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	0.353	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)	0.300
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	0.082	4-8	0.030

Total Area Contributing (ha) = 0.112

Total Pipe Volume (m^3) = 2.147

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	12.600	0.125	100.8	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	2.450	0.025	98.0	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	31.800	1.000	31.8	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	19.950	0.200	99.8	0.019	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	14.000	0.800	17.5	0.000	0.00	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)
1.000	50.00	5.21	159.150	0.024	0.0	0.0	0.0	1.00	17.7	3.2
1.001	50.00	5.25	159.025	0.033	0.0	0.0	0.0	1.02	17.9	4.5
1.002	50.00	5.55	159.000	0.067	0.0	0.0	0.0	1.79	31.7	9.1
2.000	50.00	5.33	159.000	0.019	0.0	0.0	0.0	1.01	17.8	2.6
2.001	50.00	5.43	158.800	0.019	0.0	0.0	0.0	2.42	42.8	2.6

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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
3.000	12.300	0.120	102.5	0.026	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	28.400	0.700	40.6	0.000	0.00	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	50.00	5.21	158.120	0.026	0.0	0.0	0.0	0.99	17.5	3.5
1.003	50.00	5.84	158.000	0.112	0.0	0.0	0.0	1.58	28.0	15.2

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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)	Backdr (mm)
S4	160.200	1.050	Open Manhole	460	1.000	159.150	150				
S5	160.150	1.125	Open Manhole	460	1.001	159.025	150	1.000	159.025	150	
S6	160.150	1.150	Open Manhole	460	1.002	159.000	150	1.001	159.000	150	
S7	159.950	0.950	Open Manhole	460	2.000	159.000	150				
S8	159.600	0.800	Open Manhole	460	2.001	158.800	150	2.000	158.800	150	
S1D	159.350	1.230	Open Manhole	460	3.000	158.120	150				
S9	159.270	1.270	Open Manhole	460	1.003	158.000	150	1.002	158.000	150	
								2.001	158.000	150	
								3.000	158.000	150	
EXG CW	158.100	0.800	Open Manhole	750 x 750		OUTFALL		1.003	157.300	150	

No coordinates have been specified, layout information cannot be produced.

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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	150	S4	160.200	159.150	0.900	Open Manhole	460
1.001	o	150	S5	160.150	159.025	0.975	Open Manhole	460
1.002	o	150	S6	160.150	159.000	1.000	Open Manhole	460
2.000	o	150	S7	159.950	159.000	0.800	Open Manhole	460
2.001	o	150	S8	159.600	158.800	0.650	Open Manhole	460
3.000	o	150	S1D	159.350	158.120	1.080	Open Manhole	460
1.003	o	150	S9	159.270	158.000	1.120	Open Manhole	460

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	12.600	100.8	S5	160.150	159.025	0.975	Open Manhole	460
1.001	2.450	98.0	S6	160.150	159.000	1.000	Open Manhole	460
1.002	31.800	31.8	S9	159.270	158.000	1.120	Open Manhole	460
2.000	19.950	99.8	S8	159.600	158.800	0.650	Open Manhole	460
2.001	14.000	17.5	S9	159.270	158.000	1.120	Open Manhole	460
3.000	12.300	102.5	S9	159.270	158.000	1.120	Open Manhole	460
1.003	28.400	40.6	EXG CW	158.100	157.300	0.650	Open Manhole	750 x 750

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)
1.003	EXG CW	158.100	157.300	0.000	750	750

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 Online Controls 0 Number of Storage Structures 0

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Simulation Criteria for Storm

Number of Time/Area Diagrams 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	0.353		

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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 Storage Structures	0
Number of Online Controls	0	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	0.353
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	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 35, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S4	15 Winter	1	+0%	30/15 Summer	100/15 Winter		
1.001	S5	15 Winter	1	+0%	30/15 Summer	100/15 Winter		
1.002	S6	15 Winter	1	+0%	30/15 Summer			
2.000	S7	15 Winter	1	+0%	100/15 Summer			
2.001	S8	15 Winter	1	+0%	100/15 Summer			
3.000	S1D	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
1.003	S9	15 Winter	1	+0%	30/15 Summer	100/15 Summer		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S4	159.194	-0.106	0.000	0.19			3.0	OK	1
1.001	S5	159.089	-0.086	0.000	0.36			4.0	OK	1
1.002	S6	159.051	-0.099	0.000	0.25			7.6	OK	
2.000	S7	159.038	-0.112	0.000	0.14			2.4	OK	
2.001	S8	158.824	-0.126	0.000	0.06			2.4	OK	
3.000	S1D	158.166	-0.104	0.000	0.21			3.3	OK	2
1.003	S9	158.075	-0.075	0.000	0.50			13.3	OK	2

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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 Storage Structures	0
Number of Online Controls	0	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	0.353
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	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 35, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S4	15 Winter	30	+35%	30/15 Summer	100/15 Winter		
1.001	S5	15 Winter	30	+35%	30/15 Summer	100/15 Winter		
1.002	S6	15 Winter	30	+35%	30/15 Summer			
2.000	S7	15 Winter	30	+35%	100/15 Summer			
2.001	S8	15 Winter	30	+35%	100/15 Summer			
3.000	S1D	15 Winter	30	+35%	30/15 Summer	100/15 Summer		
1.003	S9	15 Winter	30	+35%	30/15 Summer	100/15 Summer		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S4	159.533	0.233	0.000	0.57			9.1	SURCHARGED
1.001	S5	159.498	0.323	0.000	1.08			11.7	SURCHARGED
1.002	S6	159.465	0.315	0.000	0.80			24.4	SURCHARGED
2.000	S7	159.073	-0.077	0.000	0.47			7.9	OK
2.001	S8	158.913	-0.037	0.000	0.20			7.8	OK
3.000	S1D	158.934	0.664	0.000	0.59			9.4	SURCHARGED
1.003	S9	158.888	0.738	0.000	1.44			38.5	SURCHARGED

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

PN	US/MH Name	Level Exceeded
1.000	S4	1
1.001	S5	1
1.002	S6	
2.000	S7	
2.001	S8	
3.000	S1D	2
1.003	S9	2

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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 Storage Structures 0
Number of Online Controls 0 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 0.353
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 DVD Status ON
Analysis Timestep Fine Inertia Status OFF
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 35, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S4	15 Winter	100	+40%	30/15 Summer	100/15 Winter		
1.001	S5	15 Winter	100	+40%	30/15 Summer	100/15 Winter		
1.002	S6	15 Winter	100	+40%	30/15 Summer			
2.000	S7	15 Winter	100	+40%	100/15 Summer			
2.001	S8	15 Winter	100	+40%	100/15 Summer			
3.000	S1D	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
1.003	S9	15 Winter	100	+40%	30/15 Summer	100/15 Summer		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S4	160.200	0.900	0.137	0.73			11.8	FLOOD
1.001	S5	160.150	0.975	0.166	1.47			16.0	FLOOD
1.002	S6	160.127	0.977	0.000	0.91			27.7	FLOOD RISK
2.000	S7	159.392	0.242	0.000	0.57			9.5	SURCHARGED
2.001	S8	159.320	0.370	0.000	0.24			9.3	FLOOD RISK
3.000	S1D	159.350	1.080	0.055	0.81			12.8	FLOOD
1.003	S9	159.271	1.121	0.706	1.62			43.3	FLOOD

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

PN	US/MH Name	Level Exceeded
1.000	S4	1
1.001	S5	1
1.002	S6	
2.000	S7	
2.001	S8	
3.000	S1D	2
1.003	S9	2

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