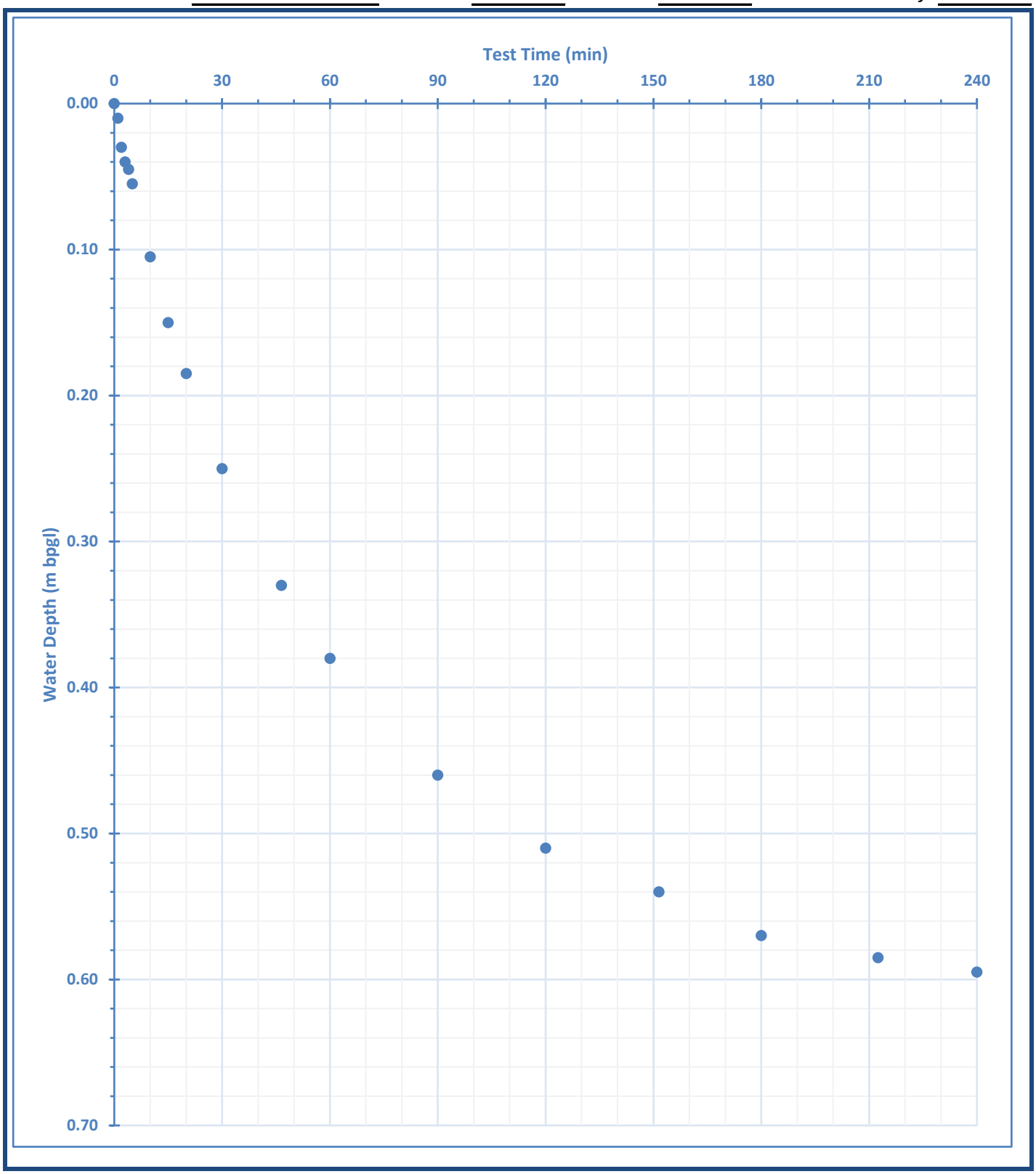
Worksheet 1: Falling Head (Variable Head) Percolation Test (graph)

[redacted]

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

Borehole #: SKG 02 Test #: 1 of total 1 tests Test by: LL



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

Borehole #: SKG 03 Test #: 1 of total 1 tests Test by: LL

Position x: Position y: mRL:

Other boreholes within influence distance (test simultaneously):

1. Attach the following (tick once attached)

√	Log of hole showing depth, rock type & moisture
√	Graph of Water Level against Time
√	Site Plan Showing location of hole(s)

2. General Information

Depth of borehole, **H**: 1.1 m

Diameter of bore, **D**: 0.1 m

Pre-test GW level : m (bpgl)

If casing is required:

Depth of casing: m

Diameter of casing: m

3. Test Log

Minutes	Interval (x; min)	Water depth (m bpgl)		Level Drop Over interval (y; m)	Interval Gradient (y/x)	Notes
		Start of interval	End of Interval			
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	
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	0.54	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	

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

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

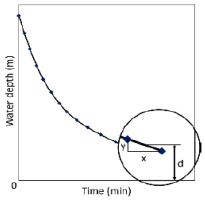
Borehole #: SKG 03 Test #: 1 of total 1 tests Test by: LL

1. Minimum Gradient [1]

Minimum Gradient [2] = $\frac{y}{x}$

= 0.0012 m/min

d = 0.3375 m



2. Percolation Rate

Percolation Rate [3] $= P_{(total)} = \frac{D \times gradient \times 1000}{4 \times d}$ = 0.09 L/min/m^2

Soakage Rate [3b] = min. $\frac{\delta \text{ Depth}}{\delta \text{ Time}}$ = 8.0 mm/hr

FoS for consequence of failure [4] $= F_{(c)}$ = 1

FoS for testing uncertainty [5] $= F_{(u)}$ = 1.4

Total Factor of Safety $F_{(total)} = F_{(c)} \times F_{(u)}$ = 1.4

Factored Percolation Rate $P_{(factored)} = \frac{P_{(total)}}{F_{(total)}}$ = **0.06 L/min/m^2**

Factored Rate Rate $P_{(factored)} = \frac{P_{(total)}}{F_{(total)}}$ = **5.7 L/min/m^2**

Additional Comments:

Name of Test Operator: LM Le Roux

Qualification: B.Sc Hydrogeology

Signature

Date: 30/05/2023

Notes: [1] 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 Section B.4.0 Table 5 for factors of safety.

[5] See Section B.4.0 Table 6 for factors of safety.

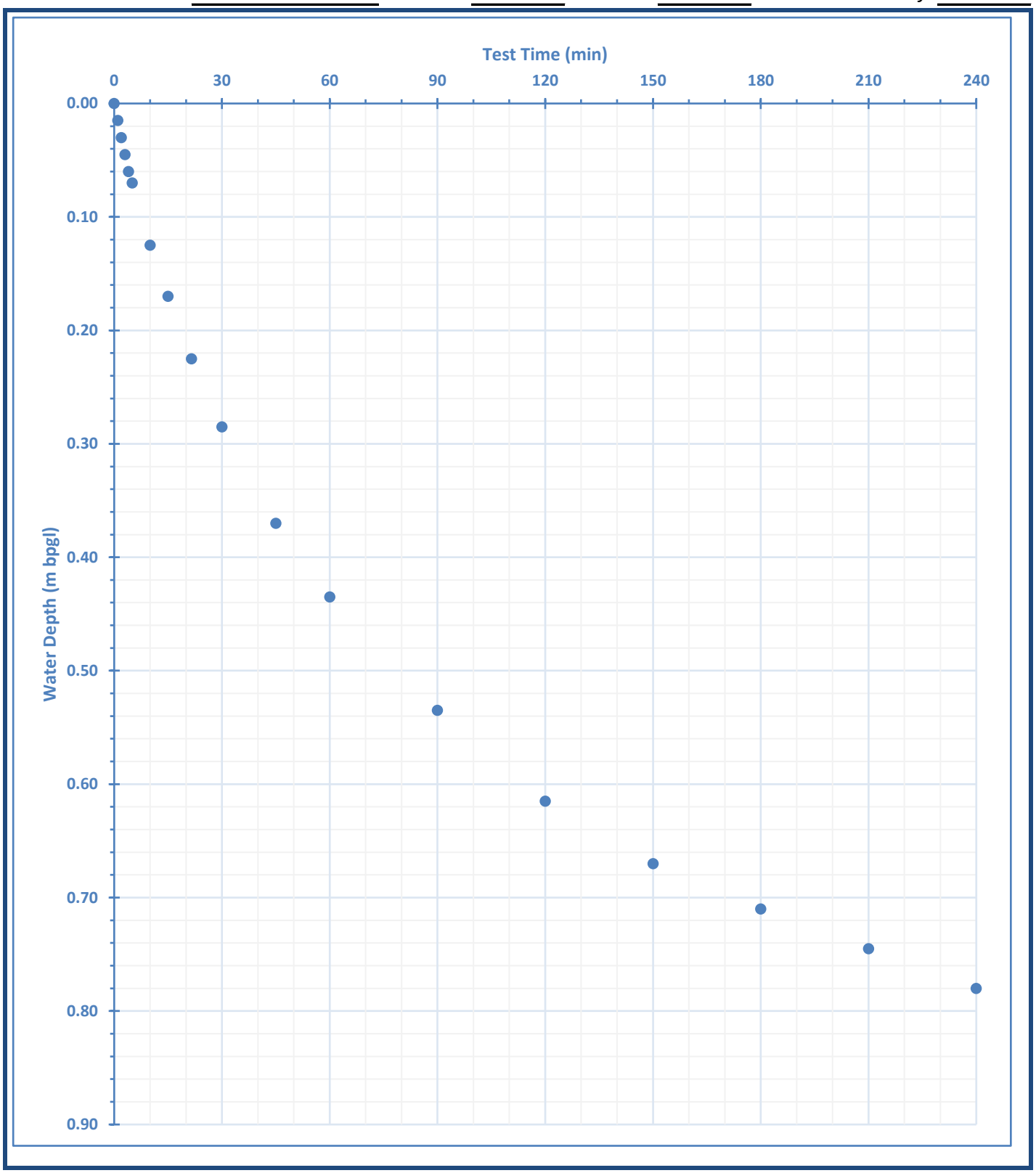
Worksheet 1: Falling Head (Variable Head) Percolation Test (graph)

[redacted]

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

Borehole #: SKG 03 Test #: 1 of total 1 tests Test by: LL



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

Borehole #: SKG 04 Test #: 1 of total 1 tests Test by: LL

Position x: Position y: mRL:

Other boreholes within influence distance (test simultaneously):

1. Attach the following (tick once attached)

√	Log of hole showing depth, rock type & moisture
√	Graph of Water Level against Time
√	Site Plan Showing location of hole(s)

2. General Information

Depth of borehole, **H**: 1 m

Diameter of bore, **D**: 0.1 m

Pre-test GW level : m (bpgl)

If casing is required:

Depth of casing: m

Diameter of casing: m

3. Test Log

Minutes	Interval (x; min)	Water depth (m bpgl)		Level Drop Over interval (y; m)	Interval Gradient (y/x)	Notes
		Start of interval	End of Interval			
0	0	0.00	0.00	0	0.00	
1	1	0.00	0.04	0.000	0.0000	
2	1	0.04	0.07	0.040	0.0400	
3	1	0.07	0.10	0.030	0.0300	
4	1	0.10	0.12	0.030	0.0300	
5	1	0.12	0.15	0.020	0.0200	
10	5	0.15	0.23	0.025	0.0050	
15	5	0.23	0.29	0.080	0.0160	
20	5	0.29	0.34	0.060	0.0120	
30	10	0.34	0.41	0.050	0.0050	
45	15	0.41	0.48	0.070	0.0047	
60	15	0.48	0.54	0.070	0.0047	
90	30	0.54	0.63	0.060	0.0020	
120	30	0.63	0.70	0.095	0.0032	
150	30	0.70	0.76	0.070	0.0023	
180	30	0.76	0.81	0.060	0.0020	
210	30	0.81	0.85	0.050	0.0017	
240	30	0.85	0.88	0.040	0.0013	

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

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

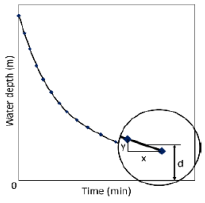
Borehole #: SKG 04 Test #: 1 of total 1 tests Test by: LL

1. Minimum Gradient [1]

Minimum Gradient [2] = $\frac{y}{x}$

= 0.0013 m/min

d = 0.135 m



2. Percolation Rate

Percolation Rate [3] $= P_{(total)} = \frac{D \times gradient \times 1000}{4 \times d}$ = 0.25 L/min/m^2

Soakage Rate [3b] = min. $\frac{\delta \text{ Depth}}{\delta \text{ Time}}$ = 10.0 mm/hr

FoS for consequence of failure [4] $= F_{(c)}$ = 1

FoS for testing uncertainty [5] $= F_{(u)}$ = 1.4

Total Factor of Safety $F_{(total)} = F_{(c)} \times F_{(u)}$ = 1.4

Factored Percolation 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

Qualification: B.Sc Hydrogeology

Signature

Date: 30/05/2023

Notes: [1] 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 Section B.4.0 Table 5 for factors of safety.

[5] See Section B.4.0 Table 6 for factors of safety.

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

[redacted]

Project Number: 21253 Date: 30/05/2023 Time: 9:30:00 AM

Site Address: 9, 33, 49 Heights Road,Pukekohe

Borehole #: SKG 04 Test #: 1 of total 1 tests Test by: LL