



Date 06/01/2020 22:31

Designed by m.m

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Network 2018.1.1

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)	20.100	Add Flow / Climate Change (%)	0
Ratio R	0.294	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	0.072	4-8	0.020

Total Area Contributing (ha) = 0.092

Total Pipe Volume (m³) = 13.575

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
S1.000	3.500	0.151	23.2	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	5.100	0.041	124.4	0.018	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	19.800	0.599	33.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	16.800	0.042	400.0	0.028	0.00	0.0	0.600	[]	-19	Pipe/Conduit	
S3.000	22.800	0.792	28.8	0.036	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	4.000	0.032	125.0	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)
S1.000	46.98	5.03	122.690	0.010	0.0	0.0	0.0	2.10	37.1	1.3
S2.000	46.74	5.09	122.580	0.018	0.0	0.0	0.0	0.90	15.9	2.3
S1.001	46.07	5.28	122.539	0.028	0.0	0.0	0.0	1.76	31.0	3.5
S1.002	45.38	5.48	121.940	0.056	0.0	0.0	0.0	1.39	1044.8	6.9
S3.000	46.35	5.20	122.690	0.036	0.0	0.0	0.0	1.88	33.3	4.5
S1.003	45.13	5.56	121.898	0.092	0.0	0.0	0.0	0.90	15.9	11.2



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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	124.040	1.350	Open Manhole	1200	S1.000	122.690	150				
S2	124.040	1.460	Open Manhole	1200	S2.000	122.580	150				
S3	124.040	1.501	Open Manhole	1200	S1.001	122.539	150	S1.000	122.539	150	
								S2.000	122.539	150	
S4	124.040	2.100	Open Manhole	1200	S1.002	121.940	-19	S1.001	121.940	150	
S5	124.040	1.350	Open Manhole	1200	S3.000	122.690	150				
S6	124.040	2.142	Open Manhole	1800	S1.003	121.898	150	S1.002	121.898	-19	
								S3.000	121.898	150	
S	123.500	1.634	Open Manhole	0		OUTFALL		S1.003	121.866	150	



Date 06/01/2020 22:31

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Network 2018.1.1

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)
S1.000	o	150	S1	124.040	122.690	1.200	Open Manhole	1200
S2.000	o	150	S2	124.040	122.580	1.310	Open Manhole	1200
S1.001	o	150	S3	124.040	122.539	1.351	Open Manhole	1200
S1.002	[]	-19	S4	124.040	121.940	1.600	Open Manhole	1200
S3.000	o	150	S5	124.040	122.690	1.200	Open Manhole	1200
S1.003	o	150	S6	124.040	121.898	1.992	Open Manhole	1800

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)
S1.000	3.500	23.2	S3	124.040	122.539	1.351	Open Manhole	1200
S2.000	5.100	124.4	S3	124.040	122.539	1.351	Open Manhole	1200
S1.001	19.800	33.1	S4	124.040	121.940	1.950	Open Manhole	1200
S1.002	16.800	400.0	S6	124.040	121.898	1.642	Open Manhole	1800
S3.000	22.800	28.8	S6	124.040	121.898	1.992	Open Manhole	1800
S1.003	4.000	125.0	S	123.500	121.866	1.484	Open Manhole	0



Date 06/01/2020 22:31
File (2019-12-20).MDX

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Network 2018.1.1

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.010	0.010	0.010
2.000	-	-	100	0.018	0.018	0.018
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.028	0.028	0.028
3.000	-	-	100	0.036	0.036	0.036
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.092	0.092	0.092



Date 06/01/2020 22:31

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Network 2018.1.1

Network Classifications for Storm

PN	USMH	Pipe	Min Cover	Max Cover	Pipe Type	MH	MH	MH Ring	MH Type
	Name	Dia	Depth	Depth		Dia	Width	Depth	
		(mm)	(m)	(m)		(mm)	(mm)	(m)	
S1.000	S1	150	1.200	1.351	Unclassified	1200	0	1.200	Unclassified
S2.000	S2	150	1.310	1.351	Unclassified	1200	0	1.310	Unclassified
S1.001	S3	150	1.351	1.950	Unclassified	1200	0	1.351	Unclassified
S1.002	S4	-19	1.600	1.642	Unclassified	1200	0	1.600	Unclassified
S3.000	S5	150	1.200	1.992	Unclassified	1200	0	1.200	Unclassified
S1.003	S6	150	1.484	1.992	Unclassified	1800	0	1.992	Unclassified

Free Flowing Outfall Details for Storm

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe Number	Name	(m)	(m)	I. Level	(mm)	(mm)
				(m)		
S1.003	S	123.500	121.866	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 * 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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 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)	20.100	Storm Duration (mins)	30
Ratio R	0.294		



Date 06/01/2020 22:31
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Network 2018.1.1

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.003, Volume (m³): 17.3

Unit Reference MD-SHE-0108-6700-1900-6700
Design Head (m) 1.900
Design Flow (l/s) 6.7
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 108
Invert Level (m) 121.898
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.900	6.7	Kick-Flo®	0.962	4.9
Flush-Flo™	0.473	6.1	Mean Flow over Head Range	-	5.6

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)	Depth (m)	Flow (l/s)
0.100	3.7	0.800	5.7	2.000	6.9	4.000	9.5	7.000	12.4
0.200	5.4	1.000	5.0	2.200	7.2	4.500	10.1	7.500	12.8
0.300	5.9	1.200	5.4	2.400	7.5	5.000	10.6	8.000	13.2
0.400	6.1	1.400	5.8	2.600	7.8	5.500	11.1	8.500	13.6
0.500	6.1	1.600	6.2	3.000	8.3	6.000	11.5	9.000	14.0
0.600	6.1	1.800	6.5	3.500	8.9	6.500	12.0	9.500	14.4

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S1.000	S1	1.527	0.062	0.000	1.589
S2.000	S2	1.651	0.090	0.000	1.741
S1.001	S3	1.698	0.350	0.000	2.047
S1.002	S4	2.375	12.600	0.000	14.975
S3.000	S5	1.527	0.403	0.000	1.930
S1.003	S6	5.451	0.071	0.000	5.521
Total		14.228	13.575	0.000	27.804

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S1.000	S1	1.527	0.041	0.000	1.567
S2.000	S2	1.651	0.069	0.000	1.720
S1.001	S3	1.698	0.329	0.000	2.026
S1.002	S4	2.375	11.475	0.000	13.850
S3.000	S5	1.527	0.376	0.000	1.903
S1.003	S6	5.451	0.055	0.000	5.506



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Volume Summary (Static)

Pipe	USMH	Manhole	Pipe	Storage	Total
Number	Name	Volume (m³)	Volume (m³)	Structure Volume (m³)	Volume (m³)
Total		14.228	12.344	0.000	26.573



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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 Coefficient 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.100 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.294 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s)

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) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
									(m)	(m)	(m ³)
S1.000	S1 15 Winter		1	+0%	100/15 Summer				122.712	-0.128	0.000
S2.000	S2 15 Winter		1	+0%	100/15 Summer				122.623	-0.107	0.000
S1.001	S3 15 Winter		1	+0%	100/15 Summer				122.574	-0.115	0.000
S1.002	S4 30 Winter		1	+0%	100/15 Summer				122.058	-0.382	0.000
S3.000	S5 15 Winter		1	+0%	100/15 Summer				122.728	-0.112	0.000
S1.003	S6 30 Winter		1	+0%	1/15 Winter				122.058	0.010	0.000

PN	US/MH Name	Flow / Cap.	Pipe Flow (l/s)	Overflow Flow (l/s)	Status	Level
						Exceeded
S1.000	S1	0.05		1.3	OK	
S2.000	S2	0.18		2.3	OK	
S1.001	S3	0.12		3.5	OK	
S1.002	S4	0.01		5.3	OK	
S3.000	S5	0.14		4.5	OK	
S1.003	S6	0.45		5.0	SURCHARGED	



Date 06/01/2020 22:31

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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 Coefficient 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.100 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.294 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s)

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) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
									(m)	(m)	(m ³)
S1.000	S1 15	Winter	30	+0%	100/15	Summer			122.726	-0.114	0.000
S2.000	S2 15	Winter	30	+0%	100/15	Summer			122.650	-0.080	0.000
S1.001	S3 15	Winter	30	+0%	100/15	Summer			122.595	-0.094	0.000
S1.002	S4 30	Winter	30	+0%	100/15	Summer			122.334	-0.106	0.000
S3.000	S5 15	Winter	30	+0%	100/15	Summer			122.752	-0.088	0.000
S1.003	S6 30	Winter	30	+0%	1/15	Winter			122.334	0.286	0.000

PN	US/MH Name	Flow / Cap.	Pipe Flow (l/s)	Level Exceeded
S1.000	S1	0.13	3.1	OK
S2.000	S2	0.44	5.5	OK
S1.001	S3	0.29	8.6	OK
S1.002	S4	0.02	13.0	OK
S3.000	S5	0.35	11.1	OK
S1.003	S6	0.54	6.1	SURCHARGED



Date 06/01/2020 22:31

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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 Coefficient 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.100 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.294 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s)

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) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
									(m)	(m)	(m ³)
S1.000	S1 60 Winter		100	+40%	100/15 Summer				123.837	0.997	0.000
S2.000	S2 60 Winter		100	+40%	100/15 Summer				123.839	1.109	0.000
S1.001	S3 60 Winter		100	+40%	100/15 Summer				123.836	1.147	0.000
S1.002	S4 60 Winter		100	+40%	100/15 Summer				123.827	1.387	0.000
S3.000	S5 60 Winter		100	+40%	100/15 Summer				123.841	1.001	0.000
S1.003	S6 60 Winter		100	+40%	1/15 Winter				123.827	1.779	0.000

PN	US/MH Name	Flow / Cap.	Pipe Flow (l/s)	Overflow (l/s)	Status	Level
						Exceeded
S1.000	S1	0.13		3.2	SURCHARGED	
S2.000	S2	0.46		5.8	SURCHARGED	
S1.001	S3	0.30		8.8	SURCHARGED	
S1.002	S4	0.02		15.4	SURCHARGED	
S3.000	S5	0.37		11.6	SURCHARGED	
S1.003	S6	0.60		6.7	SURCHARGED	