

Hydrock Consultants Ltd					Page 1																																																				
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<u>STORM SEWER DESIGN by the Modified Rational Method</u> <u>Design Criteria for Storm</u> Pipe Sizes STANDARD Manhole Sizes STANDARD FSR Rainfall Model - England and Wales <table><tr><td>Return Period (years)</td><td>100</td><td>PIMP (%)</td><td>100</td></tr><tr><td>M5-60 (mm)</td><td>19.200</td><td>Add Flow / Climate Change (%)</td><td>0</td></tr><tr><td>Ratio R</td><td>0.350</td><td>Minimum Backdrop Height (m)</td><td>0.200</td></tr><tr><td>Maximum Rainfall (mm/hr)</td><td>50</td><td>Maximum Backdrop Height (m)</td><td>1.500</td></tr><tr><td>Maximum Time of Concentration (mins)</td><td>30</td><td>Min Design Depth for Optimisation (m)</td><td>1.200</td></tr><tr><td>Foul Sewage (l/s/ha)</td><td>0.000</td><td>Min Vel for Auto Design only (m/s)</td><td>1.00</td></tr><tr><td>Volumetric Runoff Coeff.</td><td>0.750</td><td>Min Slope for Optimisation (1:X)</td><td>500</td></tr></table> Designed with Level Soffits <u>Time Area Diagram for Storm at outfall S (pipe S1.010)</u> <table><tr><td>Time (mins)</td><td>Area (ha)</td><td>Time (mins)</td><td>Area (ha)</td><td>Time (mins)</td><td>Area (ha)</td></tr><tr><td>0-4</td><td>0.061</td><td>4-8</td><td>0.795</td><td>8-12</td><td>0.151</td></tr></table> Total Area Contributing (ha) = 1.007 Total Pipe Volume (m³) = 27.583 <u>Time Area Diagram at outfall S (pipe S8.007)</u> <table><tr><td>Time (mins)</td><td>Area (ha)</td><td>Time (mins)</td><td>Area (ha)</td></tr><tr><td>0-4</td><td>0.353</td><td>4-8</td><td>0.246</td></tr></table> Total Area Contributing (ha) = 0.598 Total Pipe Volume (m³) = 15.060										Return Period (years)	100	PIMP (%)	100	M5-60 (mm)	19.200	Add Flow / Climate Change (%)	0	Ratio R	0.350	Minimum Backdrop Height (m)	0.200	Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500	Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200	Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00	Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.061	4-8	0.795	8-12	0.151	Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.353	4-8	0.246
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<u>Network Design Table for Storm</u> « - Indicates pipe capacity < flow <table><tr><td>PN</td><td>Length (m)</td><td>Fall (m)</td><td>Slope (1:X)</td><td>I.Area (ha)</td><td>T.E. (mins)</td><td>Base Flow (l/s)</td><td>k (mm)</td><td>HYD SECT</td><td>DIA (mm)</td><td>Section Type</td><td>Auto Design</td></tr></table> <u>Network Results Table</u> <table><tr><td>PN</td><td>Rain (mm/hr)</td><td>T.C. (mins)</td><td>US/IL (m)</td><td>Σ I.Area (ha)</td><td>Σ Base Flow (l/s)</td><td>Foul (l/s)</td><td>Add Flow (l/s)</td><td>Vel (m/s)</td><td>Cap (l/s)</td><td>Flow (l/s)</td></tr></table>										PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design	PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)																									
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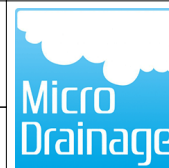
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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S8.004	9.917	0.035	283.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S9.000	39.284	0.190	206.8	0.010	5.00	0.0	0.600	o	300	Pipe/Conduit	
S10.000	13.506	0.125	108.1	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.001	7.670	0.065	118.0	0.014	0.00	0.0	0.600	o	150	Pipe/Conduit	
S9.001	19.464	0.195	99.8	0.110	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.002	13.340	0.050	266.8	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.005	22.609	0.090	251.2	0.089	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.006	21.536	0.100	215.4	0.060	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.007	19.298	0.120	160.8	0.067	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S8.004	50.00	6.43	26.195	0.202	0.0	0.0	0.0	0.93	65.7	27.3
S9.000	50.00	5.60	26.595	0.010	0.0	0.0	0.0	1.09	77.0	1.4
S10.000	50.00	5.23	26.670	0.033	0.0	0.0	0.0	0.97	17.1	4.4
S10.001	50.00	5.37	26.545	0.046	0.0	0.0	0.0	0.92	16.3	6.3
S9.001	50.00	5.85	26.405	0.166	0.0	0.0	0.0	1.31	52.0	22.4
S9.002	50.00	6.13	26.210	0.181	0.0	0.0	0.0	0.80	31.6	24.5
S8.005	50.00	6.81	26.160	0.471	0.0	0.0	0.0	0.99	69.8	63.8
S8.006	50.00	7.15	26.070	0.531	0.0	0.0	0.0	1.07	75.5	71.9
S8.007	50.00	7.46	25.970	0.598	0.0	0.0	0.0	1.03	40.9«	81.0

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Manhole Schedules for Storm

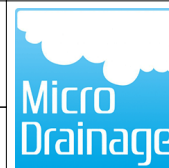
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S30	27.435	0.945	Open Manhole	1200	S8.002	26.490	300	S8.001	26.490	300	
S31	27.460	1.100	Open Manhole	1200	S8.003	26.360	300	S8.002	26.360	300	
S32	27.400	1.205	Open Manhole	1200	S8.004	26.195	300	S8.003	26.195	300	
S33	27.365	0.770	Open Manhole	1200	S9.000	26.595	300				
S34	27.460	0.790	Open Manhole	1200	S10.000	26.670	150				
S35	27.380	0.835	Open Manhole	1200	S10.001	26.545	150	S10.000	26.545	150	
S34	27.350	0.945	Open Manhole	1200	S9.001	26.405	225	S9.000	26.405	300	
								S10.001	26.480	150	
S35	27.180	0.970	Open Manhole	1200	S9.002	26.210	225	S9.001	26.210	225	
S33	27.160	1.000	Open Manhole	1200	S8.005	26.160	300	S8.004	26.160	300	
								S9.002	26.160	225	
S34	27.145	1.075	Open Manhole	1200	S8.006	26.070	300	S8.005	26.070	300	
S35	27.055	1.085	Open Manhole	1200	S8.007	25.970	225	S8.006	25.970	300	
S	26.850	1.000	Open Manhole	0		OUTFALL		S8.007	25.850	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S10	469908.167	109309.550	469908.167	109309.550	Required	
S11	469873.013	109315.972	469873.013	109315.972	Required	
S12	469872.227	109318.839	469872.227	109318.839	Required	
S13	469865.006	109320.191	469865.006	109320.191	Required	
S14	469855.320	109266.486	469855.320	109266.486	Required	
S15	469898.874	109251.091	469898.874	109251.091	Required	
S16	469861.218	109257.988	469861.218	109257.988	Required	

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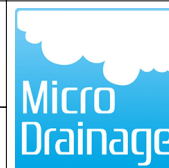
Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S17	469867.461	109292.387	469867.461	109292.387	Required	
S15	469860.200	109293.717	469860.200	109293.717	Required	
S12	469862.660	109307.443	469862.660	109307.443	Required	
S1	469927.286	109402.686	469927.286	109402.686	Required	
S2	469898.685	109407.846	469898.685	109407.846	Required	
S3	469896.842	109397.781	469896.842	109397.781	Required	
S4	469899.948	109422.357	469899.948	109422.357	Required	
S5	469897.336	109408.094	469897.336	109408.094	Required	
S4	469895.492	109398.028	469895.492	109398.028	Required	
S5	469888.102	109357.647	469888.102	109357.647	Required	
S8	469891.774	109401.647	469891.774	109401.647	Required	
S6	469877.068	109354.580	469877.068	109354.580	Required	
S20	469868.654	109337.112	469868.654	109337.112	Required	
S7	469854.452	109306.904	469854.452	109306.904	Required	
S8	469844.590	109284.190	469844.590	109284.190	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S9	469836.088	109265.216	469836.088	109265.216	Required	
S10	469829.149	109249.730	469829.149	109249.730	Required	
S11	469816.568	109230.106	469816.568	109230.106	Required	
S12	469816.949	109195.252	469816.949	109195.252	Required	
S13	469833.500	109188.610	469833.500	109188.610	Required	
S14	469882.872	109179.376	469882.872	109179.376	Required	
S	469895.899	109162.259			No Entry	
S28	469873.956	109247.701	469873.956	109247.701	Required	
S29	469856.667	109250.867	469856.667	109250.867	Required	
S30	469850.148	109252.061	469850.148	109252.061	Required	
S31	469845.316	109225.649	469845.316	109225.649	Required	
S32	469839.175	109192.147	469839.175	109192.147	Required	
S33	469834.830	109242.645	469834.830	109242.645	Required	
S34	469822.642	109218.671	469822.642	109218.671	Required	
S35	469820.208	109205.385	469820.208	109205.385	Required	

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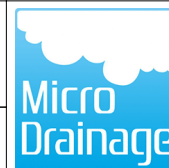
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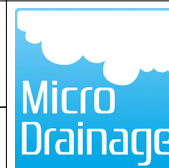


Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S34	469827.752	109204.004	469827.752	109204.004	Required	
S35	469824.298	109184.848	469824.298	109184.848	Required	
S33	469837.408	109182.388	469837.408	109182.388	Required	
S34	469859.633	109178.239	469859.633	109178.239	Required	
S35	469880.802	109174.279	469880.802	109174.279	Required	
S	469895.899	109162.259			No Entry	

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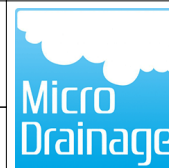
Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S1.000	o	225	S10	31.025	30.200	0.600	Open Manhole		1200
S1.001	o	225	S11	31.000	29.805	0.970	Open Manhole		1200
S2.000	o	225	S12	31.000	29.875	0.900	Open Manhole		1200
S2.001	o	225	S13	31.000	29.735	1.040	Open Manhole		1200
S3.000	o	225	S14	30.630	29.140	1.265	Open Manhole		1200
S4.000	o	225	S15	30.950	30.380	0.345	Open Manhole		1200
S4.001	o	225	S16	30.900	30.100	0.575	Open Manhole		1200
S4.002	o	225	S17	31.000	29.800	0.975	Open Manhole		1200
S3.001	o	225	S15	30.620	29.010	1.385	Open Manhole		1200
S1.002	o	225	S12	30.850	28.885	1.740	Open Manhole		1200
S5.000	o	300	S1	33.280	32.350	0.630	Open Manhole		1200
S5.001	o	300	S2	33.260	32.060	0.900	Open Manhole		1200
S5.002	o	300	S3	33.220	31.800	1.120	Open Manhole		1200
S6.000	o	225	S4	33.550	32.350	0.975	Open Manhole		1200

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S1.000	35.736	90.5	S11	31.000	29.805	0.970	Open Manhole		1200
S1.001	13.414	14.6	S12	30.850	28.885	1.740	Open Manhole		1200
S2.000	7.346	52.5	S13	31.000	29.735	1.040	Open Manhole		1200
S2.001	12.962	15.2	S12	30.850	28.885	1.740	Open Manhole		1200
S3.000	27.665	212.8	S15	30.620	29.010	1.385	Open Manhole		1200
S4.000	38.283	136.7	S16	30.900	30.100	0.575	Open Manhole		1200
S4.001	34.961	116.5	S17	31.000	29.800	0.975	Open Manhole		1200
S4.002	7.382	9.3	S15	30.620	29.010	1.385	Open Manhole		1200
S3.001	13.945	111.6	S12	30.850	28.885	1.740	Open Manhole		1200
S1.002	8.226	164.5	S7	30.940	28.835	1.880	Open Manhole		1200
S5.000	29.063	103.8	S2	33.260	32.070	0.890	Open Manhole		1200
S5.001	10.233	107.7	S3	33.220	31.965	0.955	Open Manhole		1200
S5.002	1.372	5.0	S4	33.220	31.525	1.395	Open Manhole		1200
S6.000	14.501	58.5	S5	33.255	32.102	0.928	Open Manhole		1200

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Upstream Manhole

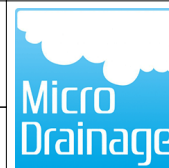
PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S8.002	o	300	S30	27.435	26.490	0.645	Open Manhole		1200
S8.003	o	300	S31	27.460	26.360	0.800	Open Manhole		1200
S8.004	o	300	S32	27.400	26.195	0.905	Open Manhole		1200
S9.000	o	300	S33	27.365	26.595	0.470	Open Manhole		1200
S10.000	o	150	S34	27.460	26.670	0.640	Open Manhole		1200
S10.001	o	150	S35	27.380	26.545	0.685	Open Manhole		1200
S9.001	o	225	S34	27.350	26.405	0.720	Open Manhole		1200
S9.002	o	225	S35	27.180	26.210	0.745	Open Manhole		1200
S8.005	o	300	S33	27.160	26.160	0.700	Open Manhole		1200
S8.006	o	300	S34	27.145	26.070	0.775	Open Manhole		1200
S8.007	o	225	S35	27.055	25.970	0.860	Open Manhole		1200

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S8.002	26.851	206.5	S31	27.460	26.360	0.800	Open Manhole		1200
S8.003	34.060	206.4	S32	27.400	26.195	0.905	Open Manhole		1200
S8.004	9.917	283.3	S33	27.160	26.160	0.700	Open Manhole		1200
S9.000	39.284	206.8	S34	27.350	26.405	0.645	Open Manhole		1200
S10.000	13.506	108.1	S35	27.380	26.545	0.685	Open Manhole		1200
S10.001	7.670	118.0	S34	27.350	26.480	0.720	Open Manhole		1200
S9.001	19.464	99.8	S35	27.180	26.210	0.745	Open Manhole		1200
S9.002	13.340	266.8	S33	27.160	26.160	0.775	Open Manhole		1200
S8.005	22.609	251.2	S34	27.145	26.070	0.775	Open Manhole		1200
S8.006	21.536	215.4	S35	27.055	25.970	0.785	Open Manhole		1200
S8.007	19.298	160.8	S	26.850	25.850	0.775	Open Manhole		0

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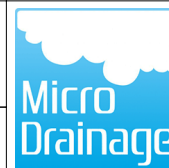
Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	As Zoned	Default	100	0.029	0.029	0.029
	As Zoned	Default	100	0.055	0.055	0.084
1.001		-	-	100	0.000	0.000
2.000	As Zoned	Default	100	0.079	0.079	0.079
	As Zoned	Default	100	0.067	0.067	0.067
	As Zoned	Default	100	0.012	0.012	0.158
2.001		-	-	100	0.000	0.000
3.000	As Zoned	Default	100	0.068	0.068	0.068
4.000	As Zoned	Default	100	0.084	0.084	0.084
4.001		-	-	100	0.000	0.000
4.002	As Zoned	Default	100	0.056	0.056	0.056
3.001	As Zoned	Default	100	0.030	0.030	0.030
1.002		-	-	100	0.000	0.000
5.000	As Zoned	Default	100	0.077	0.077	0.077
5.001		-	-	100	0.000	0.000
5.002		-	-	100	0.000	0.000
6.000	As Zoned	Default	100	0.033	0.033	0.033
6.001	As Zoned	Default	100	0.077	0.077	0.077
	As Zoned	Default	100	0.010	0.010	0.088
5.003	As Zoned	Default	100	0.077	0.077	0.077
	As Zoned	Default	100	0.036	0.036	0.114
5.004		-	-	100	0.000	0.000
7.000	As Zoned	Default	100	0.027	0.027	0.027
	As Zoned	Default	100	0.012	0.012	0.039
5.005	As Zoned	Default	100	0.049	0.049	0.049
	As Zoned	Default	100	0.006	0.006	0.006
	As Zoned	Default	100	0.018	0.018	0.072
5.006		-	-	100	0.000	0.000
1.003		-	-	100	0.000	0.000
1.004	As Zoned	Default	100	0.037	0.037	0.037
1.005	As Zoned	Default	100	0.005	0.005	0.005
1.006	As Zoned	Default	100	0.012	0.012	0.012
1.007		-	-	100	0.050	0.050
1.008		-	-	100	0.000	0.000
1.009		-	-	100	0.000	0.000
1.010		-	-	100	0.000	0.000
8.000	As Zoned	Default	100	0.134	0.134	0.134
8.001		-	-	100	0.000	0.000
8.002	As Zoned	Default	100	0.067	0.067	0.067
8.003		-	-	100	0.000	0.000
8.004		-	-	100	0.000	0.000
9.000	As Zoned	Default	100	0.010	0.010	0.010
10.000	As Zoned	Default	100	0.033	0.033	0.033
10.001	As Zoned	Default	100	0.014	0.014	0.014
9.001	As Zoned	Default	100	0.084	0.084	0.084
	As Zoned	Default	100	0.025	0.025	0.110
9.002	As Zoned	Default	100	0.015	0.015	0.015
8.005	As Zoned	Default	100	0.052	0.052	0.052
	As Zoned	Default	100	0.037	0.037	0.089
8.006	As Zoned	Default	100	0.060	0.060	0.060
8.007	As Zoned	Default	100	0.067	0.067	0.067

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
				Total	Total	Total
				1.605	1.605	1.605

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
------------------------	-----------------	-----------------	-----------------	------------------------	-------------	-----------

S1.010	S	26.850	25.850	0.000	0	0
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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
------------------------	-----------------	-----------------	-----------------	------------------------	-------------	-----------

S8.007	S	26.850	25.850	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Storm Duration (mins)	30
Ratio R	0.350		

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<u>Online Controls for Storm</u>																																																																										
<u>Hydro-Brake® Optimum Manhole: S12, DS/PN: S1.002, Volume (m³): 3.7</u>																																																																										
Unit Reference MD-SHE-0112-5100-0655-5100																																																																										
Design Head (m) 0.655																																																																										
Design Flow (l/s) 5.1																																																																										
Flush-Flo™ Calculated																																																																										
Objective Minimise upstream storage																																																																										
Application Surface																																																																										
Sump Available Yes																																																																										
Diameter (mm) 112																																																																										
Invert Level (m) 28.885																																																																										
Minimum Outlet Pipe Diameter (mm) 150																																																																										
Suggested Manhole Diameter (mm) 1200																																																																										
<table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>0.655</td><td>5.1</td></tr><tr><td>Flush-Flo™</td><td>0.204</td><td>5.1</td></tr><tr><td>Kick-Flo®</td><td>0.458</td><td>4.3</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>4.3</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.655	5.1	Flush-Flo™	0.204	5.1	Kick-Flo®	0.458	4.3	Mean Flow over Head Range	-	4.3																																																									
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Mean Flow over Head Range	-	4.3																																																																								
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<table><tr><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td></tr><tr><td>0.100</td><td>3.9</td><td>1.200</td><td>6.8</td><td>3.000</td><td>10.4</td><td>7.000</td><td>15.6</td></tr><tr><td>0.200</td><td>5.1</td><td>1.400</td><td>7.3</td><td>3.500</td><td>11.2</td><td>7.500</td><td>16.1</td></tr><tr><td>0.300</td><td>5.0</td><td>1.600</td><td>7.7</td><td>4.000</td><td>11.9</td><td>8.000</td><td>16.6</td></tr><tr><td>0.400</td><td>4.7</td><td>1.800</td><td>8.2</td><td>4.500</td><td>12.6</td><td>8.500</td><td>17.2</td></tr><tr><td>0.500</td><td>4.5</td><td>2.000</td><td>8.6</td><td>5.000</td><td>13.3</td><td>9.000</td><td>17.7</td></tr><tr><td>0.600</td><td>4.9</td><td>2.200</td><td>9.0</td><td>5.500</td><td>13.9</td><td>9.500</td><td>18.1</td></tr><tr><td>0.800</td><td>5.6</td><td>2.400</td><td>9.4</td><td>6.000</td><td>14.5</td><td></td><td></td></tr><tr><td>1.000</td><td>6.2</td><td>2.600</td><td>9.7</td><td>6.500</td><td>15.1</td><td></td><td></td></tr></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	3.9	1.200	6.8	3.000	10.4	7.000	15.6	0.200	5.1	1.400	7.3	3.500	11.2	7.500	16.1	0.300	5.0	1.600	7.7	4.000	11.9	8.000	16.6	0.400	4.7	1.800	8.2	4.500	12.6	8.500	17.2	0.500	4.5	2.000	8.6	5.000	13.3	9.000	17.7	0.600	4.9	2.200	9.0	5.500	13.9	9.500	18.1	0.800	5.6	2.400	9.4	6.000	14.5			1.000	6.2	2.600	9.7	6.500	15.1		
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
0.100	3.9	1.200	6.8	3.000	10.4	7.000	15.6																																																																			
0.200	5.1	1.400	7.3	3.500	11.2	7.500	16.1																																																																			
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0.400	4.7	1.800	8.2	4.500	12.6	8.500	17.2																																																																			
0.500	4.5	2.000	8.6	5.000	13.3	9.000	17.7																																																																			
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1.000	6.2	2.600	9.7	6.500	15.1																																																																					
<u>Hydro-Brake® Optimum Manhole: S5, DS/PN: S5.004, Volume (m³): 4.7</u>																																																																										
Unit Reference MD-SHE-0089-3500-1000-3500																																																																										
Design Head (m) 1.000																																																																										
Design Flow (l/s) 3.5																																																																										
Flush-Flo™ Calculated																																																																										
Objective Minimise upstream storage																																																																										
Application Surface																																																																										
Sump Available Yes																																																																										
Diameter (mm) 89																																																																										
Invert Level (m) 31.500																																																																										
Minimum Outlet Pipe Diameter (mm) 150																																																																										
Suggested Manhole Diameter (mm) 1200																																																																										
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Hydro-Brake® Optimum Manhole: S5, DS/PN: S5.004, Volume (m³): 4.7

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.5
Flush-Flo™	0.300	3.5
Kick-Flo®	0.632	2.8
Mean Flow over Head Range	-	3.1

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	2.7	1.200	3.8	3.000	5.8	7.000	8.7
0.200	3.4	1.400	4.1	3.500	6.2	7.500	9.0
0.300	3.5	1.600	4.3	4.000	6.7	8.000	9.2
0.400	3.4	1.800	4.6	4.500	7.0	8.500	9.5
0.500	3.3	2.000	4.8	5.000	7.4	9.000	9.8
0.600	3.0	2.200	5.0	5.500	7.7	9.500	10.0
0.800	3.1	2.400	5.2	6.000	8.1		
1.000	3.5	2.600	5.4	6.500	8.4		

Hydro-Brake® Optimum Manhole: S11, DS/PN: S1.007, Volume (m³): 2.0

Unit Reference	MD-SHE-0157-1140-0860-1140
Design Head (m)	0.860
Design Flow (l/s)	11.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	157
Invert Level (m)	26.455
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.860	11.4
Flush-Flo™	0.280	11.4
Kick-Flo®	0.609	9.7
Mean Flow over Head Range	-	9.6

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	5.6	0.300	11.4	0.500	10.8	0.800	11.0
0.200	11.2	0.400	11.2	0.600	9.9	1.000	12.2

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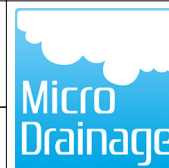
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Hydro-Brake® Optimum Manhole: S11, DS/PN: S1.007, Volume (m³): 2.0							
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	13.3	2.400	18.5	5.000	26.4	8.000	33.1
1.400	14.3	2.600	19.3	5.500	27.6	8.500	34.0
1.600	15.3	3.000	20.6	6.000	28.8	9.000	34.9
1.800	16.2	3.500	22.2	6.500	29.9	9.500	35.8
2.000	17.0	4.000	23.7	7.000	31.0		
2.200	17.8	4.500	25.1	7.500	32.0		
Hydro-Brake® Optimum Manhole: S35, DS/PN: S8.007, Volume (m³): 2.7							
Unit Reference		MD-SHE-0130-7300-0700-7300					
Design Head (m)		0.700					
Design Flow (l/s)		7.3					
Flush-Flo™		Calculated					
Objective		Minimise upstream storage					
Application		Surface					
Sump Available		Yes					
Diameter (mm)		130					
Invert Level (m)		25.970					
Minimum Outlet Pipe Diameter (mm)		150					
Suggested Manhole Diameter (mm)		1200					
Control Points		Head (m)		Flow (l/s)			
Design Point (Calculated)		0.700		7.3			
Flush-Flo™		0.229		7.3			
Kick-Flo®		0.501		6.2			
Mean Flow over Head Range		-		6.2			
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	4.7	1.200	9.4	3.000	14.5	7.000	21.8
0.200	7.3	1.400	10.1	3.500	15.6	7.500	22.4
0.300	7.2	1.600	10.8	4.000	16.6	8.000	23.2
0.400	7.0	1.800	11.4	4.500	17.6	8.500	23.9
0.500	6.3	2.000	12.0	5.000	18.5	9.000	24.6
0.600	6.8	2.200	12.5	5.500	19.4	9.500	25.3
0.800	7.8	2.400	13.0	6.000	20.2		
1.000	8.6	2.600	13.6	6.500	21.0		
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Cellular Storage Manhole: S15, DS/PN: S3.001

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	280.0	280.0	1.010	0.0	347.3
1.000	280.0	346.9			

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	200.0	200.0	1.001	0.0	256.6
1.000	200.0	256.6			

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	115.0	115.0	0.751	0.0	147.2
0.750	115.0	147.2			

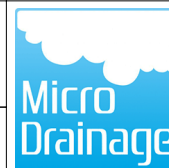
Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	130.0	130.0	0.501	0.0	152.8
0.500	130.0	152.8			

Invert Level (m)	26.070	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

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Cellular Storage Manhole: S34, DS/PN: S8.006 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>585.0</td><td>585.0</td><td>0.501</td><td>0.0</td><td>633.4</td></tr><tr><td>0.500</td><td>585.0</td><td>633.4</td><td></td><td></td><td></td></tr></table>						Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	0.000	585.0	585.0	0.501	0.0	633.4	0.500	585.0	633.4			
Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)																		
0.000	585.0	585.0	0.501	0.0	633.4																		
0.500	585.0	633.4																					
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Simulation Criteria			
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
anhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

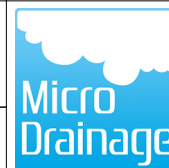
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

US/MH				Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change		Surcharge	Flood	Overflow	Act.
S1.000	S10	5760	Summer	100	+40%	100/15	Winter		
S1.001	S11	1440	Summer	100	+40%	100/15	Summer		
S2.000	S12	15	Winter	100	+40%	100/15	Summer		
S2.001	S13	480	Summer	100	+40%	100/15	Summer	100/480	Winter
S3.000	S14	1440	Winter	100	+40%	30/15	Winter		
S4.000	S15	15	Winter	100	+40%	100/15	Summer		
S4.001	S16	15	Winter	100	+40%				
S4.002	S17	1440	Winter	100	+40%	100/180	Winter		
S3.001	S15	1440	Winter	100	+40%	1/30	Winter		
S1.002	S12	1440	Winter	100	+40%	1/15	Summer	30/1440	Winter
S5.000	S1	15	Winter	100	+40%	100/15	Summer		
S5.001	S2	15	Winter	100	+40%	100/15	Summer		
S5.002	S3	15	Winter	100	+40%	30/15	Summer		
S6.000	S4	15	Winter	100	+40%	100/15	Summer		
S6.001	S5	15	Winter	100	+40%	100/15	Summer		
S5.003	S4	15	Winter	100	+40%	30/15	Summer		
S5.004	S5	360	Winter	100	+40%	30/30	Summer		

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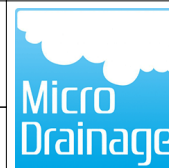
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ID	US/MH	Water	Surcharged	Flooded			Half Drain	Pipe	Status
		Level	Depth	Volume	Flow /	Overflow	Time	Flow	
	Name	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	
000	S10	30.811	0.386	0.000	0.04			2.1	FLOOD RISK
001	S11	30.824	0.794	0.000	0.04			4.9	FLOOD RISK
000	S12	30.755	0.655	0.000	1.43			75.3	FLOOD RISK
001	S13	30.879	0.919	0.000	0.13			14.8	FLOOD RISK
000	S14	30.132	0.767	0.000	0.06			1.9	SURCHARGED
000	S15	30.642	0.037	0.000	1.06			44.7	SURCHARGED
001	S16	30.279	-0.046	0.000	0.98			44.5	OK
002	S17	30.131	0.106	0.000	0.03			4.2	SURCHARGED
001	S15	30.128	0.893	0.000	0.17			7.5	SURCHARGED
002	S12	30.851	1.741	6.435	0.22			6.8	FLOOD
000	S1	32.750	0.100	0.000	0.40			39.4	SURCHARGED
001	S2	32.703	0.343	0.000	0.58			44.6	SURCHARGED
002	S3	32.678	0.578	0.000	0.37			48.5	SURCHARGED
000	S4	32.883	0.308	0.000	0.30			18.1	SURCHARGED
001	S5	32.855	0.570	0.000	0.80			59.0	SURCHARGED
003	S4	32.669	0.669	0.000	2.05			147.3	SURCHARGED
004	S5	32.378	0.653	0.000	0.03			3.5	SURCHARGED

	US/MH	Level
PN	Name	Exceeded
S1.000	S10	
S1.001	S11	
S2.000	S12	
S2.001	S13	
S3.000	S14	
S4.000	S15	
S4.001	S16	
S4.002	S17	
S3.001	S15	
S1.002	S12	16
S5.000	S1	
S5.001	S2	
S5.002	S3	
S6.000	S4	
S6.001	S5	
S5.003	S4	
S5.004	S5	

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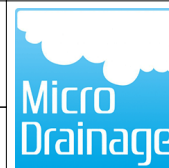
Summary of Critical Results by Maximum Level (Rank 1) for Storm

US/MH			Return	Climate	First (X)		First (Y)		First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge		Flood		Overflow	Act.
S7.000	S8	15 Winter	100	+40%						
S5.005	S6	15 Winter	100	+40%						
S5.006	S20	15 Winter	100	+40%	100/15	Summer				
S1.003	S7	15 Winter	100	+40%	100/15	Summer				
S1.004	S8	15 Winter	100	+40%						
S1.005	S9	360 Winter	100	+40%	100/30	Winter				
S1.006	S10	360 Winter	100	+40%	30/180	Summer				
S1.007	S11	360 Winter	100	+40%	30/15	Summer	100/360	Winter		
S1.008	S12	600 Winter	100	+40%						
S1.009	S13	600 Winter	100	+40%						
S1.010	S14	360 Winter	100	+40%						
S8.000	S28	15 Winter	100	+40%	100/15	Summer	100/15	Winter		
S8.001	S29	15 Summer	100	+40%	30/15	Winter				
S8.002	S30	15 Summer	100	+40%	30/15	Summer				
S8.003	S31	15 Winter	100	+40%	30/15	Summer				
S8.004	S32	15 Winter	100	+40%	30/15	Summer				
S9.000	S33	15 Winter	100	+40%	100/15	Summer				
S10.000	S34	15 Winter	100	+40%	30/15	Summer	100/15	Summer		
S10.001	S35	15 Winter	100	+40%	30/15	Summer				
S9.001	S34	15 Winter	100	+40%	30/15	Summer	100/15	Winter		
S9.002	S35	15 Winter	100	+40%	30/15	Summer	100/15	Winter		
S8.005	S33	240 Winter	100	+40%	30/15	Summer				
S8.006	S34	240 Winter	100	+40%	100/30	Summer				
S8.007	S35	240 Winter	100	+40%	30/15	Summer	100/120	Winter		

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)	
S7.000	S8	32.300	-0.145	0.000	0.27			21.9	OK
S5.005	S6	31.015	-0.110	0.000	0.51			68.4	OK
S5.006	S20	29.713	0.138	0.000	1.06			65.7	SURCHARGED
S1.003	S7	29.127	0.067	0.000	1.07			69.9	SURCHARGED
S1.004	S8	28.494	-0.091	0.000	0.65			88.1	OK
S1.005	S9	27.500	0.605	0.000	0.43			15.6	SURCHARGED
S1.006	S10	27.477	0.687	0.000	0.39			12.9	SURCHARGED
S1.007	S11	27.449	0.769	4.299	0.35			12.1	FLOOD
S1.008	S12	26.376	-0.129	0.000	0.38			12.1	OK
S1.009	S13	26.287	-0.133	0.000	0.35			12.1	OK
S1.010	S14	26.045	-0.130	0.000	0.38			12.1	OK
S8.000	S28	27.485	0.465	0.360	0.82			63.0	FLOOD
S8.001	S29	27.448	0.618	0.000	1.00			61.1	FLOOD RISK
S8.002	S30	27.430	0.640	0.000	1.10			76.4	FLOOD RISK
S8.003	S31	27.289	0.629	0.000	1.09			76.9	FLOOD RISK
S8.004	S32	27.109	0.614	0.000	1.51			77.3	FLOOD RISK
S9.000	S33	27.358	0.463	0.000	0.07			4.9	FLOOD RISK
S10.000	S34	27.461	0.641	0.575	0.89			13.9	FLOOD
S10.001	S35	27.380	0.685	0.000	2.11			29.8	FLOOD RISK

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N	US/MH Name	Water	Surcharged	Flooded			Half Drain	Pipe	Status
		Level	Depth	Volume	Flow /	Overflow	Time	Flow	
		(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	
001	S34	27.352	0.722	1.516	1.16			54.5	FLOOD
002	S35	27.180	0.745	0.047	2.07			56.7	FLOOD
005	S33	27.079	0.619	0.000	0.86			53.0	FLOOD RISK
006	S34	27.069	0.699	0.000	0.26			17.2	FLOOD RISK
007	S35	27.059	0.864	3.526	0.24			9.0	FLOOD

	US/MH	Level
PN	Name	Exceeded
S7.000	S8	
S5.005	S6	
S5.006	S20	
S1.003	S7	
S1.004	S8	
S1.005	S9	
S1.006	S10	
S1.007	S11	4
S1.008	S12	
S1.009	S13	
S1.010	S14	
S8.000	S28	1
S8.001	S29	
S8.002	S30	
S8.003	S31	
S8.004	S32	
S9.000	S33	
S10.000	S34	4
S10.001	S35	
S9.001	S34	1
S9.002	S35	1
S8.005	S33	
S8.006	S34	
S8.007	S35	2