

Innovation Centre Hillington Glasgow, G52 4RU	Designed by Daniel Checked by
Date 27/07/2021 15:20 File J3406 - PROPOSED DRAINAIN...	



Innovyze 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 - Scotland and Ireland

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	17.200	Add Flow / Climate Change (%)	0
Ratio R	0.231	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.	1.000	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)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	18.502	0.904	20.5	0.008	5.00	0.0	0.600			225	Pipe/Conduit	☺
1.001	6.340	0.127	49.9	0.023	0.00	0.0	0.600			225	Pipe/Conduit	☺
1.002	46.542	0.746	62.4	0.019	0.00	0.0	0.600			600	Pipe/Conduit	☺
1.003	4.560	0.115	39.7	0.016	0.00	0.0	0.600			225	Pipe/Conduit	☺
2.000	12.962	0.579	22.4	0.032	5.00	0.0	0.600			800	Pipe/Conduit	☺
3.000	9.808	0.723	13.6	0.007	5.00	0.0		0.075	- -		Porous Car Park	☺
3.001	3.061	0.306	10.0	0.004	0.00	0.0		0.075		225	Pipe/Conduit	☺
4.000	9.997	0.505	19.8	0.008	5.00	0.0		0.075	- -		Porous Car Park	☺
4.001	5.883	0.392	15.0	0.005	0.00	0.0		0.075		150	Pipe/Conduit	☺

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.11	78.797	0.008	0.0	0.0	0.0	2.91	115.5	1.5
1.001	50.00	5.16	77.893	0.032	0.0	0.0	0.0	1.86	73.8	5.7
1.002	50.00	5.41	77.391	0.051	0.0	0.0	0.0	3.09	872.8	9.1
1.003	50.00	5.45	76.645	0.066	0.0	0.0	0.0	2.08	82.9	12.0
2.000	50.00	5.04	76.846	0.032	0.0	0.0	0.0	6.17	3101.2	5.8
3.000	50.00	5.40	77.862	0.007	0.0	0.0	0.0	0.40	158.9	1.2
3.001	50.00	5.49	77.139	0.010	0.0	0.0	0.0	0.62	24.6	1.8
4.000	50.00	5.83	77.544	0.008	0.0	0.0	0.0	0.20	36.0	1.4
4.001	50.00	6.08	77.008	0.013	0.0	0.0	0.0	0.39	6.8	2.4

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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)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
2.001	3.572	0.029	125.0	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	☒
5.000	18.502	1.069	17.3	0.000	5.00	0.0	0.600		o	225	Pipe/Conduit	☒
5.001	20.203	2.020	10.0	0.015	0.00	0.0	0.600		o	225	Pipe/Conduit	☒
6.000	12.127	0.765	15.9	0.010	5.00	0.0		0.075	→ ↓ ←		Porous Car Park	☒
6.001	15.172	1.517	10.0	0.005	0.00	0.0	0.600		o	225	Pipe/Conduit	☒
7.000	17.799	1.000	17.8	0.010	5.00	0.0		0.075	→ ↓ ←		Porous Car Park	☒
7.001	4.204	0.420	10.0	0.006	0.00	0.0	0.600		o	225	Pipe/Conduit	☒
5.002	11.611	0.774	15.0	0.005	0.00	0.0	0.600		o	225	Pipe/Conduit	☒
8.000	9.931	0.791	12.6	0.006	5.00	0.0		0.075	→ ↓ ←		Porous Car Park	☒
8.001	14.848	1.328	11.2	0.003	0.00	0.0	0.600		o	300	Pipe/Conduit	☒
9.000	9.007	0.700	12.9	0.004	5.00	0.0		0.075	→ ↓ ←		Porous Car Park	☒
9.001	4.287	0.429	10.0	0.004	0.00	0.0	0.600		o	300	Pipe/Conduit	☒
5.003	28.116	0.047	600.0	0.021	0.00	0.0	0.600		o	1050	Pipe/Conduit	☒
5.004	7.111	0.032	225.0	0.010	0.00	0.0	0.600		o	225	Pipe/Conduit	☒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.001	50.00	6.13	76.267	0.056	0.0	0.0	0.0	1.17	46.4	10.1
5.000	50.00	5.10	78.600	0.000	0.0	0.0	0.0	3.16	125.7	0.0
5.001	50.00	5.18	77.531	0.015	0.0	0.0	0.0	4.16	165.5	2.7
6.000	50.00	5.50	77.895	0.010	0.0	0.0	0.0	0.40	178.4	1.7
6.001	50.00	5.56	77.130	0.015	0.0	0.0	0.0	4.16	165.5	2.6
7.000	50.00	5.58	78.100	0.010	0.0	0.0	0.0	0.52	373.0	1.7
7.001	50.00	5.59	77.100	0.016	0.0	0.0	0.0	4.16	165.5	2.8
5.002	50.00	5.65	75.510	0.050	0.0	0.0	0.0	3.40	135.0	9.0
8.000	50.00	5.48	76.890	0.006	0.0	0.0	0.0	0.34	97.6	1.0
8.001	50.00	5.54	75.989	0.009	0.0	0.0	0.0	4.73	334.2	1.6
9.000	50.00	5.35	76.972	0.004	0.0	0.0	0.0	0.43	173.5	0.8
9.001	50.00	5.37	76.244	0.008	0.0	0.0	0.0	5.00	353.4	1.4
5.003	50.00	5.98	74.422	0.087	0.0	0.0	0.0	1.40	1211.8	15.8
5.004	50.00	6.12	74.375	0.098	0.0	0.0	0.0	0.87	34.5	17.7

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Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	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 Storage Structures 6	
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	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.200	Storm Duration (mins)	30
Ratio R	0.231		

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Online Controls for Storm

Orifice Manhole: 4, DS/PN: 1.003, Volume (m³): 17.6

Diameter (m) 0.022 Discharge Coefficient 0.600 Invert Level (m) 76.645

Orifice Manhole: 6, DS/PN: 2.001, Volume (m³): 9.0

Diameter (m) 0.027 Discharge Coefficient 0.600 Invert Level (m) 76.267

Orifice Manhole: 11, DS/PN: 5.004, Volume (m³): 29.8

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 74.375

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Total Volume (m ³)
1.000	1	0.417	0.688	1.104
1.001	2	1.696	0.198	1.895
1.002	3	3.976	12.735	16.711
1.003	4	4.912	0.151	5.064
2.000	5	3.054	5.610	8.664
3.000	6	0.170	4.144	4.313
3.001	7	0.170	0.074	0.244
4.000	20	0.170	4.228	4.398
4.001	21	0.179	0.083	0.261
2.001	6	3.191	0.106	3.298
5.000	7	0.306	0.688	0.994
5.001	8	2.046	0.756	2.802
6.000	9	0.170	5.187	5.357
6.001	10	0.170	0.567	0.737
7.000	11	0.221	12.435	12.656
7.001	12	0.190	0.131	0.321
5.002	9	2.412	0.396	2.809
8.000	12	0.170	4.199	4.369
8.001	13	0.201	0.954	1.155
9.000	16	0.170	3.783	3.953
9.001	17	0.157	0.208	0.365
5.003	10	6.662	22.527	29.189
5.004	11	7.302	0.241	7.543
Total		38.110	80.091	118.200

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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 6
 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 0.234
 Region Scotland and Ireland Cv (Summer) 0.750
 M5-60 (mm) 17.700 Cv (Winter) 0.840

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, 30, 60, 120, 180, 240, 360, 720, 960
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 5, 5, 5

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	1	15 Winter	100	+5%					78.822
1.001	2	360 Winter	100	+5%	100/120 Winter				78.705
1.002	3	360 Winter	100	+5%	100/60 Winter				78.704
1.003	4	360 Winter	100	+5%	1/15 Summer				78.704
2.000	5	180 Winter	100	+5%					77.452
3.000	6	15 Winter	100	+5%					77.877
3.001	7	180 Winter	100	+5%	100/60 Winter				77.453
4.000	20	15 Winter	100	+5%					77.563
4.001	21	180 Winter	100	+5%	30/60 Summer				77.457
2.001	6	180 Winter	100	+5%	1/15 Summer				77.452
5.000	7	15 Summer	1	+5%					78.600
5.001	8	15 Winter	100	+5%					77.558
6.000	9	15 Winter	100	+5%					77.915
6.001	10	15 Winter	100	+5%					77.157
7.000	11	15 Winter	100	+5%					78.121
7.001	12	15 Winter	100	+5%					77.136
5.002	9	360 Winter	100	+5%	100/240 Winter				75.929
8.000	12	15 Winter	100	+5%					76.904
8.001	13	15 Winter	100	+5%					76.005
9.000	16	15 Winter	100	+5%					76.984

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

PN	US/MH Name	Surcharged		Flooded		Flow / Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Overflow (l/s)	Cap.					
1.000	1	-0.200	0.000	0.03				2.9		OK
1.001	2	0.587	0.000	0.04				2.1	SURCHARGED	
1.002	3	0.713	0.000	0.00				3.0	SURCHARGED	
1.003	4	1.834	0.000	0.03				1.4	SURCHARGED	
2.000	5	-0.194	0.000	0.00				2.6		OK
3.000	6	-0.285	0.000	0.01			5	2.2		OK
3.001	7	0.089	0.000	0.04				1.1	FLOOD RISK	
4.000	20	-0.281	0.000	0.02			5	2.7		OK
4.001	21	0.299	0.000	0.19				1.3	FLOOD RISK	
2.001	6	0.960	0.000	0.06				1.6	FLOOD RISK	
5.000	7	-0.225	0.000	0.00				0.0		OK
5.001	8	-0.197	0.000	0.04				5.5		OK
6.000	9	-0.280	0.000	0.02			5	3.3		OK
6.001	10	-0.198	0.000	0.03				5.1		OK
7.000	11	-0.461	0.000	0.01			5	3.3		OK
7.001	12	-0.189	0.000	0.06				5.4		OK
5.002	9	0.194	0.000	0.03				3.4	SURCHARGED	
8.000	12	-0.286	0.000	0.01			5	1.9		OK
8.001	13	-0.284	0.000	0.01				3.1		OK
9.000	16	-0.288	0.000	0.01			5	1.4		OK

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water
									Level (m)
9.001	17	15	Winter	100	+5%				76.269
5.003	10	360	Winter	100	+5%	100/120	Winter		75.928
5.004	11	360	Winter	100	+5%	1/15	Summer		75.928

PN	US/MH Name	Surcharged		Flooded		Half Drain		Pipe		Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status		
9.001	17	-0.275	0.000	0.02			2.8		OK	
5.003	10	0.456	0.000	0.01			5.1		SURCHARGED	
5.004	11	1.327	0.000	0.06			1.6		SURCHARGED	