

Our ref: 17-174.01L

FAO Mr William Cartwright
Heritage Planning Design
82 Park Road
Bingley
West Yorkshire
BD16 4EJ

24th November 2017

Dear William,

Re: Land north of Holme House, Oxford Road, Gomersal

Following completion of the site investigation works recently carried out at the above site, please find enclosed the following:

- Exploratory Hole Location Plan
- Soil Permeability Calculation Worksheets (BH's 01, 03 & 04)

As requested by Heritage Planning Design, on behalf of Mr Robert Martin, 3 no. variable head (falling) permeability tests (BH's 01, 03 & 04) were undertaken at the above-mentioned site, the locations of which can be seen on the attached location plan.

These tests were undertaken in order to determine the coefficient of permeability (k) for the underlying deposits present below the site, in order to assess their suitability for the use of soakaways/SUDS. The tests were carried out in general accordance with BS EN ISO 22282:2012, and the permeability coefficient has been calculated using the Hvorslev method, with the results of the tests undertaken summarised in Table 1.0 below, whilst the permeability calculation sheets and graphical representations are attached with this report.

Table 1

<u>Position</u>	<u>Test Zone (m)</u>	<u>Coefficient of Permeability, k (ms⁻¹)</u>	<u>Permeability Classification</u>
BH01	2.00	6.12 x 10 ⁻⁰⁷	Low
BH03	1.00	1.06 x 10 ⁻⁰⁷	Low
BH04	1.00	1.14 x 10 ⁻⁰⁸	Very Low

As can be seen from the results, permeability values have been calculated which indicate very low and low permeability classifications, and the above calculated coefficients of permeability can be used for preliminary design purposes.

We trust the above and attachments are to your satisfaction, and if you require any further information or clarification please do not hesitate to contact us.

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Yours sincerely,
for and on behalf of Arc Environmental Limited

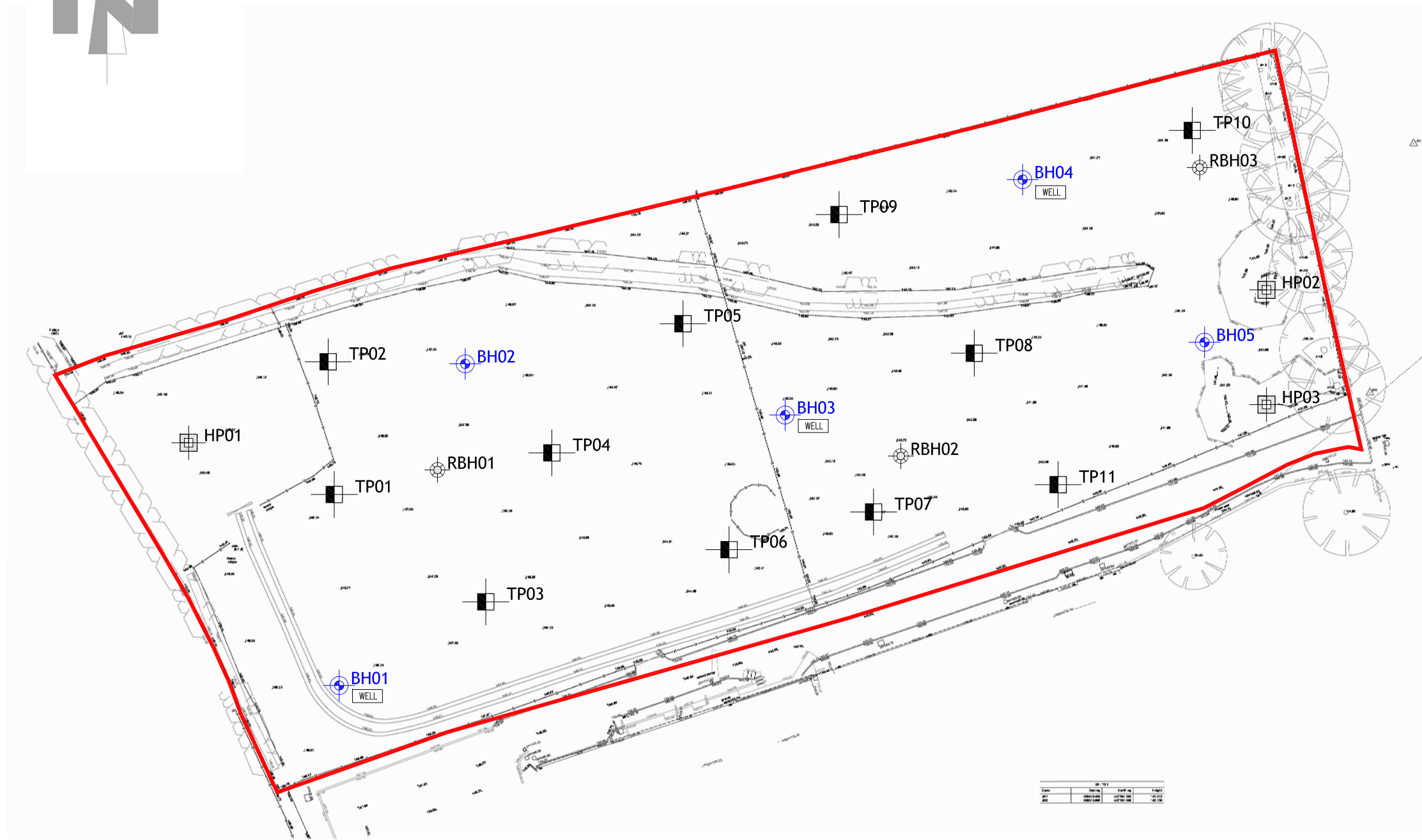
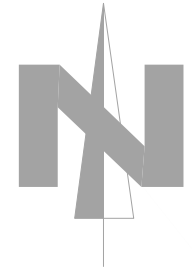
A handwritten signature in black ink, appearing to read 'R Stripp', written over a dotted line.

Richard Stripp *B.Sc. (Hons) M.Sc. FGS*
Associate

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Exploratory Hole Location Plan



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The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
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LEGEND	
	MECHANICALLY EXCAVATED TRIAL PIT POSITION
	WINDOWLESS SAMPLING BOREHOLE POSITION
	COMBINED GAS & GROUNDWATER MONITORING WELL INSTALLED
	MANUALLY EXCAVATED TRIAL PIT (CONTAMINATION)
	ROTARY BOREHOLE POSITION

rev.	date	amendments	drawn	chckd

Client:
MR ROBERT MARTIN

Project Title:
 Land North of Holme House Residential Home
 Oxford Road, Gomersal, Cleckheaton
 West Yorkshire, BD19 4LA

Drawing Title:
 Trial Pit & Borehole Location Plan (Existing)

Scale at A3: NTS @ A3	Date: 27.07.17	Drawn by: R.S	Approved by: R.S
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Job Ref: 17-174	Drg no: -	Rev: -
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Variable Head (Falling) Permeability Test Calculation Sheets

ARC ENVIRONMENTAL LIMITED

VARIABLE HEAD PERMEABILITY TEST

Variable Head (Falling) Permeability Test in Borehole BH01

3.00 mBGL

SITE Land north of Holme House, Oxford Road, Gomersal

CONTRACT 17-174 BOREHOLE BH01 DEPTH 3.00 mBGL

INITIAL CONDITIONS

Bottom of Borehole	3.00	mBGL
Base of casing	1.00	mBGL
Diameter of casing	50.00	mm
Height of casing	0.00	mAGL
Elevation of Borehole		mAOD
Groundwater Level	1.67	mBGL

Operator	KC	
Date	08/11/2017	
Time	11.36am	
Weather	Sunny	
Input volume of water	12	litres
Test Zone	2.00	m

TEST CALCULATION

Elapsed (minutes)	Elapsed (seconds)	Total seconds	Water Depth (m)	Head (metres)	H/Ho
0	0	0	0.03	1.640	1.000
1	0	60	0.10	1.570	0.957
2	0	120	0.15	1.520	0.927
3	0	180	0.36	1.310	0.799
4	0	240	0.49	1.180	0.720
5	0	300	0.60	1.070	0.652
10	0	600	1.02	0.650	0.396
15	0	900	1.15	0.520	0.317
20	0	1200	1.27	0.400	0.244
25	0	1500	1.31	0.360	0.220
30	0	1800	1.34	0.330	0.201
60	0	3600	1.39	0.280	0.171
90	0	5400	1.41	0.260	0.159

Intake Factor (F)

$$F = \frac{2 \pi L}{\text{Log}_e [(L/D) + \sqrt{1 + (L/D)^2}]} \quad (i)$$

L= length of test zone
D= diameter of standpipe

Permeability (k)

$$k = \frac{A}{F \cdot (t_2 - t_1)} \times \text{Log}_e (H_1/H_2) \quad (ii)$$

or

$$k = \frac{A}{FT} \quad (iii)$$

Where T is the Basic Time Lag Factor corresponding to an H/Ho value of 0.37

L= 2.00 m
D= 0.050 m
L/D= 40.00

t₁= 0 s
t₂= 5400 s
H₁= 1.64 m
H₂= 0.26 m

A= 0.00196 m²
F= 2.8676 From (i)

T= 690 s
k= 2.33535E-07 ms⁻¹ From (ii)

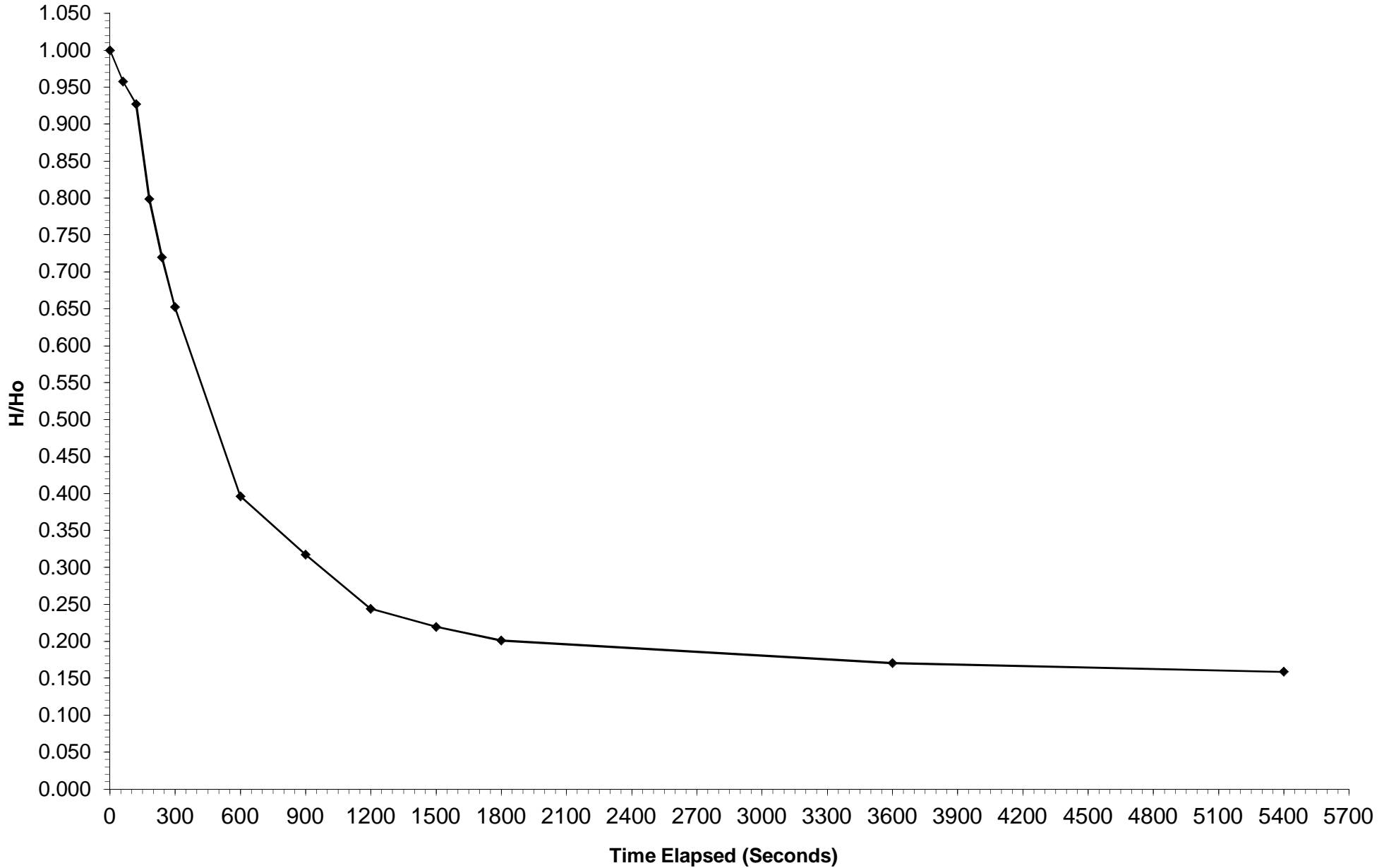
k= 9.92342E-07 ms⁻¹ From (iii)

Ave k= 6.12939E-07

Remarks

Drainage Characteristics: POOR
Permeability Classification: LOW

17-174 - Land north of Holme House, Oxford Road, Gomersal
Variable Head (Falling) Permeability Test in BH01



ARC ENVIRONMENTAL LIMITED

VARIABLE HEAD PERMEABILITY TEST

Variable Head (Falling) Permeability Test in Borehole BH03

2.00 mBGL

SITE Land north of Holme House, Oxford Road, Gomersal

CONTRACT 17-174 BOREHOLE BH03 DEPTH 2.00 mBGL

INITIAL CONDITIONS

Bottom of Borehole	2.00	mBGL	Operator	KC
Base of casing	1.00	mBGL	Date	08/11/2017
Diameter of casing	50.00	mm	Time	12.10pm
Height of casing	0.00	mAGL	Weather	Sunny
Elevation of Borehole		mAOD	Input volume of water	8 litres
Groundwater Level	1.59	mBGL	Test Zone	1.00 m

TEST CALCULATION

TEST CALCULATION	Elapsed (minutes)	Elapsed (seconds)	Total seconds	Water Depth (m)	Head (metres)	H/Ho	
<p><u>Intake Factor (F)</u></p> $F = \frac{2 \pi L}{\text{Log}_e [(L/D) + \sqrt{1 + (L/D)^2}]} \quad (i)$ <p>L= length of test zone D= diameter of standpipe</p>	0	0	0	0.14	1.450	1.000	
	1	0	60	0.16	1.430	0.986	
	2	0	120	0.19	1.400	0.966	
	3	0	180	0.22	1.370	0.945	
	4	0	240	0.25	1.340	0.924	
	5	0	300	0.28	1.310	0.903	
	10	0	600	0.35	1.240	0.855	
	15	0	900	0.40	1.190	0.821	
	20	0	1200	0.46	1.130	0.779	
	25	0	1500	0.49	1.100	0.759	
	30	0	1800	0.53	1.060	0.731	
	60	0	3600	0.64	0.950	0.655	
	90	0	5400	0.71	0.880	0.607	
	<p><u>Permeability (k)</u></p> $k = \frac{A}{F(t_2 - t_1)} \times \text{Log}_e (H_1/H_2) \quad (ii)$ <p>or</p> $k = \frac{A}{FT} \quad (iii)$ <p>Where T is the Basic Time Lag Factor corresponding to an H/Ho value of 0.37</p>						

L= 1.00 m
D= 0.050 m
L/D= 20.00

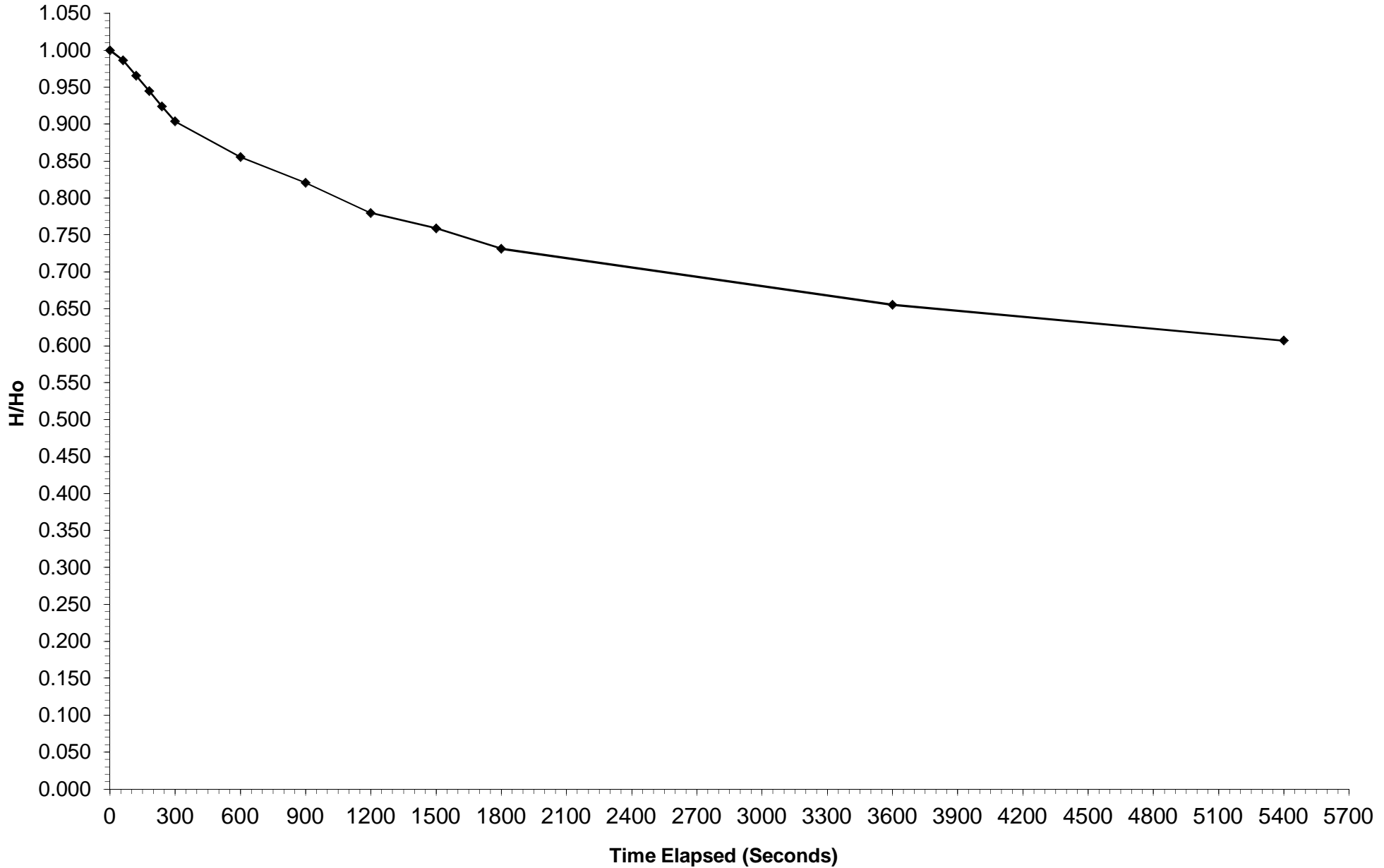
t₁= 0 s
t₂= 5400 s
H₁= 1.45 m
H₂= 0.88 m

A= 0.00196 m²
F= 1.7030 From (i)
T= s
k= 1.06628E-07 ms⁻¹ From (ii)
k= ms⁻¹ From (iii)

Remarks

Drainage Characteristics: POOR
Permeability Classification: LOW

**17-174 - Land north of Holm House, Oxford Road, Gomersal
Variable Head (Falling) Permeability Test in BH03**



ARC ENVIRONMENTAL LIMITED

VARIABLE HEAD PERMEABILITY TEST

Variable Head (Falling) Permeability Test in Borehole BH04

2.00 mBGL

SITE Land north of Holme House, Oxford Road, Gomersal

CONTRACT 17-174 BOREHOLE BH04 DEPTH 2.00 mBGL

INITIAL CONDITIONS

Bottom of Borehole	2.00	mBGL	Operator	KC
Base of casing	1.00	mBGL	Date	08/11/2017
Diameter of casing	50.00	mm	Time	12.45pm
Height of casing	0.00	mAGL	Weather	Sunny
Elevation of Borehole		mAOD	Input volume of water	7 litres
Groundwater Level	1.54	mBGL	Test Zone	1.00 m

TEST CALCULATION

TEST CALCULATION	Elapsed (minutes)	Elapsed (seconds)	Total seconds	Water Depth (m)	Head (metres)	H/Ho	
<p><u>Intake Factor (F)</u></p> $F = \frac{2 \pi L}{\text{Log}_e [(L/D) + \sqrt{1 + (L/D)^2}]} \quad (i)$ <p>L= length of test zone D= diameter of standpipe</p>	0	0	0	0.12	1.420	1.000	
	1	0	60	0.13	1.410	0.993	
	2	0	120	0.14	1.400	0.986	
	3	0	180	0.15	1.390	0.979	
	4	0	240	0.15	1.390	0.979	
	5	0	300	0.15	1.390	0.979	
	10	0	600	0.15	1.390	0.979	
	15	0	900	0.15	1.390	0.979	
	20	0	1200	0.15	1.390	0.979	
	25	0	1500	0.15	1.390	0.979	
	30	0	1800	0.16	1.380	0.972	
	60	0	3600	0.17	1.370	0.965	
	<p><u>Permeability (k)</u></p> $k = \frac{A}{F(t_2 - t_1)} \times \text{Log}_e (H_1/H_2) \quad (ii)$ <p>or</p> $k = \frac{A}{FT} \quad (iii)$ <p>Where T is the Basic Time Lag Factor corresponding to an H/Ho value of 0.37</p>						
	<p>L= 1.00 m D= 0.050 m L/D= 20.00</p> <p>t₁= 0 s t₂= 3600 s H₁= 1.42 m H₂= 1.37 m</p> <p>A= 0.00196 m² F= 1.7030 From (i) T= s k= 1.14804E-08 ms⁻¹ From (ii) k= ms⁻¹ From (iii)</p>						

Remarks

Drainage Characteristics: POOR
Permeability Classification: VERY LOW

17-174 - Land north of Holme House, Oxford Road, Gomersal
Variable Head (Falling) Permeability Test in BH04

