

William Saunders					Page 1				
Sheppard Lockton House			11974						
Cafferata Way			Hilljet Quadring						
Newark, NG24 2TN			FSR						
Date 31/10/2019			Designed by PAE						
File 19.10.31 750 5ls fsr.MDX			Checked by						
Innovyze			Network 2019.1						

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)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	60	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
S1.000	24.701	0.050	494.0	0.074	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	23.046	0.050	460.9	0.055	0.00	0.0	0.600	o	750	Pipe/Conduit	
S2.000	32.000	0.065	492.3	0.039	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.002	32.117	0.065	494.1	0.025	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.003	3.818	0.050	76.4	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E (m)	I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	64.95	5.33	2.340	0.074	0.0	0.0	0.0	1.25	553.2	13.0
S1.001	63.42	5.62	2.290	0.129	0.0	0.0	0.0	1.30	572.9	22.2
S2.000	64.44	5.43	2.305	0.039	0.0	0.0	0.0	1.25	554.2	6.8
S1.002	61.36	6.05	2.240	0.193	0.0	0.0	0.0	1.25	553.2	32.1
S1.003	61.16	6.09	2.175	0.229	0.0	0.0	0.0	1.50	59.6	38.0

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<p align="center"><u>Simulation Criteria for Storm</u></p> <p> 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 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 </p> <p> 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 </p> <p align="center"><u>Synthetic Rainfall Details</u></p> <p> 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 0.400 </p>		
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS5, DS/PN: S1.003, Volume (m³): 17.4

Unit Reference MD-SHE-0103-5000-1156-5000
Design Head (m) 1.156
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 103
Invert Level (m) 2.175
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)	1.156	5.0	Kick-Flo®	0.721	4.0
Flush-Flo™	0.341	5.0	Mean Flow over Head Range	-	4.4

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	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.8	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.0	1.600	5.8	4.000	8.9	8.000	12.4
0.400	5.0	1.800	6.1	4.500	9.5	8.500	12.8
0.500	4.9	2.000	6.5	5.000	9.9	9.000	13.2
0.600	4.6	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.0	6.000	10.8		
1.000	4.7	2.600	7.3	6.500	11.3		

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

Simulation Criteria

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

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep 2.5 Second Increment (Extended)	
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH		Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water
	Name									Level (m)
S1.000	SS1	30	Winter	2	+0%	100/15	Winter			2.548
S1.001	SS2	30	Winter	2	+0%	100/15	Winter			2.548
S2.000	SS3	30	Winter	2	+0%	100/15	Winter			2.548
S1.002	SS4	30	Winter	2	+0%	100/15	Winter			2.548
S1.003	SS5	30	Winter	2	+0%	2/15	Summer	100/30	Winter	2.548

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Flow (l/s)		
S1.000	SS1	-0.542	0.000	0.02		9.1	OK	
S1.001	SS2	-0.492	0.000	0.03		11.9	OK	
S2.000	SS3	-0.507	0.000	0.01		4.1	OK	
S1.002	SS4	-0.442	0.000	0.02		9.5	OK	
S1.003	SS5	0.148	0.000	0.16		5.0	SURCHARGED	3

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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 * 10m ³ /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	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

									Water
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
S1.000	SS1	60 Winter	100	+40%	100/15 Winter				3.786
S1.001	SS2	60 Winter	100	+40%	100/15 Winter				3.786
S2.000	SS3	60 Winter	100	+40%	100/15 Winter				3.785
S1.002	SS4	60 Winter	100	+40%	100/15 Winter				3.785
S1.003	SS5	60 Winter	100	+40%	2/15 Summer	100/30 Winter			3.784

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Flow (l/s)		
S1.000	SS1	0.696	0.000	0.05		20.4	FLOOD	RISK
S1.001	SS2	0.746	0.000	0.06		24.5	FLOOD	RISK
S2.000	SS3	0.730	0.000	0.02		9.8	FLOOD	RISK
S1.002	SS4	0.795	0.000	0.08		35.3	FLOOD	RISK
S1.003	SS5	1.384	19.389	0.18		5.8	FLOOD	3