1 June 2021 Document Ref: AKL2017-0167AE Rev 0

Neil Construction Limited
PO Box 8751
Symonds Street
Auckland 1150

Attention: Trevor Canty

Dear Trevor

RE: FALLING HEAD SOAKAGE TEST RESULTS
KAURI ROAD, WHENUAPAI

1 SCOPE AND RESULTS

CMW Geosciences (CMW) have been instructed by Neil Construction Limited to complete soakage testing at Kauri Road, Whenuapai as detailed in the email sent on 7 May 2021.

We have carried out 4 falling head tests as shown on the appended site plan. The soil units within the boreholes can be characterised as both alluvial deposits and engineered fill, generally comprised of clays and silts.

The falling head percolation testing methodology is in accordance with the Auckland Council Technical Report 2013/040: Stormwater Disposal Via Soakage in the Auckland Region dated October 2016.

Based on test data, we have estimated the percolation rates with the followings methods:

- Ciria 113 Appendix 4, Control of Groundwater for Temporary Works
- Auckland Council Technical Report 2013/040, Stormwater Disposal via Soakage in the Auckland Region.

The percolation rate estimates are summarised in Table 1 below.

Table 1: Percolation Rate Estimates

Location	Calculation Method	Percolation Rate	
		m/s	mm/hour
HA01-21	Ciria 113	2.22×10^{-8}	0.08
	Auckland Council Technical Report	6.36×10^{-8}	0.229
HA02-21	Ciria 113	5.63×10^{-7}	2.78

	Auckland Council Technical Report	$7.71x10^{-7}$	2.78
HA03-21	Ciria 113	0.0	0.0
	Auckland Council Technical Report	0.0	0.0
HA04-21	Ciria 113	$8.27x10^{-7}$	2.98
	Auckland Council Technical Report	$4.79x10^{-7}$	1.72

1.1 Stormwater Disposal

The permeability results of the falling head test are considered low and on-site disposal of stormwater via infiltration is not considered appropriate.

2 LIMITATION AND CLOSURE

This letter has been prepared for use by our client Neil Construction Limited for the development at Kauri Road, Whenuapai only. Liability for its use is limited to these parties and to the scope of work for which it was prepared, as it may not contain sufficient information for other parties or for other purposes.

We trust this letter meets your current requirements. If site conditions encountered vary from those adopted as the basis for our assessment or if any construction details or sequencing change and/or any unforeseen conditions develop, CMW must be advised immediately such that we can review the design recommendations and instruct any changes that may be required.

For and on behalf of CMW Geosciences

Prepared by:

Jasmine Walden

Project Engineering Geologist

Reviewed and authorised by:

Andrew Linton

Principal Geotechnical Engineer, CPEng

Distribution: 1 electronic copy to Neil Construction Limited via email
Original held at CMW Geosciences

Attachments: Site Plan
Calculations

RNZAF AUCKLAND GOLF COURSE

EXISTING GRADE

INDICATIVE LOCATION OF STOCKPILE. CLOSE OUT AND PROVIDE SILT FENCE WHEN NOT OPERATIONAL.

EXISTING GRADE

20-26 KAURI RD

EXISTING GRADE

TEMPORARY BUND CROSSING TO BE REINSTATE DAILY

STABILISED ENTRANCE OVER EXISTING VEHICLE CROSSING

(SRP E DESIGN CATCHMENT 1.490Ha)

CULVERT

SRP E

"T BAR" DECANTING EARTH BUND INCL. RAINFALL ACTIVATED DOSING SYSTEM TO MANAGE AREA NOT COVERED BY SRP. FLOW OUTFLOWS TO EXISTING CULVERT. DEB SIZE 11m3 SIZE AND SHAPE AS PER GD05.

INDICATIVE LOCATION OF STOCKPILE. CLOSE OUT AND PROVIDE SILT FENCE WHEN NOT OPERATIONAL.

TEMPORARY BUND CROSSING TO BE REINSTATE DAILY

EXISTING GRADE

(SRP D DESIGN CATCHMENT 1.615Ha)

EXISTING GRADE

SRP D

(SRP C DESIGN CATCHMENT 4.904Ha)

EXISTING GRADE

WHERE NECESSARY - EARTH BUND CATCHMENT SEPARATION. REINSTATE DAILY .

(SRP B DESIGN CATCHMENT 4.481Ha)

SRP B

CLEAN WATER. EXISTING TABLE DRAIN

"T BAR" DECANTING EARTH BUND INCL. RAINFALL ACTIVATED DOSING SYSTEM TO MANAGE AREA NOT COVERED BY SRP. FLOW OUTFLOWS TO EXISTING CULVERT. DEB SIZE 27m3 SIZE AND SHAPE AS PER GD05.

EXISTING GRADE

155-157 BRIGHAM CREEK ROAD

EXISTING CULVERT

SRP C

EXISTING CULVERT

EXISTING GRADE

BRIGHAM CREEK ROAD

KAURI ROAD

159 BRIGHAM CREEK ROAD

(SRP A DESIGN CATCHMENT 1.282Ha)

KERB AND CHANNEL

SRP A

CLEAN WATER. EXISTING TABLE DRAIN

EXISTING CESSPITS-SED PROTECTION

LEGEND

- EXISTING CONTOURS 50.0
- PROPOSED CONTOURS 50.0
- ESC DEVICE CATCHMENT
- STABILISED CONSTRUCTION ENTRANCE
- EARTH BUND
- SUPER SILT FENCE
- SEDIMENT LADEN DIVERSION CHANNEL
- CLEAN WATER DIVERSION CHANNEL
- INDICATIVE SPILLWAY ALIGNMENT
- RAIN ACTIVATED CHEMICAL DOSING SYSTEM
- UPSTAND DECANT & DISCHARGE POINT
- MANUAL SAMPLING LOCATIONS MS 1

FOR CONSTRUCTION

Rev	Description	By	Date
1	ISSUED FOR CONSTRUCTION	CK	11/20
0	ISSUED FOR CONSTRUCTION	CK	09-20

THE NEIL GROUP

NEIL CONSTRUCTION LIMITED
LAND DEVELOPERS

THE NEIL GROUP LIMITED
LEVEL 3, BUILDING B
8 NUGENT STREET
GRAFTON

PO BOX 8751, SYMONDS STREET
AUCKLAND, NEW ZEALAND
TELEPHONE: +64 9 918 6565
FACSIMILE: +64 9 918 6567
WEB: www.neilgroup.co.nz

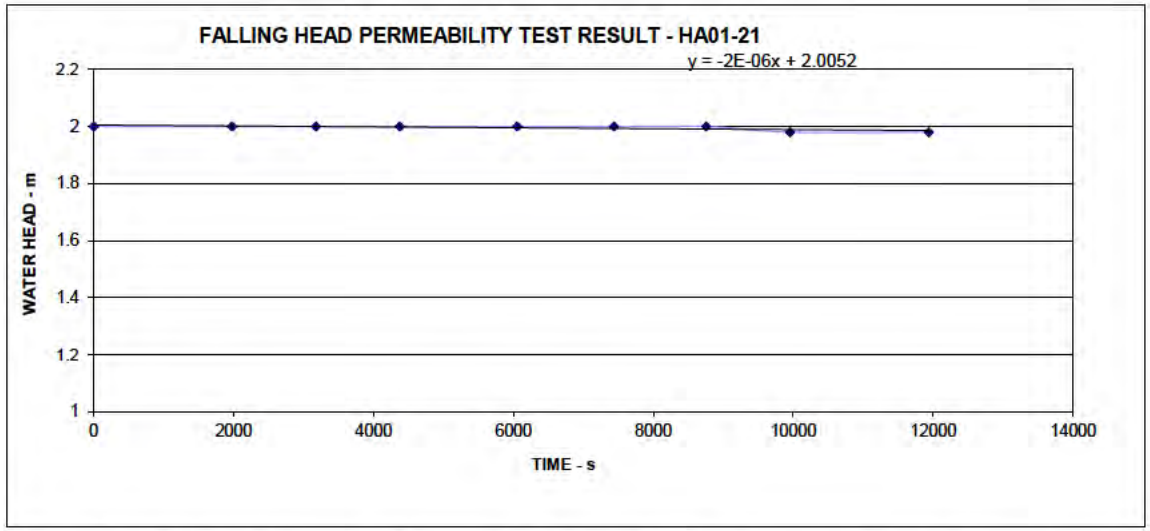
Job Title: KAURI ROAD WHENUAPAI

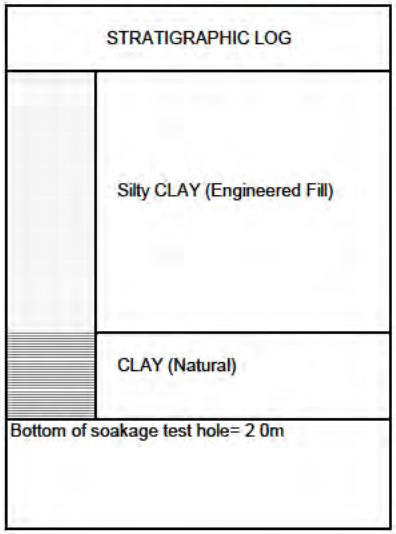
Drawing Title: EARTHWORKS EROSION & SEDIMENT CONTROL PLAN

	By	Date	Scale	Job No. 432-01	
Surveyed:	DS		1:2000 A3	Drawing No. 432-01-EW-205	Rev 1
Designed:	KLP				
Drawn:	S.F.	06/07/18			
Approved:					
CAD FILE	F:_PROJECTS\KAURI ROAD\DWG\ENG\BE 2020\432-01-EW-201.dwg				

F:_PROJECTS\KAURI ROAD\DWG\ENG\BE 2020\432-01-EW-201.dwg, 11/11/2020 8:28:52 am, Chris, DWG To PDF.pc3

CLIENT	Neil Construction Limited
PROJECT	Kauri Road, Whenuapai
LOCATION	Whenuapai
JOB NUMBER	AKL2017-0167
TEST DATE	20/05/2021





Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Report No. 113)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h + 1}\right)}{(t_2 - t_1)} \right) \times I$

where I = average piezometric head over chosen time interval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chosen interval (m)

h_2 = piezometric head at end of chosen interval (m)

$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20 0

Elapsed Time (s)	t2 - t1 (secs)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
1980	1980	2	2.00	0.00	0.00E+00	0.00E+00
3180	1200	2	2.00	0.00	0.00E+00	0.00E+00
4380	1200	2	2.00	0.00	0.00E+00	0.00E+00
6060	1680	2	2.00	0.00	0.00E+00	0.00E+00
7440	1380	2	2.00	0.00	0.00E+00	0.00E+00
8760	1320	2	2.00	0.00	0.00E+00	0.00E+00
9960	1200	1.98	1.99	0.00	1.77E-07	1 53E-02
11940	1980	1.98	1.98	0.00	0.00E+00	0.00E+00
				Average =	2.22E-08	1 92E-03

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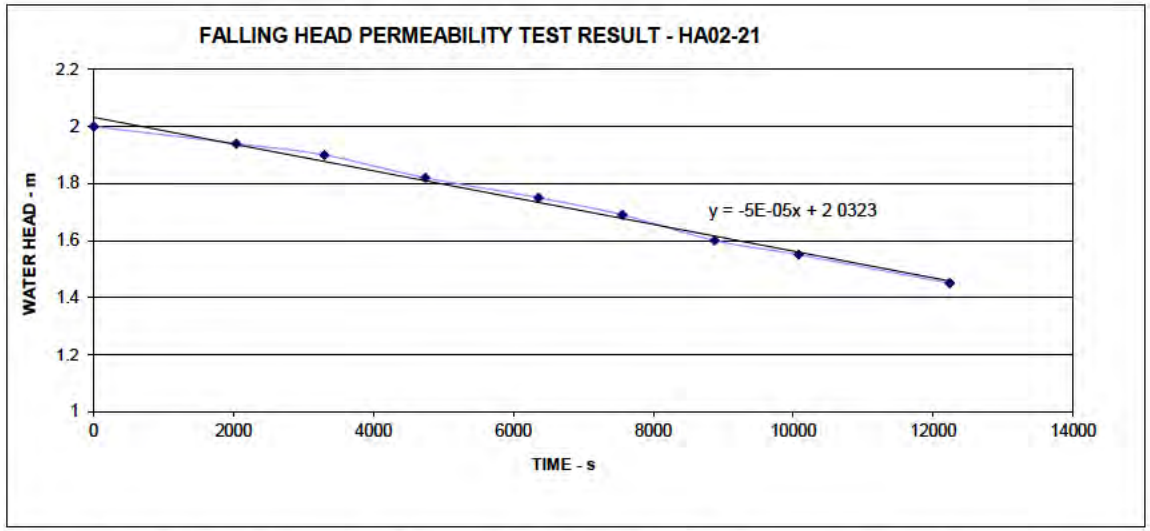

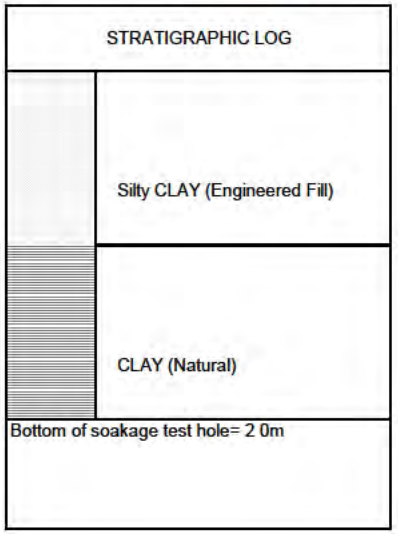

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$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20 0

Elapsed Time (s)	t2 - t1 (secs)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
2040	2040	1.94	1.97	0.01	3.16E-07	2.73E-02
3300	1260	1.9	1.92	0.01	3.50E-07	3 02E-02
4740	1440	1.82	1.86	0.02	6.32E-07	5.46E-02
6360	1620	1.75	1.79	0.02	5.12E-07	4.42E-02
7560	1200	1.69	1.72	0.02	6.14E-07	5 30E-02
8880	1320	1.6	1.65	0.02	8.74E-07	7 55E-02
10080	1200	1.55	1.58	0.01	5.57E-07	4 81E-02
12240	2160	1.45	1.50	0.03	6.49E-07	5.61E-02
				Average =	5.63E-07	4 86E-02

CLIENT	Neil Construction Limited
PROJECT	Kauri Road, Whenuapai
LOCATION	Whenuapai
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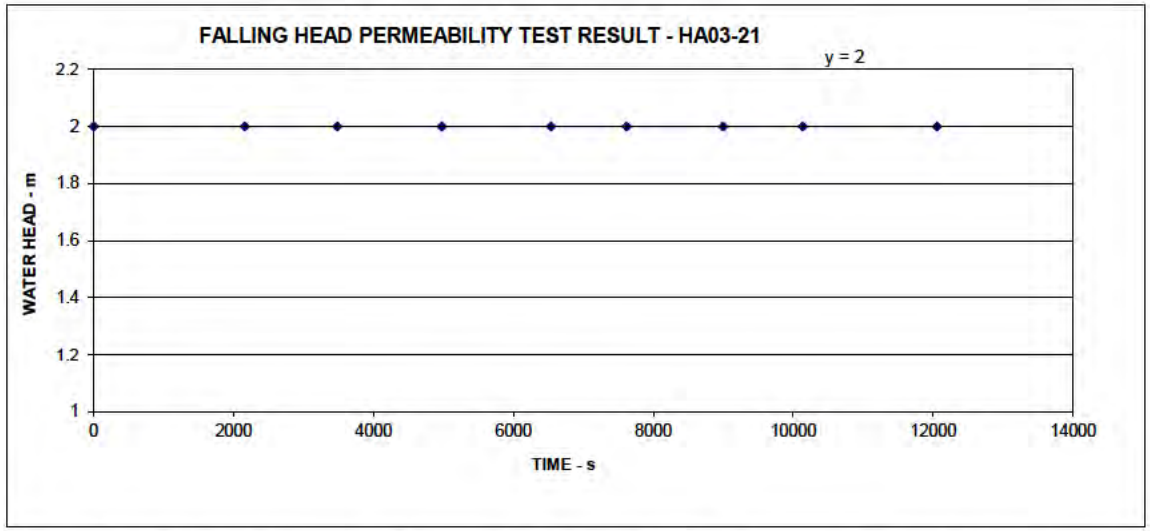

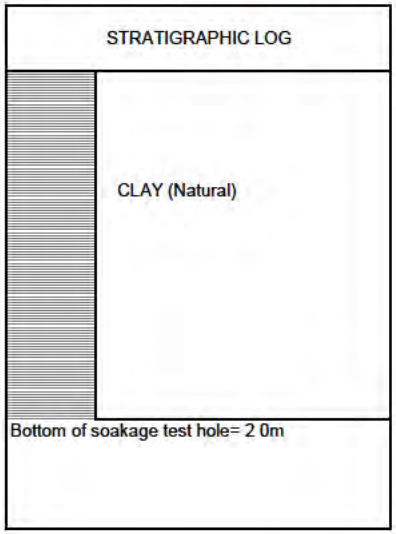

Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Report No. 113)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h + 1}\right)}{(t_2 - t_1)} \right) \times l$

where l = average piezometric head over chosen time interval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chosen interval (m)

h_2 = piezometric head at end of chosen interval (m)

$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20 0

Elapsed Time (s)	t2 - t1 (secs)	Piezometric Head h (m)	l (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
2160	2160	2	2.00	0.00	0.00E+00	0.00E+00
3480	1320	2	2.00	0.00	0.00E+00	0.00E+00
4980	1500	2	2.00	0.00	0.00E+00	0.00E+00
6540	1560	2	2.00	0.00	0.00E+00	0.00E+00
7620	1080	2	2.00	0.00	0.00E+00	0.00E+00
9000	1380	2	2.00	0.00	0.00E+00	0.00E+00
10140	1140	2	2.00	0.00	0.00E+00	0.00E+00
12060	1920	2	2.00	0.00	0.00E+00	0.00E+00
				Average =	0.00E+00	0.00E+00

CLIENT	Neil Construction Limited
PROJECT	Kauri Road, Whenuapai
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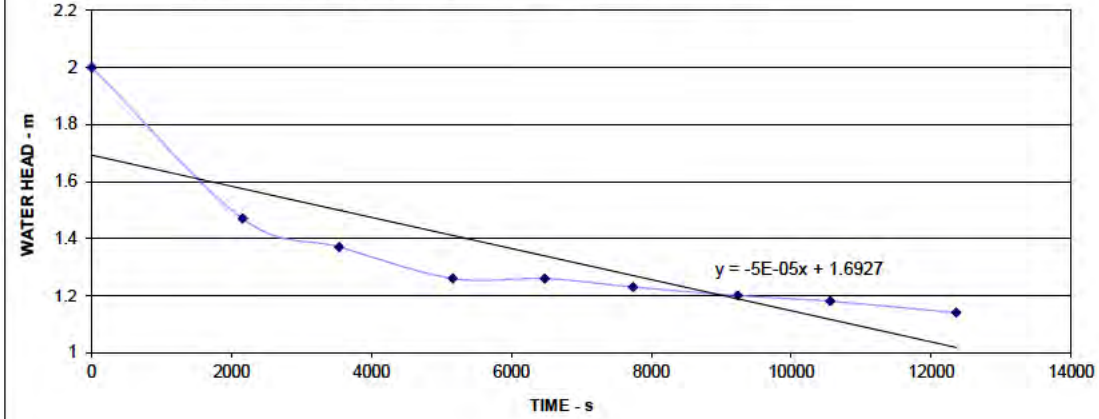
FALLING HEAD PERMEABILITY TEST RESULT - HA04-21



STRATIGRAPHIC LOG

Silty CLAY (Engineered Fill)

Bottom of soakage test hole= 2 0m

Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Report No. 113)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h + 1}\right)}{(t_2 - t_1)} \right) \times I$

where I = average piezometric head over chosen time interval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chosen interval (m)

h_2 = piezometric head at end of chosen interval (m)

$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20 0

Elapsed Time (s)	t2 - t1 (secs)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
2160	2160	1.47	1.74	0.13	3.05E-06	2.64E-01
3540	1380	1.37	1.42	0.03	1.07E-06	9 26E-02
5160	1620	1.26	1.32	0.04	1.08E-06	9 35E-02
6480	1320	1.26	1.26	0.00	0.00E+00	0.00E+00
7740	1260	1.23	1.25	0.01	3.99E-07	3.45E-02
9240	1500	1.2	1.22	0.01	3.43E-07	2 97E-02
10560	1320	1.18	1.19	0.01	2.65E-07	2 29E-02
12360	1800	1.14	1.16	0.01	3.99E-07	3.45E-02
				Average =	8.27E-07	7.14E-02

Project: Kauri Road, Whenuapai		Designed: JW
Client: Neil Construction Limited		Checked:
Project No: AKL2017 -0167	Date: 26/5/21	Page: 1 of 1

CMW Geosciences

Percolation Rate Estimate - Auckland Council Method

$$P_1 = \frac{D \times \text{gradient} \times 1000}{4 \times d}$$

D = diameter of borehole

d = distance between the midpoint of the last two readings and the base of the borehole.

HA01-21(P) = $\frac{0.1 \times 3.030E^{-4} \times 1000}{4 \times 1.985}$

$= 3.816E^{-3}$ L/m²/min

$= 6.36E^{-8}$ m/s = 0.229 mm/hr

HA02-21(P) = $\frac{0.1 \times 2.777E^{-3} \times 1000}{4 \times 1.5}$

$= 0.463$ L/m²/min

$= 7.71E^{-7}$ m/s = 2.78 mm/hr

HA03-21(P) = 0.0 m/s = 0.0 mm/hr

HA04-21(P) = $\frac{0.1 \times 1.333E^{-3} \times 1000}{4 \times 1.16}$

$= 0.0287$ L/m²/min

$= 4.78E^{-7}$ m/s = 1.72 mm/hr