

Sutcliffe		Page 0
18-20 Harrington Street	SW CALCS	
Liverpool	THE ROSSET	
L2 9QA	100YR + 45%	
Date 02/05/2024 10:28	Designed by MJG	
File 31842-MODEL001.MDX	Checked by DS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales			
Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.377	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 Surface Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.020	4-8	0.007

Total Area Contributing (ha) = 0.026

Total Pipe Volume (m³) = 1.012

Network Design Table for Surface Network 1

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	10.883	0.136	80.0	0.007	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	8.141	0.102	79.8	0.007	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	17.458	0.218	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	8.061	0.201	40.1	0.007	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	3.908	0.049	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	6.241	0.178	35.1	0.006	5.00	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	5.16	32.876	0.007	0.0	0.0	0.0	1.12	19.9	1.0
2.000	50.00	5.12	32.842	0.007	0.0	0.0	0.0	1.13	19.9	0.9
1.001	50.00	5.42	32.740	0.014	0.0	0.0	0.0	1.12	19.9	1.9
3.000	50.00	5.08	32.722	0.007	0.0	0.0	0.0	1.59	28.2	0.9
1.002	50.00	5.48	32.522	0.021	0.0	0.0	0.0	1.12	19.9	2.8
4.000	50.00	5.06	32.651	0.006	0.0	0.0	0.0	1.71	30.1	0.8

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Network Design Table for Surface Network 1

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
1.003	2.572	0.257	10.0	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)
1.003	50.00	5.49	31.277	0.026	0.0	0.0	0.0	3.20	56.6	3.6

Area Summary for Surface Network 1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.007	0.007	0.007
2.000	User	-	100	0.007	0.007	0.007
1.001	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.007	0.007	0.007
1.002	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.006	0.006	0.006
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.026	0.026	0.026

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.003S533.55031.0200.00012000

Simulation Criteria for Surface Network 1

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 0Number of Offline Controls 0Number of Time/Area Diagrams 0
Number of Online Controls 1Number of Storage Structures 0Number 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)	18.000	Storm Duration (mins)	30
Ratio R	0.377		

Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: S4, DS/PN: 1.003, Volume (m³): 3.3

Unit Reference	MD-SHE-0093-5000-1900-5000
Design Head (m)	1.900
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	93
Invert Level (m)	31.277
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	5.0	Kick-Flo®	0.830	3.4
Flush-Flo™	0.406	4.3	Mean Flow over Head Range	-	4.0

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	2.9	0.800	3.6	2.000	5.1	4.000	7.1	7.000	9.2
0.200	3.9	1.000	3.7	2.200	5.4	4.500	7.5	7.500	9.5
0.300	4.2	1.200	4.0	2.400	5.6	5.000	7.9	8.000	9.8
0.400	4.3	1.400	4.3	2.600	5.8	5.500	8.2	8.500	10.1
0.500	4.2	1.600	4.6	3.000	6.2	6.000	8.6	9.000	10.4
0.600	4.1	1.800	4.9	3.500	6.7	6.500	8.9	9.500	10.7

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)
1.000	S1	0.034	0.192	0.000	0.227
2.000	S8	0.034	0.144	0.000	0.178
1.001	S2	0.215	0.309	0.000	0.524
3.000	S7	0.039	0.142	0.000	0.182
1.002	S3	0.871	0.069	0.000	0.940
4.000	S6	0.129	0.110	0.000	0.240
1.003	S4	3.189	0.045	0.000	3.234
Total		4.512	1.012	0.000	5.524

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure	Total
				Volume (m³)	Volume (m³)
1.000	S1	0.034	0.185	0.000	0.219
2.000	S8	0.034	0.136	0.000	0.170
1.001	S2	0.215	0.294	0.000	0.509
3.000	S7	0.039	0.131	0.000	0.170
1.002	S3	0.871	0.048	0.000	0.918
4.000	S6	0.129	0.094	0.000	0.224
1.003	S4	3.189	0.023	0.000	3.211
Total		4.512	0.911	0.000	5.423

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

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) 18.000 Cv (Summer) 1.000
Region England and Wales Ratio R 0.377 Cv (Winter) 1.000

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

Profile(s) Summer and Winter
Duration(s) (mins) 15
Return Period(s) (years) 100
Climate Change (%) 45

									Water	Surcharged	Flooded	
US/MH			Return	Climate	First (X)		First (Y)	First (Z)	Overflow	Level	Depth	Volume
PN	Name	Storm	Period	Change	Surcharge		Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	S1	15 Summer	100	+45%	100/15 Summer					33.214	0.188	0.000
2.000	S8	15 Summer	100	+45%	100/15 Summer					33.212	0.220	0.000
1.001	S2	15 Summer	100	+45%	100/15 Summer					33.208	0.318	0.000
3.000	S7	15 Summer	100	+45%	100/15 Summer					33.199	0.327	0.000
1.002	S3	15 Summer	100	+45%	100/15 Summer					33.195	0.523	0.000
4.000	S6	15 Summer	100	+45%	100/15 Summer					33.191	0.390	0.000
1.003	S4	15 Summer	100	+45%	100/15 Summer					33.188	1.761	0.000

				Half Drain Pipe				Level
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Exceeded	
1.000	S1	0.29			5.1	SURCHARGED		
2.000	S8	0.28			4.8	SURCHARGED		
1.001	S2	0.53			9.8	FLOOD RISK		
3.000	S7	0.20			4.9	SURCHARGED		
1.002	S3	0.90			12.4	SURCHARGED		
4.000	S6	0.15			3.8	FLOOD RISK		
1.003	S4	0.16			5.0	SURCHARGED		