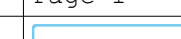


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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.360	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

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.256	4-8	0.104

Total Area Contributing (ha) = 0.360

Total Pipe Volume (m³) = 13.026

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
1.000	28.403	0.200	142.0	0.013	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	8.480	0.100	84.8	0.027	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	9.941	0.100	99.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	16.378	0.200	81.9	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	I.Area (ha)	Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	44.71	5.56	52.200	0.013	0.0	0.0	0.0	0.84	14.9	1.6
2.000	46.30	5.13	52.100	0.027	0.0	0.0	0.0	1.09	19.3	3.4
1.001	44.14	5.73	52.000	0.040	0.0	0.0	0.0	1.01	17.8	4.8
3.000	45.86	5.25	53.200	0.015	0.0	0.0	0.0	1.11	19.6	1.9

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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
3.001	16.470	1.000	16.5	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit		
1.002	38.865	0.225	172.7	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit		
4.000	22.139	0.200	110.7	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit		
4.001	16.208	1.250	13.0	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit		
1.003	32.631	0.300	108.8	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit		
1.004	4.369	0.075	58.3	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit		
5.000	34.373	0.300	114.6	0.050	5.00	0.0	0.600	o	300	Pipe/Conduit		
5.001	52.376	0.300	174.6	0.080	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.005	1.955	0.100	19.6	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.006	19.633	0.300	65.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.007	3.765	0.064	58.5	0.000	0.00	0.0	0.600	o	300	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)
3.001	45.45	5.36	53.000	0.030	0.0	0.0	0.0	2.49	44.1	3.7
1.002	42.03	6.38	51.875	0.100	0.0	0.0	0.0	0.99	39.4	11.4
4.000	45.34	5.39	53.200	0.015	0.0	0.0	0.0	0.95	16.9	1.8
4.001	44.99	5.48	53.000	0.030	0.0	0.0	0.0	2.81	49.7	3.7
1.003	40.75	6.81	51.650	0.145	0.0	0.0	0.0	1.25	49.8	16.0
1.004	40.63	6.86	51.350	0.160	0.0	0.0	0.0	1.72	68.3	17.6
5.000	45.33	5.39	52.100	0.050	0.0	0.0	0.0	1.47	103.8	6.1
5.001	42.82	6.13	51.800	0.130	0.0	0.0	0.0	1.19	83.9	15.1
1.005	40.60	6.87	51.200	0.360	0.0	0.0	0.0	3.57	252.5	39.6
1.006	40.14	7.03	51.100	0.360	0.0	0.0	0.0	1.95	137.6	39.6
1.007	40.05	7.06	50.800	0.360	0.0	0.0	0.0	2.06	145.6	39.6

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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 Coefficient	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	1
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	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.360		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 6, DS/PN: 1.005, Volume (m³): 6.5

Unit Reference	MD-SHE-0128-8000-1200-8000
Design Head (m)	1.200
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	128
Invert Level (m)	51.200
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	8.0
Flush-Flo™	0.357	8.0
Kick-Flo®	0.767	6.5
Mean Flow over Head Range	-	6.9

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	4.6	1.200	8.0	3.000	12.3	7.000	18.4
0.200	7.5	1.400	8.6	3.500	13.2	7.500	19.1
0.300	7.9	1.600	9.1	4.000	14.1	8.000	19.7
0.400	8.0	1.800	9.7	4.500	14.9	8.500	20.2
0.500	7.8	2.000	10.2	5.000	15.7	9.000	20.8
0.600	7.6	2.200	10.6	5.500	16.4	9.500	21.4
0.800	6.6	2.400	11.1	6.000	17.1		
1.000	7.3	2.600	11.5	6.500	17.8		

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Storage Structures for Storm

Tank or Pond Manhole: 6, DS/PN: 1.005

Invert Level (m) 51.200

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	150.0	1.000	150.0	1.002	0.0

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

Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000

Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coefficient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 0

Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm)

Ratio R 0.360
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep
DTS Status

DVD Status OFF
Fine Inertia Status OFF
ON

Profile(s)

Duration(s) (mins)

Return Period(s) (years)

Climate Change (%)

Summer and Winter
15, 30, 60, 120, 180, 240, 360, 480, 600,
720, 960, 1440, 2160, 2880, 4320, 5760,
7200, 8640, 10080
1, 30, 100
0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%	100/15 Summer				52.569
2.000	2	15 Winter	100	+40%	100/15 Summer				52.584
1.001	2	15 Winter	100	+40%	100/15 Summer				52.537
3.000	4	15 Winter	100	+40%					53.270
3.001	5	15 Winter	100	+40%					53.066
1.002	3	15 Winter	100	+40%	100/15 Summer				52.461
4.000	7	15 Winter	100	+40%					53.276
4.001	8	15 Winter	100	+40%					53.062
1.003	4	15 Winter	100	+40%	100/15 Summer				52.204
1.004	5	180 Winter	100	+40%	30/15 Summer				52.129
5.000	11	15 Winter	100	+40%					52.208
5.001	12	180 Winter	100	+40%	100/120 Winter				52.130
1.005	6	180 Winter	100	+40%	30/30 Summer				52.126
1.006	7	180 Summer	30	+0%					51.150
1.007	8	120 Summer	30	+0%					50.870

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

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
1.000	1	0.219	0.000	0.42			5.9	SURCHARGED	
2.000	2	0.334	0.000	0.65			11.0	SURCHARGED	
1.001	2	0.387	0.000	1.17			18.5	SURCHARGED	
3.000	4	-0.080	0.000	0.44			8.0	OK	
3.001	5	-0.084	0.000	0.40			16.4	OK	
1.002	3	0.361	0.000	1.05			39.2	SURCHARGED	
4.000	7	-0.074	0.000	0.49			7.8	OK	
4.001	8	-0.088	0.000	0.35			16.2	OK	
1.003	4	0.329	0.000	1.26			59.1	SURCHARGED	
1.004	5	0.554	0.000	0.52			20.2	SURCHARGED	
5.000	11	-0.192	0.000	0.27			26.1	OK	
5.001	12	0.030	0.000	0.23			17.8	SURCHARGED	
1.005	6	0.626	0.000	0.10			8.0	SURCHARGED	
1.006	7	-0.250	0.000	0.07			8.0	OK	
1.007	8	-0.230	0.000	0.13			8.0	OK	