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)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.366	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

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	14.100	0.028	503.6	0.067	5.00	0.0	0.600	o	1500	Pipe/Conduit	
1.001	7.000	0.014	500.0	0.067	0.00	0.0	0.600	o	1500	Pipe/Conduit	
1.002	14.600	0.029	503.4	0.067	0.00	0.0	0.600	o	1500	Pipe/Conduit	
2.000	25.000	0.050	500.0	0.000	5.00	0.0	0.600	o	1500	Pipe/Conduit	
1.003	24.350	0.048	507.3	0.133	0.00	0.0	0.600	o	1500	Pipe/Conduit	
1.004	41.120	0.274	150.1	0.000	0.00	0.0	0.600	o	1500	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	50.00	5.12	58.093	0.067	0.0	0.0	0.0	1.90	3365.7	9.1
1.001	50.00	5.18	58.065	0.134	0.0	0.0	0.0	1.91	3377.8	18.1
1.002	50.00	5.31	58.051	0.201	0.0	0.0	0.0	1.90	3366.1	27.2
2.000	50.00	5.22	58.072	0.000	0.0	0.0	0.0	1.91	3377.8	0.0
1.003	50.00	5.53	58.022	0.334	0.0	0.0	0.0	1.90	3353.2	45.2
1.004	50.00	5.72	57.974	0.334	0.0	0.0	0.0	3.50	6184.1	45.2

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	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	0
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)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.366		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 6, DS/PN: 1.004, Volume (m³): 48.0

Unit Reference	MD-SHE-0080-3700-1800-3700
Design Head (m)	1.800
Design Flow (l/s)	3.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	80
Invert Level (m)	57.974
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	3.7
Flush-Flo™	0.354	3.0
Kick-Flo®	0.719	2.4
Mean Flow over Head Range	-	2.9

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	2.3	1.200	3.1	3.000	4.7	7.000	7.0
0.200	2.9	1.400	3.3	3.500	5.0	7.500	7.2
0.300	3.0	1.600	3.5	4.000	5.4	8.000	7.4
0.400	3.0	1.800	3.7	4.500	5.7	8.500	7.7
0.500	2.9	2.000	3.9	5.000	6.0	9.000	7.9
0.600	2.8	2.200	4.1	5.500	6.2	9.500	8.1
0.800	2.5	2.400	4.2	6.000	6.5		
1.000	2.8	2.600	4.4	6.500	6.7		

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

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	0
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	0.379
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 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	1	240 Winter	100	+40%	100/240 Winter				59.776
1.001	2	240 Winter	100	+40%	100/240 Winter				59.776
1.002	3	240 Winter	100	+40%	100/240 Winter				59.776
2.000	4	240 Winter	100	+40%	100/240 Winter				59.776
1.003	5	240 Winter	100	+40%	100/120 Winter				59.776
1.004	6	240 Winter	100	+40%	100/120 Winter				59.776

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.183	0.000	0.01		6.5	SURCHARGED	
1.001	2	0.211	0.000	0.01		8.4	SURCHARGED	
1.002	3	0.225	0.000	0.01		13.2	SURCHARGED	
2.000	4	0.204	0.000	0.00		0.4	FLOOD RISK	
1.003	5	0.254	0.000	0.01		12.5	SURCHARGED	
1.004	6	0.302	0.000	0.00		3.7	FLOOD RISK	