

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	90.228	0.528	8.5	499.7	O K
30 min Summer	90.324	0.624	8.5	654.1	O K
60 min Summer	90.411	0.711	8.5	812.6	O K
120 min Summer	90.494	0.794	8.5	985.8	O K
180 min Summer	90.536	0.836	8.5	1079.5	O K
240 min Summer	90.560	0.860	8.5	1135.3	O K
360 min Summer	90.581	0.881	8.5	1188.2	O K
480 min Summer	90.586	0.886	8.5	1199.1	O K
600 min Summer	90.582	0.882	8.5	1190.0	O K
720 min Summer	90.574	0.874	8.5	1169.0	O K
960 min Summer	90.548	0.848	8.5	1107.6	O K
1440 min Summer	90.493	0.793	8.5	983.3	O K
2160 min Summer	90.436	0.736	8.5	863.7	O K
2880 min Summer	90.392	0.692	8.5	777.0	O K
4320 min Summer	90.319	0.619	8.5	645.5	O K
5760 min Summer	90.255	0.555	8.5	540.7	O K
7200 min Summer	89.700	0.000	0.0	0.0	O K
8640 min Summer	89.700	0.000	0.0	0.0	O K
10080 min Summer	89.700	0.000	0.0	0.0	O K
15 min Winter	90.228	0.528	8.5	499.7	O K
30 min Winter	90.324	0.624	8.5	654.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	508.1	19
30 min Summer	102.312	0.0	641.5	34
60 min Summer	64.330	0.0	842.2	64
120 min Summer	39.872	0.0	1043.5	124
180 min Summer	29.699	0.0	1166.1	184
240 min Summer	23.895	0.0	1250.4	242
360 min Summer	17.332	0.0	1314.5	362
480 min Summer	13.654	0.0	1312.6	482
600 min Summer	11.294	0.0	1312.6	602
720 min Summer	9.647	0.0	1313.7	722
960 min Summer	7.494	0.0	1317.3	960
1440 min Summer	5.214	0.0	1304.8	1212
2160 min Summer	3.623	0.0	1707.6	1560
2880 min Summer	2.808	0.0	1763.8	1960
4320 min Summer	1.985	0.0	1871.7	2768
5760 min Summer	1.569	0.0	1970.7	3576
7200 min Summer	-0.012	0.0	-18.3	0
8640 min Summer	-0.010	0.0	-18.3	0
10080 min Summer	-0.008	0.0	-18.3	0
15 min Winter	155.288	0.0	508.1	19
30 min Winter	102.312	0.0	641.5	33

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
60 min Winter	90.410	0.710	8.5	812.3	O K
120 min Winter	90.495	0.795	8.5	987.1	O K
180 min Winter	90.537	0.837	8.5	1081.6	O K
240 min Winter	90.561	0.861	8.5	1138.5	O K
360 min Winter	90.583	0.883	8.5	1192.8	O K
<b>480 min Winter</b>	<b>90.589</b>	<b>0.889</b>	<b>8.5</b>	<b>1205.8</b>	<b>O K</b>
600 min Winter	90.586	0.886	8.5	1199.3	O K
720 min Winter	90.579	0.879	8.5	1181.8	O K
960 min Winter	90.557	0.857	8.5	1128.8	O K
1440 min Winter	90.498	0.798	8.5	994.7	O K
2160 min Winter	90.433	0.733	8.5	857.4	O K
2880 min Winter	90.375	0.675	8.5	745.2	O K
4320 min Winter	90.266	0.566	8.5	558.3	O K
5760 min Winter	90.156	0.456	8.5	398.5	O K
7200 min Winter	89.700	0.000	0.0	0.0	O K
8640 min Winter	89.700	0.000	0.0	0.0	O K
10080 min Winter	89.700	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
60 min Winter	64.330	0.0	841.1	64
120 min Winter	39.872	0.0	1043.8	122
180 min Winter	29.699	0.0	1165.9	180
240 min Winter	23.895	0.0	1250.7	240
360 min Winter	17.332	0.0	1311.7	356
<b>480 min Winter</b>	<b>13.654</b>	<b>0.0</b>	<b>1308.5</b>	<b>472</b>
600 min Winter	11.294	0.0	1307.2	588
720 min Winter	9.647	0.0	1306.4	702
960 min Winter	7.494	0.0	1305.5	924
1440 min Winter	5.214	0.0	1299.8	1338
2160 min Winter	3.623	0.0	1707.3	1644
2880 min Winter	2.808	0.0	1764.0	2104
4320 min Winter	1.985	0.0	1870.5	2980
5760 min Winter	1.569	0.0	1972.0	3808
7200 min Winter	-0.012	0.0	-18.3	0
8640 min Winter	-0.010	0.0	-18.3	0
10080 min Winter	-0.008	0.0	-18.3	0

Waterloo House  
Victoria Square  
Birmingham B2 5TB



Date 18/01/2019 10:20  
File BASIN\_2.SRCX

Designed by flazzarin  
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XP Solutions

Source Control 2018.1

Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.540

<b>Time (mins)</b>	<b>Area</b>
<b>From:</b>	<b>To: (ha)</b>

0	4 1.540
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Model Details

Storage is Online Cover Level (m) 91.000

Tank or Pond Structure

Invert Level (m) 89.700

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	494.0	1.300	3900.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0124-1090-3000-1090
Design Head (m)	3.000
Design Flow (l/s)	10.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	89.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	10.9
Flush-Flo™	0.540	8.6
Kick-Flo®	1.109	6.8
Mean Flow over Head Range	-	8.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	7.1	3.000	10.9	7.000	16.3
0.200	7.4	1.400	7.6	3.500	11.7	7.500	16.9
0.300	8.1	1.600	8.1	4.000	12.5	8.000	17.4
0.400	8.5	1.800	8.6	4.500	13.2	8.500	17.9
0.500	8.6	2.000	9.0	5.000	13.9	9.000	18.4
0.600	8.6	2.200	9.4	5.500	14.5	9.500	18.9
0.800	8.4	2.400	9.8	6.000	15.2		
1.000	7.6	2.600	10.2	6.500	15.7		

Summary of Results for 100 year Return Period (+40%)


Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	91.608	0.408	17.8	1423.9	O K
30 min Summer	91.725	0.525	17.8	1867.2	O K
60 min Summer	91.841	0.641	17.8	2327.1	O K
120 min Summer	91.966	0.766	17.8	2838.9	O K
180 min Summer	92.034	0.834	17.8	3125.2	O K
240 min Summer	92.076	0.876	17.8	3304.6	O K
360 min Summer	92.119	0.919	17.8	3493.8	O K
480 min Summer	92.136	0.936	17.8	3566.0	O K
600 min Summer	92.139	0.939	17.8	3581.1	O K
720 min Summer	92.135	0.935	17.8	3563.6	O K
960 min Summer	92.114	0.914	17.8	3472.3	O K
1440 min Summer	92.046	0.846	17.8	3178.5	O K
2160 min Summer	91.960	0.760	17.8	2812.8	O K
2880 min Summer	91.903	0.703	17.8	2577.5	O K
4320 min Summer	91.824	0.624	17.8	2256.9	O K
5760 min Summer	91.763	0.563	17.8	2014.5	O K
7200 min Summer	91.200	0.000	0.0	0.0	O K
8640 min Summer	91.200	0.000	0.0	0.0	O K
10080 min Summer	91.200	0.000	0.0	0.0	O K
15 min Winter	91.608	0.408	17.8	1423.9	O K
30 min Winter	91.725	0.525	17.8	1867.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	1394.9	19
30 min Summer	102.312	0.0	1340.8	34
60 min Summer	64.330	0.0	2388.3	64
120 min Summer	39.872	0.0	2762.2	124
180 min Summer	29.699	0.0	2756.2	184
240 min Summer	23.895	0.0	2765.1	244
360 min Summer	17.332	0.0	2793.3	362
480 min Summer	13.654	0.0	2818.9	482
600 min Summer	11.294	0.0	2836.0	602
720 min Summer	9.647	0.0	2847.5	722
960 min Summer	7.494	0.0	2862.2	962
1440 min Summer	5.214	0.0	2877.1	1440
2160 min Summer	3.623	0.0	4844.9	1752
2880 min Summer	2.808	0.0	5005.1	2104
4320 min Summer	1.985	0.0	4964.1	2900
5760 min Summer	1.569	0.0	5591.1	3744
7200 min Summer	-0.012	0.0	-52.0	0
8640 min Summer	-0.010	0.0	-52.0	0
10080 min Summer	-0.008	0.0	-52.0	0
15 min Winter	155.288	0.0	1394.8	19
30 min Winter	102.312	0.0	1340.8	34

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
60 min Winter	91.841	0.641	17.8	2327.3	O K
120 min Winter	91.967	0.767	17.8	2840.9	O K
180 min Winter	92.035	0.835	17.8	3128.3	O K
240 min Winter	92.077	0.877	17.8	3309.8	O K
360 min Winter	92.121	0.921	17.8	3502.9	O K
480 min Winter	92.138	0.938	17.8	3577.9	O K
600 min Winter	92.143	0.943	17.8	3597.4	O K
720 min Winter	92.140	0.940	17.8	3584.8	O K
960 min Winter	92.122	0.922	17.8	3506.0	O K
1440 min Winter	92.063	0.863	17.8	3248.0	O K
2160 min Winter	91.964	0.764	17.8	2829.8	O K
2880 min Winter	91.900	0.700	17.8	2564.8	O K
4320 min Winter	91.794	0.594	17.8	2137.6	O K
5760 min Winter	91.702	0.502	17.8	1779.4	O K
7200 min Winter	91.200	0.000	0.0	0.0	O K
8640 min Winter	91.200	0.000	0.0	0.0	O K
10080 min Winter	91.200	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
60 min Winter	64.330	0.0	2388.1	64
120 min Winter	39.872	0.0	2761.3	122
180 min Winter	29.699	0.0	2754.1	182
240 min Winter	23.895	0.0	2762.6	240
360 min Winter	17.332	0.0	2789.3	358
480 min Winter	13.654	0.0	2813.0	474
600 min Winter	11.294	0.0	2827.5	590
720 min Winter	9.647	0.0	2836.5	708
960 min Winter	7.494	0.0	2844.7	934
1440 min Winter	5.214	0.0	2840.2	1382
2160 min Winter	3.623	0.0	4843.5	1816
2880 min Winter	2.808	0.0	5007.7	2216
4320 min Winter	1.985	0.0	5025.6	3112
5760 min Winter	1.569	0.0	5594.4	3984
7200 min Winter	-0.012	0.0	-52.0	0
8640 min Winter	-0.010	0.0	-52.0	0
10080 min Winter	-0.008	0.0	-52.0	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.370

Time (mins)		Area
From:	To:	(ha)
0	4	4.370

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Model Details

Storage is Online Cover Level (m) 92.500

Tank or Pond Structure

Invert Level (m) 91.200

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	3249.0	1.300	4900.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0171-2040-3000-2040
Design Head (m)	3.000
Design Flow (l/s)	20.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	171
Invert Level (m)	90.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	20.4
Flush-Flo™	0.742	18.9
Kick-Flo®	1.530	14.8
Mean Flow over Head Range	-	17.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.1	1.200	17.8	3.000	20.4	7.000	30.6
0.200	14.6	1.400	16.4	3.500	22.0	7.500	31.7
0.300	16.6	1.600	15.1	4.000	23.4	8.000	32.7
0.400	17.7	1.800	16.0	4.500	24.8	8.500	33.6
0.500	18.4	2.000	16.8	5.000	26.1	9.000	34.6
0.600	18.8	2.200	17.6	5.500	27.3	9.500	35.5
0.800	18.9	2.400	18.3	6.000	28.4		
1.000	18.6	2.600	19.1	6.500	29.6		



Cascade Summary of Results for Basin\_2a.srcx

**Upstream      Outflow To      Overflow To**  
**Structures**

Swale\_7.srcx                      (None)                      (None)  
Swale\_4.srcx  
Swale\_3.srcx  
Swale\_6.srcx  
Swale\_5.srcx

<b>Storm Event</b>	<b>Max Level (m)</b>	<b>Max Depth (m)</b>	<b>Max Control (l/s)</b>	<b>Max Volume (m<sup>3</sup>)</b>	<b>Status</b>
15 min Summer	89.583	0.583	50.4	2528.4	O K
30 min Summer	89.749	0.749	50.4	3385.3	O K
60 min Summer	89.915	0.915	50.4	4302.7	O K
120 min Summer	90.096	1.096	50.4	5379.6	O K
180 min Summer	90.200	1.200	50.4	6032.0	Flood Risk
240 min Summer	90.269	1.269	50.4	6480.5	Flood Risk
360 min Summer	90.354	1.354	50.4	7047.6	Flood Risk
480 min Summer	90.401	1.401	50.4	7375.8	Flood Risk
600 min Summer	90.431	1.431	50.4	7581.2	Flood Risk
720 min Summer	90.449	1.449	50.4	7710.6	Flood Risk
960 min Summer	90.466	1.466	50.4	7831.9	Flood Risk
1440 min Summer	90.461	1.461	50.4	7797.0	Flood Risk
2160 min Summer	90.374	1.374	50.4	7184.5	Flood Risk
2880 min Summer	90.279	1.279	50.4	6547.2	Flood Risk
4320 min Summer	90.138	1.138	50.4	5634.9	O K
5760 min Summer	90.019	1.019	50.4	4908.0	O K

<b>Storm Event</b>	<b>Rain (mm/hr)</b>	<b>Flooded Volume (m<sup>3</sup>)</b>	<b>Discharge Volume (m<sup>3</sup>)</b>	<b>Time-Peak (mins)</b>
15 min Summer	155.288	0.0	3858.0	429
30 min Summer	102.312	0.0	4287.8	553
60 min Summer	64.330	0.0	6396.1	686
120 min Summer	39.872	0.0	7930.3	844
180 min Summer	29.699	0.0	8514.8	944
240 min Summer	23.895	0.0	8502.9	1014
360 min Summer	17.332	0.0	8444.3	1114
480 min Summer	13.654	0.0	8391.0	1188
600 min Summer	11.294	0.0	8347.5	1250
720 min Summer	9.647	0.0	8312.1	1308
960 min Summer	7.494	0.0	8257.0	1418
1440 min Summer	5.214	0.0	8166.7	1634
2160 min Summer	3.623	0.0	12969.8	1944
2880 min Summer	2.808	0.0	13409.2	2216
4320 min Summer	1.985	0.0	14212.0	2912
5760 min Summer	1.569	0.0	14975.4	3704

Cascade Summary of Results for Basin\_2a.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
7200 min Summer	89.000	0.000	0.0	0.0	O K
8640 min Summer	89.000	0.000	0.0	0.0	O K
10080 min Summer	89.000	0.000	0.0	0.0	O K
15 min Winter	89.583	0.583	50.4	2528.5	O K
30 min Winter	89.749	0.749	50.4	3386.3	O K
60 min Winter	89.916	0.916	50.4	4304.6	O K
120 min Winter	90.097	1.097	50.4	5383.1	O K
180 min Winter	90.201	1.201	50.4	6037.4	Flood Risk
240 min Winter	90.270	1.270	50.4	6488.3	Flood Risk
360 min Winter	90.356	1.356	50.4	7062.2	Flood Risk
480 min Winter	90.405	1.405	50.4	7400.5	Flood Risk
600 min Winter	90.436	1.436	50.4	7619.5	Flood Risk
720 min Winter	90.457	1.457	50.4	7765.0	Flood Risk
960 min Winter	90.479	1.479	50.4	7921.7	Flood Risk
1440 min Winter	90.483	1.483	50.4	7949.3	Flood Risk
2160 min Winter	90.380	1.380	50.4	7231.4	Flood Risk
2880 min Winter	90.265	1.265	50.4	6456.2	Flood Risk
4320 min Winter	90.060	1.060	50.4	5155.8	O K
5760 min Winter	89.877	0.877	50.4	4086.9	O K
7200 min Winter	89.000	0.000	0.0	0.0	O K
8640 min Winter	89.000	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
7200 min Summer	-0.012	0.0	-139.2	0
8640 min Summer	-0.010	0.0	-139.2	0
10080 min Summer	-0.008	0.0	-139.2	0
15 min Winter	155.288	0.0	3858.0	429
30 min Winter	102.312	0.0	4287.2	553
60 min Winter	64.330	0.0	6394.2	686
120 min Winter	39.872	0.0	7931.0	846
180 min Winter	29.699	0.0	8506.6	944
240 min Winter	23.895	0.0	8491.0	1016
360 min Winter	17.332	0.0	8425.2	1116
480 min Winter	13.654	0.0	8364.4	1188
600 min Winter	11.294	0.0	8313.2	1248
720 min Winter	9.647	0.0	8270.1	1302
960 min Winter	7.494	0.0	8199.4	1404
1440 min Winter	5.214	0.0	8086.8	1606
2160 min Winter	3.623	0.0	12970.3	1936
2880 min Winter	2.808	0.0	13406.8	2236
4320 min Winter	1.985	0.0	14210.2	3100
5760 min Winter	1.569	0.0	14969.8	3928
7200 min Winter	-0.012	0.0	-139.2	0
8640 min Winter	-0.010	0.0	-139.2	0

Waterloo House  
Victoria Square  
Birmingham B2 5TB



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File CatchmentC\_cascade.casx

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Source Control 2018.1

Cascade Summary of Results for Basin\_2a.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	89.000	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	-0.008	0.0	-139.2	0

Waterloo House  
Victoria Square  
Birmingham B2 5TB



Date 28/02/2019 16:41  
File CatchmentC\_cascade.casx

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Cascade Rainfall Details for Basin\_2a.srcx


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins)	Area
From:	To: (ha)

0	4 0.000
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Cascade Model Details for Basin\_2a.srcx

Storage is Online Cover Level (m) 90.500

Tank or Pond Structure

Invert Level (m) 89.000

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	3750.0	1.500	7200.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0256-5460-4500-5460
Design Head (m)	4.500
Design Flow (l/s)	54.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	256
Invert Level (m)	88.500
Minimum Outlet Pipe Diameter (mm)	Site Specific Design (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	4.500	54.6
Flush-Flo™	1.105	50.4
Kick-Flo®	2.278	39.3
Mean Flow over Head Range	-	45.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.2	1.200	50.4	3.000	44.9	7.000	67.6
0.200	26.2	1.400	49.9	3.500	48.3	7.500	69.9
0.300	39.0	1.600	48.9	4.000	51.6	8.000	72.1
0.400	42.7	1.800	47.4	4.500	54.6	8.500	74.3
0.500	45.4	2.000	45.0	5.000	57.4	9.000	76.4
0.600	47.3	2.200	41.3	5.500	60.1	9.500	78.4
0.800	49.5	2.400	40.3	6.000	62.7		
1.000	50.3	2.600	41.9	6.500	65.2		

Summary of Results for 100 year Return Period (+40%)


Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	90.576	0.376	14.7	802.1	O K
30 min Summer	90.678	0.478	15.1	1050.8	O K
60 min Summer	90.777	0.577	15.2	1307.3	O K
120 min Summer	90.881	0.681	15.2	1590.1	O K
180 min Summer	90.936	0.736	15.2	1745.7	O K
240 min Summer	90.969	0.769	15.2	1841.2	O K
360 min Summer	91.001	0.801	15.2	1936.7	O K
480 min Summer	91.011	0.811	15.2	1965.8	O K
600 min Summer	91.010	0.810	15.2	1963.1	O K
720 min Summer	91.003	0.803	15.2	1942.3	O K
960 min Summer	90.979	0.779	15.2	1871.6	O K
1440 min Summer	90.931	0.731	15.2	1731.2	O K
2160 min Summer	90.870	0.670	15.2	1558.6	O K
2880 min Summer	90.818	0.618	15.2	1415.7	O K
4320 min Summer	90.734	0.534	15.2	1194.1	O K
5760 min Summer	90.668	0.468	15.1	1026.7	O K
7200 min Summer	90.200	0.000	0.0	0.0	O K
8640 min Summer	90.200	0.000	0.0	0.0	O K
10080 min Summer	90.200	0.000	0.0	0.0	O K
15 min Winter	90.576	0.376	14.7	802.0	O K
30 min Winter	90.678	0.478	15.1	1050.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	720.4	19
30 min Summer	102.312	0.0	942.1	34
60 min Summer	64.330	0.0	1296.2	64
120 min Summer	39.872	0.0	1605.5	124
180 min Summer	29.699	0.0	1789.1	182
240 min Summer	23.895	0.0	1913.0	242
360 min Summer	17.332	0.0	2066.4	362
480 min Summer	13.654	0.0	2153.4	482
600 min Summer	11.294	0.0	2207.5	602
720 min Summer	9.647	0.0	2241.1	720
960 min Summer	7.494	0.0	2267.9	914
1440 min Summer	5.214	0.0	2217.9	1112
2160 min Summer	3.623	0.0	2693.5	1488
2880 min Summer	2.808	0.0	2779.5	1876
4320 min Summer	1.985	0.0	2930.0	2680
5760 min Summer	1.569	0.0	3135.9	3456
7200 min Summer	-0.012	0.0	-29.3	0
8640 min Summer	-0.010	0.0	-29.3	0
10080 min Summer	-0.008	0.0	-29.3	0
15 min Winter	155.288	0.0	720.5	19
30 min Winter	102.312	0.0	942.2	33

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
60 min Winter	90.777	0.577	15.2	1306.9	O K
120 min Winter	90.881	0.681	15.2	1590.2	O K
180 min Winter	90.936	0.736	15.2	1746.0	O K
240 min Winter	90.969	0.769	15.2	1841.3	O K
360 min Winter	91.002	0.802	15.2	1937.3	O K
<b>480 min Winter</b>	<b>91.012</b>	<b>0.812</b>	<b>15.2</b>	<b>1967.2</b>	<b>O K</b>
600 min Winter	91.011	0.811	15.2	1965.8	O K
720 min Winter	91.005	0.805	15.2	1946.7	O K
960 min Winter	90.982	0.782	15.2	1879.9	O K
1440 min Winter	90.925	0.725	15.2	1714.3	O K
2160 min Winter	90.851	0.651	15.2	1506.9	O K
2880 min Winter	90.783	0.583	15.2	1322.1	O K
4320 min Winter	90.668	0.468	15.1	1027.0	O K
5760 min Winter	90.579	0.379	14.7	810.1	O K
7200 min Winter	90.200	0.000	0.0	0.0	O K
8640 min Winter	90.200	0.000	0.0	0.0	O K
10080 min Winter	90.200	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
60 min Winter	64.330	0.0	1296.2	62
120 min Winter	39.872	0.0	1605.6	122
180 min Winter	29.699	0.0	1789.2	180
240 min Winter	23.895	0.0	1913.2	238
360 min Winter	17.332	0.0	2066.8	356
<b>480 min Winter</b>	<b>13.654</b>	<b>0.0</b>	<b>2154.2</b>	<b>472</b>
600 min Winter	11.294	0.0	2208.8	584
720 min Winter	9.647	0.0	2243.2	698
960 min Winter	7.494	0.0	2272.5	914
1440 min Winter	5.214	0.0	2231.3	1140
2160 min Winter	3.623	0.0	2694.0	1580
2880 min Winter	2.808	0.0	2780.4	2016
4320 min Winter	1.985	0.0	2932.6	2812
5760 min Winter	1.569	0.0	3136.1	3576
7200 min Winter	-0.012	0.0	-29.3	0
8640 min Winter	-0.010	0.0	-29.3	0
10080 min Winter	-0.008	0.0	-29.3	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 2.460

**Time (mins) Area**  
**From: To: (ha)**

0 4 2.460



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Model Details

Storage is Online Cover Level (m) 91.500

Tank or Pond Structure

Invert Level (m) 90.200

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	1904.0	1.300	3750.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0161-1530-2000-1530
Design Head (m)	2.000
Design Flow (l/s)	15.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	161
Invert Level (m)	90.200
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	15.2
Flush-Flo™	0.586	15.2
Kick-Flo®	1.221	12.1
Mean Flow over Head Range	-	13.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.8	1.200	12.4	3.000	18.5	7.000	27.7
0.200	12.7	1.400	12.9	3.500	19.9	7.500	28.7
0.300	14.1	1.600	13.7	4.000	21.2	8.000	29.6
0.400	14.8	1.800	14.5	4.500	22.4	8.500	30.4
0.500	15.1	2.000	15.2	5.000	23.6	9.000	31.3
0.600	15.2	2.200	15.9	5.500	24.7	9.500	32.1
0.800	14.9	2.400	16.6	6.000	25.7		
1.000	14.2	2.600	17.3	6.500	26.8		

Cascade Summary of Results for Basin\_4.srcx

Upstream Structures	Outflow To	Overflow To
Swale_10.srcx	(None)	(None)
Swale_9.srcx		
Swale_11.srcx		


Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	88.615	0.415	26.0	1133.2	O K
30 min Summer	88.715	0.515	27.2	1438.9	O K
60 min Summer	88.817	0.617	28.0	1761.2	O K
120 min Summer	88.933	0.733	28.4	2145.0	O K
180 min Summer	89.003	0.803	28.6	2386.7	O K
240 min Summer	89.052	0.852	28.6	2559.9	O K
360 min Summer	89.117	0.917	28.6	2795.0	O K
480 min Summer	89.159	0.959	28.6	2949.3	O K
600 min Summer	89.189	0.989	28.6	3062.2	O K
720 min Summer	89.212	1.012	28.6	3148.3	Flood Risk
960 min Summer	89.243	1.043	28.6	3266.6	Flood Risk
1440 min Summer	89.272	1.072	28.6	3376.7	Flood Risk
2160 min Summer	89.287	1.087	28.6	3433.2	Flood Risk
2880 min Summer	89.277	1.077	28.6	3397.0	Flood Risk
4320 min Summer	89.205	1.005	28.6	3120.1	Flood Risk
5760 min Summer	89.147	0.947	28.6	2903.2	O K
7200 min Summer	88.200	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	1774.1	587
30 min Summer	102.312	0.0	2149.1	772
60 min Summer	64.330	0.0	3228.3	976
120 min Summer	39.872	0.0	3958.4	1218
180 min Summer	29.699	0.0	4342.5	1368
240 min Summer	23.895	0.0	4533.1	1474
360 min Summer	17.332	0.0	4623.0	1616
480 min Summer	13.654	0.0	4623.2	1710
600 min Summer	11.294	0.0	4601.2	1782
720 min Summer	9.647	0.0	4569.9	1842
960 min Summer	7.494	0.0	4493.3	1948
1440 min Summer	5.214	0.0	4309.3	2152
2160 min Summer	3.623	0.0	6691.0	2464
2880 min Summer	2.808	0.0	6895.1	2776
4320 min Summer	1.985	0.0	7194.4	3276
5760 min Summer	1.569	0.0	7799.2	3864
7200 min Summer	-0.012	0.0	-72.7	0

Cascade Summary of Results for Basin\_4.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
8640 min Summer	88.200	0.000	0.0	0.0	O K
10080 min Summer	88.200	0.000	0.0	0.0	O K
15 min Winter	88.615	0.415	26.0	1133.1	O K
30 min Winter	88.715	0.515	27.2	1437.8	O K
60 min Winter	88.816	0.616	28.0	1759.4	O K
120 min Winter	88.932	0.732	28.4	2142.0	O K
180 min Winter	89.001	0.801	28.6	2382.1	O K
240 min Winter	89.050	0.850	28.6	2554.2	O K
360 min Winter	89.115	0.915	28.6	2788.1	O K
480 min Winter	89.157	0.957	28.6	2942.4	O K
600 min Winter	89.188	0.988	28.6	3056.2	O K
720 min Winter	89.211	1.011	28.6	3144.5	Flood Risk
960 min Winter	89.244	1.044	28.6	3270.6	Flood Risk
1440 min Winter	89.278	1.078	28.6	3400.9	Flood Risk
2160 min Winter	89.300	1.100	28.6	3483.7	Flood Risk
2880 min Winter	89.290	1.090	28.6	3446.1	Flood Risk
4320 min Winter	89.185	0.985	28.6	3045.4	O K
5760 min Winter	89.050	0.850	28.6	2553.7	O K
7200 min Winter	88.200	0.000	0.0	0.0	O K
8640 min Winter	88.200	0.000	0.0	0.0	O K
10080 min Winter	88.200	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
8640 min Summer	-0.010	0.0	-72.7	0
10080 min Summer	-0.008	0.0	-72.7	0
15 min Winter	155.288	0.0	1774.1	587
30 min Winter	102.312	0.0	2149.7	773
60 min Winter	64.330	0.0	3228.4	976
120 min Winter	39.872	0.0	3958.5	1218
180 min Winter	29.699	0.0	4343.0	1370
240 min Winter	23.895	0.0	4533.9	1476
360 min Winter	17.332	0.0	4623.6	1620
480 min Winter	13.654	0.0	4622.9	1714
600 min Winter	11.294	0.0	4600.0	1786
720 min Winter	9.647	0.0	4568.5	1844
960 min Winter	7.494	0.0	4493.3	1946
1440 min Winter	5.214	0.0	4317.3	2134
2160 min Winter	3.623	0.0	6691.9	2420
2880 min Winter	2.808	0.0	6897.9	2708
4320 min Winter	1.985	0.0	7218.4	3164
5760 min Winter	1.569	0.0	7799.7	3840
7200 min Winter	-0.012	0.0	-72.7	0
8640 min Winter	-0.010	0.0	-72.7	0
10080 min Winter	-0.008	0.0	-72.7	0

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Cascade Rainfall Details for Basin\_4.srcx

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins)		Area
From:	To:	(ha)
0	4	0.000

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Cascade Model Details for Basin\_4.srcx

Storage is Online Cover Level (m) 89.500

Tank or Pond Structure

Invert Level (m) 88.200

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	2484.0	1.300	4200.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0203-2860-3000-2860
Design Head (m)	3.000
Design Flow (l/s)	28.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	203
Invert Level (m)	88.200
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	28.6
Flush-Flo™	0.877	28.6
Kick-Flo®	1.803	22.4
Mean Flow over Head Range	-	25.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.0	1.200	28.0	3.000	28.6	7.000	43.0
0.200	19.3	1.400	27.1	3.500	30.8	7.500	44.5
0.300	23.8	1.600	25.4	4.000	32.8	8.000	45.9
0.400	25.8	1.800	22.5	4.500	34.8	8.500	47.3
0.500	27.1	2.000	23.6	5.000	36.6	9.000	48.6
0.600	27.9	2.200	24.7	5.500	38.3	9.500	49.9
0.800	28.6	2.400	25.7	6.000	39.9		
1.000	28.5	2.600	26.7	6.500	41.5		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	88.395	0.195	8.1	245.1	O K
30 min Summer	88.447	0.247	8.1	318.4	O K
60 min Summer	88.498	0.298	8.1	390.6	O K
120 min Summer	88.546	0.346	8.1	462.7	O K
180 min Summer	88.567	0.367	8.1	495.6	O K
240 min Summer	88.576	0.376	8.1	509.6	O K
360 min Summer	88.575	0.375	8.1	507.5	O K
480 min Summer	88.560	0.360	8.1	484.6	O K
600 min Summer	88.543	0.343	8.1	458.0	O K
720 min Summer	88.528	0.328	8.1	435.7	O K
960 min Summer	88.502	0.302	8.1	397.9	O K
1440 min Summer	88.459	0.259	8.1	335.1	O K
2160 min Summer	88.404	0.204	8.1	258.3	O K
2880 min Summer	88.358	0.158	8.1	196.4	O K
4320 min Summer	88.288	0.088	8.1	105.9	O K
5760 min Summer	88.242	0.042	8.1	49.3	O K
7200 min Summer	88.200	0.000	0.0	0.0	O K
8640 min Summer	88.200	0.000	0.0	0.0	O K
10080 min Summer	88.200	0.000	0.0	0.0	O K
15 min Winter	88.395	0.195	8.1	245.1	O K
30 min Winter	88.448	0.248	8.1	319.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	253.5	19
30 min Summer	102.312	0.0	334.0	33
60 min Summer	64.330	0.0	420.7	64
120 min Summer	39.872	0.0	521.2	122
180 min Summer	29.699	0.0	582.2	182
240 min Summer	23.895	0.0	625.0	242
360 min Summer	17.332	0.0	680.3	360
480 min Summer	13.654	0.0	714.1	480
600 min Summer	11.294	0.0	738.9	524
720 min Summer	9.647	0.0	756.7	578
960 min Summer	7.494	0.0	784.1	694
1440 min Summer	5.214	0.0	818.5	954
2160 min Summer	3.623	0.0	853.2	1360
2880 min Summer	2.808	0.0	881.1	1732
4320 min Summer	1.985	0.0	935.3	2460
5760 min Summer	1.569	0.0	985.8	3120
7200 min Summer	-0.012	0.0	-9.2	0
8640 min Summer	-0.010	0.0	-9.2	0
10080 min Summer	-0.008	0.0	-9.2	0
15 min Winter	155.288	0.0	253.5	19
30 min Winter	102.312	0.0	334.3	33

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
60 min Winter	88.498	0.298	8.1	391.1	O K
120 min Winter	88.547	0.347	8.1	464.2	O K
180 min Winter	88.569	0.369	8.1	497.7	O K
240 min Winter	88.578	0.378	8.1	512.6	O K
<b>360 min Winter</b>	<b>88.578</b>	<b>0.378</b>	<b>8.1</b>	<b>513.0</b>	<b>O K</b>
480 min Winter	88.566	0.366	8.1	493.6	O K
600 min Winter	88.548	0.348	8.1	465.7	O K
720 min Winter	88.528	0.328	8.1	436.0	O K
960 min Winter	88.499	0.299	8.1	392.9	O K
1440 min Winter	88.442	0.242	8.1	311.1	O K
2160 min Winter	88.365	0.165	8.1	206.0	O K
2880 min Winter	88.302	0.102	8.1	123.5	O K
4320 min Winter	88.217	0.017	8.0	20.3	O K
5760 min Winter	88.200	0.000	7.2	0.0	O K
7200 min Winter	88.200	0.000	0.0	0.0	O K
8640 min Winter	88.200	0.000	0.0	0.0	O K
10080 min Winter	88.200	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
60 min Winter	64.330	0.0	420.7	62
120 min Winter	39.872	0.0	521.5	120
180 min Winter	29.699	0.0	582.0	178
240 min Winter	23.895	0.0	625.4	236
<b>360 min Winter</b>	<b>17.332</b>	<b>0.0</b>	<b>679.6</b>	<b>350</b>
480 min Winter	13.654	0.0	714.4	460
600 min Winter	11.294	0.0	739.0	564
720 min Winter	9.647	0.0	756.7	594
960 min Winter	7.494	0.0	784.0	732
1440 min Winter	5.214	0.0	818.2	1024
2160 min Winter	3.623	0.0	852.2	1428
2880 min Winter	2.808	0.0	882.2	1792
4320 min Winter	1.985	0.0	935.0	2420
5760 min Winter	1.569	0.0	985.8	0
7200 min Winter	-0.012	0.0	-9.2	0
8640 min Winter	-0.010	0.0	-9.2	0
10080 min Winter	-0.008	0.0	-9.2	0

Waterloo House  
Victoria Square  
Birmingham B2 5TB



Date 18/01/2019 10:32  
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 0.770

<b>Time (mins)</b>	<b>Area</b>
<b>From:</b>	<b>To: (ha)</b>

0	4 0.770
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Model Details

Storage is Online Cover Level (m) 89.500

Tank or Pond Structure

Invert Level (m) 88.200

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	1164.0	1.300	2750.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0121-1120-3500-1120
Design Head (m)	3.500
Design Flow (l/s)	11.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	121
Invert Level (m)	87.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.500	11.2
Flush-Flo™	0.533	8.1
Kick-Flo®	1.084	6.5
Mean Flow over Head Range	-	8.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	6.8	3.000	10.4	7.000	15.6
0.200	7.0	1.400	7.3	3.500	11.2	7.500	16.1
0.300	7.7	1.600	7.7	4.000	11.9	8.000	16.6
0.400	8.0	1.800	8.2	4.500	12.6	8.500	17.1
0.500	8.1	2.000	8.6	5.000	13.3	9.000	17.6
0.600	8.1	2.200	9.0	5.500	13.9	9.500	18.0
0.800	7.8	2.400	9.4	6.000	14.5		
1.000	7.1	2.600	9.7	6.500	15.0		

Summary of Results for 100 year Return Period (+40%)


Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	89.249	0.349	8.8	660.7	O K
30 min Summer	89.348	0.448	9.0	867.0	O K
60 min Summer	89.447	0.547	9.1	1081.6	O K
120 min Summer	89.552	0.652	9.1	1322.3	O K
180 min Summer	89.610	0.710	9.1	1458.6	O K
240 min Summer	89.646	0.746	9.1	1545.4	O K
360 min Summer	89.685	0.785	9.1	1641.3	O K
480 min Summer	89.702	0.802	9.1	1682.5	O K
600 min Summer	89.708	0.808	9.1	1697.5	O K
720 min Summer	89.708	0.808	9.1	1697.5	O K
960 min Summer	89.698	0.798	9.1	1671.7	O K
1440 min Summer	89.657	0.757	9.1	1572.6	O K
2160 min Summer	89.604	0.704	9.1	1444.5	O K
2880 min Summer	89.562	0.662	9.1	1344.8	O K
4320 min Summer	89.495	0.595	9.1	1191.1	O K
5760 min Summer	89.442	0.542	9.1	1072.4	O K
7200 min Summer	88.900	0.000	0.0	0.0	O K
8640 min Summer	88.900	0.000	0.0	0.0	O K
10080 min Summer	88.900	0.000	0.0	0.0	O K
15 min Winter	89.249	0.349	8.8	660.7	O K
30 min Winter	89.348	0.448	9.0	866.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	555.4	19
30 min Summer	102.312	0.0	685.4	34
60 min Summer	64.330	0.0	1041.6	64
120 min Summer	39.872	0.0	1271.1	124
180 min Summer	29.699	0.0	1386.5	184
240 min Summer	23.895	0.0	1441.8	244
360 min Summer	17.332	0.0	1469.5	362
480 min Summer	13.654	0.0	1468.6	482
600 min Summer	11.294	0.0	1460.3	602
720 min Summer	9.647	0.0	1448.8	722
960 min Summer	7.494	0.0	1421.5	960
1440 min Summer	5.214	0.0	1359.0	1340
2160 min Summer	3.623	0.0	2186.3	1624
2880 min Summer	2.808	0.0	2246.3	2016
4320 min Summer	1.985	0.0	2308.6	2808
5760 min Summer	1.569	0.0	2571.4	3624
7200 min Summer	-0.012	0.0	-24.0	0
8640 min Summer	-0.010	0.0	-24.0	0
10080 min Summer	-0.008	0.0	-24.0	0
15 min Winter	155.288	0.0	555.4	19
30 min Winter	102.312	0.0	685.5	33

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
60 min Winter	89.446	0.546	9.1	1081.2	O K
120 min Winter	89.552	0.652	9.1	1322.4	O K
180 min Winter	89.610	0.710	9.1	1458.7	O K
240 min Winter	89.646	0.746	9.1	1545.8	O K
360 min Winter	89.686	0.786	9.1	1641.7	O K
480 min Winter	89.702	0.802	9.1	1683.2	O K
600 min Winter	89.709	0.809	9.1	1698.7	O K
720 min Winter	89.709	0.809	9.1	1699.3	O K
960 min Winter	89.699	0.799	9.1	1675.5	O K
1440 min Winter	89.660	0.760	9.1	1580.0	O K
2160 min Winter	89.598	0.698	9.1	1429.4	O K
2880 min Winter	89.547	0.647	9.1	1309.1	O K
4320 min Winter	89.458	0.558	9.1	1106.2	O K
5760 min Winter	89.383	0.483	9.1	942.2	O K
7200 min Winter	88.900	0.000	0.0	0.0	O K
8640 min Winter	88.900	0.000	0.0	0.0	O K
10080 min Winter	88.900	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
60 min Winter	64.330	0.0	1041.6	64
120 min Winter	39.872	0.0	1271.2	122
180 min Winter	29.699	0.0	1386.8	180
240 min Winter	23.895	0.0	1442.4	240
360 min Winter	17.332	0.0	1470.7	358
480 min Winter	13.654	0.0	1470.3	474
600 min Winter	11.294	0.0	1462.5	590
720 min Winter	9.647	0.0	1451.6	706
960 min Winter	7.494	0.0	1425.6	932
1440 min Winter	5.214	0.0	1366.3	1368
2160 min Winter	3.623	0.0	2187.1	1688
2880 min Winter	2.808	0.0	2248.4	2132
4320 min Winter	1.985	0.0	2321.5	2988
5760 min Winter	1.569	0.0	2571.6	3816
7200 min Winter	-0.012	0.0	-24.0	0
8640 min Winter	-0.010	0.0	-24.0	0
10080 min Winter	-0.008	0.0	-24.0	0

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Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.020

**Time (mins) Area**  
**From: To: (ha)**

0 4 2.020

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Model Details

Storage is Online Cover Level (m) 90.200

Tank or Pond Structure

Invert Level (m) 88.900

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	1740.0	1.300	3000.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0127-9400-2000-9400
Design Head (m)	2.000
Design Flow (l/s)	9.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	127
Invert Level (m)	88.900
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	9.4
Flush-Flo™	0.555	9.1
Kick-Flo®	1.134	7.2
Mean Flow over Head Range	-	8.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	1.200	7.4	3.000	11.4	7.000	17.0
0.200	7.7	1.400	7.9	3.500	12.2	7.500	17.6
0.300	8.5	1.600	8.5	4.000	13.0	8.000	18.2
0.400	8.9	1.800	8.9	4.500	13.8	8.500	18.7
0.500	9.1	2.000	9.4	5.000	14.5	9.000	19.2
0.600	9.1	2.200	9.8	5.500	15.2	9.500	19.7
0.800	8.8	2.400	10.2	6.000	15.8		
1.000	8.2	2.600	10.6	6.500	16.4		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 583 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	91.441	0.641	0.0	8.0	8.0	252.9	O K
30 min Summer	91.514	0.714	0.0	8.0	8.0	329.1	O K
60 min Summer	91.579	0.779	0.0	8.0	8.0	404.5	O K
120 min Summer	91.641	0.841	0.0	8.0	8.0	482.3	O K
180 min Summer	91.669	0.869	0.0	8.0	8.0	519.8	O K
240 min Summer	91.683	0.883	0.0	8.0	8.0	538.1	O K
360 min Summer	91.687	0.887	0.0	8.0	8.0	544.3	O K
480 min Summer	91.676	0.876	0.0	8.0	8.0	529.5	O K
600 min Summer	91.658	0.858	0.0	8.0	8.0	505.2	O K
720 min Summer	91.640	0.840	0.0	8.0	8.0	480.3	O K
960 min Summer	91.607	0.807	0.0	8.0	8.0	438.4	O K
1440 min Summer	91.552	0.752	0.0	8.0	8.0	372.3	O K
2160 min Summer	91.482	0.682	0.0	8.0	8.0	293.9	O K
2880 min Summer	91.417	0.617	0.0	8.0	8.0	230.8	O K
4320 min Summer	91.298	0.498	0.0	8.0	8.0	138.4	O K
5760 min Summer	91.193	0.393	0.0	8.0	8.0	79.9	O K
7200 min Summer	90.800	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	90.800	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	90.800	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	91.441	0.641	0.0	8.0	8.0	252.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	260.7	19
30 min Summer	102.312	0.0	343.5	34
60 min Summer	64.330	0.0	432.0	64
120 min Summer	39.872	0.0	535.5	122
180 min Summer	29.699	0.0	598.3	182
240 min Summer	23.895	0.0	641.8	242
360 min Summer	17.332	0.0	698.3	362
480 min Summer	13.654	0.0	733.5	480
600 min Summer	11.294	0.0	758.4	594
720 min Summer	9.647	0.0	777.4	622
960 min Summer	7.494	0.0	805.2	730
1440 min Summer	5.214	0.0	840.4	980
2160 min Summer	3.623	0.0	875.9	1364
2880 min Summer	2.808	0.0	905.2	1756
4320 min Summer	1.985	0.0	959.8	2464
5760 min Summer	1.569	0.0	1011.4	3168
7200 min Summer	-0.012	0.0	-9.4	0
8640 min Summer	-0.010	0.0	-9.4	0
10080 min Summer	-0.008	0.0	-9.4	0
15 min Winter	155.288	0.0	260.7	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	91.515	0.715	0.0	8.0	8.0	329.5	O K
60 min Winter	91.580	0.780	0.0	8.0	8.0	405.2	O K
120 min Winter	91.642	0.842	0.0	8.0	8.0	483.7	O K
180 min Winter	91.671	0.871	0.0	8.0	8.0	521.9	O K
240 min Winter	91.685	0.885	0.0	8.0	8.0	540.9	O K
<b>360 min Winter</b>	<b>91.690</b>	<b>0.890</b>	<b>0.0</b>	<b>8.0</b>	<b>8.0</b>	<b>548.6</b>	<b>O K</b>
480 min Winter	91.681	0.881	0.0	8.0	8.0	535.2	O K
600 min Winter	91.664	0.864	0.0	8.0	8.0	512.3	O K
720 min Winter	91.643	0.843	0.0	8.0	8.0	484.8	O K
960 min Winter	91.604	0.804	0.0	8.0	8.0	434.1	O K
1440 min Winter	91.534	0.734	0.0	8.0	8.0	350.8	O K
2160 min Winter	91.431	0.631	0.0	8.0	8.0	244.2	O K
2880 min Winter	91.329	0.529	0.0	8.0	8.0	159.8	O K
4320 min Winter	91.133	0.333	0.0	7.9	7.9	54.9	O K
5760 min Winter	90.992	0.192	0.0	7.1	7.1	16.2	O K
7200 min Winter	90.800	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	90.800	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	90.800	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	102.312	0.0	343.5	33
60 min Winter	64.330	0.0	432.0	62
120 min Winter	39.872	0.0	535.5	120
180 min Winter	29.699	0.0	598.3	180
240 min Winter	23.895	0.0	641.8	238
<b>360 min Winter</b>	<b>17.332</b>	<b>0.0</b>	<b>698.3</b>	<b>352</b>
480 min Winter	13.654	0.0	733.5	466
600 min Winter	11.294	0.0	758.4	574
720 min Winter	9.647	0.0	777.4	676
960 min Winter	7.494	0.0	805.2	752
1440 min Winter	5.214	0.0	840.4	1040
2160 min Winter	3.623	0.0	875.9	1448
2880 min Winter	2.808	0.0	905.2	1816
4320 min Winter	1.985	0.0	959.8	2464
5760 min Winter	1.569	0.0	1011.4	3048
7200 min Winter	-0.012	0.0	-9.4	0
8640 min Winter	-0.010	0.0	-9.4	0
10080 min Winter	-0.008	0.0	-9.4	0

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Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.790

Time (mins)		Area
From:	To:	(ha)
0	4	0.790



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Model Details

Storage is Online Cover Level (m) 92.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	205.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	0.900
Invert Level (m)	90.800	Cap Infiltration Depth (m)	0.000
Base Width (m)	2.4		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0124-8000-1500-8000
Design Head (m)	1.500
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	90.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	8.0
Flush-Flo™	0.444	8.0
Kick-Flo®	0.925	6.4
Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	7.2	3.000	11.1	7.000	16.6
0.200	7.2	1.400	7.7	3.500	11.9	7.500	17.2
0.300	7.8	1.600	8.2	4.000	12.7	8.000	17.7
0.400	8.0	1.800	8.7	4.500	13.4	8.500	18.2
0.500	8.0	2.000	9.2	5.000	14.1	9.000	18.7
0.600	7.9	2.200	9.6	5.500	14.8	9.500	19.2
0.800	7.3	2.400	10.0	6.000	15.4		
1.000	6.6	2.600	10.4	6.500	16.0		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 101 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	91.532	1.032	0.0	169.9	169.9	1297.2	O K
30 min Summer	91.662	1.162	0.0	169.9	169.9	1629.5	O K
60 min Summer	91.750	1.250	0.0	169.9	169.9	1865.5	Flood Risk
120 min Summer	91.786	1.286	0.0	169.9	169.9	1957.9	Flood Risk
180 min Summer	91.769	1.269	0.0	169.9	169.9	1916.8	Flood Risk
240 min Summer	91.740	1.240	0.0	169.9	169.9	1839.1	Flood Risk
360 min Summer	91.666	1.166	0.0	169.9	169.9	1640.8	O K
480 min Summer	91.585	1.085	0.0	169.9	169.9	1429.2	O K
600 min Summer	91.503	1.003	0.0	169.9	169.9	1226.2	O K
720 min Summer	91.423	0.923	0.0	169.9	169.9	1038.8	O K
960 min Summer	91.276	0.776	0.0	169.9	169.9	725.3	O K
1440 min Summer	91.051	0.551	0.0	166.5	166.5	340.1	O K
2160 min Summer	90.903	0.403	0.0	140.2	140.2	172.6	O K
2880 min Summer	90.843	0.343	0.0	111.9	111.9	122.1	O K
4320 min Summer	90.778	0.278	0.0	80.1	80.1	78.2	O K
5760 min Summer	90.743	0.243	0.0	63.5	63.5	58.6	O K
7200 min Summer	90.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	90.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	90.500	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	91.533	1.033	0.0	169.9	169.9	1298.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	1438.7	18
30 min Summer	102.312	0.0	1895.8	32
60 min Summer	64.330	0.0	2384.1	62
120 min Summer	39.872	0.0	2955.3	106
180 min Summer	29.699	0.0	3301.9	138
240 min Summer	23.895	0.0	3542.1	170
360 min Summer	17.332	0.0	3853.9	238
480 min Summer	13.654	0.0	4048.0	304
600 min Summer	11.294	0.0	4185.5	368
720 min Summer	9.647	0.0	4290.3	432
960 min Summer	7.494	0.0	4443.9	548
1440 min Summer	5.214	0.0	4637.9	766
2160 min Summer	3.623	0.0	4834.0	1104
2880 min Summer	2.808	0.0	4995.9	1468
4320 min Summer	1.985	0.0	5297.4	2200
5760 min Summer	1.569	0.0	5581.7	2928
7200 min Summer	-0.012	0.0	-51.9	0
8640 min Summer	-0.010	0.0	-51.9	0
10080 min Summer	-0.008	0.0	-51.9	0
15 min Winter	155.288	0.0	1438.7	18

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	91.664	1.164	0.0	169.9	169.9	1634.3	O K
60 min Winter	91.754	1.254	0.0	169.9	169.9	1877.1	Flood Risk
120 min Winter	91.791	1.291	0.0	169.9	169.9	1969.9	Flood Risk
180 min Winter	91.762	1.262	0.0	169.9	169.9	1898.0	Flood Risk
240 min Winter	91.720	1.220	0.0	169.9	169.9	1785.0	Flood Risk
360 min Winter	91.612	1.112	0.0	169.9	169.9	1496.4	O K
480 min Winter	91.490	0.990	0.0	169.9	169.9	1194.7	O K
600 min Winter	91.368	0.868	0.0	169.9	169.9	918.1	O K
720 min Winter	91.253	0.753	0.0	169.9	169.9	680.5	O K
960 min Winter	91.055	0.555	0.0	166.6	166.6	345.2	O K
1440 min Winter	90.888	0.388	0.0	133.4	133.4	158.6	O K
2160 min Winter	90.807	0.307	0.0	94.0	94.0	96.2	O K
2880 min Winter	90.763	0.263	0.0	73.0	73.0	69.8	O K
4320 min Winter	90.716	0.216	0.0	51.8	51.8	46.0	O K
5760 min Winter	90.690	0.190	0.0	40.9	40.9	35.1	O K
7200 min Winter	90.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	90.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	90.500	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	1895.8	32
60 min Winter	64.330	0.0	2384.1	60
120 min Winter	39.872	0.0	2955.3	114
180 min Winter	29.699	0.0	3301.9	142
240 min Winter	23.895	0.0	3542.1	180
360 min Winter	17.332	0.0	3853.9	254
480 min Winter	13.654	0.0	4048.0	322
600 min Winter	11.294	0.0	4185.5	386
720 min Winter	9.647	0.0	4290.3	442
960 min Winter	7.494	0.0	4443.9	542
1440 min Winter	5.214	0.0	4637.9	750
2160 min Winter	3.623	0.0	4834.0	1100
2880 min Winter	2.808	0.0	4995.9	1468
4320 min Winter	1.985	0.0	5297.4	2204
5760 min Winter	1.569	0.0	5581.7	2896
7200 min Winter	-0.012	0.0	-51.9	0
8640 min Winter	-0.010	0.0	-51.9	0
10080 min Winter	-0.008	0.0	-51.9	0

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Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.360

**Time (mins) Area**  
**From: To: (ha)**

0 4 4.360

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Model Details

Storage is Online Cover Level (m) 92.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	215.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	1.200
Invert Level (m)	90.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	6.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0480-1700-2000-1700
Design Head (m)	2.000
Design Flow (l/s)	170.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	480
Invert Level (m)	90.500
Minimum Outlet Pipe Diameter (mm)	500
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	169.9
Flush-Flo™	0.764	169.9
Kick-Flo®	1.483	146.9
Mean Flow over Head Range	-	140.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	12.3	1.200	162.8	3.000	207.1	7.000	313.8
0.200	45.0	1.400	153.5	3.500	223.4	7.500	324.6
0.300	90.6	1.600	152.4	4.000	238.5	8.000	335.0
0.400	138.8	1.800	161.4	4.500	252.6	8.500	345.2
0.500	164.3	2.000	169.9	5.000	266.0	9.000	355.0
0.600	168.0	2.200	178.0	5.500	278.7	9.500	364.6
0.800	169.8	2.400	185.7	6.000	290.9		
1.000	167.5	2.600	193.1	6.500	302.6		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 63 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	90.503	0.503	0.0	98.1	98.1	463.7	O K
30 min Summer	90.553	0.553	0.0	98.8	98.8	570.5	O K
60 min Summer	90.577	0.577	0.0	99.1	99.1	627.9	O K
120 min Summer	90.585	0.585	0.0	99.2	99.2	646.1	O K
180 min Summer	90.574	0.574	0.0	99.1	99.1	621.1	O K
240 min Summer	90.558	0.558	0.0	98.9	98.9	581.8	O K
360 min Summer	90.517	0.517	0.0	98.3	98.3	492.2	O K
480 min Summer	90.474	0.474	0.0	97.4	97.4	407.6	O K
600 min Summer	90.434	0.434	0.0	96.3	96.3	336.4	O K
720 min Summer	90.398	0.398	0.0	95.0	95.0	280.0	O K
960 min Summer	90.349	0.349	0.0	87.3	87.3	210.6	O K
1440 min Summer	90.289	0.289	0.0	68.5	68.5	141.0	O K
2160 min Summer	90.238	0.238	0.0	50.9	50.9	94.0	O K
2880 min Summer	90.208	0.208	0.0	40.6	40.6	70.9	O K
4320 min Summer	90.173	0.173	0.0	29.4	29.4	48.1	O K
5760 min Summer	90.152	0.152	0.0	23.3	23.3	37.0	O K
7200 min Summer	90.000	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	90.000	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	90.000	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	90.503	0.503	0.0	98.1	98.1	464.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	531.3	17
30 min Summer	102.312	0.0	700.1	31
60 min Summer	64.330	0.0	880.4	54
120 min Summer	39.872	0.0	1091.3	86
180 min Summer	29.699	0.0	1219.3	120
240 min Summer	23.895	0.0	1308.0	154
360 min Summer	17.332	0.0	1423.1	220
480 min Summer	13.654	0.0	1494.8	282
600 min Summer	11.294	0.0	1545.6	342
720 min Summer	9.647	0.0	1584.3	398
960 min Summer	7.494	0.0	1641.0	512
1440 min Summer	5.214	0.0	1712.6	750
2160 min Summer	3.623	0.0	1785.0	1104
2880 min Summer	2.808	0.0	1844.8	1468
4320 min Summer	1.985	0.0	1956.1	2200
5760 min Summer	1.569	0.0	2061.1	2936
7200 min Summer	-0.012	0.0	-19.2	0
8640 min Summer	-0.010	0.0	-19.2	0
10080 min Summer	-0.008	0.0	-19.2	0
15 min Winter	155.288	0.0	531.3	17

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	90.553	0.553	0.0	98.8	98.8	571.6	O K
60 min Winter	90.577	0.577	0.0	99.1	99.1	627.3	O K
120 min Winter	90.578	0.578	0.0	99.1	99.1	630.8	O K
180 min Winter	90.559	0.559	0.0	98.9	98.9	586.1	O K
240 min Winter	90.532	0.532	0.0	98.6	98.6	525.7	O K
360 min Winter	90.470	0.470	0.0	97.3	97.3	401.0	O K
480 min Winter	90.409	0.409	0.0	95.5	95.5	297.2	O K
600 min Winter	90.363	0.363	0.0	91.2	91.2	229.8	O K
720 min Winter	90.331	0.331	0.0	82.2	82.2	188.9	O K
960 min Winter	90.286	0.286	0.0	67.6	67.6	138.3	O K
1440 min Winter	90.232	0.232	0.0	48.9	48.9	89.1	O K
2160 min Winter	90.189	0.189	0.0	34.5	34.5	58.1	O K
2880 min Winter	90.164	0.164	0.0	26.9	26.9	43.4	O K
4320 min Winter	90.136	0.136	0.0	19.1	19.1	29.4	O K
5760 min Winter	90.120	0.120	0.0	15.2	15.2	22.8	O K
7200 min Winter	90.000	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	90.000	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	90.000	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	700.1	31
60 min Winter	64.330	0.0	880.4	58
120 min Winter	39.872	0.0	1091.3	92
180 min Winter	29.699	0.0	1219.3	130
240 min Winter	23.895	0.0	1308.0	164
360 min Winter	17.332	0.0	1423.1	230
480 min Winter	13.654	0.0	1494.8	290
600 min Winter	11.294	0.0	1545.6	344
720 min Winter	9.647	0.0	1584.3	400
960 min Winter	7.494	0.0	1641.0	518
1440 min Winter	5.214	0.0	1712.6	752
2160 min Winter	3.623	0.0	1785.0	1104
2880 min Winter	2.808	0.0	1844.8	1468
4320 min Winter	1.985	0.0	1956.1	2192
5760 min Winter	1.569	0.0	2061.1	2912
7200 min Winter	-0.012	0.0	-19.2	0
8640 min Winter	-0.010	0.0	-19.2	0
10080 min Winter	-0.008	0.0	-19.2	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 1.610

**Time (mins) Area**  
**From: To: (ha)**

0            4    1.610



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Model Details

Storage is Online Cover Level (m) 91.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	370.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	1.200
Invert Level (m)	90.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	6.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0382-1000-2000-1000
Design Head (m)	2.000
Design Flow (l/s)	100.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	382
Invert Level (m)	90.000
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	99.9
Flush-Flo™	0.671	99.5
Kick-Flo®	1.412	84.4
Mean Flow over Head Range	-	84.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	10.7	1.200	93.5	3.000	121.7	7.000	184.1
0.200	38.0	1.400	85.3	3.500	131.2	7.500	190.4
0.300	72.4	1.600	89.7	4.000	140.0	8.000	196.5
0.400	95.1	1.800	94.9	4.500	148.3	8.500	202.4
0.500	98.0	2.000	99.9	5.000	156.1	9.000	208.2
0.600	99.3	2.200	104.7	5.500	163.6	9.500	213.8
0.800	99.0	2.400	109.2	6.000	170.7		
1.000	97.0	2.600	113.5	6.500	177.5		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 7 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	92.504	1.004	0.0	536.0	536.0	400.2	FLOOD
30 min Summer	92.517	1.017	0.0	536.0	536.0	421.6	FLOOD
60 min Summer	92.469	0.969	0.0	532.3	532.3	370.8	Flood Risk
120 min Summer	92.325	0.825	0.0	479.2	479.2	273.0	Flood Risk
180 min Summer	92.220	0.720	0.0	423.9	423.9	202.8	Flood Risk
240 min Summer	92.145	0.645	0.0	379.2	379.2	154.8	O K
360 min Summer	92.041	0.541	0.0	306.3	306.3	100.7	O K
480 min Summer	91.974	0.474	0.0	251.5	251.5	73.2	O K
600 min Summer	91.926	0.426	0.0	212.8	212.8	57.1	O K
720 min Summer	91.890	0.390	0.0	183.9	183.9	46.4	O K
960 min Summer	91.839	0.339	0.0	144.3	144.3	33.4	O K
1440 min Summer	91.777	0.277	0.0	101.0	101.0	21.0	O K
2160 min Summer	91.727	0.227	0.0	70.1	70.1	13.5	O K
2880 min Summer	91.698	0.198	0.0	54.3	54.3	9.9	O K
4320 min Summer	91.665	0.165	0.0	38.5	38.5	6.7	O K
5760 min Summer	91.646	0.146	0.0	30.5	30.5	5.1	O K
7200 min Summer	91.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	91.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	91.500	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	92.496	0.996	0.0	535.7	535.7	391.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	4.4	689.7	13
30 min Summer	102.312	17.4	908.8	22
60 min Summer	64.330	0.0	1142.8	38
120 min Summer	39.872	0.0	1416.7	70
180 min Summer	29.699	0.0	1582.8	100
240 min Summer	23.895	0.0	1697.9	128
360 min Summer	17.332	0.0	1847.4	188
480 min Summer	13.654	0.0	1940.4	248
600 min Summer	11.294	0.0	2006.3	308
720 min Summer	9.647	0.0	2056.6	368
960 min Summer	7.494	0.0	2130.2	490
1440 min Summer	5.214	0.0	2223.2	734
2160 min Summer	3.623	0.0	2317.2	1096
2880 min Summer	2.808	0.0	2394.8	1428
4320 min Summer	1.985	0.0	2539.3	2188
5760 min Summer	1.569	0.0	2675.7	2896
7200 min Summer	-0.012	0.0	-24.9	0
8640 min Summer	-0.010	0.0	-24.9	0
10080 min Summer	-0.008	0.0	-24.9	0
15 min Winter	155.288	0.0	689.7	14

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	92.500	1.000	0.0	535.9	535.9	393.7	Flood Risk
60 min Winter	92.381	0.881	0.0	506.4	506.4	310.8	Flood Risk
120 min Winter	92.201	0.701	0.0	413.0	413.0	190.3	Flood Risk
180 min Winter	92.089	0.589	0.0	342.1	342.1	124.1	O K
240 min Winter	92.017	0.517	0.0	287.0	287.0	90.2	O K
360 min Winter	91.927	0.427	0.0	213.2	213.2	57.1	O K
480 min Winter	91.872	0.372	0.0	169.4	169.4	41.3	O K
600 min Winter	91.834	0.334	0.0	140.6	140.6	32.2	O K
720 min Winter	91.805	0.305	0.0	120.1	120.1	26.3	O K
960 min Winter	91.766	0.266	0.0	93.5	93.5	19.1	O K
1440 min Winter	91.718	0.218	0.0	65.0	65.0	12.3	O K
2160 min Winter	91.680	0.180	0.0	45.4	45.4	8.0	O K
2880 min Winter	91.658	0.158	0.0	35.2	35.2	6.0	O K
4320 min Winter	91.632	0.132	0.0	24.9	24.9	4.1	O K
5760 min Winter	91.616	0.116	0.0	19.6	19.6	3.1	O K
7200 min Winter	91.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	91.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	91.500	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	908.8	23
60 min Winter	64.330	0.0	1142.8	40
120 min Winter	39.872	0.0	1416.7	70
180 min Winter	29.699	0.0	1582.8	100
240 min Winter	23.895	0.0	1697.9	128
360 min Winter	17.332	0.0	1847.4	188
480 min Winter	13.654	0.0	1940.4	246
600 min Winter	11.294	0.0	2006.3	306
720 min Winter	9.647	0.0	2056.6	368
960 min Winter	7.494	0.0	2130.2	488
1440 min Winter	5.214	0.0	2223.2	734
2160 min Winter	3.623	0.0	2317.2	1092
2880 min Winter	2.808	0.0	2394.8	1452
4320 min Winter	1.985	0.0	2539.3	2184
5760 min Winter	1.569	0.0	2675.6	2840
7200 min Winter	-0.012	0.0	-24.9	0
8640 min Winter	-0.010	0.0	-24.9	0
10080 min Winter	-0.008	0.0	-24.9	0

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Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.090

**Time (mins) Area**  
**From: To: (ha)**

0 4 2.090

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Model Details

Storage is Online Cover Level (m) 92.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	230.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	1.00	Cap Volume Depth (m)	0.700
Invert Level (m)	91.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	2.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0689-5400-1500-5400
Design Head (m)	1.500
Design Flow (l/s)	540.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	689
Invert Level (m)	91.500
Minimum Outlet Pipe Diameter (mm)	Site Specific Design (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	539.6
Flush-Flo™	1.007	536.1
Kick-Flo®	1.181	486.5
Mean Flow over Head Range	-	348.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	14.6	1.200	487.6	3.000	758.9	7.000	1151.7
0.200	55.2	1.400	521.6	3.500	818.7	7.500	1191.5
0.300	116.4	1.600	557.0	4.000	874.3	8.000	1230.0
0.400	191.7	1.800	590.2	4.500	926.5	8.500	1267.3
0.500	272.8	2.000	621.6	5.000	975.9	9.000	1303.5
0.600	349.5	2.200	651.5	5.500	1022.7	9.500	1338.7
0.800	466.7	2.400	680.0	6.000	1067.5		
1.000	535.9	2.600	707.3	6.500	1110.4		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 67 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	90.739	0.739	0.0	119.3	119.3	653.8	O K
30 min Summer	90.812	0.812	0.0	119.8	119.8	807.5	O K
60 min Summer	90.849	0.849	0.0	119.9	119.9	893.0	O K
120 min Summer	90.857	0.857	0.0	120.0	120.0	913.6	O K
180 min Summer	90.843	0.843	0.0	119.9	119.9	880.0	O K
240 min Summer	90.821	0.821	0.0	119.8	119.8	827.8	O K
360 min Summer	90.766	0.766	0.0	119.5	119.5	707.0	O K
480 min Summer	90.705	0.705	0.0	118.8	118.8	588.0	O K
600 min Summer	90.645	0.645	0.0	117.8	117.8	482.1	O K
720 min Summer	90.588	0.588	0.0	116.4	116.4	392.0	O K
960 min Summer	90.487	0.487	0.0	112.8	112.8	259.7	O K
1440 min Summer	90.368	0.368	0.0	98.5	98.5	141.6	O K
2160 min Summer	90.293	0.293	0.0	73.4	73.4	87.4	O K
2880 min Summer	90.252	0.252	0.0	58.1	58.1	63.6	O K
4320 min Summer	90.206	0.206	0.0	41.5	41.5	41.7	O K
5760 min Summer	90.181	0.181	0.0	32.9	32.9	31.7	O K
7200 min Summer	90.000	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	90.000	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	90.000	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	90.740	0.740	0.0	119.3	119.3	654.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	745.8	17
30 min Summer	102.312	0.0	982.7	31
60 min Summer	64.330	0.0	1235.8	58
120 min Summer	39.872	0.0	1531.9	90
180 min Summer	29.699	0.0	1711.5	124
240 min Summer	23.895	0.0	1836.1	158
360 min Summer	17.332	0.0	1997.7	226
480 min Summer	13.654	0.0	2098.3	290
600 min Summer	11.294	0.0	2169.5	350
720 min Summer	9.647	0.0	2223.9	410
960 min Summer	7.494	0.0	2303.5	522
1440 min Summer	5.214	0.0	2404.1	748
2160 min Summer	3.623	0.0	2505.7	1104
2880 min Summer	2.808	0.0	2589.6	1468
4320 min Summer	1.985	0.0	2745.9	2200
5760 min Summer	1.569	0.0	2893.3	2928
7200 min Summer	-0.012	0.0	-26.9	0
8640 min Summer	-0.010	0.0	-26.9	0
10080 min Summer	-0.008	0.0	-26.9	0
15 min Winter	155.288	0.0	745.8	17

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	90.813	0.813	0.0	119.8	119.8	810.4	O K
60 min Winter	90.851	0.851	0.0	120.0	120.0	898.4	O K
120 min Winter	90.853	0.853	0.0	120.0	120.0	902.9	O K
180 min Winter	90.829	0.829	0.0	119.9	119.9	845.9	O K
240 min Winter	90.793	0.793	0.0	119.7	119.7	765.8	O K
360 min Winter	90.707	0.707	0.0	118.9	118.9	592.1	O K
480 min Winter	90.616	0.616	0.0	117.2	117.2	434.3	O K
600 min Winter	90.527	0.527	0.0	114.4	114.4	308.1	O K
720 min Winter	90.448	0.448	0.0	110.9	110.9	216.8	O K
960 min Winter	90.360	0.360	0.0	96.3	96.3	135.7	O K
1440 min Winter	90.282	0.282	0.0	69.3	69.3	80.7	O K
2160 min Winter	90.227	0.227	0.0	48.8	48.8	50.8	O K
2880 min Winter	90.196	0.196	0.0	37.9	37.9	37.4	O K
4320 min Winter	90.161	0.161	0.0	26.8	26.8	25.0	O K
5760 min Winter	90.142	0.142	0.0	21.2	21.2	19.2	O K
7200 min Winter	90.000	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	90.000	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	90.000	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	982.7	31
60 min Winter	64.330	0.0	1235.8	58
120 min Winter	39.872	0.0	1531.9	94
180 min Winter	29.699	0.0	1711.5	132
240 min Winter	23.895	0.0	1836.1	170
360 min Winter	17.332	0.0	1997.7	238
480 min Winter	13.654	0.0	2098.3	300
600 min Winter	11.294	0.0	2169.5	358
720 min Winter	9.647	0.0	2223.9	410
960 min Winter	7.494	0.0	2303.5	512
1440 min Winter	5.214	0.0	2404.1	748
2160 min Winter	3.623	0.0	2505.7	1100
2880 min Winter	2.808	0.0	2589.6	1468
4320 min Winter	1.985	0.0	2745.9	2188
5760 min Winter	1.569	0.0	2893.3	2936
7200 min Winter	-0.012	0.0	-26.9	0
8640 min Winter	-0.010	0.0	-26.9	0
10080 min Winter	-0.008	0.0	-26.9	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 2.260

**Time (mins) Area**  
**From: To: (ha)**

0 4 2.260



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Model Details

Storage is Online Cover Level (m) 91.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	370.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	1.200
Invert Level (m)	90.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	6.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0400-1200-3000-1200
Design Head (m)	3.000
Design Flow (l/s)	120.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	400
Invert Level (m)	90.000
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	120.0
Flush-Flo™	0.894	120.0
Kick-Flo®	1.954	97.4
Mean Flow over Head Range	-	103.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	11.0	1.200	118.3	3.000	120.0	7.000	181.4
0.200	39.3	1.400	116.0	3.500	129.3	7.500	187.7
0.300	75.9	1.600	112.4	4.000	138.0	8.000	193.7
0.400	108.1	1.800	105.9	4.500	146.2	8.500	199.5
0.500	113.4	2.000	98.5	5.000	153.9	9.000	205.2
0.600	116.8	2.200	103.2	5.500	161.3	9.500	210.7
0.800	119.7	2.400	107.7	6.000	168.3		
1.000	119.7	2.600	111.9	6.500	175.0		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 32 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.755	0.455	0.0	142.9	142.9	372.5	O K
30 min Summer	89.790	0.490	0.0	146.0	146.0	438.5	O K
60 min Summer	89.805	0.505	0.0	147.3	147.3	469.3	O K
120 min Summer	89.800	0.500	0.0	146.9	146.9	458.6	O K
180 min Summer	89.780	0.480	0.0	145.2	145.2	419.2	O K
240 min Summer	89.757	0.457	0.0	143.1	143.1	376.6	O K
360 min Summer	89.715	0.415	0.0	130.8	130.8	306.7	O K
480 min Summer	89.681	0.381	0.0	118.4	118.4	254.1	O K
600 min Summer	89.652	0.352	0.0	107.2	107.2	215.4	O K
720 min Summer	89.629	0.329	0.0	97.2	97.2	186.4	O K
960 min Summer	89.593	0.293	0.0	81.5	81.5	145.7	O K
1440 min Summer	89.546	0.246	0.0	61.0	61.0	100.5	O K
2160 min Summer	89.505	0.205	0.0	44.6	44.6	68.8	O K
2880 min Summer	89.480	0.180	0.0	35.2	35.2	52.4	O K
4320 min Summer	89.450	0.150	0.0	25.3	25.3	36.0	O K
5760 min Summer	89.433	0.133	0.0	20.1	20.1	27.9	O K
7200 min Summer	89.300	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	89.300	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	89.300	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	89.755	0.455	0.0	142.9	142.9	373.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.288	0.0	455.4	16
30 min Summer	102.312	0.0	600.1	27
60 min Summer	64.330	0.0	754.6	44
120 min Summer	39.872	0.0	935.4	78
180 min Summer	29.699	0.0	1045.1	112
240 min Summer	23.895	0.0	1121.1	144
360 min Summer	17.332	0.0	1219.8	204
480 min Summer	13.654	0.0	1281.2	266
600 min Summer	11.294	0.0	1324.8	326
720 min Summer	9.647	0.0	1357.9	384
960 min Summer	7.494	0.0	1406.5	502
1440 min Summer	5.214	0.0	1468.0	740
2160 min Summer	3.623	0.0	1530.0	1104
2880 min Summer	2.808	0.0	1581.3	1468
4320 min Summer	1.985	0.0	1676.7	2200
5760 min Summer	1.569	0.0	1766.7	2928
7200 min Summer	-0.012	0.0	-16.4	0
8640 min Summer	-0.010	0.0	-16.4	0
10080 min Summer	-0.008	0.0	-16.4	0
15 min Winter	155.288	0.0	455.4	16

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	89.790	0.490	0.0	146.0	146.0	438.1	O K
60 min Winter	89.800	0.500	0.0	146.9	146.9	459.3	O K
120 min Winter	89.782	0.482	0.0	145.4	145.4	423.9	O K
180 min Winter	89.751	0.451	0.0	142.6	142.6	366.3	O K
240 min Winter	89.721	0.421	0.0	132.8	132.8	315.8	O K
360 min Winter	89.669	0.369	0.0	114.0	114.0	238.2	O K
480 min Winter	89.630	0.330	0.0	97.6	97.6	187.5	O K
600 min Winter	89.600	0.300	0.0	84.6	84.6	153.1	O K
720 min Winter	89.577	0.277	0.0	74.3	74.3	128.8	O K
960 min Winter	89.542	0.242	0.0	59.3	59.3	97.1	O K
1440 min Winter	89.499	0.199	0.0	42.3	42.3	64.7	O K
2160 min Winter	89.464	0.164	0.0	29.7	29.7	43.2	O K
2880 min Winter	89.443	0.143	0.0	23.2	23.2	32.6	O K
4320 min Winter	89.419	0.119	0.0	16.4	16.4	22.4	O K
5760 min Winter	89.405	0.105	0.0	12.9	12.9	17.3	O K
7200 min Winter	89.300	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	89.300	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	89.300	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	600.1	28
60 min Winter	64.330	0.0	754.6	46
120 min Winter	39.872	0.0	935.4	82
180 min Winter	29.699	0.0	1045.1	116
240 min Winter	23.895	0.0	1121.1	148
360 min Winter	17.332	0.0	1219.8	210
480 min Winter	13.654	0.0	1281.2	272
600 min Winter	11.294	0.0	1324.8	332
720 min Winter	9.647	0.0	1357.9	390
960 min Winter	7.494	0.0	1406.5	510
1440 min Winter	5.214	0.0	1468.0	750
2160 min Winter	3.623	0.0	1530.0	1104
2880 min Winter	2.808	0.0	1581.3	1468
4320 min Winter	1.985	0.0	1676.7	2176
5760 min Winter	1.569	0.0	1766.7	2896
7200 min Winter	-0.012	0.0	-16.4	0
8640 min Winter	-0.010	0.0	-16.4	0
10080 min Winter	-0.008	0.0	-16.4	0

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Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.380

**Time (mins) Area**  
**From: To: (ha)**

0 4 1.380

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Model Details

Storage is Online Cover Level (m) 90.800

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	355.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	1.200
Invert Level (m)	89.300	Cap Infiltration Depth (m)	0.000
Base Width (m)	6.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0444-1700-4500-1700
Design Head (m)	4.500
Design Flow (l/s)	170.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	444
Invert Level (m)	89.300
Minimum Outlet Pipe Diameter (mm)	Site Specific Design (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	4.500	169.8
Flush-Flo™	1.292	169.8
Kick-Flo®	2.767	134.0
Mean Flow over Head Range	-	147.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	11.7	1.200	169.7	3.000	139.3	7.000	210.7
0.200	42.6	1.400	169.6	3.500	150.2	7.500	218.0
0.300	84.5	1.600	168.4	4.000	160.3	8.000	225.0
0.400	125.5	1.800	166.4	4.500	169.8	8.500	231.7
0.500	146.9	2.000	163.5	5.000	178.8	9.000	238.3
0.600	153.9	2.200	159.3	5.500	187.3	9.500	244.7
0.800	163.1	2.400	153.3	6.000	195.4		
1.000	167.8	2.600	144.5	6.500	203.2		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 21 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	91.835	0.635	0.0	99.8	99.8	197.6	Flood Risk
30 min Summer	91.868	0.668	0.0	99.8	99.8	223.4	Flood Risk
60 min Summer	91.866	0.666	0.0	99.8	99.8	222.0	Flood Risk
120 min Summer	91.829	0.629	0.0	99.8	99.8	193.0	Flood Risk
180 min Summer	91.776	0.576	0.0	99.8	99.8	156.4	Flood Risk
240 min Summer	91.721	0.521	0.0	99.8	99.8	121.9	Flood Risk
360 min Summer	91.618	0.418	0.0	98.3	98.3	71.3	O K
480 min Summer	91.550	0.350	0.0	92.6	92.6	46.5	O K
600 min Summer	91.513	0.313	0.0	80.3	80.3	35.7	O K
720 min Summer	91.485	0.285	0.0	70.2	70.2	28.9	O K
960 min Summer	91.447	0.247	0.0	55.9	55.9	20.7	O K
1440 min Summer	91.401	0.201	0.0	39.5	39.5	12.9	O K
2160 min Summer	91.364	0.164	0.0	27.5	27.5	8.2	O K
2880 min Summer	91.343	0.143	0.0	21.4	21.4	6.0	O K
4320 min Summer	91.318	0.118	0.0	15.1	15.1	4.0	O K
5760 min Summer	91.305	0.105	0.0	12.0	12.0	3.1	O K
7200 min Summer	91.200	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	91.200	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	91.200	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	91.835	0.635	0.0	99.8	99.8	197.6	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.288	0.0	270.6	16
30 min Summer	102.312	0.0	356.6	25
60 min Summer	64.330	0.0	448.4	42
120 min Summer	39.872	0.0	555.8	76
180 min Summer	29.699	0.0	621.0	108
240 min Summer	23.895	0.0	666.2	140
360 min Summer	17.332	0.0	724.8	196
480 min Summer	13.654	0.0	761.3	250
600 min Summer	11.294	0.0	787.2	308
720 min Summer	9.647	0.0	806.9	370
960 min Summer	7.494	0.0	835.8	490
1440 min Summer	5.214	0.0	872.3	734
2160 min Summer	3.623	0.0	909.2	1100
2880 min Summer	2.808	0.0	939.6	1468
4320 min Summer	1.985	0.0	996.3	2136
5760 min Summer	1.569	0.0	1049.8	2864
7200 min Summer	-0.012	0.0	-9.8	0
8640 min Summer	-0.010	0.0	-9.8	0
10080 min Summer	-0.008	0.0	-9.8	0
15 min Winter	155.288	0.0	270.6	16

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	91.866	0.666	0.0	99.8	99.8	221.5	Flood Risk
60 min Winter	91.852	0.652	0.0	99.8	99.8	211.0	Flood Risk
120 min Winter	91.780	0.580	0.0	99.8	99.8	159.1	Flood Risk
180 min Winter	91.693	0.493	0.0	99.7	99.7	106.3	O K
240 min Winter	91.607	0.407	0.0	97.9	97.9	66.6	O K
360 min Winter	91.517	0.317	0.0	81.7	81.7	36.8	O K
480 min Winter	91.473	0.273	0.0	65.7	65.7	26.1	O K
600 min Winter	91.444	0.244	0.0	54.8	54.8	20.0	O K
720 min Winter	91.422	0.222	0.0	47.0	47.0	16.2	O K
960 min Winter	91.392	0.192	0.0	36.6	36.6	11.7	O K
1440 min Winter	91.357	0.157	0.0	25.5	25.5	7.5	O K
2160 min Winter	91.329	0.129	0.0	17.8	17.8	4.9	O K
2880 min Winter	91.313	0.113	0.0	13.8	13.8	3.6	O K
4320 min Winter	91.294	0.094	0.0	9.8	9.8	2.5	O K
5760 min Winter	91.283	0.083	0.0	7.7	7.7	1.9	O K
7200 min Winter	91.200	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	91.200	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	91.200	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	356.6	26
60 min Winter	64.330	0.0	448.4	46
120 min Winter	39.872	0.0	555.8	80
180 min Winter	29.699	0.0	621.0	112
240 min Winter	23.895	0.0	666.2	138
360 min Winter	17.332	0.0	724.8	192
480 min Winter	13.654	0.0	761.3	250
600 min Winter	11.294	0.0	787.2	308
720 min Winter	9.647	0.0	806.9	368
960 min Winter	7.494	0.0	835.8	490
1440 min Winter	5.214	0.0	872.3	722
2160 min Winter	3.623	0.0	909.2	1100
2880 min Winter	2.808	0.0	939.6	1464
4320 min Winter	1.985	0.0	996.3	2152
5760 min Winter	1.569	0.0	1049.8	2872
7200 min Winter	-0.012	0.0	-9.8	0
8640 min Winter	-0.010	0.0	-9.8	0
10080 min Winter	-0.008	0.0	-9.8	0

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Source Control 2018.1

Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.820

Time (mins)		Area
From:	To:	(ha)
0	4	0.820



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Model Details

Storage is Online Cover Level (m) 92.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	250.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	0.600
Invert Level (m)	91.200	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.6		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0398-1000-0800-1000
Design Head (m)	0.800
Design Flow (l/s)	100.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	398
Invert Level (m)	91.200
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	100.0
Flush-Flo™	0.523	99.8
Kick-Flo®	0.723	95.2
Mean Flow over Head Range	-	71.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	11.0	1.200	121.8	3.000	190.4	7.000	288.6
0.200	39.2	1.400	131.2	3.500	205.4	7.500	298.5
0.300	75.7	1.600	140.1	4.000	219.3	8.000	308.2
0.400	97.7	1.800	148.4	4.500	232.3	8.500	314.0
0.500	99.7	2.000	156.2	5.000	244.6	9.000	323.3
0.600	99.1	2.200	163.6	5.500	256.3	9.500	332.4
0.800	100.0	2.400	170.7	6.000	267.5		
1.000	111.4	2.600	177.5	6.500	278.3		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 382 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	90.436	0.736	0.0	34.9	34.9	34.9	776.5	O K
30 min Summer	90.529	0.829	0.0	34.9	34.9	34.9	1005.9	O K
60 min Summer	90.611	0.911	0.0	34.9	34.9	34.9	1223.6	O K
120 min Summer	90.686	0.986	0.0	34.9	34.9	34.9	1433.1	O K
180 min Summer	90.716	1.016	0.0	34.9	34.9	34.9	1516.4	Flood Risk
240 min Summer	90.724	1.024	0.0	34.9	34.9	34.9	1540.9	Flood Risk
360 min Summer	90.710	1.010	0.0	34.9	34.9	34.9	1500.1	Flood Risk
480 min Summer	90.682	0.982	0.0	34.9	34.9	34.9	1421.6	O K
600 min Summer	90.655	0.955	0.0	34.9	34.9	34.9	1344.9	O K
720 min Summer	90.629	0.929	0.0	34.9	34.9	34.9	1273.8	O K
960 min Summer	90.582	0.882	0.0	34.9	34.9	34.9	1144.5	O K
1440 min Summer	90.494	0.794	0.0	34.9	34.9	34.9	919.0	O K
2160 min Summer	90.378	0.678	0.0	34.9	34.9	34.9	648.5	O K
2880 min Summer	90.272	0.572	0.0	34.9	34.9	34.9	447.2	O K
4320 min Summer	90.100	0.400	0.0	34.1	34.1	34.1	208.3	O K
5760 min Summer	89.988	0.288	0.0	32.1	32.1	32.1	103.7	O K
7200 min Summer	89.700	0.000	0.0	0.0	0.0	0.0	0.0	O K
8640 min Summer	89.700	0.000	0.0	0.0	0.0	0.0	0.0	O K
10080 min Summer	89.700	0.000	0.0	0.0	0.0	0.0	0.0	O K
15 min Winter	90.436	0.736	0.0	34.9	34.9	34.9	777.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.288	0.0	808.5	19
30 min Summer	102.312	0.0	1065.3	33
60 min Summer	64.330	0.0	1339.7	62
120 min Summer	39.872	0.0	1660.7	122
180 min Summer	29.699	0.0	1855.4	182
240 min Summer	23.895	0.0	1990.4	242
360 min Summer	17.332	0.0	2165.6	354
480 min Summer	13.654	0.0	2274.7	402
600 min Summer	11.294	0.0	2351.9	458
720 min Summer	9.647	0.0	2410.8	518
960 min Summer	7.494	0.0	2497.1	648
1440 min Summer	5.214	0.0	2606.2	910
2160 min Summer	3.623	0.0	2716.4	1296
2880 min Summer	2.808	0.0	2807.3	1644
4320 min Summer	1.985	0.0	2976.7	2332
5760 min Summer	1.569	0.0	3136.5	2992
7200 min Summer	-0.012	0.0	-29.2	0
8640 min Summer	-0.010	0.0	-29.2	0
10080 min Summer	-0.008	0.0	-29.2	0
15 min Winter	155.288	0.0	808.5	18

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	90.529	0.829	0.0	34.9	34.9	1007.2	O K
60 min Winter	90.612	0.912	0.0	34.9	34.9	1226.8	O K
120 min Winter	90.688	0.988	0.0	34.9	34.9	1438.8	O K
180 min Winter	90.719	1.019	0.0	34.9	34.9	1525.2	Flood Risk
<b>240 min Winter</b>	<b>90.729</b>	<b>1.029</b>	<b>0.0</b>	<b>34.9</b>	<b>34.9</b>	<b>1552.7</b>	<b>Flood Risk</b>
360 min Winter	90.716	1.016	0.0	34.9	34.9	1518.1	Flood Risk
480 min Winter	90.684	0.984	0.0	34.9	34.9	1427.6	O K
600 min Winter	90.652	0.952	0.0	34.9	34.9	1337.2	O K
720 min Winter	90.621	0.921	0.0	34.9	34.9	1251.0	O K
960 min Winter	90.559	0.859	0.0	34.9	34.9	1083.4	O K
1440 min Winter	90.437	0.737	0.0	34.9	34.9	778.7	O K
2160 min Winter	90.260	0.560	0.0	34.9	34.9	427.0	O K
2880 min Winter	90.100	0.400	0.0	34.1	34.1	208.2	O K
4320 min Winter	89.932	0.232	0.0	28.7	28.7	66.3	O K
5760 min Winter	89.891	0.191	0.0	22.9	22.9	44.6	O K
7200 min Winter	89.700	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	89.700	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	89.700	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	1065.3	33
60 min Winter	64.330	0.0	1339.7	62
120 min Winter	39.872	0.0	1660.7	120
180 min Winter	29.699	0.0	1855.4	178
<b>240 min Winter</b>	<b>23.895</b>	<b>0.0</b>	<b>1990.4</b>	<b>234</b>
360 min Winter	17.332	0.0	2165.6	346
480 min Winter	13.654	0.0	2274.7	444
600 min Winter	11.294	0.0	2351.9	472
720 min Winter	9.647	0.0	2410.8	544
960 min Winter	7.494	0.0	2497.1	692
1440 min Winter	5.214	0.0	2606.2	968
2160 min Winter	3.623	0.0	2716.4	1340
2880 min Winter	2.808	0.0	2807.3	1644
4320 min Winter	1.985	0.0	2976.7	2208
5760 min Winter	1.569	0.0	3136.5	2936
7200 min Winter	-0.012	0.0	-29.2	0
8640 min Winter	-0.010	0.0	-29.2	0
10080 min Winter	-0.008	0.0	-29.2	0

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Source Control 2018.1

Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.450

<b>Time (mins)</b>	<b>Area</b>
<b>From:</b>	<b>To: (ha)</b>

0	4 2.450
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Model Details

Storage is Online Cover Level (m) 91.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	230.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	1.000
Invert Level (m)	89.700	Cap Infiltration Depth (m)	0.000
Base Width (m)	7.6		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0239-3500-2000-3500
Design Head (m)	2.000
Design Flow (l/s)	35.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	239
Invert Level (m)	89.700
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	35.0
Flush-Flo™	0.590	34.9
Kick-Flo®	1.282	28.3
Mean Flow over Head Range	-	30.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	30.4	3.000	42.5	7.000	64.1
0.200	24.2	1.400	29.5	3.500	45.8	7.500	66.3
0.300	32.4	1.600	31.4	4.000	48.9	8.000	68.4
0.400	34.0	1.800	33.3	4.500	51.7	8.500	70.4
0.500	34.8	2.000	35.0	5.000	54.4	9.000	72.4
0.600	34.9	2.200	36.6	5.500	57.0	9.500	74.3
0.800	34.4	2.400	38.2	6.000	59.5		
1.000	33.2	2.600	39.7	6.500	61.8		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 218 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	89.339	0.639	0.0	39.8	39.8	570.1	O K
30 min Summer	89.416	0.716	0.0	39.9	39.9	731.8	O K
60 min Summer	89.477	0.777	0.0	39.9	39.9	875.0	O K
120 min Summer	89.521	0.821	0.0	39.9	39.9	990.7	O K
180 min Summer	89.530	0.830	0.0	39.9	39.9	1014.3	O K
240 min Summer	89.525	0.825	0.0	39.9	39.9	1001.1	O K
360 min Summer	89.506	0.806	0.0	39.9	39.9	948.8	O K
480 min Summer	89.481	0.781	0.0	39.9	39.9	885.9	O K
600 min Summer	89.456	0.756	0.0	39.9	39.9	823.4	O K
720 min Summer	89.430	0.730	0.0	39.9	39.9	763.4	O K
960 min Summer	89.380	0.680	0.0	39.9	39.9	652.3	O K
1440 min Summer	89.282	0.582	0.0	39.6	39.6	465.6	O K
2160 min Summer	89.154	0.454	0.0	38.5	38.5	272.2	O K
2880 min Summer	89.054	0.354	0.0	36.7	36.7	160.2	O K
4320 min Summer	88.947	0.247	0.0	32.0	32.0	75.6	O K
5760 min Summer	88.906	0.206	0.0	26.2	26.2	52.1	O K
7200 min Summer	88.700	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	88.700	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	88.700	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	89.339	0.639	0.0	39.8	39.8	570.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	603.9	18
30 min Summer	102.312	0.0	795.7	33
60 min Summer	64.330	0.0	1000.7	62
120 min Summer	39.872	0.0	1240.4	122
180 min Summer	29.699	0.0	1385.9	180
240 min Summer	23.895	0.0	1486.7	210
360 min Summer	17.332	0.0	1617.6	272
480 min Summer	13.654	0.0	1699.0	336
600 min Summer	11.294	0.0	1756.8	404
720 min Summer	9.647	0.0	1800.7	470
960 min Summer	7.494	0.0	1865.2	600
1440 min Summer	5.214	0.0	1946.6	852
2160 min Summer	3.623	0.0	2029.0	1208
2880 min Summer	2.808	0.0	2096.9	1532
4320 min Summer	1.985	0.0	2223.4	2204
5760 min Summer	1.569	0.0	2342.8	2936
7200 min Summer	-0.012	0.0	-21.8	0
8640 min Summer	-0.010	0.0	-21.8	0
10080 min Summer	-0.008	0.0	-21.8	0
15 min Winter	155.288	0.0	603.9	18

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 Victoria Square  
 Birmingham B2 5TB



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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	89.417	0.717	0.0	39.9	39.9	733.0	O K
60 min Winter	89.478	0.778	0.0	39.9	39.9	877.1	O K
120 min Winter	89.524	0.824	0.0	39.9	39.9	996.9	O K
180 min Winter	89.534	0.834	0.0	39.9	39.9	1023.6	O K
240 min Winter	89.528	0.828	0.0	39.9	39.9	1009.6	O K
360 min Winter	89.503	0.803	0.0	39.9	39.9	942.8	O K
480 min Winter	89.472	0.772	0.0	39.9	39.9	863.4	O K
600 min Winter	89.437	0.737	0.0	39.9	39.9	780.4	O K
720 min Winter	89.402	0.702	0.0	39.9	39.9	699.3	O K
960 min Winter	89.329	0.629	0.0	39.8	39.8	549.7	O K
1440 min Winter	89.185	0.485	0.0	38.9	38.9	313.8	O K
2160 min Winter	89.009	0.309	0.0	35.5	35.5	120.5	O K
2880 min Winter	88.933	0.233	0.0	30.1	30.1	66.7	O K
4320 min Winter	88.880	0.180	0.0	21.6	21.6	39.2	O K
5760 min Winter	88.855	0.155	0.0	17.1	17.1	28.8	O K
7200 min Winter	88.700	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	88.700	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	88.700	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	102.312	0.0	795.7	32
60 min Winter	64.330	0.0	1000.7	62
120 min Winter	39.872	0.0	1240.4	118
180 min Winter	29.699	0.0	1385.9	174
240 min Winter	23.895	0.0	1486.7	228
360 min Winter	17.332	0.0	1617.6	282
480 min Winter	13.654	0.0	1699.0	356
600 min Winter	11.294	0.0	1756.8	430
720 min Winter	9.647	0.0	1800.7	502
960 min Winter	7.494	0.0	1865.2	636
1440 min Winter	5.214	0.0	1946.6	880
2160 min Winter	3.623	0.0	2029.0	1192
2880 min Winter	2.808	0.0	2096.9	1496
4320 min Winter	1.985	0.0	2223.4	2204
5760 min Winter	1.569	0.0	2342.8	2936
7200 min Winter	-0.012	0.0	-21.8	0
8640 min Winter	-0.010	0.0	-21.8	0
10080 min Winter	-0.008	0.0	-21.8	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 1.830

<b>Time (mins)</b>	<b>Area</b>
<b>From:</b>	<b>To: (ha)</b>

0	4 1.830
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Model Details

Storage is Online Cover Level (m) 90.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	250.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	1.000
Invert Level (m)	88.700	Cap Infiltration Depth (m)	0.000
Base Width (m)	7.6		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0247-4000-2500-4000
Design Head (m)	2.500
Design Flow (l/s)	40.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	247
Invert Level (m)	88.700
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	40.0
Flush-Flo™	0.716	39.9
Kick-Flo®	1.539	31.7
Mean Flow over Head Range	-	34.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.0	1.200	37.7	3.000	43.7	7.000	65.8
0.200	25.2	1.400	35.1	3.500	47.0	7.500	68.0
0.300	35.3	1.600	32.3	4.000	50.2	8.000	70.2
0.400	37.7	1.800	34.1	4.500	53.1	8.500	72.3
0.500	39.0	2.000	35.9	5.000	55.9	9.000	74.3
0.600	39.7	2.200	37.6	5.500	58.5	9.500	76.3
0.800	39.8	2.400	39.2	6.000	61.0		
1.000	39.1	2.600	40.7	6.500	63.4		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 17 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.877	0.977	0.0	349.9	349.9	419.2	O K
30 min Summer	90.007	1.107	0.0	349.9	349.9	480.1	Flood Risk
60 min Summer	89.961	1.061	0.0	349.3	349.3	465.2	Flood Risk
120 min Summer	89.811	0.911	0.0	348.8	348.8	379.2	O K
180 min Summer	89.696	0.796	0.0	326.2	326.2	312.9	O K
240 min Summer	89.608	0.708	0.0	295.5	295.5	264.9	O K
360 min Summer	89.481	0.581	0.0	244.9	244.9	200.4	O K
480 min Summer	89.401	0.501	0.0	206.7	206.7	162.5	O K
600 min Summer	89.348	0.448	0.0	177.0	177.0	138.7	O K
720 min Summer	89.309	0.409	0.0	154.1	154.1	121.9	O K
960 min Summer	89.255	0.355	0.0	122.7	122.7	99.1	O K
1440 min Summer	89.190	0.290	0.0	87.0	87.0	73.4	O K
2160 min Summer	89.138	0.238	0.0	61.1	61.1	53.6	O K
2880 min Summer	89.107	0.207	0.0	47.4	47.4	42.4	O K
4320 min Summer	89.072	0.172	0.0	33.5	33.5	30.0	O K
5760 min Summer	89.052	0.152	0.0	26.6	26.6	23.2	O K
7200 min Summer	88.900	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	88.900	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	88.900	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	89.871	0.971	0.0	349.9	349.9	415.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.288	0.0	603.9	14
30 min Summer	102.312	0.0	795.7	24
60 min Summer	64.330	0.0	1000.7	40
120 min Summer	39.872	0.0	1240.4	72
180 min Summer	29.699	0.0	1385.9	102
240 min Summer	23.895	0.0	1486.7	132
360 min Summer	17.332	0.0	1617.6	192
480 min Summer	13.654	0.0	1699.0	250
600 min Summer	11.294	0.0	1756.8	310
720 min Summer	9.647	0.0	1800.7	370
960 min Summer	7.494	0.0	1865.2	492
1440 min Summer	5.214	0.0	1946.6	734
2160 min Summer	3.623	0.0	2029.0	1100
2880 min Summer	2.808	0.0	2096.9	1468
4320 min Summer	1.985	0.0	2223.4	2200
5760 min Summer	1.569	0.0	2342.8	2936
7200 min Summer	-0.012	0.0	-21.8	0
8640 min Summer	-0.010	0.0	-21.8	0
10080 min Summer	-0.008	0.0	-21.8	0
15 min Winter	155.288	0.0	603.9	14

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	89.948	1.048	0.0	349.9	349.9	459.8	Flood Risk
60 min Winter	89.866	0.966	0.0	349.9	349.9	412.4	O K
120 min Winter	89.685	0.785	0.0	322.5	322.5	306.8	O K
180 min Winter	89.554	0.654	0.0	275.3	275.3	237.1	O K
240 min Winter	89.463	0.563	0.0	237.1	237.1	191.9	O K
360 min Winter	89.356	0.456	0.0	181.8	181.8	142.2	O K
480 min Winter	89.294	0.394	0.0	145.3	145.3	115.5	O K
600 min Winter	89.252	0.352	0.0	121.2	121.2	98.2	O K
720 min Winter	89.222	0.322	0.0	104.0	104.0	85.8	O K
960 min Winter	89.179	0.279	0.0	81.3	81.3	69.1	O K
1440 min Winter	89.129	0.229	0.0	56.8	56.8	50.1	O K
2160 min Winter	89.088	0.188	0.0	39.6	39.6	35.4	O K
2880 min Winter	89.064	0.164	0.0	30.7	30.7	27.1	O K
4320 min Winter	89.037	0.137	0.0	21.8	21.8	18.7	O K
5760 min Winter	89.021	0.121	0.0	17.2	17.2	14.5	O K
7200 min Winter	88.900	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	88.900	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	88.900	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	795.7	24
60 min Winter	64.330	0.0	1000.7	42
120 min Winter	39.872	0.0	1240.4	74
180 min Winter	29.699	0.0	1385.9	104
240 min Winter	23.895	0.0	1486.7	134
360 min Winter	17.332	0.0	1617.6	192
480 min Winter	13.654	0.0	1699.0	252
600 min Winter	11.294	0.0	1756.8	312
720 min Winter	9.647	0.0	1800.7	372
960 min Winter	7.494	0.0	1865.2	492
1440 min Winter	5.214	0.0	1946.6	736
2160 min Winter	3.623	0.0	2029.0	1096
2880 min Winter	2.808	0.0	2096.9	1468
4320 min Winter	1.985	0.0	2223.4	2180
5760 min Winter	1.569	0.0	2342.8	2912
7200 min Winter	-0.012	0.0	-21.8	0
8640 min Winter	-0.010	0.0	-21.8	0
10080 min Winter	-0.008	0.0	-21.8	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.830

<b>Time (mins)</b>		<b>Area</b>
<b>From:</b>	<b>To:</b>	<b>(ha)</b>
0	4	1.830

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Model Details

Storage is Online Cover Level (m) 90.200

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	42.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	250.0
Porosity	1.00	Cap Volume Depth (m)	1.000
Invert Level (m)	88.900	Cap Infiltration Depth (m)	0.000
Base Width (m)	7.6		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0604-3500-2000-3500
Design Head (m)	2.000
Design Flow (l/s)	350.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	604
Invert Level (m)	88.900
Minimum Outlet Pipe Diameter (mm)	Site Specific Design (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	350.0
Flush-Flo™	0.939	349.9
Kick-Flo®	1.185	275.2
Mean Flow over Head Range	-	250.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	11.9	1.200	275.6	3.000	427.3	7.000	648.4
0.200	44.3	1.400	293.7	3.500	460.9	7.500	670.8
0.300	92.2	1.600	313.6	4.000	492.2	8.000	692.4
0.400	148.9	1.800	332.3	4.500	521.6	8.500	713.4
0.500	206.3	2.000	350.0	5.000	549.4	9.000	733.8
0.600	253.2	2.200	366.8	5.500	575.8	9.500	753.6
0.800	327.4	2.400	382.8	6.000	601.0		
1.000	339.1	2.600	398.2	6.500	625.1		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 638 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E (l/s)	Max Outflow Volume (m <sup>3</sup> )	Status
15 min Summer	90.710	0.610	0.0	7.6	7.6	274.5	O K
30 min Summer	90.791	0.691	0.0	7.8	7.8	357.6	O K
60 min Summer	90.862	0.762	0.0	7.9	7.9	440.2	O K
120 min Summer	90.930	0.830	0.0	8.1	8.1	525.4	Flood Risk
180 min Summer	90.967	0.867	0.0	8.1	8.1	566.2	Flood Risk
240 min Summer	90.987	0.887	0.0	8.2	8.2	586.4	Flood Risk
360 min Summer	90.994	0.894	0.0	8.2	8.2	593.8	Flood Risk
480 min Summer	90.979	0.879	0.0	8.1	8.1	579.0	Flood Risk
600 min Summer	90.957	0.857	0.0	8.1	8.1	554.7	Flood Risk
720 min Summer	90.934	0.834	0.0	8.1	8.1	530.1	Flood Risk
960 min Summer	90.900	0.800	0.0	8.0	8.0	487.8	Flood Risk
1440 min Summer	90.848	0.748	0.0	7.9	7.9	422.6	O K
2160 min Summer	90.781	0.681	0.0	7.8	7.8	347.1	O K
2880 min Summer	90.723	0.623	0.0	7.7	7.7	286.6	O K
4320 min Summer	90.622	0.522	0.0	7.5	7.5	195.1	O K
5760 min Summer	90.534	0.434	0.0	7.3	7.3	129.8	O K
7200 min Summer	90.100	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	90.100	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	90.100	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	90.710	0.610	0.0	7.6	7.6	274.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	282.4	19
30 min Summer	102.312	0.0	372.3	34
60 min Summer	64.330	0.0	467.9	64
120 min Summer	39.872	0.0	580.3	122
180 min Summer	29.699	0.0	648.3	182
240 min Summer	23.895	0.0	695.1	242
360 min Summer	17.332	0.0	756.8	362
480 min Summer	13.654	0.0	794.5	480
600 min Summer	11.294	0.0	821.5	560
720 min Summer	9.647	0.0	842.5	608
960 min Summer	7.494	0.0	872.5	722
1440 min Summer	5.214	0.0	910.9	982
2160 min Summer	3.623	0.0	948.6	1384
2880 min Summer	2.808	0.0	981.5	1784
4320 min Summer	1.985	0.0	1039.9	2548
5760 min Summer	1.569	0.0	1096.1	3240
7200 min Summer	-0.012	0.0	-10.2	0
8640 min Summer	-0.010	0.0	-10.2	0
10080 min Summer	-0.008	0.0	-10.2	0
15 min Winter	155.288	0.0	282.4	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	90.791	0.691	0.0	7.8	7.8	357.8	O K
60 min Winter	90.862	0.762	0.0	7.9	7.9	440.4	O K
120 min Winter	90.931	0.831	0.0	8.1	8.1	526.5	Flood Risk
180 min Winter	90.969	0.869	0.0	8.1	8.1	568.1	Flood Risk
240 min Winter	90.989	0.889	0.0	8.2	8.2	588.9	Flood Risk
<b>360 min Winter</b>	<b>90.998</b>	<b>0.898</b>	<b>0.0</b>	<b>8.2</b>	<b>8.2</b>	<b>598.2</b>	<b>Flood Risk</b>
480 min Winter	90.986	0.886	0.0	8.2	8.2	585.7	Flood Risk
600 min Winter	90.965	0.865	0.0	8.1	8.1	563.6	Flood Risk
720 min Winter	90.941	0.841	0.0	8.1	8.1	537.1	Flood Risk
960 min Winter	90.900	0.800	0.0	8.0	8.0	487.5	Flood Risk
1440 min Winter	90.836	0.736	0.0	7.9	7.9	408.4	O K
2160 min Winter	90.745	0.645	0.0	7.7	7.7	308.5	O K
2880 min Winter	90.659	0.559	0.0	7.5	7.5	227.2	O K
4320 min Winter	90.504	0.404	0.0	7.2	7.2	109.7	O K
5760 min Winter	90.359	0.259	0.0	6.9	6.9	38.2	O K
7200 min Winter	90.100	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	90.100	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	90.100	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	372.3	33
60 min Winter	64.330	0.0	467.9	62
120 min Winter	39.872	0.0	580.0	120
180 min Winter	29.699	0.0	648.6	180
240 min Winter	23.895	0.0	695.2	238
<b>360 min Winter</b>	<b>17.332</b>	<b>0.0</b>	<b>756.3</b>	<b>352</b>
480 min Winter	13.654	0.0	794.9	462
600 min Winter	11.294	0.0	822.0	570
720 min Winter	9.647	0.0	842.4	668
960 min Winter	7.494	0.0	872.8	750
1440 min Winter	5.214	0.0	910.5	1052
2160 min Winter	3.623	0.0	949.0	1472
2880 min Winter	2.808	0.0	981.0	1876
4320 min Winter	1.985	0.0	1040.4	2596
5760 min Winter	1.569	0.0	1096.0	3232
7200 min Winter	-0.012	0.0	-10.2	0
8640 min Winter	-0.010	0.0	-10.2	0
10080 min Winter	-0.008	0.0	-10.2	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 0.856

**Time (mins) Area**  
**From: To: (ha)**

0 4 0.856



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Model Details

Storage is Online Cover Level (m) 91.200

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	205.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	600.0
Porosity	1.00	Cap Volume Depth (m)	0.800
Invert Level (m)	90.100	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.2		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0117-8000-2000-8000
Design Head (m)	2.000
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	117
Invert Level (m)	88.900
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	8.0
Flush-Flo™	0.511	7.4
Kick-Flo®	1.045	5.9
Mean Flow over Head Range	-	6.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.1	1.200	6.3	3.000	9.7	7.000	14.5
0.200	6.5	1.400	6.8	3.500	10.4	7.500	15.0
0.300	7.1	1.600	7.2	4.000	11.1	8.000	15.4
0.400	7.4	1.800	7.6	4.500	11.7	8.500	15.9
0.500	7.4	2.000	8.0	5.000	12.3	9.000	16.3
0.600	7.4	2.200	8.4	5.500	12.9	9.500	16.8
0.800	7.1	2.400	8.7	6.000	13.5		
1.000	6.2	2.600	9.0	6.500	14.0		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 60 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	90.136	0.736	0.0	45.0	45.0	214.5	O K
30 min Summer	90.193	0.793	0.0	45.0	45.0	260.5	O K
60 min Summer	90.215	0.815	0.0	45.0	45.0	279.0	Flood Risk
120 min Summer	90.211	0.811	0.0	45.0	45.0	275.9	Flood Risk
180 min Summer	90.192	0.792	0.0	45.0	45.0	260.0	O K
240 min Summer	90.168	0.768	0.0	45.0	45.0	239.4	O K
360 min Summer	90.108	0.708	0.0	45.0	45.0	193.2	O K
480 min Summer	90.040	0.640	0.0	45.0	45.0	148.6	O K
600 min Summer	89.970	0.570	0.0	45.0	45.0	110.3	O K
720 min Summer	89.901	0.501	0.0	44.7	44.7	79.6	O K
960 min Summer	89.778	0.378	0.0	43.4	43.4	39.3	O K
1440 min Summer	89.650	0.250	0.0	36.6	36.6	14.5	O K
2160 min Summer	89.591	0.191	0.0	25.8	25.8	7.8	O K
2880 min Summer	89.563	0.163	0.0	20.0	20.0	5.4	O K
4320 min Summer	89.533	0.133	0.0	14.2	14.2	3.4	O K
5760 min Summer	89.516	0.116	0.0	11.2	11.2	2.6	O K
7200 min Summer	89.400	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	89.400	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	89.400	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	90.137	0.737	0.0	45.0	45.0	215.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.288	0.0	254.1	17
30 min Summer	102.312	0.0	334.8	31
60 min Summer	64.330	0.0	421.0	56
120 min Summer	39.872	0.0	521.9	88
180 min Summer	29.699	0.0	583.1	122
240 min Summer	23.895	0.0	625.6	156
360 min Summer	17.332	0.0	680.6	222
480 min Summer	13.654	0.0	714.9	284
600 min Summer	11.294	0.0	739.2	344
720 min Summer	9.647	0.0	757.7	400
960 min Summer	7.494	0.0	784.8	510
1440 min Summer	5.214	0.0	819.1	734
2160 min Summer	3.623	0.0	853.7	1092
2880 min Summer	2.808	0.0	882.3	1464
4320 min Summer	1.985	0.0	935.5	2176
5760 min Summer	1.569	0.0	985.8	2928
7200 min Summer	-0.012	0.0	-9.2	0
8640 min Summer	-0.010	0.0	-9.2	0
10080 min Summer	-0.008	0.0	-9.2	0
15 min Winter	155.288	0.0	254.1	17

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	90.195	0.795	0.0	45.0	45.0	262.3	O K
60 min Winter	90.218	0.818	0.0	45.0	45.0	281.6	Flood Risk
120 min Winter	90.205	0.805	0.0	45.0	45.0	271.0	Flood Risk
180 min Winter	90.174	0.774	0.0	45.0	45.0	244.4	O K
240 min Winter	90.133	0.733	0.0	45.0	45.0	211.8	O K
360 min Winter	90.033	0.633	0.0	45.0	45.0	144.6	O K
480 min Winter	89.920	0.520	0.0	44.8	44.8	87.4	O K
600 min Winter	89.806	0.406	0.0	43.8	43.8	47.0	O K
720 min Winter	89.707	0.307	0.0	41.8	41.8	23.8	O K
960 min Winter	89.635	0.235	0.0	34.2	34.2	12.6	O K
1440 min Winter	89.582	0.182	0.0	24.0	24.0	7.0	O K
2160 min Winter	89.546	0.146	0.0	16.7	16.7	4.2	O K
2880 min Winter	89.526	0.126	0.0	13.0	13.0	3.1	O K
4320 min Winter	89.504	0.104	0.0	9.2	9.2	2.0	O K
5760 min Winter	89.492	0.092	0.0	7.3	7.3	1.5	O K
7200 min Winter	89.400	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	89.400	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	89.400	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	334.8	31
60 min Winter	64.330	0.0	421.0	58
120 min Winter	39.872	0.0	521.9	92
180 min Winter	29.699	0.0	583.1	130
240 min Winter	23.895	0.0	625.6	166
360 min Winter	17.332	0.0	680.6	232
480 min Winter	13.654	0.0	714.9	290
600 min Winter	11.294	0.0	739.2	344
720 min Winter	9.647	0.0	757.7	388
960 min Winter	7.494	0.0	784.8	492
1440 min Winter	5.214	0.0	819.1	730
2160 min Winter	3.623	0.0	853.7	1088
2880 min Winter	2.808	0.0	882.3	1456
4320 min Winter	1.985	0.0	935.5	2156
5760 min Winter	1.569	0.0	985.8	2912
7200 min Winter	-0.012	0.0	-9.2	0
8640 min Winter	-0.010	0.0	-9.2	0
10080 min Winter	-0.008	0.0	-9.2	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.770

Time (mins)		Area
From:	To:	(ha)
0	4	0.770

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Model Details

Storage is Online Cover Level (m) 90.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	350.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	250.0
Porosity	1.00	Cap Volume Depth (m)	0.800
Invert Level (m)	89.400	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.2		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0268-4500-2000-4500
Design Head (m)	2.000
Design Flow (l/s)	45.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	268
Invert Level (m)	89.400
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	45.0
Flush-Flo™	0.599	45.0
Kick-Flo®	1.312	36.7
Mean Flow over Head Range	-	38.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.5	1.200	40.0	3.000	54.7	7.000	82.5
0.200	27.6	1.400	37.9	3.500	58.9	7.500	85.3
0.300	41.6	1.600	40.4	4.000	62.8	8.000	88.0
0.400	43.8	1.800	42.7	4.500	66.5	8.500	90.6
0.500	44.7	2.000	45.0	5.000	70.0	9.000	93.2
0.600	45.0	2.200	47.1	5.500	73.3	9.500	95.7
0.800	44.4	2.400	49.1	6.000	76.5		
1.000	43.0	2.600	51.0	6.500	79.5		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 373 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	90.445	0.945	0.0	39.8	39.8	872.8	O K
30 min Summer	90.552	1.052	0.0	39.8	39.8	1130.4	O K
60 min Summer	90.641	1.141	0.0	39.8	39.8	1374.7	O K
120 min Summer	90.719	1.219	0.0	39.8	39.8	1610.9	Flood Risk
180 min Summer	90.750	1.250	0.0	39.8	39.8	1705.9	Flood Risk
240 min Summer	90.760	1.260	0.0	39.8	39.8	1734.2	Flood Risk
360 min Summer	90.744	1.244	0.0	39.8	39.8	1687.2	Flood Risk
480 min Summer	90.711	1.211	0.0	39.8	39.8	1586.3	Flood Risk
600 min Summer	90.681	1.181	0.0	39.8	39.8	1493.9	O K
720 min Summer	90.653	1.153	0.0	39.8	39.8	1410.8	O K
960 min Summer	90.601	1.101	0.0	39.8	39.8	1262.3	O K
1440 min Summer	90.501	1.001	0.0	39.8	39.8	1001.9	O K
2160 min Summer	90.354	0.854	0.0	39.8	39.8	687.6	O K
2880 min Summer	90.215	0.715	0.0	39.8	39.8	452.4	O K
4320 min Summer	89.976	0.476	0.0	39.4	39.4	179.1	O K
5760 min Summer	89.815	0.315	0.0	37.2	37.2	72.2	O K
7200 min Summer	89.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	89.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	89.500	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	90.445	0.945	0.0	39.8	39.8	873.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	910.8	19
30 min Summer	102.312	0.0	1200.1	33
60 min Summer	64.330	0.0	1509.2	62
120 min Summer	39.872	0.0	1870.8	122
180 min Summer	29.699	0.0	2090.2	182
240 min Summer	23.895	0.0	2242.3	242
360 min Summer	17.332	0.0	2439.7	360
480 min Summer	13.654	0.0	2562.5	416
600 min Summer	11.294	0.0	2649.5	470
720 min Summer	9.647	0.0	2715.9	526
960 min Summer	7.494	0.0	2813.1	654
1440 min Summer	5.214	0.0	2935.9	912
2160 min Summer	3.623	0.0	3060.1	1296
2880 min Summer	2.808	0.0	3162.5	1644
4320 min Summer	1.985	0.0	3353.4	2296
5760 min Summer	1.569	0.0	3533.4	2944
7200 min Summer	-0.012	0.0	-32.8	0
8640 min Summer	-0.010	0.0	-32.8	0
10080 min Summer	-0.008	0.0	-32.8	0
15 min Winter	155.288	0.0	910.8	18

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status
30 min Winter	90.553	1.053	0.0	39.8	39.8	1132.1	O K
60 min Winter	90.642	1.142	0.0	39.8	39.8	1378.9	O K
120 min Winter	90.722	1.222	0.0	39.8	39.8	1618.2	Flood Risk
180 min Winter	90.754	1.254	0.0	39.8	39.8	1716.8	Flood Risk
240 min Winter	90.764	1.264	0.0	39.8	39.8	1748.7	Flood Risk
360 min Winter	90.751	1.251	0.0	39.8	39.8	1708.0	Flood Risk
480 min Winter	90.716	1.216	0.0	39.8	39.8	1599.9	Flood Risk
600 min Winter	90.678	1.178	0.0	39.8	39.8	1485.3	O K
720 min Winter	90.645	1.145	0.0	39.8	39.8	1385.6	O K
960 min Winter	90.576	1.076	0.0	39.8	39.8	1192.2	O K
1440 min Winter	90.428	0.928	0.0	39.8	39.8	836.8	O K
2160 min Winter	90.194	0.694	0.0	39.8	39.8	423.2	O K
2880 min Winter	89.967	0.467	0.0	39.4	39.4	171.9	O K
4320 min Winter	89.741	0.241	0.0	32.6	32.6	40.4	O K
5760 min Winter	89.699	0.199	0.0	25.8	25.8	26.9	O K
7200 min Winter	89.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	89.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	89.500	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	102.312	0.0	1200.1	33
60 min Winter	64.330	0.0	1509.2	62
120 min Winter	39.872	0.0	1870.8	120
180 min Winter	29.699	0.0	2090.2	178
240 min Winter	23.895	0.0	2242.3	236
360 min Winter	17.332	0.0	2439.7	348
480 min Winter	13.654	0.0	2562.5	450
600 min Winter	11.294	0.0	2649.5	482
720 min Winter	9.647	0.0	2715.9	550
960 min Winter	7.494	0.0	2813.1	696
1440 min Winter	5.214	0.0	2935.9	968
2160 min Winter	3.623	0.0	3060.1	1336
2880 min Winter	2.808	0.0	3162.5	1640
4320 min Winter	1.985	0.0	3353.4	2204
5760 min Winter	1.569	0.0	3533.4	2936
7200 min Winter	-0.012	0.0	-32.8	0
8640 min Winter	-0.010	0.0	-32.8	0
10080 min Winter	-0.008	0.0	-32.8	0

Waterloo House  
Victoria Square  
Birmingham B2 5TB



Date 18/01/2019 10:35  
File SWALE\_15.SRCX

Designed by flazzarin  
Checked by

XP Solutions

Source Control 2018.1

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 2.760

<b>Time (mins)</b>	<b>Area</b>
<b>From:</b>	<b>To: (ha)</b>

0	4 2.760
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Model Details

Storage is Online Cover Level (m) 91.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	345.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	300.0
Porosity	1.00	Cap Volume Depth (m)	1.200
Invert Level (m)	89.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	4.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0254-4000-2000-4000
Design Head (m)	2.000
Design Flow (l/s)	40.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	254
Invert Level (m)	89.500
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	40.0
Flush-Flo™	0.599	39.8
Kick-Flo®	1.297	32.5
Mean Flow over Head Range	-	34.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.2	1.200	35.2	3.000	48.6	7.000	73.3
0.200	26.1	1.400	33.7	3.500	52.4	7.500	75.8
0.300	36.8	1.600	35.9	4.000	55.8	8.000	78.2
0.400	38.7	1.800	38.0	4.500	59.1	8.500	80.5
0.500	39.6	2.000	40.0	5.000	62.2	9.000	82.8
0.600	39.8	2.200	41.8	5.500	65.2	9.500	85.0
0.800	39.3	2.400	43.6	6.000	68.0		
1.000	38.0	2.600	45.4	6.500	70.7		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 2271 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	90.346	0.846	0.0	2.2	2.2	232.7	O K
30 min Summer	90.435	0.935	0.0	2.2	2.2	305.5	O K
60 min Summer	90.515	1.015	0.0	2.2	2.2	381.4	O K
120 min Summer	90.593	1.093	0.0	2.3	2.3	466.9	O K
180 min Summer	90.635	1.135	0.0	2.3	2.3	515.7	O K
240 min Summer	90.660	1.160	0.0	2.3	2.3	547.0	O K
360 min Summer	90.687	1.187	0.0	2.4	2.4	582.2	O K
480 min Summer	90.700	1.200	0.0	2.4	2.4	598.1	O K
600 min Summer	90.705	1.205	0.0	2.4	2.4	604.8	Flood Risk
720 min Summer	90.706	1.206	0.0	2.4	2.4	606.1	Flood Risk
960 min Summer	90.701	1.201	0.0	2.4	2.4	599.7	Flood Risk
1440 min Summer	90.677	1.177	0.0	2.3	2.3	568.8	O K
2160 min Summer	90.632	1.132	0.0	2.3	2.3	513.1	O K
2880 min Summer	90.599	1.099	0.0	2.3	2.3	473.4	O K
4320 min Summer	90.556	1.056	0.0	2.2	2.2	425.2	O K
5760 min Summer	90.525	1.025	0.0	2.2	2.2	392.5	O K
7200 min Summer	89.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	89.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	89.500	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	90.346	0.846	0.0	2.2	2.2	232.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	164.8	19
30 min Summer	102.312	0.0	172.4	34
60 min Summer	64.330	0.0	347.1	64
120 min Summer	39.872	0.0	359.2	124
180 min Summer	29.699	0.0	369.4	184
240 min Summer	23.895	0.0	375.3	244
360 min Summer	17.332	0.0	381.7	362
480 min Summer	13.654	0.0	384.7	482
600 min Summer	11.294	0.0	386.2	602
720 min Summer	9.647	0.0	386.9	722
960 min Summer	7.494	0.0	387.0	962
1440 min Summer	5.214	0.0	384.7	1440
2160 min Summer	3.623	0.0	725.7	1920
2880 min Summer	2.808	0.0	714.3	2252
4320 min Summer	1.985	0.0	679.3	3024
5760 min Summer	1.569	0.0	911.5	3856
7200 min Summer	-0.012	0.0	-8.5	0
8640 min Summer	-0.010	0.0	-8.5	0
10080 min Summer	-0.008	0.0	-8.5	0
15 min Winter	155.288	0.0	164.8	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	90.435	0.935	0.0	2.2	2.2	305.6	O K
60 min Winter	90.515	1.015	0.0	2.2	2.2	381.5	O K
120 min Winter	90.594	1.094	0.0	2.3	2.3	467.3	O K
180 min Winter	90.635	1.135	0.0	2.3	2.3	516.3	O K
240 min Winter	90.661	1.161	0.0	2.3	2.3	547.8	O K
360 min Winter	90.688	1.188	0.0	2.4	2.4	583.3	O K
480 min Winter	90.701	1.201	0.0	2.4	2.4	599.6	Flood Risk
600 min Winter	90.706	1.206	0.0	2.4	2.4	606.8	Flood Risk
720 min Winter	90.708	1.208	0.0	2.4	2.4	608.6	Flood Risk
960 min Winter	90.704	1.204	0.0	2.4	2.4	603.5	Flood Risk
1440 min Winter	90.683	1.183	0.0	2.4	2.4	576.0	O K
2160 min Winter	90.641	1.141	0.0	2.3	2.3	523.3	O K
2880 min Winter	90.602	1.102	0.0	2.3	2.3	476.6	O K
4320 min Winter	90.550	1.050	0.0	2.2	2.2	418.8	O K
5760 min Winter	90.507	1.007	0.0	2.2	2.2	373.6	O K
7200 min Winter	89.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	89.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	89.500	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	172.3	34
60 min Winter	64.330	0.0	347.0	64
120 min Winter	39.872	0.0	359.0	122
180 min Winter	29.699	0.0	369.1	182
240 min Winter	23.895	0.0	374.9	240
360 min Winter	17.332	0.0	381.1	358
480 min Winter	13.654	0.0	383.8	476
600 min Winter	11.294	0.0	385.1	594
720 min Winter	9.647	0.0	385.6	708
960 min Winter	7.494	0.0	385.0	942
1440 min Winter	5.214	0.0	381.1	1396
2160 min Winter	3.623	0.0	720.8	2032
2880 min Winter	2.808	0.0	711.8	2304
4320 min Winter	1.985	0.0	680.2	3200
5760 min Winter	1.569	0.0	911.5	4096
7200 min Winter	-0.012	0.0	-8.5	0
8640 min Winter	-0.010	0.0	-8.5	0
10080 min Winter	-0.008	0.0	-8.5	0

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Victoria Square  
Birmingham B2 5TB



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Rainfall Details


Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.712

<b>Time (mins)</b>	<b>Area</b>
<b>From:</b>	<b>To: (ha)</b>

0	4 0.712
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Model Details

Storage is Online Cover Level (m) 91.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	200.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	1.00	Cap Volume Depth (m)	1.200
Invert Level (m)	89.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-3000-2000-3000
Design Head (m)	2.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	89.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.0
Flush-Flo™	0.310	2.2
Kick-Flo®	0.630	1.8
Mean Flow over Head Range	-	2.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.6	7.000	5.4
0.200	2.1	1.400	2.5	3.500	3.9	7.500	5.6
0.300	2.2	1.600	2.7	4.000	4.1	8.000	5.7
0.400	2.2	1.800	2.9	4.500	4.4	8.500	5.9
0.500	2.1	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.9	2.200	3.1	5.500	4.8	9.500	6.2
0.800	2.0	2.400	3.3	6.000	5.0		
1.000	2.2	2.600	3.4	6.500	5.2		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 662 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	89.022	0.722	0.0	33.1	33.1	1163.7	O K
30 min Summer	89.114	0.814	0.0	33.1	33.1	1516.4	O K
60 min Summer	89.194	0.894	0.0	33.1	33.1	1867.9	O K
120 min Summer	89.269	0.969	0.0	33.1	33.1	2234.8	O K
180 min Summer	89.303	1.003	0.0	33.1	33.1	2416.1	O K
240 min Summer	89.320	1.020	0.0	33.1	33.1	2509.2	O K
360 min Summer	89.329	1.029	0.0	33.1	33.1	2556.8	O K
480 min Summer	89.320	1.020	0.0	33.1	33.1	2509.6	O K
600 min Summer	89.304	1.004	0.0	33.1	33.1	2419.3	O K
720 min Summer	89.285	0.985	0.0	33.1	33.1	2319.5	O K
960 min Summer	89.251	0.951	0.0	33.1	33.1	2141.7	O K
1440 min Summer	89.190	0.890	0.0	33.1	33.1	1850.7	O K
2160 min Summer	89.113	0.813	0.0	33.1	33.1	1510.7	O K
2880 min Summer	89.042	0.742	0.0	33.1	33.1	1237.3	O K
4320 min Summer	88.918	0.618	0.0	33.1	33.1	828.4	O K
5760 min Summer	88.811	0.511	0.0	33.0	33.0	549.5	O K
7200 min Summer	88.300	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	88.300	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	88.300	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	89.022	0.722	0.0	33.1	33.1	1163.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	1193.9	19
30 min Summer	102.312	0.0	1573.2	34
60 min Summer	64.330	0.0	1978.3	64
120 min Summer	39.872	0.0	2452.4	122
180 min Summer	29.699	0.0	2740.0	182
240 min Summer	23.895	0.0	2939.3	242
360 min Summer	17.332	0.0	3198.1	362
480 min Summer	13.654	0.0	3359.1	480
600 min Summer	11.294	0.0	3473.2	596
720 min Summer	9.647	0.0	3560.2	630
960 min Summer	7.494	0.0	3687.6	742
1440 min Summer	5.214	0.0	3848.6	984
2160 min Summer	3.623	0.0	4011.4	1384
2880 min Summer	2.808	0.0	4145.7	1764
4320 min Summer	1.985	0.0	4395.8	2508
5760 min Summer	1.569	0.0	4631.8	3224
7200 min Summer	-0.012	0.0	-43.1	0
8640 min Summer	-0.010	0.0	-43.1	0
10080 min Summer	-0.008	0.0	-43.1	0
15 min Winter	155.288	0.0	1193.9	19

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	89.114	0.814	0.0	33.1	33.1	1517.9	O K
60 min Winter	89.195	0.895	0.0	33.1	33.1	1870.5	O K
120 min Winter	89.270	0.970	0.0	33.1	33.1	2240.2	O K
180 min Winter	89.304	1.004	0.0	33.1	33.1	2424.1	O K
240 min Winter	89.322	1.022	0.0	33.1	33.1	2519.8	O K
<b>360 min Winter</b>	<b>89.331</b>	<b>1.031</b>	<b>0.0</b>	<b>33.1</b>	<b>33.1</b>	<b>2573.2</b>	<b>O K</b>
480 min Winter	89.324	1.024	0.0	33.1	33.1	2532.1	O K
600 min Winter	89.309	1.009	0.0	33.1	33.1	2448.3	O K
720 min Winter	89.289	0.989	0.0	33.1	33.1	2343.5	O K
960 min Winter	89.249	0.949	0.0	33.1	33.1	2133.2	O K
1440 min Winter	89.175	0.875	0.0	33.1	33.1	1778.0	O K
2160 min Winter	89.065	0.765	0.0	33.1	33.1	1322.9	O K
2880 min Winter	88.959	0.659	0.0	33.1	33.1	953.4	O K
4320 min Winter	88.764	0.464	0.0	32.8	32.8	448.5	O K
5760 min Winter	88.612	0.312	0.0	30.9	30.9	193.9	O K
7200 min Winter	88.300	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	88.300	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	88.300	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	102.312	0.0	1573.2	33
60 min Winter	64.330	0.0	1978.3	62
120 min Winter	39.872	0.0	2452.4	120
180 min Winter	29.699	0.0	2740.0	180
240 min Winter	23.895	0.0	2939.3	238
<b>360 min Winter</b>	<b>17.332</b>	<b>0.0</b>	<b>3198.1</b>	<b>352</b>
480 min Winter	13.654	0.0	3359.1	466
600 min Winter	11.294	0.0	3473.2	574
720 min Winter	9.647	0.0	3560.2	678
960 min Winter	7.494	0.0	3687.6	760
1440 min Winter	5.214	0.0	3848.6	1054
2160 min Winter	3.623	0.0	4011.4	1472
2880 min Winter	2.808	0.0	4145.7	1872
4320 min Winter	1.985	0.0	4395.8	2552
5760 min Winter	1.569	0.0	4631.8	3168
7200 min Winter	-0.012	0.0	-43.1	0
8640 min Winter	-0.010	0.0	-43.1	0
10080 min Winter	-0.008	0.0	-43.1	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40


Time Area Diagram

Total Area (ha) 3.618

**Time (mins) Area**  
**From: To: (ha)**

0 4 3.618



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Model Details

Storage is Online Cover Level (m) 89.800

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	560.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	450.0
Porosity	1.00	Cap Volume Depth (m)	1.200
Invert Level (m)	88.300	Cap Infiltration Depth (m)	0.000
Base Width (m)	8.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0233-3310-2000-3310
Design Head (m)	2.000
Design Flow (l/s)	33.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	233
Invert Level (m)	88.300
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	33.1
Flush-Flo™	0.587	33.1
Kick-Flo®	1.276	26.7
Mean Flow over Head Range	-	28.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.7	1.200	28.6	3.000	40.2	7.000	60.5
0.200	23.4	1.400	27.9	3.500	43.3	7.500	62.6
0.300	30.7	1.600	29.7	4.000	46.2	8.000	64.6
0.400	32.2	1.800	31.4	4.500	48.9	8.500	66.5
0.500	32.9	2.000	33.1	5.000	51.4	9.000	68.4
0.600	33.1	2.200	34.6	5.500	53.9	9.500	70.2
0.800	32.6	2.400	36.1	6.000	56.2		
1.000	31.3	2.600	37.5	6.500	58.4		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1375 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	89.742	0.742	0.0	5.2	5.2	328.1	O K
30 min Summer	89.826	0.826	0.0	5.2	5.2	429.8	O K
60 min Summer	89.900	0.900	0.0	5.2	5.2	534.9	O K
120 min Summer	89.972	0.972	0.0	5.2	5.2	650.9	O K
180 min Summer	90.008	1.008	0.0	5.2	5.2	714.4	O K
240 min Summer	90.029	1.029	0.0	5.2	5.2	753.3	O K
360 min Summer	90.049	1.049	0.0	5.2	5.2	792.1	O K
480 min Summer	90.055	1.055	0.0	5.2	5.2	803.7	O K
600 min Summer	90.055	1.055	0.0	5.2	5.2	802.5	O K
720 min Summer	90.050	1.050	0.0	5.2	5.2	793.9	O K
960 min Summer	90.035	1.035	0.0	5.2	5.2	765.0	O K
1440 min Summer	89.994	0.994	0.0	5.2	5.2	689.9	O K
2160 min Summer	89.944	0.944	0.0	5.2	5.2	604.6	O K
2880 min Summer	89.905	0.905	0.0	5.2	5.2	542.9	O K
4320 min Summer	89.837	0.837	0.0	5.2	5.2	444.9	O K
5760 min Summer	89.778	0.778	0.0	5.2	5.2	369.4	O K
7200 min Summer	89.000	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	89.000	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	89.000	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	89.742	0.742	0.0	5.2	5.2	328.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	155.288	0.0	333.3	19
30 min Summer	102.312	0.0	429.3	34
60 min Summer	64.330	0.0	552.3	64
120 min Summer	39.872	0.0	684.6	124
180 min Summer	29.699	0.0	764.9	184
240 min Summer	23.895	0.0	804.4	244
360 min Summer	17.332	0.0	795.1	362
480 min Summer	13.654	0.0	789.1	482
600 min Summer	11.294	0.0	785.5	602
720 min Summer	9.647	0.0	782.9	722
960 min Summer	7.494	0.0	778.7	960
1440 min Summer	5.214	0.0	767.1	1368
2160 min Summer	3.623	0.0	1119.8	1684
2880 min Summer	2.808	0.0	1157.3	2048
4320 min Summer	1.985	0.0	1227.1	2808
5760 min Summer	1.569	0.0	1293.0	3576
7200 min Summer	-0.012	0.0	-12.0	0
8640 min Summer	-0.010	0.0	-12.0	0
10080 min Summer	-0.008	0.0	-12.0	0
15 min Winter	155.288	0.0	333.3	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m <sup>3</sup> )	Status
30 min Winter	89.826	0.826	0.0	5.2	5.2	430.0	O K
60 min Winter	89.900	0.900	0.0	5.2	5.2	535.1	O K
120 min Winter	89.973	0.973	0.0	5.2	5.2	651.7	O K
180 min Winter	90.009	1.009	0.0	5.2	5.2	715.7	O K
240 min Winter	90.030	1.030	0.0	5.2	5.2	755.2	O K
360 min Winter	90.051	1.051	0.0	5.2	5.2	794.9	O K
<b>480 min Winter</b>	<b>90.057</b>	<b>1.057</b>	<b>0.0</b>	<b>5.2</b>	<b>5.2</b>	<b>807.6</b>	<b>O K</b>
600 min Winter	90.057	1.057	0.0	5.2	5.2	807.4	O K
720 min Winter	90.053	1.053	0.0	5.2	5.2	800.0	O K
960 min Winter	90.040	1.040	0.0	5.2	5.2	773.4	O K
1440 min Winter	90.000	1.000	0.0	5.2	5.2	700.3	O K
2160 min Winter	89.940	0.940	0.0	5.2	5.2	597.9	O K
2880 min Winter	89.889	0.889	0.0	5.2	5.2	518.9	O K
4320 min Winter	89.787	0.787	0.0	5.2	5.2	381.2	O K
5760 min Winter	89.688	0.688	0.0	5.2	5.2	272.4	O K
7200 min Winter	89.000	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	89.000	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	89.000	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
30 min Winter	102.312	0.0	429.1	33
60 min Winter	64.330	0.0	552.3	64
120 min Winter	39.872	0.0	684.6	122
180 min Winter	29.699	0.0	764.9	180
240 min Winter	23.895	0.0	803.1	240
360 min Winter	17.332	0.0	792.9	358
<b>480 min Winter</b>	<b>13.654</b>	<b>0.0</b>	<b>786.2</b>	<b>474</b>
600 min Winter	11.294	0.0	781.9	590
720 min Winter	9.647	0.0	778.7	706
960 min Winter	7.494	0.0	773.7	932
1440 min Winter	5.214	0.0	763.8	1370
2160 min Winter	3.623	0.0	1119.8	1712
2880 min Winter	2.808	0.0	1157.3	2160
4320 min Winter	1.985	0.0	1227.1	2984
5760 min Winter	1.569	0.0	1293.0	3752
7200 min Winter	-0.012	0.0	-12.0	0
8640 min Winter	-0.010	0.0	-12.0	0
10080 min Winter	-0.008	0.0	-12.0	0

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XP Solutions	Source Control 2018.1	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 420000 186000 SU 20000 86000
Data Type	
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.850
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.010

Time (mins)		Area
From:	To:	(ha)
0	4	1.010