STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for S

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.325	Minimum Backdrop Height (m)	0.600
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	3.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
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 S

- Indicates pipe length does not match coordinates

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	11.957	0.030	398.6	0.056	5.00	0.0	0.600	o	900	Pipe/Conduit	
2.000	10.353	0.026	398.2	0.134	5.00	0.0	0.600	o	900	Pipe/Conduit	
1.001	26.824#	0.070	383.2	0.036	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.002	3.036	0.048	63.3	0.046	0.00	0.0	0.600	o	225	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	5.13	99.400	0.056	0.0	0.0	0.0	1.56	994.5	7.6
2.000	50.00	5.11	99.396	0.134	0.0	0.0	0.0	1.56	995.0	18.1
1.001	50.00	5.41	99.370	0.226	0.0	0.0	0.0	1.59	1014.4	30.6
1.002	50.00	5.44	99.300	0.272	0.0	0.0	0.0	1.65	65.5	36.8

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Manhole Schedules for S

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)	Backdrop (mm)
S4	101.405	2.005	Open Manhole	2400	1.000	99.400	900				
S1	101.691	2.295	Open Manhole	2400	2.000	99.396	900				
S2	101.566	2.196	Open Manhole	2700	1.001	99.370	900	1.000	99.370	900	
								2.000	99.370	900	
S3	102.496	3.196	Open Manhole	2400	1.002	99.300	225	1.001	99.300	900	
MH4	103.100	3.848	Open Manhole	1200		OUTFALL		1.002	99.252	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S4	385261.925	404092.847	385261.925	404092.847	Required	
S1	385242.883	404082.282	385242.883	404082.282	Required	
S2	385250.512	404089.281	385250.512	404089.281	Required	
S3	385241.231	404115.851	385241.231	404115.851	Required	
MH4	385243.257	404118.113			No Entry	

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PIPELINE SCHEDULES for S

Upstream Manhole

- Indicates pipe length does not match coordinates

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	900	S4	101.405	99.400	1.105	Open Manhole	2400
2.000	o	900	S1	101.691	99.396	1.395	Open Manhole	2400
1.001	o	900	S2	101.566	99.370	1.296	Open Manhole	2700
1.002	o	225	S3	102.496	99.300	2.971	Open Manhole	2400

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	11.957	398.6	S2	101.566	99.370	1.296	Open Manhole	2700
2.000	10.353	398.2	S2	101.566	99.370	1.296	Open Manhole	2700
1.001	26.824#	383.2	S3	102.496	99.300	2.296	Open Manhole	2400
1.002	3.036	63.3	MH4	103.100	99.252	3.623	Open Manhole	1200

Free Flowing Outfall Details for S

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	MH4	103.100	99.252	0.000	1200	0

Simulation Criteria for S

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	4.000
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	0	Number of Real Time Controls	0

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Simulation Criteria for S

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Storm Duration (mins)	30
Ratio R	0.325		

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Online Controls for S

Hydro-Brake® Optimum Manhole: S3, DS/PN: 1.002, Volume (m³): 29.9

Unit Reference	MD-SHE-0158-1470-2050-1470
Design Head (m)	2.050
Design Flow (l/s)	14.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	158
Invert Level (m)	99.300
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.050	14.7	Kick-Flo®	1.257	11.6
Flush-Flo™	0.607	14.7	Mean Flow over Head Range	-	12.9

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	5.7	1.200	12.3	3.000	17.6	7.000	26.4
0.200	12.1	1.400	12.3	3.500	18.9	7.500	27.3
0.300	13.5	1.600	13.0	4.000	20.2	8.000	28.1
0.400	14.3	1.800	13.8	4.500	21.3	8.500	29.0
0.500	14.6	2.000	14.5	5.000	22.5	9.000	29.8
0.600	14.7	2.200	15.2	5.500	23.5	9.500	30.6
0.800	14.5	2.400	15.8	6.000	24.5		
1.000	13.8	2.600	16.4	6.500	25.5		

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 4.000
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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.325
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.800 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
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) 100
Climate Change (%) 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	S4	60 Winter	100	+40%	100/15 Summer	100/60 Winter			101.407
2.000	S1	60 Winter	100	+40%	100/15 Summer				101.429
1.001	S2	60 Winter	100	+40%	100/15 Summer				101.429
1.002	S3	60 Winter	100	+40%	100/15 Summer				101.435

PN	US/MH Name	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	1.107	2.247	0.03			14.6	FLOOD	1
2.000	S1	1.133	0.000	0.07			31.3	FLOOD RISK	
1.001	S2	1.159	0.000	0.04			27.8	FLOOD RISK	
1.002	S3	1.910	0.000	0.48			14.8	SURCHARGED	

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