STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.800	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	0	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

Designed with Level Soffits

Time Area Diagram for Surface

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.431	4-8	0.702	8-12	0.008

Total Area Contributing (ha) = 1.141

Total Pipe Volume (m^3) = 104.419

Network Design Table for Surface

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
1.000	5.610	0.037	151.6	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	5.348	0.036	148.6	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	22.661	0.051	444.3	0.160	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.002	22.952	0.051	450.0	0.037	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.003	6.432	0.045	142.9	0.062	0.00	0.0	0.600	o	600	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)
1.000	0.00	5.11	2.254	0.000	0.0	0.0	0.0	0.81	14.4	0.0
2.000	0.00	5.11	2.302	0.000	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	5.44	1.816	0.160	0.0	0.0	0.0	1.15	324.8	0.0
1.002	0.00	5.78	1.765	0.197	0.0	0.0	0.0	1.14	322.7	0.0
1.003	0.00	5.83	1.714	0.259	0.0	0.0	0.0	2.03	575.4	0.0

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Network Design Table for Surface

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
3.000	5.829	0.039	149.5	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	31.274	0.070	446.8	0.092	0.00	0.0	0.600	o	600	Pipe/Conduit	
4.000	4.179	0.027	154.8	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	36.555	0.082	445.8	0.061	0.00	0.0	0.600	o	600	Pipe/Conduit	
5.000	15.781	0.036	438.4	0.040	5.00	0.0	0.600	o	600	Pipe/Conduit	
5.001	17.774	0.040	444.4	0.078	0.00	0.0	0.600	o	600	Pipe/Conduit	
5.002	6.079	0.014	434.2	0.024	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.006	26.037	0.058	448.9	0.050	0.00	0.0	0.600	o	600	Pipe/Conduit	
6.000	5.687	0.036	158.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	31.898	0.071	449.3	0.168	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.008	17.578	0.039	450.7	0.052	0.00	0.0	0.600	o	600	Pipe/Conduit	
7.000	4.376	0.029	150.9	0.000	5.00	0.0	0.600	o	150	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)
3.000	0.00	5.12	2.158	0.000	0.0	0.0	0.0	0.82	14.5	0.0
1.004	0.00	6.29	1.669	0.351	0.0	0.0	0.0	1.15	323.9	0.0
4.000	0.00	5.09	2.076	0.000	0.0	0.0	0.0	0.81	14.2	0.0
1.005	0.00	6.82	1.599	0.412	0.0	0.0	0.0	1.15	324.3	0.0
5.000	0.00	5.23	1.607	0.040	0.0	0.0	0.0	1.16	327.0	0.0
5.001	0.00	5.49	1.571	0.118	0.0	0.0	0.0	1.15	324.8	0.0
5.002	0.00	5.57	1.531	0.142	0.0	0.0	0.0	1.16	328.6	0.0
1.006	0.00	7.20	1.517	0.604	0.0	0.0	0.0	1.14	323.1	0.0
6.000	0.00	5.12	1.945	0.000	0.0	0.0	0.0	0.80	14.1	0.0
1.007	0.00	7.66	1.459	0.772	0.0	0.0	0.0	1.14	323.0	0.0
1.008	0.00	7.92	1.388	0.824	0.0	0.0	0.0	1.14	322.5	0.0
7.000	0.00	5.09	1.828	0.000	0.0	0.0	0.0	0.82	14.4	0.0

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Network Design Table for Surface

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
1.009	27.082	0.061	444.0	0.104	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.010	24.952	0.056	445.6	0.031	0.00	0.0	0.600	o	600	Pipe/Conduit	
8.000	6.213	0.041	151.5	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	16.140	0.036	448.3	0.083	0.00	0.0	0.600	o	600	Pipe/Conduit	
9.000	6.666	0.015	444.4	0.001	5.00	0.0	0.600	o	600	Pipe/Conduit	
8.002	21.878	0.049	446.5	0.054	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.011	33.966	0.080	424.6	0.044	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.012	9.057	0.052	174.2	0.000	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)
1.009	0.00	8.31	1.349	0.928	0.0	0.0	0.0	1.15	324.9	0.0
1.010	0.00	8.68	1.288	0.959	0.0	0.0	0.0	1.15	324.3	0.0
8.000	0.00	5.13	1.808	0.000	0.0	0.0	0.0	0.81	14.4	0.0
8.001	0.00	5.36	1.317	0.083	0.0	0.0	0.0	1.14	323.3	0.0
9.000	0.00	5.10	1.296	0.001	0.0	0.0	0.0	1.15	324.8	0.0
8.002	0.00	5.68	1.281	0.138	0.0	0.0	0.0	1.15	324.0	0.0
1.011	0.00	9.16	1.232	1.141	0.0	0.0	0.0	1.18	332.3	0.0
1.012	0.00	9.31	1.152	1.141	0.0	0.0	0.0	0.99	39.3	0.0

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Manhole Schedules for Surface

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
IC01	3.220	0.966	Open Manhole	600	1.000	2.254	150				
ICS02	3.200	0.898	Open Manhole	600	2.000	2.302	150				
MHS01	3.120	1.304	Open Manhole	1800	1.001	1.816	600	1.000	2.217	150	
								2.000	2.266	150	
MHS02	3.260	1.495	Open Manhole	1800	1.002	1.765	600	1.001	1.765	600	
MHS03	3.331	1.617	Open Manhole	1800	1.003	1.714	600	1.002	1.714	600	
ICS04	3.160	1.002	Open Manhole	600	3.000	2.158	150				
MHS04	3.474	1.805	Open Manhole	1800	1.004	1.669	600	1.003	1.669	600	
								3.000	2.119	150	
ICS05	3.210	1.134	Open Manhole	600	4.000	2.076	150				
MHS05	3.403	1.804	Open Manhole	1800	1.005	1.599	600	1.004	1.599	600	
								4.000	2.049	150	
MHS06	2.850	1.243	Open Manhole	1800	5.000	1.607	600				
MHS07	2.750	1.179	Open Manhole	1800	5.001	1.571	600	5.000	1.571	600	
MHS08	2.830	1.299	Open Manhole	1800	5.002	1.531	600	5.001	1.531	600	
MHS09	2.850	1.333	Open Manhole	1800	1.006	1.517	600	1.005	1.517	600	
								5.002	1.517	600	
ICS06	2.815	0.870	Open Manhole	600	6.000	1.945	150				
MHS10	2.700	1.241	Open Manhole	1800	1.007	1.459	600	1.006	1.459	600	
								6.000	1.909	150	
MHS11	2.750	1.362	Open Manhole	1800	1.008	1.388	600	1.007	1.388	600	
ICS07	2.970	1.142	Open Manhole	600	7.000	1.828	150				
MHS12	2.840	1.491	Open Manhole	1800	1.009	1.349	600	1.008	1.349	600	
								7.000	1.799	150	
MHS13	3.025	1.737	Open Manhole	1800	1.010	1.288	600	1.009	1.288	600	
ICS08	2.765	0.957	Open Manhole	600	8.000	1.808	150				
MHS14	2.650	1.333	Open Manhole	1800	8.001	1.317	600	8.000	1.767	150	
MHS15	2.400	1.104	Open Manhole	1800	9.000	1.296	600				
MHS16	2.750	1.469	Open Manhole	1800	8.002	1.281	600	8.001	1.281	600	
								9.000	1.281	600	
MHS17	2.900	1.668	Open Manhole	1800	1.011	1.232	600	1.010	1.232	600	
								8.002	1.232	600	
MHS17	2.900	1.748	Open Manhole	2700	1.012	1.152	225	1.011	1.152	600	
	2.000	0.900	Open Manhole	0		OUTFALL		1.012	1.100	225	

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PIPELINE SCHEDULES for Surface

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	IC01	3.220	2.254	0.816	Open Manhole	600
2.000	o	150	ICS02	3.200	2.302	0.748	Open Manhole	600
1.001	o	600	MHS01	3.120	1.816	0.704	Open Manhole	1800
1.002	o	600	MHS02	3.260	1.765	0.895	Open Manhole	1800
1.003	o	600	MHS03	3.331	1.714	1.017	Open Manhole	1800
3.000	o	150	ICS04	3.160	2.158	0.852	Open Manhole	600
1.004	o	600	MHS04	3.474	1.669	1.205	Open Manhole	1800
4.000	o	150	ICS05	3.210	2.076	0.984	Open Manhole	600
1.005	o	600	MHS05	3.403	1.599	1.204	Open Manhole	1800
5.000	o	600	MHS06	2.850	1.607	0.643	Open Manhole	1800
5.001	o	600	MHS07	2.750	1.571	0.579	Open Manhole	1800
5.002	o	600	MHS08	2.830	1.531	0.699	Open Manhole	1800
1.006	o	600	MHS09	2.850	1.517	0.733	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	5.610	151.6	MHS01	3.120	2.217	0.753	Open Manhole	1800
2.000	5.348	148.6	MHS01	3.120	2.266	0.704	Open Manhole	1800
1.001	22.661	444.3	MHS02	3.260	1.765	0.895	Open Manhole	1800
1.002	22.952	450.0	MHS03	3.331	1.714	1.017	Open Manhole	1800
1.003	6.432	142.9	MHS04	3.474	1.669	1.205	Open Manhole	1800
3.000	5.829	149.5	MHS04	3.474	2.119	1.205	Open Manhole	1800
1.004	31.274	446.8	MHS05	3.403	1.599	1.204	Open Manhole	1800
4.000	4.179	154.8	MHS05	3.403	2.049	1.204	Open Manhole	1800
1.005	36.555	445.8	MHS09	2.850	1.517	0.733	Open Manhole	1800
5.000	15.781	438.4	MHS07	2.750	1.571	0.579	Open Manhole	1800
5.001	17.774	444.4	MHS08	2.830	1.531	0.699	Open Manhole	1800
5.002	6.079	434.2	MHS09	2.850	1.517	0.733	Open Manhole	1800
1.006	26.037	448.9	MHS10	2.700	1.459	0.641	Open Manhole	1800

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PIPELINE SCHEDULES for Surface

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.000	o	150	ICS06	2.815	1.945	0.720	Open Manhole	600
1.007	o	600	MHS10	2.700	1.459	0.641	Open Manhole	1800
1.008	o	600	MHS11	2.750	1.388	0.762	Open Manhole	1800
7.000	o	150	ICS07	2.970	1.828	0.992	Open Manhole	600
1.009	o	600	MHS12	2.840	1.349	0.891	Open Manhole	1800
1.010	o	600	MHS13	3.025	1.288	1.137	Open Manhole	1800
8.000	o	150	ICS08	2.765	1.808	0.807	Open Manhole	600
8.001	o	600	MHS14	2.650	1.317	0.733	Open Manhole	1800
9.000	o	600	MHS15	2.400	1.296	0.504	Open Manhole	1800
8.002	o	600	MHS16	2.750	1.281	0.869	Open Manhole	1800
1.011	o	600	MHS17	2.900	1.232	1.068	Open Manhole	1800
1.012	o	225	MHS17	2.900	1.152	1.523	Open Manhole	2700

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.000	5.687	158.0	MHS10	2.700	1.909	0.641	Open Manhole	1800
1.007	31.898	449.3	MHS11	2.750	1.388	0.762	Open Manhole	1800
1.008	17.578	450.7	MHS12	2.840	1.349	0.891	Open Manhole	1800
7.000	4.376	150.9	MHS12	2.840	1.799	0.891	Open Manhole	1800
1.009	27.082	444.0	MHS13	3.025	1.288	1.137	Open Manhole	1800
1.010	24.952	445.6	MHS17	2.900	1.232	1.068	Open Manhole	1800
8.000	6.213	151.5	MHS14	2.650	1.767	0.733	Open Manhole	1800
8.001	16.140	448.3	MHS16	2.750	1.281	0.869	Open Manhole	1800
9.000	6.666	444.4	MHS16	2.750	1.281	0.869	Open Manhole	1800
8.002	21.878	446.5	MHS17	2.900	1.232	1.068	Open Manhole	1800
1.011	33.966	424.6	MHS17	2.900	1.152	1.148	Open Manhole	2700
1.012	9.057	174.2		2.000	1.100	0.675	Open Manhole	0

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Setting Out Information - Site Coordinates (Surface)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
1.000	IC01	600		526541.419	317778.017	
2.000	ICS02	600		526532.293	317772.940	
1.001	MHS01	1800		526535.930	317776.861	
1.002	MHS02	1800		526530.301	317798.811	
1.003	MHS03	1800		526507.695	317794.841	
3.000	ICS04	600		526497.405	317794.980	
1.004	MHS04	1800		526502.146	317791.589	
4.000	ICS05	600		526487.437	317762.150	
1.005	MHS05	1800		526484.920	317765.486	
5.000	MHS06	1800		526440.816	317795.278	
5.001	MHS07	1800		526444.272	317779.880	
5.002	MHS08	1800		526448.139	317762.532	
1.006	MHS09	1800		526449.462	317756.598	
6.000	ICS06	600		526423.825	317756.481	
1.007	MHS10	1800		526424.079	317750.800	
1.008	MHS11	1800		526392.828	317744.405	

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Setting Out Information - Site Coordinates (Surface)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
7.000	ICS07	600		526376.696	317751.546	
1.009	MHS12	1800		526375.497	317747.337	
1.010	MHS13	1800		526348.953	317741.965	
8.000	ICS08	600		526286.198	317722.075	
8.001	MHS14	1800		526287.558	317728.137	
9.000	MHS15	1800		526301.574	317738.942	
8.002	MHS16	1800		526303.110	317732.455	
1.011	MHS17	1800		526324.629	317736.403	
1.012	MHS17	2700		526317.787	317769.673	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.012		0		526317.132	317778.706	

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Area Summary for Surface

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.160	0.160	0.160
1.002	-	-	100	0.037	0.037	0.037
1.003	-	-	100	0.062	0.062	0.062
3.000	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.092	0.092	0.092
4.000	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.061	0.061	0.061
5.000	-	-	100	0.040	0.040	0.040
5.001	-	-	100	0.078	0.078	0.078
5.002	-	-	100	0.024	0.024	0.024
1.006	-	-	100	0.050	0.050	0.050
6.000	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.168	0.168	0.168
1.008	-	-	100	0.052	0.052	0.052
7.000	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.104	0.104	0.104
1.010	-	-	100	0.031	0.031	0.031
8.000	-	-	100	0.000	0.000	0.000
8.001	-	-	100	0.083	0.083	0.083
9.000	-	-	100	0.001	0.001	0.001
8.002	-	-	100	0.054	0.054	0.054
1.011	-	-	100	0.044	0.044	0.044
1.012	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.141	1.141	1.141

Free Flowing Outfall Details for Surface

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.012		2.000	1.100	1.100	0	0

Simulation Criteria for Surface

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
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	8
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

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Simulation Criteria for Surface

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)	19.000	Storm Duration (mins)	30
Ratio R	0.403		

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Online Controls for Surface

Hydro-Brake® Optimum Manhole: MHS17, DS/PN: 1.012, Volume (m³): 19.0

Unit Reference	MD-SHE-0201-2200-1448-2200
Design Head (m)	1.448
Design Flow (l/s)	22.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	201
Invert Level (m)	1.152
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.448	22.0
Flush-Flo™	0.435	22.0
Kick-Flo®	0.959	18.1
Mean Flow over Head Range	-	18.9

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	6.9	1.200	20.1	3.000	31.2	7.000	46.9
0.200	19.0	1.400	21.6	3.500	33.6	7.500	48.5
0.300	21.5	1.600	23.1	4.000	35.8	8.000	50.1
0.400	22.0	1.800	24.4	4.500	37.9	8.500	51.5
0.500	21.9	2.000	25.7	5.000	39.9	9.000	53.0
0.600	21.6	2.200	26.9	5.500	41.7	9.500	54.4
0.800	20.5	2.400	28.0	6.000	43.5		
1.000	18.4	2.600	29.1	6.500	45.3		

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Storage Structures for Surface

Porous Car Park Manhole: IC01, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	8.0
Max Percolation (l/s)	17.8	Slope (1:X)	350.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.860	Cap Volume Depth (m)	0.110

Porous Car Park Manhole: ICS02, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	20.0
Max Percolation (l/s)	33.3	Slope (1:X)	350.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.840	Cap Volume Depth (m)	0.110

Porous Car Park Manhole: ICS04, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	29.0
Max Percolation (l/s)	40.3	Slope (1:X)	350.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.800	Cap Volume Depth (m)	0.110

Porous Car Park Manhole: ICS05, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.0
Max Percolation (l/s)	30.6	Slope (1:X)	350.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.850	Cap Volume Depth (m)	0.110

Porous Car Park Manhole: ICS06, DS/PN: 6.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	41.0
Max Percolation (l/s)	56.9	Slope (1:X)	350.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.455	Cap Volume Depth (m)	0.110

Porous Car Park Manhole: ICS07, DS/PN: 7.000

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	45.0
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

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Porous Car Park Manhole: ICS07, DS/PN: 7.000

Porosity	0.30	Slope (1:X)	350.0
Invert Level (m)	2.610	Depression Storage (mm)	5
Width (m)	6.0	Evaporation (mm/day)	3
Length (m)	27.0	Cap Volume Depth (m)	0.110

Porous Car Park Manhole: ICS08, DS/PN: 8.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	22.2	Slope (1:X)	350.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.405	Cap Volume Depth (m)	0.110

Cellular Storage Manhole: MHS17, DS/PN: 1.012

Invert Level (m)	1.152	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	400.0	0.0	5.200	0.0	0.0
0.400	400.0	0.0	5.600	0.0	0.0
0.800	400.0	0.0	6.000	0.0	0.0
1.200	400.0	0.0	6.400	0.0	0.0
1.201	0.0	0.0	6.800	0.0	0.0
2.000	0.0	0.0	7.200	0.0	0.0
2.400	0.0	0.0	7.600	0.0	0.0
2.800	0.0	0.0	8.000	0.0	0.0
3.200	0.0	0.0	8.400	0.0	0.0
3.600	0.0	0.0	8.800	0.0	0.0
4.000	0.0	0.0	9.200	0.0	0.0
4.400	0.0	0.0	9.600	0.0	0.0
4.800	0.0	0.0	10.000	0.0	0.0

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
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	8
Number of Online Controls	1	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	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	IC01	360 Winter	2	+0%	100/15 Summer				2.254
2.000	ICS02	360 Winter	2	+0%	100/15 Winter				2.302
1.001	MHS01	15 Winter	2	+0%	100/15 Summer				1.960
1.002	MHS02	15 Winter	2	+0%	100/15 Summer				1.922
1.003	MHS03	15 Winter	2	+0%	100/15 Summer				1.883
3.000	ICS04	360 Winter	2	+0%	100/15 Winter				2.158
1.004	MHS04	15 Winter	2	+0%	100/15 Summer				1.874
4.000	ICS05	360 Winter	2	+0%	100/15 Summer				2.076
1.005	MHS05	15 Winter	2	+0%	100/15 Summer				1.826
5.000	MHS06	15 Winter	2	+0%	100/15 Summer				1.783
5.001	MHS07	15 Winter	2	+0%	100/15 Summer				1.782
5.002	MHS08	15 Winter	2	+0%	100/15 Summer				1.780
1.006	MHS09	15 Winter	2	+0%	100/15 Summer				1.778
6.000	ICS06	360 Winter	2	+0%	100/15 Summer				1.945
1.007	MHS10	15 Winter	2	+0%	100/15 Summer				1.737
1.008	MHS11	15 Winter	2	+0%	100/15 Summer				1.678
7.000	ICS07	360 Winter	2	+0%	100/15 Summer				1.828
1.009	MHS12	15 Winter	2	+0%	100/15 Summer				1.629
1.010	MHS13	15 Winter	2	+0%	100/15 Summer				1.565

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	IC01	-0.150	0.000	0.00		0.0	OK	
2.000	ICS02	-0.150	0.000	0.00		0.0	OK	
1.001	MHS01	-0.456	0.000	0.09		23.8	OK	
1.002	MHS02	-0.443	0.000	0.11		28.1	OK	
1.003	MHS03	-0.431	0.000	0.12		36.1	OK	
3.000	ICS04	-0.150	0.000	0.00		0.0	OK	
1.004	MHS04	-0.395	0.000	0.18		48.0	OK	
4.000	ICS05	-0.150	0.000	0.00		0.0	OK	
1.005	MHS05	-0.373	0.000	0.20		53.2	OK	
5.000	MHS06	-0.424	0.000	0.03		6.1	OK	
5.001	MHS07	-0.389	0.000	0.07		14.9	OK	
5.002	MHS08	-0.351	0.000	0.07		14.9	OK	
1.006	MHS09	-0.339	0.000	0.28		71.2	OK	
6.000	ICS06	-0.150	0.000	0.00		0.0	OK	
1.007	MHS10	-0.322	0.000	0.33		87.0	OK	
1.008	MHS11	-0.310	0.000	0.43		90.7	OK	
7.000	ICS07	-0.150	0.000	0.00		0.0	OK	
1.009	MHS12	-0.320	0.000	0.38		98.6	OK	
1.010	MHS13	-0.323	0.000	0.39		100.0	OK	

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
8.000	ICS08	360 Winter	2	+0%	100/60 Summer				1.808
8.001	MHS14	15 Winter	2	+0%	100/15 Winter				1.502
9.000	MHS15	15 Winter	2	+0%	100/15 Winter				1.500
8.002	MHS16	15 Winter	2	+0%	100/15 Winter				1.500
1.011	MHS17	15 Winter	2	+0%	100/15 Summer				1.497
1.012	MHS17	120 Winter	2	+0%	2/30 Winter				1.429

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	ICS08	-0.150	0.000	0.00		0.0	OK	
8.001	MHS14	-0.415	0.000	0.06		11.8	OK	
9.000	MHS15	-0.396	0.000	0.00		0.6	OK	
8.002	MHS16	-0.381	0.000	0.06		15.5	OK	
1.011	MHS17	-0.335	0.000	0.40		111.4	OK	
1.012	MHS17	0.052	0.000	0.66		21.2	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
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	8
Number of Online Controls	1	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	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	IC01	360 Winter	30	+0%	100/15 Summer				2.254
2.000	ICS02	360 Winter	30	+0%	100/15 Winter				2.302
1.001	MHS01	15 Winter	30	+0%	100/15 Summer				2.066
1.002	MHS02	15 Winter	30	+0%	100/15 Summer				2.044
1.003	MHS03	15 Winter	30	+0%	100/15 Summer				2.022
3.000	ICS04	360 Winter	30	+0%	100/15 Winter				2.158
1.004	MHS04	15 Winter	30	+0%	100/15 Summer				2.014
4.000	ICS05	360 Winter	30	+0%	100/15 Summer				2.076
1.005	MHS05	15 Winter	30	+0%	100/15 Summer				1.981
5.000	MHS06	15 Winter	30	+0%	100/15 Summer				1.966
5.001	MHS07	15 Winter	30	+0%	100/15 Summer				1.964
5.002	MHS08	15 Winter	30	+0%	100/15 Summer				1.947
1.006	MHS09	15 Winter	30	+0%	100/15 Summer				1.940
6.000	ICS06	360 Winter	30	+0%	100/15 Summer				1.945
1.007	MHS10	15 Winter	30	+0%	100/15 Summer				1.899
1.008	MHS11	15 Winter	30	+0%	100/15 Summer				1.838
7.000	ICS07	360 Winter	30	+0%	100/15 Summer				1.828
1.009	MHS12	15 Winter	30	+0%	100/15 Summer				1.784
1.010	MHS13	120 Winter	30	+0%	100/15 Summer				1.750

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	IC01	-0.150	0.000	0.00		0.0	OK	
2.000	ICS02	-0.150	0.000	0.00		0.0	OK	
1.001	MHS01	-0.350	0.000	0.23		56.8	OK	
1.002	MHS02	-0.321	0.000	0.25		63.8	OK	
1.003	MHS03	-0.292	0.000	0.26		79.9	OK	
3.000	ICS04	-0.150	0.000	0.00		0.0	OK	
1.004	MHS04	-0.255	0.000	0.40		106.7	OK	
4.000	ICS05	-0.150	0.000	0.00		0.0	OK	
1.005	MHS05	-0.218	0.000	0.42		114.9	OK	
5.000	MHS06	-0.241	0.000	0.06		11.2	OK	
5.001	MHS07	-0.207	0.000	0.14		29.0	OK	
5.002	MHS08	-0.184	0.000	0.14		29.3	OK	
1.006	MHS09	-0.177	0.000	0.57		147.7	OK	
6.000	ICS06	-0.150	0.000	0.00		0.0	OK	
1.007	MHS10	-0.160	0.000	0.67		178.4	OK	
1.008	MHS11	-0.150	0.000	0.89		185.4	OK	
7.000	ICS07	-0.150	0.000	0.00		0.0	OK	
1.009	MHS12	-0.165	0.000	0.76		199.0	OK	
1.010	MHS13	-0.138	0.000	0.37		95.4	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
8.000	ICS08	360 Winter	30	+0%	100/60 Summer				1.808
8.001	MHS14	120 Winter	30	+0%	100/15 Winter				1.718
9.000	MHS15	120 Winter	30	+0%	100/15 Winter				1.718
8.002	MHS16	120 Winter	30	+0%	100/15 Winter				1.718
1.011	MHS17	120 Winter	30	+0%	100/15 Summer				1.717
1.012	MHS17	120 Winter	30	+0%	2/30 Winter				1.665

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	ICS08	-0.150	0.000	0.00		0.0	OK	
8.001	MHS14	-0.199	0.000	0.04		8.5	OK	
9.000	MHS15	-0.178	0.000	0.00		0.1	OK	
8.002	MHS16	-0.163	0.000	0.05		12.3	OK	
1.011	MHS17	-0.115	0.000	0.39		107.8	OK	
1.012	MHS17	0.288	0.000	0.68		21.9	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
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	8
Number of Online Controls	1	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	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	IC01	15 Winter	100	+40%	100/15 Summer				2.489
2.000	ICS02	15 Winter	100	+40%	100/15 Winter				2.489
1.001	MHS01	15 Winter	100	+40%	100/15 Summer				2.490
1.002	MHS02	15 Winter	100	+40%	100/15 Summer				2.478
1.003	MHS03	15 Winter	100	+40%	100/15 Summer				2.462
3.000	ICS04	15 Winter	100	+40%	100/15 Winter				2.452
1.004	MHS04	15 Winter	100	+40%	100/15 Summer				2.453
4.000	ICS05	15 Winter	100	+40%	100/15 Summer				2.421
1.005	MHS05	15 Winter	100	+40%	100/15 Summer				2.422
5.000	MHS06	15 Winter	100	+40%	100/15 Summer				2.398
5.001	MHS07	15 Winter	100	+40%	100/15 Summer				2.394
5.002	MHS08	15 Winter	100	+40%	100/15 Summer				2.385
1.006	MHS09	15 Winter	100	+40%	100/15 Summer				2.380
6.000	ICS06	15 Winter	100	+40%	100/15 Summer				2.326
1.007	MHS10	15 Winter	100	+40%	100/15 Summer				2.326
1.008	MHS11	180 Winter	100	+40%	100/15 Summer				2.265
7.000	ICS07	180 Winter	100	+40%	100/15 Summer				2.262
1.009	MHS12	180 Winter	100	+40%	100/15 Summer				2.262
1.010	MHS13	180 Winter	100	+40%	100/15 Summer				2.258

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	IC01	0.085	0.000	0.02		0.3	SURCHARGED	
2.000	ICS02	0.037	0.000	0.02		0.3	SURCHARGED	
1.001	MHS01	0.074	0.000	0.38		95.6	SURCHARGED	
1.002	MHS02	0.113	0.000	0.38		94.3	SURCHARGED	
1.003	MHS03	0.148	0.000	0.39		122.2	SURCHARGED	
3.000	ICS04	0.144	0.000	0.04		0.5	SURCHARGED	
1.004	MHS04	0.184	0.000	0.60		159.4	SURCHARGED	
4.000	ICS05	0.195	0.000	0.05		0.5	SURCHARGED	
1.005	MHS05	0.223	0.000	0.63		171.1	SURCHARGED	
5.000	MHS06	0.191	0.000	0.10		19.4	SURCHARGED	
5.001	MHS07	0.223	0.000	0.26		56.0	FLOOD RISK	
5.002	MHS08	0.254	0.000	0.30		62.2	FLOOD RISK	
1.006	MHS09	0.263	0.000	0.94		242.5	SURCHARGED	
6.000	ICS06	0.231	0.000	0.04		0.5	SURCHARGED	
1.007	MHS10	0.267	0.000	1.12		297.4	FLOOD RISK	
1.008	MHS11	0.277	0.000	0.50		103.7	SURCHARGED	
7.000	ICS07	0.284	0.000	0.00		0.0	SURCHARGED	
1.009	MHS12	0.313	0.000	0.45		116.1	SURCHARGED	
1.010	MHS13	0.370	0.000	0.46		118.1	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
8.000	ICS08	180 Winter	100	+40%	100/60 Summer				2.254
8.001	MHS14	180 Winter	100	+40%	100/15 Winter				2.254
9.000	MHS15	180 Winter	100	+40%	100/15 Winter				2.254
8.002	MHS16	180 Winter	100	+40%	100/15 Winter				2.254
1.011	MHS17	180 Winter	100	+40%	100/15 Summer				2.254
1.012	MHS17	180 Winter	100	+40%	2/30 Winter				2.249

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	ICS08	0.296	0.000	0.00		0.0	SURCHARGED	
8.001	MHS14	0.337	0.000	0.06		11.1	FLOOD RISK	
9.000	MHS15	0.358	0.000	0.00		0.1	FLOOD RISK	
8.002	MHS16	0.373	0.000	0.07		18.3	SURCHARGED	
1.011	MHS17	0.422	0.000	0.49		136.6	SURCHARGED	
1.012	MHS17	0.872	0.000	0.68		21.9	SURCHARGED	

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