STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes Standard Manhole Sizes Standard

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.400	Maximum Backdrop Height (m)	8.000
Maximum Rainfall (mm/hr)	550	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500
PIMP (%)	100		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.982	4-8	0.709

Total Area Contributing (ha) = 1.691

Total Pipe Volume (m³) = 58.762

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)
1.000	10.826	0.043	250.0	0.315	5.00	0.0	0.600	o	500
2.000	31.064	0.207	150.0	0.137	5.00	0.0	0.600	o	225
1.001	42.123	0.168	250.0	0.024	0.00	0.0	0.600	o	500
1.002	29.087	0.116	250.0	0.033	0.00	0.0	0.600	o	500
3.000	15.357	0.360	42.7	0.060	5.00	0.0	0.600	o	225
1.003	65.902	0.264	250.0	0.422	0.00	0.0	0.600	o	500
1.004	6.807	0.027	250.0	0.000	0.00	0.0	0.600	o	500

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	54.09	5.13	48.300	0.315	0.0	0.0	0.0	1.37	268.9	46.1
2.000	52.50	5.49	48.700	0.137	0.0	0.0	0.0	1.07	42.4	19.5
1.001	50.37	6.00	48.218	0.476	0.0	0.0	0.0	1.37	268.9	64.9
1.002	49.01	6.35	48.049	0.509	0.0	0.0	0.0	1.37	268.9	67.6
3.000	54.11	5.13	48.675	0.060	0.0	0.0	0.0	2.01	79.9	8.8
1.003	46.23	7.15	47.933	0.991	0.0	0.0	0.0	1.37	268.9	124.1
1.004	45.96	7.24	47.669	0.991	0.0	0.0	0.0	1.37	268.9	124.1

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)
4.000	78.235	0.830	94.3	0.182	5.00	0.0	0.600	o	300
4.001	28.935	0.800	36.2	0.131	0.00	0.0	0.600	o	300
5.000	86.490	0.450	192.2	0.387	5.00	0.0	0.600	o	450
4.002	16.676	0.150	111.2	0.000	0.00	0.0	0.600	o	450
1.005	9.014	0.021	429.2	0.000	0.00	0.0	0.600	o	600

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)
4.000	51.15	5.80	50.830	0.182	0.0	0.0	0.0	1.62	114.5	25.2
4.001	50.41	5.99	50.000	0.313	0.0	0.0	0.0	2.62	185.4	42.7
5.000	50.42	5.99	49.550	0.387	0.0	0.0	0.0	1.46	232.7	52.8
4.002	49.85	6.13	49.050	0.700	0.0	0.0	0.0	1.93	306.6	94.5
1.005	45.55	7.37	47.542	1.691	0.0	0.0	0.0	1.17	330.5	208.6

Manhole Schedules for Storm

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)
1	50.000	1.700	Open Manhole	1500	1.000	48.300	500				
2	50.000	1.300	Open Manhole	1200	2.000	48.700	225				
3	50.000	1.782	Open Manhole	1500	1.001	48.218	500	1.000	48.257	500	39
								2.000	48.493	225	
4	50.100	2.051	Open Manhole	1500	1.002	48.049	500	1.001	48.049	500	
5	50.100	1.425	Open Manhole	1200	3.000	48.675	225				
6	50.100	2.167	Open Manhole	1500	1.003	47.933	500	1.002	47.933	500	
								3.000	48.315	225	107
7	50.420	2.751	Open Manhole	1500	1.004	47.669	500	1.003	47.669	500	
8	52.330	1.500	Open Manhole	1200	4.000	50.830	300				
9	51.500	1.500	Open Manhole	1200	4.001	50.000	300	4.000	50.000	300	
10	51.200	1.650	Open Manhole	1500	5.000	49.550	450				
11	50.750	1.700	Open Manhole	1500	4.002	49.050	450	4.001	49.200	300	
								5.000	49.100	450	50
12	50.600	3.058	Open Manhole	1500	1.005	47.542	600	1.004	47.642	500	
								4.002	48.900	450	1208
	50.600	3.079	Open Manhole	0		OUTFALL		1.005	47.521	600	

PIPELINE SCHEDULES for Storm

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	500	1	50.000	48.300	1.200	Open Manhole	1500
2.000	o	225	2	50.000	48.700	1.075	Open Manhole	1200
1.001	o	500	3	50.000	48.218	1.282	Open Manhole	1500
1.002	o	500	4	50.100	48.049	1.551	Open Manhole	1500
3.000	o	225	5	50.100	48.675	1.200	Open Manhole	1200
1.003	o	500	6	50.100	47.933	1.667	Open Manhole	1500
1.004	o	500	7	50.420	47.669	2.251	Open Manhole	1500
4.000	o	300	8	52.330	50.830	1.200	Open Manhole	1200
4.001	o	300	9	51.500	50.000	1.200	Open Manhole	1200
5.000	o	450	10	51.200	49.550	1.200	Open Manhole	1500
4.002	o	450	11	50.750	49.050	1.250	Open Manhole	1500
1.005	o	600	12	50.600	47.542	2.458	Open Manhole	1500

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	10.826	250.0	3	50.000	48.257	1.243	Open Manhole	1500
2.000	31.064	150.0	3	50.000	48.493	1.282	Open Manhole	1500
1.001	42.123	250.0	4	50.100	48.049	1.551	Open Manhole	1500
1.002	29.087	250.0	6	50.100	47.933	1.667	Open Manhole	1500
3.000	15.357	42.7	6	50.100	48.315	1.560	Open Manhole	1500
1.003	65.902	250.0	7	50.420	47.669	2.251	Open Manhole	1500
1.004	6.807	250.0	12	50.600	47.642	2.458	Open Manhole	1500
4.000	78.235	94.3	9	51.500	50.000	1.200	Open Manhole	1200
4.001	28.935	36.2	11	50.750	49.200	1.250	Open Manhole	1500
5.000	86.490	192.2	11	50.750	49.100	1.200	Open Manhole	1500
4.002	16.676	111.2	12	50.600	48.900	1.250	Open Manhole	1500
1.005	9.014	429.2		50.600	47.521	2.479	Open Manhole	0

Setting Out Information - Site Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
1.000	1	1500		370180.300	237940.500	
2.000	2	1200		370193.300	237962.900	
1.001	3	1500		370169.700	237942.700	
1.002	4	1500		370138.500	237914.400	
3.000	5	1200		370108.400	237881.700	
1.003	6	1500		370118.800	237893.000	
1.004	7	1500		370139.700	237830.500	
4.000	8	1200		370246.100	237822.600	
4.001	9	1200		370171.800	237798.100	
5.000	10	1500		370244.400	237853.300	
4.002	11	1500		370162.500	237825.500	
1.005	12	1500		370146.500	237830.200	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.005		0		370149.500	237821.700	

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)
1.005		50.600	47.521	0.000	0	0

Simulation Criteria for Storm

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm

Hydro-Brake® Manhole: 12, DS/PN: 1.005, Volume (m³): 8.9

Design Head (m) 1.320 Hydro-Brake® Type Md4 Invert Level (m) 47.542
Design Flow (l/s) 10.0 Diameter (mm) 105

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	0.800	7.7	2.000	12.2	4.000	17.2	7.000	22.7
0.200	7.0	1.000	8.6	2.200	12.7	4.500	18.2	7.500	23.5
0.300	6.4	1.200	9.4	2.400	13.3	5.000	19.2	8.000	24.3
0.400	5.9	1.400	10.2	2.600	13.9	5.500	20.1	8.500	25.0
0.500	6.2	1.600	10.9	3.000	14.9	6.000	21.0	9.000	25.8
0.600	6.7	1.800	11.5	3.500	16.1	6.500	21.9	9.500	26.5

Storage Structures for Storm

Cellular Storage Manhole: 12, DS/PN: 1.005

Invert Level (m) 47.542 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	731.0	705.0	0.900	731.0	800.6	1.800	0.0	848.4
0.100	731.0	715.6	1.000	731.0	811.2	1.900	0.0	848.4
0.200	731.0	726.2	1.100	731.0	821.8	2.000	0.0	848.4
0.300	731.0	736.9	1.200	731.0	832.4	2.100	0.0	848.4
0.400	731.0	747.5	1.300	731.0	843.1	2.200	0.0	848.4
0.500	731.0	758.1	1.400	0.0	848.4	2.300	0.0	848.4
0.600	731.0	768.7	1.500	0.0	848.4	2.400	0.0	848.4
0.700	731.0	779.3	1.600	0.0	848.4	2.500	0.0	848.4
0.800	731.0	790.0	1.700	0.0	848.4			