

PROPOSED HOUSING DEVELOPMENT

WHARNCLIFFE ARMS

CARLTON

BARNSELY

DRAINAGE REPORT



1. INTRODUCTION

This report provides the background calculations for the surface water drainage design for the proposed development adjacent to the Wharnccliffe Arms, Carlton, Barnsley.

It should be read with the Drainage Strategy Report and Percolation test results, revision A dated 08/11/2016.

The report should be read with the drainage design drawings, YH374/HD/1 and 4.

The highway details are covered with a separate report and calculations.

2. DESIGN PHILOSOPHY

The development site, as outlined within the drainage strategy report, will be drained using infiltration methods. These will be either permeable paving or standard lined soakaways, dependant on house and site layout. In some cases, it has been possible to use the additional hydraulic capacity within the permeable pavements to allow connection of rainwater pipes from roofs.

Foul water and surface water will have separate systems on site and the foul drainage will connect to the public sewerage system.

3. DESIGN STANDARDS

The design of the infiltration systems has been based on The SuDS Manual (CIRIA Publication C753) and also the Guide to the Design, Construction and Maintenance of Concrete Block Permeable Pavements, published by Interpave.

The following design parameters were used in the design.

Return Period 1 in 100 year storm event.

Climate Change + 30% added to rainfall.

Urban Creep +10% added to paved areas/roofs

The industry standard microdrainage drainage software has been used to design each infiltration system. Using the following parameters.

M5-60 = 19MM

R= 0.363



4. MICRODRAINAGE CALCULATIONS

- PLOTS 1 , 2 , 3, 4, 5 and 6

Roofs to lined soakaways. Roof areas = 47sq m + 10% = 51.7 sq m

Infiltration Coefficient = 0.006m/hr

1.5m diameter soakaway, 1.8m depth satisfactory.

Driveways standard permeable paving. (250mm depth of course aggregate).

Calculations appended to rear of report.

- PLOTS 7-10

Rear rwps to soakaways. Each roof area = 38sq m +10% = 41.8sq m

Infiltration Coefficient = 0.006m/hr

1.2m diameter soakaway, 1.8m depth satisfactory.

Driveways to front to be permeable paving and allowing discharge from front rwp's.

Permeable paving area = 25 sq m Roof area = 39 +10% = 43 sq m Total contributing area = 68sq m.

Fall on driveway = 1 in 20

Infiltration Coefficient = 0.027m/hr

350mm course graded aggregate. Calculations with volume capped at 350mm deep.

Calculations appended to rear of report.

- PLOTS 11 and 12

Driveways to be permeable paving and allowing discharge from rwp's.

Permeable paving area = 37 sq m Roof area = 47 +10% = 52 sq m Total contributing area = 89sq m.

Fall on driveway = None

Infiltration Coefficient = 0.027m/hr

350mm course graded aggregate. Calculations with volume capped at 350mm deep.

Calculations appended to rear of report.



- PLOTS 13-16

Roofs to lined soakaways. Roof areas = 47sq m + 10% = 51.7 sq m

Infiltration Coefficient = 0.014m/hr

1.2m diameter soakaway, 1.8m depth satisfactory.

Driveways standard permeable paving. (250mm depth of course aggregate).

Calculations appended to rear of report.

- PLOTS 17-24

Driveways to be permeable paving and allowing discharge from rwp's.

Permeable paving area = 23 sq m Roof area = 48 +10% = 53 sq m Total contributing area = 76sq m.

Fall on driveway = None

Infiltration Coefficient = 0.027m/hr

350mm course graded aggregate. Calculations with volume capped at 350mm deep.

Calculations appended to rear of report.

5. EXCEEDENCE AND FLOOD ROUTES

In the unlikely event that the surface water systems floods for any reason, a safe flood route is provided. Any flood water would flow to the east, generally using the proposed highway as a conduit and to the open land to the east.

6. CONCLUSIONS

- This development site can be drained successfully.
- Foul water and surface water will have separate systems on site.
- Foul water flows will be connected to the public sewerage system.
- Surface water from the development will be disposed of by infiltration.

Report by



Hugh Morris BSc CEng MICE

08/11/2016



10 The Green York YO26 5LR 07919 031289

APPENDIX

Infiltration System Calculations.

- Soakaways Plots 1 - 6
- Soakaways Plots 7 - 10
- Permeable Paving Plots 7 - 10
- Permeable Paving Plots 11 - 12
- Soakaways Plots 13 - 16
- Permeable Paving Plots 17 - 24



HM Design

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York
YO26 5LR

SOAKAWAYS PLOTS 1-6

Date 08-11-2016
File PLOT 1.srcx

Designed by HM
Checked by

Micro Drainage

Source Control 2016.1

Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1259 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	61.095	0.395	0.0	1.1	O K
30 min Summer	61.225	0.525	0.0	1.4	O K
60 min Summer	61.362	0.662	0.0	1.8	O K
120 min Summer	61.500	0.800	0.0	2.2	O K
180 min Summer	61.575	0.875	0.0	2.4	O K
240 min Summer	61.622	0.922	0.0	2.5	O K
360 min Summer	61.678	0.978	0.0	2.7	O K
480 min Summer	61.710	1.010	0.0	2.8	O K
600 min Summer	61.728	1.028	0.0	2.8	O K
720 min Summer	61.736	1.036	0.0	2.9	O K
960 min Summer	61.736	1.036	0.0	2.9	O K
1440 min Summer	61.727	1.027	0.0	2.8	O K
2160 min Summer	61.699	0.999	0.0	2.8	O K
2880 min Summer	61.662	0.962	0.0	2.7	O K
4320 min Summer	61.586	0.886	0.0	2.4	O K
5760 min Summer	61.518	0.818	0.0	2.3	O K
7200 min Summer	61.457	0.757	0.0	2.1	O K
8640 min Summer	61.402	0.702	0.0	1.9	O K
10080 min Summer	61.353	0.653	0.0	1.8	O K
15 min Winter	61.142	0.442	0.0	1.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	117.218	0.0	19
30 min Summer	78.317	0.0	34
60 min Summer	49.937	0.0	64
120 min Summer	30.767	0.0	124
180 min Summer	22.850	0.0	182
240 min Summer	18.379	0.0	242
360 min Summer	13.462	0.0	362
480 min Summer	10.795	0.0	482
600 min Summer	9.088	0.0	600
720 min Summer	7.892	0.0	720
960 min Summer	6.311	0.0	876
1440 min Summer	4.597	0.0	1112
2160 min Summer	3.342	0.0	1512
2880 min Summer	2.662	0.0	1928
4320 min Summer	1.929	0.0	2764
5760 min Summer	1.533	0.0	3576
7200 min Summer	1.281	0.0	4392
8640 min Summer	1.107	0.0	5184
10080 min Summer	0.978	0.0	5952
15 min Winter	117.218	0.0	19

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10 The Green York YO26 5LR		SOAKAWAYS PLOTS 1-6			
Date 08-11-2016 File PLOT 1.srcx		Designed by HM Checked by			
Micro Drainage		Source Control 2016.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	61.288	0.588	0.0	1.6	O K
60 min Winter	61.443	0.743	0.0	2.0	O K
120 min Winter	61.600	0.900	0.0	2.5	O K
180 min Winter	61.685	0.985	0.0	2.7	O K
240 min Winter	61.739	1.039	0.0	2.9	O K
360 min Winter	61.805	1.105	0.0	3.0	O K
480 min Winter	61.845	1.145	0.0	3.2	O K
600 min Winter	61.868	1.168	0.0	3.2	O K
720 min Winter	61.881	1.181	0.0	3.3	O K
960 min Winter	61.888	1.188	0.0	3.3	O K
1440 min Winter	61.871	1.171	0.0	3.2	O K
2160 min Winter	61.835	1.135	0.0	3.1	O K
2880 min Winter	61.785	1.085	0.0	3.0	O K
4320 min Winter	61.677	0.977	0.0	2.7	O K
5760 min Winter	61.579	0.879	0.0	2.4	O K
7200 min Winter	61.492	0.792	0.0	2.2	O K
8640 min Winter	61.416	0.716	0.0	2.0	O K
10080 min Winter	61.349	0.649	0.0	1.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	78.317	0.0	33		
60 min Winter	49.927	0.0	64		
120 min Winter	30.767	0.0	122		
180 min Winter	22.850	0.0	180		
240 min Winter	18.379	0.0	238		
360 min Winter	13.462	0.0	356		
480 min Winter	10.795	0.0	470		
600 min Winter	9.088	0.0	584		
720 min Winter	7.892	0.0	694		
960 min Winter	6.311	0.0	912		
1440 min Winter	4.597	0.0	1152		
2160 min Winter	3.342	0.0	1604		
2880 min Winter	2.662	0.0	2076		
4320 min Winter	1.929	0.0	2980		
5760 min Winter	1.533	0.0	3816		
7200 min Winter	1.281	0.0	4680		
8640 min Winter	1.107	0.0	5456		
10080 min Winter	0.978	0.0	6256		
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Micro Drainage Source Control 2016.1		

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change $\pm$	+30

Time Area Diagram

Total Area (ha) 0.005

Time (mins)	Area
From:	To: (ha)
0	4 0.005

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Model Details

Storage is Online Cover Level (m) 62.500

Lined Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00600	Ring Diameter (m)	1.50
Infiltration Coefficient Side (m/hr)	0.00600	Pit Multiplier	1.5
Safety Factor	1.0	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	1.250
Invert Level (m)	60.700	Cap Infiltration Depth (m)	1.250

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Summer</td><td>60.556</td><td>1.256</td><td>0.0</td><td>2.2</td><td>O K</td></tr><tr><td>600 min Summer</td><td>60.576</td><td>1.276</td><td>0.0</td><td>2.2</td><td>O K</td></tr><tr><td>720 min Summer</td><td>60.583</td><td>1.283</td><td>0.0</td><td>2.3</td><td>O K</td></tr><tr><td>960 min Summer</td><td>60.586</td><td>1.286</td><td>0.0</td><td>2.3</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>60.578</td><td>1.278</td><td>0.0</td><td>2.3</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>60.546</td><td>1.246</td><td>0.0</td><td>2.2</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>60.503</td><td>1.203</td><td>0.0</td><td>2.1</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>60.411</td><td>1.111</td><td>0.0</td><td>2.0</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>60.325</td><td>1.025</td><td>0.0</td><td>1.8</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>60.251</td><td>0.951</td><td>0.0</td><td>1.7</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>60.185</td><td>0.885</td><td>0.0</td><td>1.6</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>60.126</td><td>0.826</td><td>0.0</td><td>1.5</td><td>O K</td></tr><tr><td>15 min Winter</td><td>59.653</td><td>0.553</td><td>0.0</td><td>1.0</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>117.218</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>78.317</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>49.927</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>30.767</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>22.850</td><td>0.0</td><td>182</td></tr><tr><td>240 min Summer</td><td>18.379</td><td>0.0</td><td>242</td></tr><tr><td>360 min Summer</td><td>13.462</td><td>0.0</td><td>362</td></tr><tr><td>480 min Summer</td><td>10.795</td><td>0.0</td><td>482</td></tr><tr><td>600 min Summer</td><td>9.088</td><td>0.0</td><td>600</td></tr><tr><td>720 min Summer</td><td>7.892</td><td>0.0</td><td>720</td></tr><tr><td>960 min Summer</td><td>6.311</td><td>0.0</td><td>828</td></tr><tr><td>1440 min Summer</td><td>4.597</td><td>0.0</td><td>1070</td></tr><tr><td>2160 min Summer</td><td>3.342</td><td>0.0</td><td>1472</td></tr><tr><td>2880 min Summer</td><td>2.662</td><td>0.0</td><td>1900</td></tr><tr><td>4320 min Summer</td><td>1.929</td><td>0.0</td><td>2724</td></tr><tr><td>5760 min Summer</td><td>1.533</td><td>0.0</td><td>3520</td></tr><tr><td>7200 min Summer</td><td>1.281</td><td>0.0</td><td>4326</td></tr><tr><td>8640 min Summer</td><td>1.107</td><td>0.0</td><td>5104</td></tr><tr><td>10080 min Summer</td><td>0.978</td><td>0.0</td><td>5944</td></tr><tr><td>15 min Winter</td><td>117.218</td><td>0.0</td><td>19</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	59.794	0.494	0.0	0.9	O K	30 min 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1440 min Summer	4.597	0.0	1070																																																																																																																																																																																																																				
2160 min Summer	3.342	0.0	1472																																																																																																																																																																																																																				
2880 min Summer	2.662	0.0	1900																																																																																																																																																																																																																				
4320 min Summer	1.929	0.0	2724																																																																																																																																																																																																																				
5760 min Summer	1.533	0.0	3520																																																																																																																																																																																																																				
7200 min Summer	1.281	0.0	4326																																																																																																																																																																																																																				
8640 min Summer	1.107	0.0	5104																																																																																																																																																																																																																				
10080 min Summer	0.978	0.0	5944																																																																																																																																																																																																																				
15 min Winter	117.218	0.0	19																																																																																																																																																																																																																				
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HM Design

Page 2

10 The Green
York
YO26 5LR

PLOTS 7-10
SOAKAWAYS TO REAR

Date 08-11-16
File PLOT 7.srcx

Designed by HM
Checked by

Micro Drainage

Source Control 2016.1

Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	60.036	0.736	0.0	1.3	O K
60 min Winter	60.229	0.929	0.0	1.6	O K
120 min Winter	60.424	1.124	0.0	2.0	O K
180 min Winter	60.530	1.230	0.0	2.2	O K
240 min Winter	60.596	1.296	0.0	2.3	O K
360 min Winter	60.675	1.375	0.0	2.4	O K
480 min Winter	60.722	1.422	0.0	2.5	O K
600 min Winter	60.749	1.449	0.0	2.6	O K
720 min Winter	60.763	1.463	0.0	2.6	O K
960 min Winter	60.767	1.467	0.0	2.6	O K
1440 min Winter	60.750	1.450	0.0	2.6	O K
2160 min Winter	60.705	1.405	0.0	2.5	O K
2880 min Winter	60.643	1.343	0.0	2.4	O K
4320 min Winter	60.511	1.211	0.0	2.1	O K
5760 min Winter	60.389	1.089	0.0	1.9	O K
7200 min Winter	60.285	0.985	0.0	1.7	O K
8640 min Winter	60.195	0.895	0.0	1.6	O K
10080 min Winter	60.117	0.817	0.0	1.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	78.317	0.0	33
60 min Winter	49.937	0.0	62
120 min Winter	30.767	0.0	122
180 min Winter	22.850	0.0	180
240 min Winter	18.379	0.0	238
360 min Winter	13.462	0.0	354
480 min Winter	10.795	0.0	468
600 min Winter	9.088	0.0	582
720 min Winter	7.892	0.0	692
960 min Winter	6.311	0.0	902
1440 min Winter	4.597	0.0	1124
2160 min Winter	3.342	0.0	1580
2880 min Winter	2.662	0.0	2044
4320 min Winter	1.929	0.0	2936
5760 min Winter	1.533	0.0	3800
7200 min Winter	1.281	0.0	4608
8640 min Winter	1.107	0.0	5440
10080 min Winter	0.978	0.0	6248

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HM Design		Page 3
10 The Green York YO26 5LR	PLOTS 7-10 SOAKAWAYS TO REAR	
Date 08-11-16 File PLOT 7.srcx	Designed by HM Checked by	
Micro Drainage Source Control 2016.1		

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.004

Time (mins)	Area
From:	To: (ha)
0	4 0.004

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HM Design		Page 4
10 The Green York YO26 5LR	PLOTS 7-10 SOAKAWAYS TO REAR	
Date 08-11-16 File PLOT 7.srcx	Designed by HM Checked by	
Micro Drainage	Source Control 2016.1	

Model Details

Storage is Online Cover Level (m) 61.100

Lined Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00600	Ring Diameter (m)	1.20
Infiltration Coefficient Side (m/hr)	0.00600	Pit Multiplier	1.5
Safety Factor	1.0	Number Required	1
Porosity	0.30	Cap Volume Depth (m)	1.500
Invert Level (m)	59.300	Cap Infiltration Depth (m)	1.500

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HM Design

10 The Green

York

YO26 5LR

Date 08-11-2016

File PP1.srnx

Micro Drainage

Permeable paving to front of plots 7-10 with rwps connected

Designed by HM

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Source Control 2016.1

Page 1



Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 116 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	60.399	0.309	0.2	1.3	O K
30 min Summer	60.452	0.362	0.2	1.7	O K
60 min Summer	60.496	0.406	0.2	2.0	O K
120 min Summer	60.520	0.430	0.2	2.2	Flood Risk
180 min Summer	60.521	0.431	0.2	2.2	Flood Risk
240 min Summer	60.514	0.424	0.2	2.2	Flood Risk
360 min Summer	60.492	0.402	0.2	2.0	O K
480 min Summer	60.471	0.381	0.2	1.8	O K
600 min Summer	60.451	0.361	0.2	1.7	O K
720 min Summer	60.432	0.342	0.2	1.5	O K
960 min Summer	60.398	0.308	0.2	1.3	O K
1440 min Summer	60.350	0.260	0.2	0.9	O K
2160 min Summer	60.308	0.218	0.2	0.7	O K
2880 min Summer	60.278	0.188	0.1	0.5	O K
4320 min Summer	60.237	0.147	0.1	0.3	O K
5760 min Summer	60.211	0.121	0.1	0.2	O K
7200 min Summer	60.193	0.103	0.1	0.1	O K
8640 min Summer	60.180	0.090	0.1	0.1	O K
10080 min Summer	60.170	0.080	0.1	0.1	O K
15 min Winter	60.423	0.323	0.2	1.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	117.218	0.0	18
30 min Summer	78.317	0.0	32
60 min Summer	49.937	0.0	60
120 min Summer	30.767	0.0	102
180 min Summer	22.850	0.0	134
240 min Summer	18.379	0.0	168
360 min Summer	13.462	0.0	236
480 min Summer	10.795	0.0	304
600 min Summer	9.088	0.0	368
720 min Summer	7.892	0.0	434
960 min Summer	6.311	0.0	558
1440 min Summer	4.597	0.0	792
2160 min Summer	3.342	0.0	1148
2880 min Summer	2.662	0.0	1500
4320 min Summer	1.929	0.0	2208
5760 min Summer	1.533	0.0	2944
7200 min Summer	1.281	0.0	3672
8640 min Summer	1.107	0.0	4400
10080 min Summer	0.978	0.0	5136
15 min Winter	117.218	0.0	18

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HM Design				Page 2	
10 The Green York YO26 5LR		Permeable paving to front of plots 7-10 with rwps connected			
Date 08-11-2016 File PP1.srcx		Designed by HM Checked by			
Micro Drainage		Source Control 2016.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	60.483	0.393	0.2	1.9	O K
60 min Winter	60.545	0.455	0.2	2.3	Flood Risk
120 min Winter	60.586	0.496	0.2	2.5	Flood Risk
180 min Winter	60.582	0.492	0.2	2.5	Flood Risk
240 min Winter	60.567	0.477	0.2	2.5	Flood Risk
360 min Winter	60.526	0.436	0.2	2.2	Flood Risk
480 min Winter	60.490	0.400	0.2	2.0	O K
600 min Winter	60.458	0.368	0.2	1.7	O K
720 min Winter	60.430	0.340	0.2	1.5	O K
960 min Winter	60.380	0.290	0.2	1.2	O K
1440 min Winter	60.325	0.235	0.2	0.8	O K
2160 min Winter	60.275	0.185	0.1	0.5	O K
2880 min Winter	60.242	0.152	0.1	0.3	O K
4320 min Winter	60.203	0.113	0.1	0.2	O K
5760 min Winter	60.180	0.090	0.1	0.1	O K
7200 min Winter	60.165	0.075	0.1	0.1	O K
8640 min Winter	60.155	0.065	0.0	0.1	O K
10080 min Winter	60.147	0.057	0.0	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	78.317	0.0	32		
60 min Winter	49.937	0.0	60		
120 min Winter	30.767	0.0	114		
180 min Winter	22.850	0.0	144		
240 min Winter	18.379	0.0	182		
360 min Winter	13.462	0.0	258		
480 min Winter	10.795	0.0	328		
600 min Winter	9.088	0.0	398		
720 min Winter	7.892	0.0	462		
960 min Winter	6.311	0.0	578		
1440 min Winter	4.597	0.0	810		
2160 min Winter	3.342	0.0	1168		
2880 min Winter	2.662	0.0	1524		
4320 min Winter	1.929	0.0	2208		
5760 min Winter	1.533	0.0	2936		
7200 min Winter	1.281	0.0	3672		
8640 min Winter	1.107	0.0	4392		
10080 min Winter	0.978	0.0	5136		
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HM Design		Page 4																								
10 The Green York YO26 5LR	Permeable paving to front of plots 7-10 with rwps connected																									
Date 08-11-2016 File PPl.srcx	Designed by HM Checked by																									
Micro Drainage Source Control 2016.1																										
<u>Model Details</u> Storage is Online Cover Level (m) 60.650 <u>Porous Car Park Structure</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.02700</td> <td>Width (m)</td> <td>4.6</td> </tr> <tr> <td>Membrane Percolation (mm/hr)</td> <td>1000</td> <td>Length (m)</td> <td>5.4</td> </tr> <tr> <td>Max Percolation (l/s)</td> <td>6.9</td> <td>Slope (1:X)</td> <td>20.0</td> </tr> <tr> <td>Safety Factor</td> <td>1.0</td> <td>Depression Storage (mm)</td> <td>5</td> </tr> <tr> <td>Porosity</td> <td>0.30</td> <td>Evaporation (mm/day)</td> <td>3</td> </tr> <tr> <td>Invert Level (m)</td> <td>60.090</td> <td>Cap Volume Depth (m)</td> <td>0.350</td> </tr> </table>			Infiltration Coefficient Base (m/hr)	0.02700	Width (m)	4.6	Membrane Percolation (mm/hr)	1000	Length (m)	5.4	Max Percolation (l/s)	6.9	Slope (1:X)	20.0	Safety Factor	1.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	60.090	Cap Volume Depth (m)	0.350
Infiltration Coefficient Base (m/hr)	0.02700	Width (m)	4.6																							
Membrane Percolation (mm/hr)	1000	Length (m)	5.4																							
Max Percolation (l/s)	6.9	Slope (1:X)	20.0																							
Safety Factor	1.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	60.090	Cap Volume Depth (m)	0.350																							
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HM Design		Page 4																								
10 The Green York YO26 5LR	Permeable paving to front of plots 7-10 with rwps connected																									
Date 08-11-2016 File PPl.srcx	Designed by HM Checked by																									
Micro Drainage Source Control 2016.1																										
<u>Model Details</u> Storage is Online Cover Level (m) 60.650 <u>Porous Car Park Structure</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.02700</td> <td>Width (m)</td> <td>4.6</td> </tr> <tr> <td>Membrane Percolation (mm/hr)</td> <td>1000</td> <td>Length (m)</td> <td>5.4</td> </tr> <tr> <td>Max Percolation (l/s)</td> <td>6.9</td> <td>Slope (1:X)</td> <td>20.0</td> </tr> <tr> <td>Safety Factor</td> <td>1.0</td> <td>Depression Storage (mm)</td> <td>5</td> </tr> <tr> <td>Porosity</td> <td>0.30</td> <td>Evaporation (mm/day)</td> <td>3</td> </tr> <tr> <td>Invert Level (m)</td> <td>60.090</td> <td>Cap Volume Depth (m)</td> <td>0.350</td> </tr> </table>			Infiltration Coefficient Base (m/hr)	0.02700	Width (m)	4.6	Membrane Percolation (mm/hr)	1000	Length (m)	5.4	Max Percolation (l/s)	6.9	Slope (1:X)	20.0	Safety Factor	1.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	60.090	Cap Volume Depth (m)	0.350
Infiltration Coefficient Base (m/hr)	0.02700	Width (m)	4.6																							
Membrane Percolation (mm/hr)	1000	Length (m)	5.4																							
Max Percolation (l/s)	6.9	Slope (1:X)	20.0																							
Safety Factor	1.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	60.090	Cap Volume Depth (m)	0.350																							
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HM Design				Page 1	
10 The Green York YO26 5LR		PLOTS 11 AND 12 Permeable paving with rwps connected.			
Date 08-11-16 File PP-PLOT 11&12.srcx		Designed by HM Checked by			
Micro Drainage		Source Control 2016.1			
Summary of Results for 100 year Return Period (+30%)					
Half Drain Time : 90 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	59.651	0.141	0.3	1.6	O K
30 min Summer	59.695	0.185	0.3	2.1	O K
60 min Summer	59.728	0.218	0.3	2.5	O K
120 min Summer	59.740	0.230	0.3	2.6	O K
180 min Summer	59.737	0.227	0.3	2.6	O K
240 min Summer	59.728	0.218	0.3	2.5	O K
360 min Summer	59.705	0.195	0.3	2.2	O K
480 min Summer	59.682	0.172	0.3	2.0	O K
600 min Summer	59.661	0.151	0.3	1.7	O K
720 min Summer	59.641	0.131	0.3	1.5	O K
960 min Summer	59.608	0.098	0.3	1.1	O K
1440 min Summer	59.567	0.057	0.3	0.6	O K
2160 min Summer	59.551	0.041	0.2	0.5	O K
2880 min Summer	59.543	0.033	0.2	0.4	O K
4320 min Summer	59.535	0.025	0.1	0.3	O K
5760 min Summer	59.530	0.020	0.1	0.2	O K
7200 min Summer	59.526	0.016	0.1	0.2	O K
8640 min Summer	59.524	0.014	0.1	0.2	O K
10080 min Summer	59.523	0.013	0.1	0.1	O K
15 min Winter	59.672	0.162	0.3	1.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
15 min Summer	117.218	0.0	18		
30 min Summer	78.317	0.0	32		
60 min Summer	49.937	0.0	60		
120 min Summer	30.767	0.0	94		
180 min Summer	22.850	0.0	128		
240 min Summer	18.379	0.0	162		
360 min Summer	13.462	0.0	230		
480 min Summer	10.795	0.0	296		
600 min Summer	9.088	0.0	360		
720 min Summer	7.892	0.0	420		
960 min Summer	6.311	0.0	540		
1440 min Summer	4.597	0.0	754		
2160 min Summer	3.342	0.0	1104		
2880 min Summer	2.662	0.0	1468		
4320 min Summer	1.929	0.0	2200		
5760 min Summer	1.533	0.0	2936		
7200 min Summer	1.261	0.0	3672		
8640 min Summer	1.107	0.0	4336		
10080 min Summer	0.978	0.0	5072		
15 min Winter	117.218	0.0	17		
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HM Design			Page 2		
10 The Green York YO26 5LR		PLOTS 11 AND 12 Permeable paving with rwps connected.			
Date 08-11-16 File PP-PLOT 11&12.srcx		Designed by HM Checked by			
Micro Drainage		Source Control 2016.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	59.722	0.212	0.3	2.4	O K
60 min Winter	59.762	0.252	0.3	2.9	O K
120 min Winter	59.775	0.265	0.3	3.0	O K
180 min Winter	59.769	0.259	0.3	2.9	O K
240 min Winter	59.755	0.245	0.3	2.8	O K
360 min Winter	59.719	0.209	0.3	2.4	O K
480 min Winter	59.684	0.174	0.3	2.0	O K
600 min Winter	59.651	0.141	0.3	1.6	O K
720 min Winter	59.622	0.112	0.3	1.3	O K
960 min Winter	59.577	0.067	0.3	0.8	O K
1440 min Winter	59.552	0.042	0.2	0.5	O K
2160 min Winter	59.541	0.031	0.2	0.3	O K
2880 min Winter	59.535	0.025	0.1	0.3	O K
4320 min Winter	59.528	0.018	0.1	0.2	O K
5760 min Winter	59.524	0.014	0.1	0.2	O K
7200 min Winter	59.522	0.012	0.1	0.1	O K
8640 min Winter	59.520	0.010	0.1	0.1	O K
10080 min Winter	59.519	0.009	0.1	0.1	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	78.317	0.0	31		
60 min Winter	49.927	0.0	60		
120 min Winter	30.767	0.0	110		
180 min Winter	22.850	0.0	138		
240 min Winter	18.379	0.0	176		
360 min Winter	13.462	0.0	250		
480 min Winter	10.795	0.0	318		
600 min Winter	9.088	0.0	382		
720 min Winter	7.892	0.0	442		
960 min Winter	6.311	0.0	548		
1440 min Winter	4.597	0.0	752		
2160 min Winter	3.342	0.0	1104		
2880 min Winter	2.662	0.0	1456		
4320 min Winter	1.929	0.0	2204		
5760 min Winter	1.533	0.0	2848		
7200 min Winter	1.281	0.0	3672		
8640 min Winter	1.107	0.0	4304		
10080 min Winter	0.978	0.0	5224		
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HM Design		Page 3
10 The Green York YO26 5LR	PLOTS 11 AND 12 Permeable paving with rwps connected.	
Date 08-11-16 File PP-PLOT 11&12.srcx	Designed by HM Checked by	
Micro Drainage		Source Control 2016.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.009

Time (mins)	Area
From:	To: (ha)
0	4 0.009

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10 The Green York YO26 5LR	PLOTS 11 AND 12 Permeable paving with rwps connected.																									
Date 08-11-16 File PP-PLOT 11&12.srcx	Designed by HM Checked by																									
Micro Drainage Source Control 2016.1																										
<u>Model Details</u> Storage is Online Cover Level (m) 59.950 <u>Porous Car Park Structure</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.02700</td> <td>Width (m)</td> <td>3.5</td> </tr> <tr> <td>Membrane Percolation (mm/hr)</td> <td>1000</td> <td>Length (m)</td> <td>10.8</td> </tr> <tr> <td>Max Percolation (l/s)</td> <td>10.5</td> <td>Slope (1:X)</td> <td>0.0</td> </tr> <tr> <td>Safety Factor</td> <td>1.0</td> <td>Depression Storage (mm)</td> <td>5</td> </tr> <tr> <td>Porosity</td> <td>0.30</td> <td>Evaporation (mm/day)</td> <td>3</td> </tr> <tr> <td>Invert Level (m)</td> <td>59.510</td> <td>Cap Volume Depth (m)</td> <td>0.350</td> </tr> </table>			Infiltration Coefficient Base (m/hr)	0.02700	Width (m)	3.5	Membrane Percolation (mm/hr)	1000	Length (m)	10.8	Max Percolation (l/s)	10.5	Slope (1:X)	0.0	Safety Factor	1.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	59.510	Cap Volume Depth (m)	0.350
Infiltration Coefficient Base (m/hr)	0.02700	Width (m)	3.5																							
Membrane Percolation (mm/hr)	1000	Length (m)	10.8																							
Max Percolation (l/s)	10.5	Slope (1:X)	0.0																							
Safety Factor	1.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	59.510	Cap Volume Depth (m)	0.350																							
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HM Design

Page 1

10 The Green
York
YO26 5LR

PLOTS 13-16
SOAKAWAYS

Date 08-11-16
File PLOT 13.srcx

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Micro Drainage

Source Control 2016.1

Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 507 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	58.211	0.611	0.0	1.1	O K
30 min Summer	58.407	0.807	0.0	1.4	O K
60 min Summer	58.606	1.006	0.0	1.8	O K
120 min Summer	58.788	1.188	0.0	2.1	O K
180 min Summer	58.870	1.270	0.0	2.2	O K
240 min Summer	58.907	1.307	0.0	2.3	O K
360 min Summer	58.927	1.327	0.0	2.3	O K
480 min Summer	58.932	1.332	0.0	2.3	O K
600 min Summer	58.930	1.330	0.0	2.3	O K
720 min Summer	58.923	1.323	0.0	2.3	O K
960 min Summer	58.901	1.301	0.0	2.3	O K
1440 min Summer	58.836	1.236	0.0	2.2	O K
2160 min Summer	58.733	1.133	0.0	2.0	O K
2880 min Summer	58.640	1.040	0.0	1.8	O K
4320 min Summer	58.489	0.889	0.0	1.6	O K
5760 min Summer	58.369	0.769	0.0	1.4	O K
7200 min Summer	58.271	0.671	0.0	1.2	O K
8640 min Summer	58.189	0.589	0.0	1.0	O K
10080 min Summer	58.121	0.521	0.0	0.9	O K
15 min Winter	58.285	0.685	0.0	1.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	117.218	0.0	19
30 min Summer	78.317	0.0	33
60 min Summer	49.927	0.0	64
120 min Summer	30.767	0.0	122
180 min Summer	22.850	0.0	182
240 min Summer	18.379	0.0	240
360 min Summer	13.462	0.0	336
480 min Summer	10.795	0.0	392
600 min Summer	9.088	0.0	452
720 min Summer	7.892	0.0	520
960 min Summer	6.311	0.0	656
1440 min Summer	4.597	0.0	936
2160 min Summer	3.342	0.0	1344
2880 min Summer	2.662	0.0	1756
4320 min Summer	1.929	0.0	2548
5760 min Summer	1.533	0.0	3288
7200 min Summer	1.281	0.0	4040
8640 min Summer	1.107	0.0	4760
10080 min Summer	0.978	0.0	5544
15 min Winter	117.218	0.0	19

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York
YO26 5LR

PLOTS 13-16
SOAKAWAYS

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Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	58.506	0.906	0.0	1.6	O K
60 min Winter	58.731	1.131	0.0	2.0	O K
120 min Winter	58.940	1.340	0.1	2.4	O K
180 min Winter	59.036	1.436	0.1	2.5	O K
240 min Winter	59.083	1.483	0.1	2.6	O K
360 min Winter	59.127	1.527	0.1	2.7	O K
480 min Winter	59.124	1.524	0.1	2.7	O K
600 min Winter	59.117	1.517	0.1	2.7	O K
720 min Winter	59.099	1.499	0.1	2.6	O K
960 min Winter	59.064	1.464	0.1	2.6	O K
1440 min Winter	58.969	1.369	0.1	2.4	O K
2160 min Winter	58.821	1.221	0.0	2.2	O K
2880 min Winter	58.688	1.088	0.0	1.9	O K
4320 min Winter	58.482	0.882	0.0	1.6	O K
5760 min Winter	58.325	0.725	0.0	1.3	O K
7200 min Winter	58.202	0.602	0.0	1.1	O K
8640 min Winter	58.103	0.503	0.0	0.9	O K
10080 min Winter	58.023	0.423	0.0	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	78.317	0.0	33
60 min Winter	49.937	0.0	62
120 min Winter	30.767	0.0	120
180 min Winter	22.850	0.0	178
240 min Winter	18.379	0.0	234
360 min Winter	13.462	0.0	344
480 min Winter	10.795	0.0	438
600 min Winter	9.088	0.0	472
720 min Winter	7.892	0.0	548
960 min Winter	6.311	0.0	702
1440 min Winter	4.597	0.0	1008
2160 min Winter	3.342	0.0	1444
2880 min Winter	2.662	0.0	1848
4320 min Winter	1.929	0.0	2680
5760 min Winter	1.533	0.0	3456
7200 min Winter	1.281	0.0	4248
8640 min Winter	1.107	0.0	5008
10080 min Winter	0.978	0.0	5744

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
MS-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.005

Time (mins)	Area
From: To:	(ha)
0 4	0.005

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10 The Green York YO26 5LR	PLOTS 13-16 SOAKAWAYS																					
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<u>Model Details</u> Storage is Online Cover Level (m) 59.400 <u>Lined Soakaway Structure</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.01400</td> <td>Ring Diameter (m)</td> <td>1.20</td> </tr> <tr> <td>Infiltration Coefficient Side (m/hr)</td> <td>0.01400</td> <td>Pit Multiplier</td> <td>1.5</td> </tr> <tr> <td>Safety Factor</td> <td>1.0</td> <td>Number Required</td> <td>1</td> </tr> <tr> <td>Porosity</td> <td>0.30</td> <td>Cap Volume Depth (m)</td> <td>1.500</td> </tr> <tr> <td>Invert Level (m)</td> <td>57.600</td> <td>Cap Infiltration Depth (m)</td> <td>1.500</td> </tr> </table>			Infiltration Coefficient Base (m/hr)	0.01400	Ring Diameter (m)	1.20	Infiltration Coefficient Side (m/hr)	0.01400	Pit Multiplier	1.5	Safety Factor	1.0	Number Required	1	Porosity	0.30	Cap Volume Depth (m)	1.500	Invert Level (m)	57.600	Cap Infiltration Depth (m)	1.500
Infiltration Coefficient Base (m/hr)	0.01400	Ring Diameter (m)	1.20																			
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Porosity	0.30	Cap Volume Depth (m)	1.500																			
Invert Level (m)	57.600	Cap Infiltration Depth (m)	1.500																			
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