STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes SW NET Manhole Sizes SW NET

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.700	Minimum Backdrop Height (m)	0.200
Ratio R	0.306	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.014	4-8	0.005

Total Area Contributing (ha) = 0.019

Total Pipe Volume (m^3) = 0.991

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	9.900	2.427	4.1	0.005	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	14.600	0.763	19.1	0.005	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	10.600	1.459	7.3	0.009	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.003	15.500	2.178	7.1	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.004	42.300	8.283	5.1	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.005	2.900	0.072	40.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.006	30.400	1.308	23.2	0.000	0.00	0.0	0.600	o	100	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	5.04	238.390	0.005	0.0	0.0	0.0	3.86	30.3	0.7
1.001	50.00	5.18	235.963	0.010	0.0	0.0	0.0	1.77	13.9	1.4
1.002	50.00	5.24	235.200	0.019	0.0	0.0	0.0	2.89	22.7	2.6
1.003	50.00	5.33	233.741	0.019	0.0	0.0	0.0	2.92	22.9	2.6
1.004	50.00	5.53	231.563	0.019	0.0	0.0	0.0	3.45	27.1	2.6
1.005	50.00	5.57	223.280	0.019	0.0	0.0	0.0	1.22	9.6	2.6
1.006	50.00	5.89	223.208	0.019	0.0	0.0	0.0	1.61	12.6	2.6

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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	-	-	100	0.005	0.005	0.005
1.001	-	-	100	0.005	0.005	0.005
1.002	-	-	100	0.009	0.009	0.009
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.019	0.019	0.019

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)
1.006		222.800	221.900	221.900	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)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Storm Duration (mins)	30
Ratio R	0.306		

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Online Controls for Storm

Crown Vortex Valve® Manhole: S06, DS/PN: 1.006, Volume (m³): 1.1

Design Head (m) 0.670 Vortex Valve® Type R1 SW Only Invert Level (m) 223.208
Design Flow (l/s) 1.6 Diameter (mm) 57

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	0.7	0.800	1.7	2.000	2.7	4.000	3.8	7.000	5.1
0.200	0.9	1.000	1.9	2.200	2.9	4.500	4.1	7.500	5.3
0.300	1.1	1.200	2.1	2.400	3.0	5.000	4.3	8.000	5.4
0.400	1.2	1.400	2.3	2.600	3.1	5.500	4.5	8.500	5.6
0.500	1.4	1.600	2.4	3.000	3.3	6.000	4.7	9.000	5.8
0.600	1.5	1.800	2.6	3.500	3.6	6.500	4.9	9.500	5.9

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Storage Structures for Storm

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

Invert Level (m) 223.280

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4.2	0.550	20.0

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1 year Return Period 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	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 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	M5-60 (mm) 19.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.306	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S01	15 Winter	1	+0%					238.400	-0.090	0.000
1.001	S02	15 Winter	1	+0%					235.983	-0.080	0.000
1.002	S03	15 Winter	1	+0%					235.221	-0.079	0.000
1.003	S04	15 Winter	1	+0%					233.762	-0.079	0.000
1.004	S05	15 Winter	1	+0%					231.582	-0.081	0.000
1.005	POND	30 Winter	1	+0%	30/15 Summer				223.365	-0.015	0.000
1.006	S06	30 Winter	1	+0%	1/15 Summer				223.363	0.055	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S01	0.02		0.6	OK	
1.001	S02	0.09		1.2	OK	
1.002	S03	0.10		2.1	OK	
1.003	S04	0.10		2.1	OK	
1.004	S05	0.08		2.1	OK	
1.005	POND	0.13		1.0	OK	
1.006	S06	0.06		0.8	SURCHARGED	

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30 year Return Period 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	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 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	M5-60 (mm) 19.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.306	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S01	15 Winter	30	+0%					238.405	-0.085	0.000
1.001	S02	15 Winter	30	+0%					235.996	-0.067	0.000
1.002	S03	15 Winter	30	+0%					235.237	-0.063	0.000
1.003	S04	15 Winter	30	+0%					233.777	-0.064	0.000
1.004	S05	15 Winter	30	+0%					231.595	-0.068	0.000
1.005	POND	60 Winter	30	+0%	30/15 Summer				223.535	0.155	0.000
1.006	S06	60 Winter	30	+0%	1/15 Summer				223.532	0.224	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S01	0.05		1.5	OK	
1.001	S02	0.24		3.2	OK	
1.002	S03	0.29		6.1	OK	
1.003	S04	0.28		6.1	OK	
1.004	S05	0.23		6.0	OK	
1.005	POND	0.16		1.2	SURCHARGED	
1.006	S06	0.09		1.1	SURCHARGED	

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100 year Return Period 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	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 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	M5-60 (mm) 19.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.306	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S01	15 Winter	100	+40%					238.411	-0.079	0.000
1.001	S02	15 Winter	100	+40%					236.009	-0.054	0.000
1.002	S03	15 Winter	100	+40%					235.252	-0.048	0.000
1.003	S04	15 Winter	100	+40%					233.792	-0.049	0.000
1.004	S05	15 Winter	100	+40%					231.608	-0.055	0.000
1.005	POND	60 Winter	100	+40%	30/15 Summer				223.736	0.356	0.000
1.006	S06	60 Winter	100	+40%	1/15 Summer				223.737	0.429	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S01	0.10		2.8	OK	
1.001	S02	0.43		5.7	OK	
1.002	S03	0.52		11.0	OK	
1.003	S04	0.50		11.0	OK	
1.004	S05	0.41		10.9	OK	
1.005	POND	0.24		1.8	FLOOD RISK	
1.006	S06	0.11		1.4	SURCHARGED	

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