Design Settings

Frequency of use (kDU)	1.00	Minimum Velocity (m/s)	0.75
Flow per dwelling per day (l/day)	7200	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	0.750
Additional Flow (%)	10	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
1	2	147.000	1 REV FW01A5	302693.536	516817.459	0.850
2	1	146.389	1 REV FW01A5	302670.243	516828.525	0.853
3	1	145.740	1 REV FW01A5	302643.306	516805.582	0.850
4	1	145.037	1 REV FW01A5	302620.316	516794.828	0.852
5	2	144.065	1 REV FW01A5	302601.026	516796.565	0.853
6	1	143.654	1 REV FW01A5	302599.559	516815.628	0.849
7		143.511	1 REV FW01A5	302609.180	516834.749	0.984
8	1	142.536	1 REV FW01A5	302597.270	516847.382	0.877
9		142.439	1 REV FW01A5	302612.438	516864.362	1.072
10		141.451	1 REV FW01A5	302606.875	516883.773	0.852
11		141.410	1 REV FW01A5	302675.933	516917.835	1.798
15	1	145.100	1 REV FW01A5	302641.768	516842.241	0.850
20	1	146.150	1 REV FW01A5	302657.545	516849.854	1.600
21	1	143.850	1 REV FW01A5	302640.790	516864.343	0.850
16		144.874	1 REV FW01A5	302654.294	516867.426	2.052
17	3	143.629	1 REV FW01A5	302668.771	516896.618	1.225
18	2	143.369	1 REV FW01A5	302714.430	516886.217	1.565
19		141.882	1 REV FW01A5	302750.580	516880.254	0.858
12		141.372	1 REV FW01A5	302760.402	516882.905	2.947
22	1	147.000	1 REV FW01A5	302712.539	516820.524	0.850
23	1	146.521	1 REV FW01A5	302718.751	516833.343	0.941
24	1	144.877	1 REV FW01A5	302742.684	516841.439	0.981
25		144.350	1 REV FW01A5	302744.575	516835.603	0.863
26	1	143.050	1 REV FW01A5	302765.437	516841.013	0.869
27	1	143.050	1 REV FW01A5	302775.578	516844.882	1.009
28		142.233	1 REV FW01A5	302770.540	516859.683	0.857
29		142.139	1 REV FW01A5	302767.118	516863.884	0.854
13		142.077	1 REV FW01A5	302766.352	516866.133	3.794
14		141.327	1 REV FW01A5	302796.255	516874.329	3.251

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	1	2	25.788	1.500	146.150	145.536	0.614	42.0	100
1.001	2	3	35.383	1.500	145.536	144.890	0.646	54.8	100
1.002	3	4	25.381	1.500	144.890	144.185	0.705	36.0	100
1.003	4	5	19.368	1.500	144.185	143.212	0.973	19.9	100
1.004	5	6	19.119	1.500	143.212	142.805	0.407	47.0	100
1.005	6	7	21.405	1.500	142.805	142.527	0.278	77.0	100
1.006	7	8	17.362	1.500	142.527	141.659	0.868	20.0	100
1.007	8	9	22.768	1.500	141.659	141.367	0.292	78.0	100
1.008	9	10	20.192	1.500	141.367	140.599	0.768	26.3	100
1.009	10	11	77.002	1.500	140.599	139.612	0.987	78.0	100

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Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.010	11	12	91.406	1.500	139.612	138.425	1.187	77.0	100
2.000	15	16	28.128	1.500	144.250	142.822	1.428	19.7	100
3.000	20	16	17.870	1.500	144.550	144.020	0.530	33.7	100
4.000	21	16	13.852	1.500	143.000	142.822	0.178	77.8	100
2.001	16	17	32.584	1.500	142.822	142.404	0.418	78.0	100
2.002	17	18	46.830	1.500	142.404	141.804	0.600	78.0	100
2.003	18	19	36.639	1.500	141.804	141.024	0.780	47.0	100
2.004	19	12	10.174	1.500	141.024	140.516	0.509	20.0	100
1.011	12	13	17.796	1.500	138.425	138.283	0.142	125.3	100
5.000	22	23	14.245	1.500	146.150	145.580	0.570	25.0	100
5.001	23	24	25.266	1.500	145.580	143.896	1.684	15.0	100
5.002	24	25	6.135	1.500	143.896	143.487	0.409	15.0	100
5.003	25	26	21.552	1.500	143.487	142.181	1.306	16.5	100
5.004	26	27	10.854	1.500	142.181	142.041	0.140	77.5	100
5.005	27	28	15.635	1.500	142.041	141.376	0.665	23.5	100
5.006	28	29	5.419	1.500	141.376	141.285	0.090	60.0	100
5.007	29	13	2.376	1.500	141.285	141.217	0.068	35.0	100
1.012	13	14	31.006	1.500	138.283	138.076	0.207	149.8	100

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	25.788	42.0	100	1 REV FW01A5	147.000	146.150	0.750	146.389	145.536	0.753
1.001	35.383	54.8	100	1 REV FW01A5	146.389	145.536	0.753	145.740	144.890	0.750
1.002	25.381	36.0	100	1 REV FW01A5	145.740	144.890	0.750	145.037	144.185	0.752
1.003	19.368	19.9	100	1 REV FW01A5	145.037	144.185	0.752	144.065	143.212	0.753
1.004	19.119	47.0	100	1 REV FW01A5	144.065	143.212	0.753	143.654	142.805	0.749
1.005	21.405	77.0	100	1 REV FW01A5	143.654	142.805	0.749	143.511	142.527	0.884
1.006	17.362	20.0	100	1 REV FW01A5	143.511	142.527	0.884	142.536	141.659	0.777
1.007	22.768	78.0	100	1 REV FW01A5	142.536	141.659	0.777	142.439	141.367	0.972
1.008	20.192	26.3	100	1 REV FW01A5	142.439	141.367	0.972	141.451	140.599	0.752
1.009	77.002	78.0	100	1 REV FW01A5	141.451	140.599	0.752	141.410	139.612	1.698
1.010	91.406	77.0	100	1 REV FW01A5	141.410	139.612	1.698	141.372	138.425	2.847
2.000	28.128	19.7	100	1 REV FW01A5	145.100	144.250	0.750	144.874	142.822	1.952
3.000	17.870	33.7	100	1 REV FW01A5	146.150	144.550	1.500	144.874	144.020	0.754

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	450	Manhole	1 REV FW01A5	2	450	Manhole	1 REV FW01A5
1.001	2	450	Manhole	1 REV FW01A5	3	450	Manhole	1 REV FW01A5
1.002	3	450	Manhole	1 REV FW01A5	4	450	Manhole	1 REV FW01A5
1.003	4	450	Manhole	1 REV FW01A5	5	540	Manhole	1 REV FW01A5
1.004	5	540	Manhole	1 REV FW01A5	6	450	Manhole	1 REV FW01A5
1.005	6	450	Manhole	1 REV FW01A5	7	450	Manhole	1 REV FW01A5
1.006	7	450	Manhole	1 REV FW01A5	8	450	Manhole	1 REV FW01A5
1.007	8	450	Manhole	1 REV FW01A5	9	450	Manhole	1 REV FW01A5
1.008	9	450	Manhole	1 REV FW01A5	10	450	Manhole	1 REV FW01A5
1.009	10	450	Manhole	1 REV FW01A5	11	450	Manhole	1 REV FW01A5
1.010	11	450	Manhole	1 REV FW01A5	12	1200	Manhole	1 REV FW01A5
2.000	15	450	Manhole	1 REV FW01A5	16	450	Manhole	1 REV FW01A5
3.000	20	450	Manhole	1 REV FW01A5	16	450	Manhole	1 REV FW01A5

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Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.000	13.852	77.8	100	1 REV FW01A5	143.850	143.000	0.750	144.874	142.822	1.952
2.001	32.584	78.0	100	1 REV FW01A5	144.874	142.822	1.952	143.629	142.404	1.125
2.002	46.830	78.0	100	1 REV FW01A5	143.629	142.404	1.125	143.369	141.804	1.465
2.003	36.639	47.0	100	1 REV FW01A5	143.369	141.804	1.465	141.882	141.024	0.758
2.004	10.174	20.0	100	1 REV FW01A5	141.882	141.024	0.758	141.372	140.516	0.756
1.011	17.796	125.3	100	1 REV FW01A5	141.372	138.425	2.847	142.077	138.283	3.694
5.000	14.245	25.0	100	1 REV FW01A5	147.000	146.150	0.750	146.521	145.580	0.841
5.001	25.266	15.0	100	1 REV FW01A5	146.521	145.580	0.841	144.877	143.896	0.881
5.002	6.135	15.0	100	1 REV FW01A5	144.877	143.896	0.881	144.350	143.487	0.763
5.003	21.552	16.5	100	1 REV FW01A5	144.350	143.487	0.763	143.050	142.181	0.769
5.004	10.854	77.5	100	1 REV FW01A5	143.050	142.181	0.769	143.050	142.041	0.909
5.005	15.635	23.5	100	1 REV FW01A5	143.050	142.041	0.909	142.233	141.376	0.757
5.006	5.419	60.0	100	1 REV FW01A5	142.233	141.376	0.757	142.139	141.285	0.754
5.007	2.376	35.0	100	1 REV FW01A5	142.139	141.285	0.754	142.077	141.217	0.760
1.012	31.006	149.8	100	1 REV FW01A5	142.077	138.283	3.694	141.327	138.076	3.151

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.000	21	450	Manhole	1 REV FW01A5	16	450	Manhole	1 REV FW01A5
2.001	16	450	Manhole	1 REV FW01A5	17	450	Manhole	1 REV FW01A5
2.002	17	450	Manhole	1 REV FW01A5	18	450	Manhole	1 REV FW01A5
2.003	18	450	Manhole	1 REV FW01A5	19	450	Manhole	1 REV FW01A5
2.004	19	450	Manhole	1 REV FW01A5	12	1200	Manhole	1 REV FW01A5
1.011	12	1200	Manhole	1 REV FW01A5	13	1200	Manhole	1 REV FW01A5
5.000	22	450	Manhole	1 REV FW01A5	23	450	Manhole	1 REV FW01A5
5.001	23	450	Manhole	1 REV FW01A5	24	450	Manhole	1 REV FW01A5
5.002	24	450	Manhole	1 REV FW01A5	25	450	Manhole	1 REV FW01A5
5.003	25	450	Manhole	1 REV FW01A5	26	450	Manhole	1 REV FW01A5
5.004	26	450	Manhole	1 REV FW01A5	27	450	Manhole	1 REV FW01A5
5.005	27	450	Manhole	1 REV FW01A5	28	450	Manhole	1 REV FW01A5
5.006	28	450	Manhole	1 REV FW01A5	29	450	Manhole	1 REV FW01A5
5.007	29	450	Manhole	1 REV FW01A5	13	1200	Manhole	1 REV FW01A5
1.012	13	1200	Manhole	1 REV FW01A5	14	2100	Manhole	1 REV FW01A5

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	302693.536	516817.459	147.000	0.850	450				
						0	1.000	146.150	100
2	302670.243	516828.525	146.389	0.853	450	1	1.000	145.536	100
									
						0	1.001	145.536	100
3	302643.306	516805.582	145.740	0.850	450	1	1.001	144.890	100
									
						0	1.002	144.890	100

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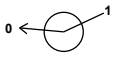
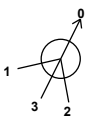
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
4	302620.316	516794.828	145.037	0.852	450		1	1.002	144.185	100
							0	1.003	144.185	100
5	302601.026	516796.565	144.065	0.853	540		1	1.003	143.212	100
							0	1.004	143.212	100
6	302599.559	516815.628	143.654	0.849	450		1	1.004	142.805	100
							0	1.005	142.805	100
7	302609.180	516834.749	143.511	0.984	450		1	1.005	142.527	100
							0	1.006	142.527	100
8	302597.270	516847.382	142.536	0.877	450		1	1.006	141.659	100
							0	1.007	141.659	100
9	302612.438	516864.362	142.439	1.072	450		1	1.007	141.367	100
							0	1.008	141.367	100
10	302606.875	516883.773	141.451	0.852	450		1	1.008	140.599	100
							0	1.009	140.599	100
11	302675.933	516917.835	141.410	1.798	450		1	1.009	139.612	100
							0	1.010	139.612	100
15	302641.768	516842.241	145.100	0.850	450		0	2.000	144.250	100
20	302657.545	516849.854	146.150	1.600	450		0	3.000	144.550	100
21	302640.790	516864.343	143.850	0.850	450		0	4.000	143.000	100
16	302654.294	516867.426	144.874	2.052	450		1	4.000	142.822	100
							2	3.000	144.020	100
							3	2.000	142.822	100
							0	2.001	142.822	100
17	302668.771	516896.618	143.629	1.225	450		1	2.001	142.404	100
							0	2.002	142.404	100

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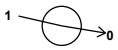
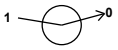
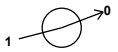
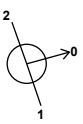
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
18	302714.430	516886.217	143.369	1.565	450	1	2.002	141.804	100
									
						0	2.003	141.804	100
19	302750.580	516880.254	141.882	0.858	450	1	2.003	141.024	100
									
						0	2.004	141.024	100
12	302760.402	516882.905	141.372	2.947	1200	1	2.004	140.516	100
						2	1.010	138.425	100
									
						0	1.011	138.425	100
22	302712.539	516820.524	147.000	0.850	450				
						0	5.000	146.150	100
23	302718.751	516833.343	146.521	0.941	450	1	5.000	145.580	100
									
						0	5.001	145.580	100
24	302742.684	516841.439	144.877	0.981	450	1	5.001	143.896	100
									
						0	5.002	143.896	100
25	302744.575	516835.603	144.350	0.863	450	1	5.002	143.487	100
									
						0	5.003	143.487	100
26	302765.437	516841.013	143.050	0.869	450	1	5.003	142.181	100
									
						0	5.004	142.181	100
27	302775.578	516844.882	143.050	1.009	450	1	5.004	142.041	100
									
						0	5.005	142.041	100
28	302770.540	516859.683	142.233	0.857	450	1	5.005	141.376	100
									
						0	5.006	141.376	100
29	302767.118	516863.884	142.139	0.854	450	1	5.006	141.285	100
									
						0	5.007	141.285	100
13	302766.352	516866.133	142.077	3.794	1200	1	5.007	141.217	100
						2	1.011	138.283	100
									
						0	1.012	138.283	100
14	302796.255	516874.329	141.327	3.251	2100	1	1.012	138.076	100
									

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Site Evolution Ltd

Proposed Housing Development,

Rheda Park North,

Frizington.

Drainage Strategy and Calculations

asher ASSOCIATES

Civil Engineers

Structural Engineers

Project Managers

Document No: AA7281/9/1/1

Asher Associates Ltd

32 George Street

DUMFRIES

DG1 1EH

	Name	Signature	Date
Prepared by	William Milne		20.05.24
Purpose of Issue	**Planning Application**		

20 May 2024

Introduction

This proposed 22-unit development is located on a greenfield site to the West Frizington. The site is a continuation of the 'Beckstones' development completed by Genesis Homes. The proposed site was granted outline planning permission in 2018 (ref: 4/18/2426/0O1). Asher Associates Ltd have been commissioned to prepare designs to discharge reserved matter conditions 4, 7, 9, 10, 15, 16, 17 and 18 of the outline approval.

Site Description

The topography of this site falls from a central crest to the boundaries in north, east and west. The ground surface continues to fall to the north beyond the site boundary and is within the Dub Beck catchment.

The underlying soils are clay to variable depths over gravel and weathered bedrock which is suitable for surface water disposal by infiltration. Infiltration testing was carried out by Geo Environmental Engineering in July 2022. Three of the four tests undertaken were successful. Test 3 was abandoned as it was carried out in the clay layer above the permeable substrate. There will be a SUDS infiltration feature at this location. The bottom of the feature shall be excavated down to the gravel layer allowing infiltration from the base only.

Foul Water Design

The design of the foul drainage network installed in the first phase of the development does not cater for a gravity system in this phase. A private foul network will be installed for phase to and will discharge to an adoptable pumping station in the public open space to the east of the development.

Surface Water Design

The development will be drained via a private network with infiltration SUDS and a flow control before discharging at greenfield rate to a ditch in the Dub Beck catchment. The western part of the development has filter drains along the site boundary to intercept overland flows from the site and prevent them entering adjacent properties.

Surface water run-off from adopted surfaces will be conveyed to infiltration SUDS via highway drains. Due to the site topography, there will be two separate drain runs to the east and west of the central crest. The drain runs will have an infiltration blanket to provide storage and afford disposal. Each drain run will have a high-level overflow connected to the private drainage network for exceedance purposes. Catchpits will be installed upstream of the infiltration features to prevent silting.

Greenfield runoff rates for the development site:

Greenfield runoff rates were calculated using HR Wallingford's Greenfield runoff rate estimation for sites and the following value was obtained for the positively drained site area of 0.704ha. Peak surface water discharge from the site is to be discharged at QBar = 7.88l/s.

Calculations: All calculations are as prescribed by the Wallingford Procedure – 'Modified Rational Method' and use the parameters set out in Design and construction Guidance for foul and surface water sewers version 2.1 as the design criteria. The Causeway Flow application was used to generate various rainfall events with return periods of 1, 30 & 100 years.

The design criteria for the network is as follows:

Design Storm, pipes full	2 year
Design Storm, no flooding	30 year
Flood Risk Assessment	100 year
Minimum velocity, pipe full	1m/sec
Ks roughness value	0.6mm
Time of Entry	5 mins
Contributing Area classification:	
Impervious areas	100%

For all storm simulations the model was set to record a flood risk when manhole surcharge reached a level of 300mm below the cover level. A 40% uplift for climate change was added to the design storms. A further 10% was added to the impervious areas contributing to the proposed networks to allow for urban creep. The model was also run for a 50% climate change uplift in accordance with the South Lakes Management Catchment Peak Rainlfall Allowances.

Where possible, a minimum cover of 1200mm has been applied to pipework under roads and 900mm in open ground. Where cover is less then 1200mm below the road, concrete protection will be applied to pipework.

Critical Storms:

The network was modelled in Causeway Flow to ensure that no flooding is experienced for storms with a return period of up to 30 years and also to establish the critical storms with return periods of 1, 30 and 100 years for use in the network simulation. The critical storms for the network were established during this process and are presented in the Flow calculations.

Network Simulation:

The network including all manholes, pipes, storage features and flow control was simulated for the critical storm events shown in the Causeway Flow calculations.

During the 2-year return period critical storms all flows are contained within the system. Some minor surcharging was experienced at the lowest points in each system during the 2-year return period critical storms.

During the 30-year return period critical storms all flows are contained within the system, some surcharging is evident in the manholes. No flooding is experienced at any point in the system during the 30-year return period critical storms.

No flooding is experienced in the system during the 100-year return period critical storms

Greenfield Runoff Calculation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	William Milne
Site name:	North Park
Site location:	Rheda

Site Details

Latitude:	54.53758° N
Longitude:	3.50531° W
Reference:	3717490634
Date:	May 28 2024 10:46

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.776

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1321	1321
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	7.88	7.88
1 in 1 year (l/s):	6.85	6.85
1 in 30 years (l/s):	13.39	13.39
1 in 100 year (l/s):	16.38	16.38
1 in 200 years (l/s):	18.67	18.67

Percolation Testing Report

Mr Ian Storey
T: 07970 283140
E: ian.storey@siteevolution.co.uk

Site Evolution Limited
14 Pinecroft, Carlisle,
United Kingdom, CA3 0DB

Date: 08.07.2022
Project No: GEO2022-5394
Project Title: Land at Rheda Phase 2 – Soil Infiltration Test Report

Introduction:

Geo Environmental Engineering Ltd (GEO) were commissioned by Mr Ian Storey to carry out soil infiltration tests for the proposed residential development at a site at Rheda, near Frizington, Cumbria.

The site works were completed on the 7th July 2022 and comprised 4 No. trial pits (PT1 to PT4) with in-situ soil infiltration testing (soakaway tests to BRE365 methodology). A copy of the exploratory hole location plan and the trial pit logs are enclosed.

Ground Conditions:

The trial pits typically encountered topsoil overlying sandy tabular/angular gravel of sandstone with cobbles and boulders. PT3 differed in that this location noted topsoil over clay soils. All the trial pits remained dry, with no water ingress noted. All the trial pits were noted as stable.

In-situ Testing:

Soil Infiltration tests were completed in all four trial pits to the BRE365 methodology. This involved partially filling the pits with water and monitoring the water levels until the water had drained sufficiently to calculate a soil infiltration rate. A summary of the results is below:

- PT1: Three tests were completed within PT1 from starting depths of c.0.90m to c.1.00m below ground level, to the base of the trial pit.

  Test 1 took 12 minutes to complete, and this equates to a soil infiltration rate of $1.4x10^{-04}$m/s.
  Test 2 took 16 minutes to complete, and this equates to a soil infiltration rate of $1.1x10^{-04}$m/s.
  Test 3 took 20 minutes to complete, and this equates to a soil infiltration rate of $8.6x10^{-05}$m/s.

  All the above results at PT1 would equate to soil with good drainage characteristics and a medium permeability classification.

- PT2: Three tests were completed within PT2 from starting depths of c.0.35m to c.0.40m below ground level, to the base of the trial pit.

  Test 1 took 60 minutes to complete, and this equates to a soil infiltration rate of $2.9x10^{-05}$m/s.
  Test 2 took 97 minutes to complete, and this equates to a soil infiltration rate of $1.8x10^{-05}$m/s.
  Test 3 took 94 minutes to complete, and this equates to a soil infiltration rate of $1.9x10^{-05}$m/s.

All the above results at PT2 would equate to soil with good drainage characteristics and a medium permeability classification.

- PT3: One test was completed at PT3. The test commenced at c.0.60m below ground level. Following a 300-minute monitoring period the water had only drained c.0.96m in total. This test was considered as a failure as it had not fallen enough during the time allocated for the fieldworks to determine a soil infiltration rate.

- PT4: Three tests were completed within PT4 from starting depths of c.0.45m to c.0.50m below ground level, to the base of the trial pit.

  Test 1 took 30 minutes to complete, and this equates to a soil infiltration rate of $5.8x10^{-05}$m/s.
  Test 2 took 48 minutes to complete, and this equates to a soil infiltration rate of $3.6x10^{-05}$m/s.
  Test 3 took 56 minutes to complete, and this equates to a soil infiltration rate of $3.1x10^{-05}$m/s.

  All the above results would equate to soil with good drainage characteristics and a medium permeability classification.

The results of the tests should therefore be passed to a Civil Engineer to determine an appropriate drainage design.

Exploratory Hole Locations:

A surveyor was present on site to record the trial pit locations, with the details below:

Exploratory Hole	Easting	Northing	Ground Level
PT1	302615.825	516814.448	144.500
PT2	302691.974	516843.717	146.900
PT3	302772.183	516867.664	141.704
PT4	302637.381	516896.808	142.500

General Comments:

Consideration must be made for variations to occur in the ground conditions between the exploratory hole locations for which GEO holds no responsibility. It is therefore recommended that a "watching brief" be applied to ensure that if ground conditions appear to vary from those identified within this investigation, then advice should be sought from a suitably qualified and experienced Geo-Environmental Engineer.

The recommendations and opinions expressed in this report are based on the ground conditions observed. Consequently, GEO takes no responsibility for conditions that have not been revealed or which occur between them.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders, including warranty providers in order to seek their approval of the findings prior to undertaking any development works on site.

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GEO Environmental Engineering Ltd
North West (Registered Office):
4 Culgarth Avenue, Cockermouth, Cumbria CA13 9PL
North East:
19-20 Brenkley Way, Newcastle Upon Tyne, Tyne and Wear, NE13 6DS
Telephone: 01900 826 027
Email: info@geoenvironmentalengineering.com
Website: www.geoenvironmentalengineering.com
Company No.: 07180338
VAT No.: GB 986617072

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If there are any queries, please do not hesitate to contact Geo-Environmental Engineering Ltd.

Yours Faithfully

.....

Curtis R Evans *BSc (Hons), FGS*
Director - Geo Environmental Engineering Limited
Tel: 01900 826 027, Mob: 07883 440 186

GEO Environmental Engineering Ltd
North West (Registered Office):
4 Culgarth Avenue, Cockermouth, Cumbria CA13 9PL
North East:
19-20 Brenkley Way, Newcastle Upon Tyne, Tyne and Wear, NE13 6DS

Telephone: 01900 826 027
Email: info@geoenvironmentalengineering.com
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Company No.: 07180338
VAT No.: GB 986617072

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GEO2022-5394: Rheda Phase 2

Exploratory Hole Location Plan – Approximate Locations – Not to Scale

Website: www.geoenvironmentalengineering.com
Email: info@geoenvironmentalengineering.com
Telephone: 01900 826 027 / 07883 440 186

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GEO2022-5394: Rheda Phase 2 – PT1

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Grass over brown slightly sandy slightly gravelly LOAM(TOPSOIL).		No samples retained
0.20	1.70	Brown slightly clayey angular/tabular GRAVEL of SANDSTONE with occasional cobbles and boulders. 1.70 Difficult to excavate, unable to continue deeper.		Soakaway Test Completed

Log Notes:
End of trial hole at 1.70m.
Trial hole remained open and dry on completion.
Trial hole backfilled with arisings on completion.

Site: Rheda Phase 2
Engineer: CR Evans
Site Works Date: 08/07/2022
Plant: Tracked 360 Excavator supplied by Client

Log Key:
HSV = Hand Shear Vane (kN/m^2)
CBR = California Bearing Ratio (%)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Website: www.geoenvironmentalengineering.com
Email: info@geoenvironmentalengineering.com
Telephone: 01900 826 027 / 07883 440 186

GEO Environmental Engineering

GEO2022-5394: Rheda Phase 2 – PT2

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.25	TOPSOIL: Grass over brown slightly sandy slightly gravelly LOAM(TOPSOIL).		No samples retained
0.25	1.15	Brown angular/tabular GRAVEL of SANDSTONE with occasional cobbles and boulders. 1.15 Difficult to excavate, unable to continue deeper.		Soakaway Test Completed

Log Notes:
End of trial hole at 1.70m.
Trial hole remained open and dry on completion.
Trial hole backfilled with arisings on completion.

Site: Rheda Phase 2
Engineer: CR Evans
Site Works Date: 08/07/2022
Plant: Tracked 360 Excavator supplied by Client

Log Key:
HSV = Hand Shear Vane (kN/m^2)
CBR = California Bearing Ratio (%)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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Telephone: 01900 826 027 / 07883 440 186

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GEO2022-5394: Rheda Phase 2 – PT3

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	TOPSOIL: Grass over brown slightly sandy slightly gravelly LOAM(TOPSOIL).		No samples retained
0.30	2.30	Red brown slightly sandy slightly gravelly CLAY.		Soakaway Test Completed

Log Notes:
End of trial hole at 2.30m.
Trial hole remained open and dry on completion.
Trial hole backfilled with arisings on completion.

Site: Rheda Phase 2
Engineer: CR Evans
Site Works Date: 08/07/2022
Plant: Tracked 360 Excavator supplied by Client

Log Key:
HSV = Hand Shear Vane (kN/m^2)
CBR = California Bearing Ratio (%)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Website: www.geoenvironmentalengineering.com
Email: info@geoenvironmentalengineering.com
Telephone: 01900 826 027 / 07883 440 186

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GEO2022-5394: Rheda Phase 2 – PT4

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	TOPSOIL: Grass over brown slightly sandy slightly gravelly LOAM(TOPSOIL).		No samples retained
0.30	1.30	Brown slightly clayey angular/tabular GRAVEL of SANDSTONE with occasional cobbles and boulders. 1.30 Difficult to excavate, unable to continue deeper.		Soakaway Test Completed

Log Notes:
End of trial hole at 1.30m.
Trial hole remained open and dry on completion.
Trial hole backfilled with arisings on completion.

Site: Rheda Phase 2
Engineer: CR Evans
Site Works Date: 08/07/2022
Plant: Tracked 360 Excavator supplied by Client

Log Key:
HSV = Hand Shear Vane (kN/m^2)
CBR = California Bearing Ratio (%)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Website: www.geoenvironmentalengineering.com
Email: info@geoenvironmentalengineering.com
Telephone: 01900 826 027 / 07883 440 186

GEO2022-5394: Rheda Phase 2 – Site Works Photographs

Website: www.geoenvironmentalengineering.com
Email: info@geoenvironmentalengineering.com
Telephone: 01900 826 027 / 07883 440 186

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SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	**Land at Rheda (Phase 2)**
JOB NO:	**2022-5394**
TRIAL PIT:	**PT1**
TEST NO.:	**1**

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	**350**	mm
Length	**1400**	mm
Depth of hole	**1700**	mm
Change Water Level	**700**	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	12	0	720	1700
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: **1**

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = **0.1715** m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = **1.715** m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = **720** secs

Soil Infiltration rate:

f = **1.4E-04** m/s

GEO Environmental Engineering

SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	**Land at Rheda (Phase 2)**
JOB NO:	**2022-5394**
TRIAL PIT:	**PT1**
TEST NO.:	**2**

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	**350**	mm
Length	**1400**	mm
Depth of hole	**1700**	mm
Change Water Level	**800**	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	16	0	960	1700
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: **2**

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = **0.196** m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = **1.89** m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = **960** secs

Soil Infiltration rate:

f = **1.1E-04** m/s

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SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	Land at Rheda (Phase 2)
JOB NO:	2022-5394
TRIAL PIT:	PT1
TEST NO.:	3

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	350	mm
Length	1400	mm
Depth of hole	1700	mm
Change Water Level	800	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	20	0	1200	1700
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: 3

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = 0.196 m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = 1.89 m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = 1200 secs

Soil Infiltration rate:

f = 8.6E-05 m/s

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SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	Land at Rheda (Phase 2)
JOB NO:	2022-5394
TRIAL PIT:	PT2
TEST NO.:	1

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	350	mm
Length	1500	mm
Depth of hole	1150	mm
Change Water Level	750	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	60	0	3600	1150
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: 1

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = 0.196875 m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = 1.9125 m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = 3600 secs

Soil Infiltration rate:

f = 2.9E-05 m/s

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SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	**Land at Rheda (Phase 2)**
JOB NO:	**2022-5394**
TRIAL PIT:	**PT2**
TEST NO.:	**2**

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	**350**	mm
Length	**1500**	mm
Depth of hole	**1150**	mm
Change Water Level	**750**	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	97	0	5820	1150
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: **2**

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = **0.196875** m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = **1.9125** m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = **5820** secs

Soil Infiltration rate:

f = **1.8E-05** m/s

GEO Environmental Engineering

SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	**Land at Rheda (Phase 2)**
JOB NO:	**2022-5394**
TRIAL PIT:	**PT2**
TEST NO.:	**3**

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	**350**	mm
Length	**1500**	mm
Depth of hole	**1150**	mm
Change Water Level	**800**	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	94	0	5640	1150
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: **3**

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = **0.21** m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = **2.005** m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = **5640** secs

Soil Infiltration rate:

f = **1.9E-05** m/s

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SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	Land at Rheda (Phase 2)
JOB NO:	2022-5394
TRIAL PIT:	PT4
TEST NO.:	1

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	350	mm
Length	1400	mm
Depth of hole	1300	mm
Change Water Level	800	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	30	0	1800	1300
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: 1

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = 0.196 m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = 1.89 m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = 1800 secs

Soil Infiltration rate:

f = 5.8E-05 m/s

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SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	**Land at Rheda (Phase 2)**
JOB NO:	**2022-5394**
TRIAL PIT:	**PT4**
TEST NO.:	**2**

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	**350**	mm
Length	**1400**	mm
Depth of hole	**1300**	mm
Change Water Level	**800**	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	48	0	2880	1300
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: **2**

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = **0.196** m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = **1.89** m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = **2880** secs

Soil Infiltration rate:

f = **3.6E-05** m/s

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SOIL INFILTRATION TEST CALCULATION SHEET

SITE:	**Land at Rheda (Phase 2)**
JOB NO:	**2022-5394**
TRIAL PIT:	**PT4**
TEST NO.:	**3**

GROUND CONDITIONS: See Trial Pit Logs for Details

TEST HOLE SIZE:

Width	**350**	mm
Length	**1400**	mm
Depth of hole	**1300**	mm
Change Water Level	**850**	mm

MONITORING RESULTS:

Recorded Time			Total Time (secs)	Depth of water (mm)
Hours	Minutes	Seconds		
0	0	0	0	0
0	56	0	3360	1300
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	
0		0	0	

PERCOLATION TEST RESULTS AND SOIL INFILTRATION ASSESSMENT

TEST NO.: **3**

SOIL INFILTRATION RATE ASSESSMENT:

Vol. Outflowing between 75% and 25% effective depth:

V_{p75-25} = **0.20825** m^3

Mean surface area (pit sides to 50% effective depth + base of pit):

A_{p50} = **1.9775** m^2

Time for the outflow between 75% and 25% effective depth:

t_{p75-25} = **3360** secs

Soil Infiltration rate:

f = **3.1E-05** m/s

End of Report

GEO Environmental Engineering Ltd
North West (Registered Office):
4 Culgarth Avenue, Cockermouth, Cumbria CA13 9PL
North East:
19-20 Brenkley Way, Newcastle Upon Tyne, Tyne and Wear, NE13 6DS

Telephone: 01900 826 027
Email: info@geoenvironmentalengineering.com
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