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Causeway Network 2020.1.3		

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)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	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 at outfall (pipe 1.003)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.180	4-8	0.079

Total Area Contributing (ha) = 0.259

Total Pipe Volume (m³) = 7.549

Time Area Diagram at outfall (pipe 2.004)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.119	4-8	0.057

Total Area Contributing (ha) = 0.176

Total Pipe Volume (m³) = 7.072

Time Area Diagram at outfall (pipe 5.003)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.380	4-8	0.164

Total Area Contributing (ha) = 0.544

Total Pipe Volume (m³) = 16.471

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<u>Simulation Criteria for Storm</u> 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 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 Storage Structures 3 Number of Online Controls 3 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FSR Profile Type Summer Return Period (years) 100 Cv (Summer) 0.750 Region England and Wales Cv (Winter) 0.840 M5-60 (mm) 20.000 Storm Duration (mins) 30 Ratio R 0.400		
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S1.2A, DS/PN: 1.003, Volume (m³): 8.0

Unit Reference	MD-SHE-0115-6000-1000-6000
Design Head (m)	1.000
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	115
Invert Level (m)	45.187
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)	1.000	6.0	Kick-Flo®	0.647	4.9
Flush-Flo™	0.298	6.0	Mean Flow over Head Range	-	5.2

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	4.0	1.200	6.5	3.000	10.0	7.000	15.0
0.200	5.8	1.400	7.0	3.500	10.8	7.500	15.5
0.300	6.0	1.600	7.5	4.000	11.5	8.000	16.0
0.400	5.9	1.800	7.9	4.500	12.2	8.500	16.5
0.500	5.7	2.000	8.3	5.000	12.8	9.000	17.0
0.600	5.3	2.200	8.7	5.500	13.4	9.500	17.4
0.800	5.4	2.400	9.0	6.000	14.0		
1.000	6.0	2.600	9.4	6.500	14.5		

Hydro-Brake® Optimum Manhole: S2.1, DS/PN: 2.003, Volume (m³): 3.6

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	45.325
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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<u>Hydro-Brake® Optimum Manhole: S2.1, DS/PN: 2.003, Volume (m³): 3.6</u>							
Control Points		Head (m)	Flow (l/s)	Control Points		Head (m)	Flow (l/s)
Design Point (Calculated)		1.000	5.0	Kick-Flo®		0.637	4.1
Flush-Flo™		0.296	5.0	Mean Flow over Head Range		-	4.3
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	3.6	1.200	5.4	3.000	8.4	7.000	12.5
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		
<u>Hydro-Brake® Optimum Manhole: S4.3, DS/PN: 5.003, Volume (m³): 8.0</u>							
Unit Reference MD-SHE-0175-1500-1000-1500							
Design Head (m) 1.000							
Design Flow (l/s) 15.0							
Flush-Flo™ Calculated							
Objective Minimise upstream storage							
Application Surface							
Sump Available Yes							
Diameter (mm) 175							
Invert Level (m) 41.877							
Minimum Outlet Pipe Diameter (mm) 225							
Suggested Manhole Diameter (mm) 1200							
Control Points		Head (m)	Flow (l/s)	Control Points		Head (m)	Flow (l/s)
Design Point (Calculated)		1.000	15.0	Kick-Flo®		0.704	12.7
Flush-Flo™		0.323	15.0	Mean Flow over Head Range		-	12.7
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	6.2	0.600	14.1	1.600	18.7	2.600	23.6
0.200	14.4	0.800	13.5	1.800	19.8	3.000	25.3
0.300	15.0	1.000	15.0	2.000	20.8	3.500	27.2
0.400	14.9	1.200	16.3	2.200	21.8	4.000	29.0
0.500	14.6	1.400	17.6	2.400	22.7	4.500	30.7
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Hydro-Brake® Optimum Manhole: S4.3, DS/PN: 5.003, Volume (m³): 8.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
5.000	32.3	6.500	36.7	8.000	40.6	9.500	44.1
5.500	33.9	7.000	38.0	8.500	41.8		
6.000	35.3	7.500	39.3	9.000	43.0		

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Causeway						Network 2020.1.3			
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 Storage Structures		3			
Number of Online Controls		3		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)		20.000 Cv (Winter)		0.840					
Margin for Flood Risk Warning (mm)		300.0		DVD Status		ON			
Analysis Timestep		Fine Inertia Status		ON					
DTS Status		ON							
Profile(s)		Summer and Winter							
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080							
Return Period(s) (years)		1, 30, 100							
Climate Change (%)		0, 0, 30							
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S14	120 Winter	100	+30%	30/60 Winter				46.405
1.001	S15	120 Winter	100	+30%	30/30 Summer				46.404
1.002	S16	360 Winter	100	+30%	30/15 Summer				46.767
1.003	S1.2A	360 Winter	100	+30%	1/15 Summer				47.101
2.000	S2.4	15 Winter	100	+30%	100/15 Summer				45.998
2.001	S2.3	120 Winter	100	+30%	100/15 Summer				45.966
2.002	S2.2	120 Winter	100	+30%	30/15 Summer				45.962
3.000	S2	15 Winter	100	+30%					46.068
4.000	S3	15 Winter	100	+30%					46.154
4.001	S3.1	120 Winter	100	+30%					45.959
2.003	S2.1	120 Winter	100	+30%	30/60 Winter				45.957
2.004	S2.6	240 Summer	100	+30%					45.360
5.000	S4	15 Winter	100	+30%					45.653
5.001	S4.1	15 Winter	100	+30%					45.261
6.000	S10	15 Winter	100	+30%	30/15 Summer				46.445
6.001	S11	15 Winter	100	+30%					45.528
7.000	S12	15 Winter	100	+30%	100/15 Summer				44.614
6.002	S13	15 Winter	100	+30%					44.348
5.002	S4.2	120 Winter	100	+30%	30/15 Summer				43.543
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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>									
		Surcharged	Flooded		Half Drain	Pipe			
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
1.000	S14	0.505	0.000	0.00			0.2	SURCHARGED	
1.001	S15	0.598	0.000	0.23			14.0	SURCHARGED	
1.002	S16	1.022	0.000	0.23			15.4	SURCHARGED	
1.003	S1.2A	1.614	0.000	0.13			6.7	SURCHARGED	
2.000	S2.4	0.073	0.000	0.74			27.4	SURCHARGED	
2.001	S2.3	0.179	0.000	0.29			9.3	SURCHARGED	
2.002	S2.2	0.313	0.000	1.07			11.7	SURCHARGED	
3.000	S2	-0.157	0.000	0.20			20.4	OK	
4.000	S3	-0.071	0.000	0.81			30.1	OK	
4.001	S3.1	-0.116	0.000	0.13			12.7	OK	
2.003	S2.1	0.332	0.000	0.09			5.0	SURCHARGED	
2.004	S2.6	-0.252	0.000	0.06			5.0	OK	
5.000	S4	-0.072	0.000	0.75			29.0	OK	
5.001	S4.1	-0.123	0.000	0.42			59.4	OK	
6.000	S10	0.520	0.000	1.65			63.3	SURCHARGED	
6.001	S11	-0.128	0.000	0.60			119.2	OK	
7.000	S12	0.014	0.000	1.08			5.9	SURCHARGED	
6.002	S13	-0.176	0.000	0.35			124.5	OK	
5.002	S4.2	1.088	0.000	0.70			71.4	SURCHARGED	
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