STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 388329 164175 ST 88329 64175
Data Type	Point
Maximum Rainfall (mm/hr)	75
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SW.SWS

- 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	72.430	0.955	75.8	0.088	15.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	38.253	0.255	150.0	0.053	15.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	74.146	0.570	130.1	0.130	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	12.838	0.099	129.7	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	30.177	0.450	67.1	0.027	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	38.631	0.386	100.1	0.021	15.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	62.101	0.351	176.9	0.047	0.00	0.0	0.600	o	300	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	32.93	15.80	43.500	0.088	0.0	0.0	0.0	1.50	59.8	7.8
2.000	33.19	15.60	42.800	0.053	0.0	0.0	0.0	1.07	42.4	4.8
1.001	31.83	16.70	42.470	0.271	0.0	0.0	0.0	1.38	97.3	23.4
1.002	31.64	16.86	41.900	0.283	0.0	0.0	0.0	1.38	97.5	24.3
1.003	31.34	17.12	41.801	0.310	0.0	0.0	0.0	1.92	135.9	26.3
3.000	33.33	15.49	41.900	0.021	0.0	0.0	0.0	1.31	52.0	1.9
1.004	30.38	18.00	41.351	0.378	0.0	0.0	0.0	1.18	83.3	31.1

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Network Design Table for SW.SWS

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
1.005	63.727	0.362	176.0	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	67.705	0.846	80.0	0.043	15.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	44.529	0.445	100.1	0.043	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.002	73.005	1.123	65.0	0.026	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.003	35.852	0.450	79.7	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	128.000#	0.640	200.0	0.000	0.00	0.0	0.600	o	300	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)
1.005	29.46	18.89	41.000	0.403	0.0	0.0	0.0	1.18	83.5	32.2
4.000	32.97	15.77	43.600	0.043	0.0	0.0	0.0	1.46	58.2	3.8
4.001	32.26	16.34	42.754	0.086	0.0	0.0	0.0	1.31	52.0	7.5
4.002	31.38	17.09	42.309	0.112	0.0	0.0	0.0	1.62	64.6	9.5
4.003	30.92	17.50	41.186	0.152	0.0	0.0	0.0	1.47	58.3	12.7
1.006	27.70	20.82	40.638	0.555	0.0	0.0	0.0	1.11	78.3	41.6

Simulation Criteria for SW.SWS

Volumetric Runoff Coeff	1.000	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)	2880
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	24

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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	No
Return Period (years)	100	Winter Storms	Yes
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 388329 164175 ST 88329 64175	Cv (Winter)	1.000
Data Type	Point	Storm Duration (mins)	1440

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Online Controls for SW.SWS

Hydro-Brake® Optimum Manhole: S13, DS/PN: 1.006, Volume (m³): 9.2

Unit Reference	MD-SHE-0083-3100-1050-3100
Design Head (m)	1.050
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	40.638
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.050	3.1	Kick-Flo®	0.658	2.5
Flush-Flo™	0.318	3.1	Mean Flow over Head Range	-	2.7

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)	Depth (m)	Flow (l/s)
0.100	2.5	0.800	2.7	2.000	4.2	4.000	5.8	7.000	7.5
0.200	3.0	1.000	3.0	2.200	4.4	4.500	6.1	7.500	7.8
0.300	3.1	1.200	3.3	2.400	4.5	5.000	6.4	8.000	8.0
0.400	3.1	1.400	3.5	2.600	4.7	5.500	6.7	8.500	8.2
0.500	3.0	1.600	3.8	3.000	5.0	6.000	7.0	9.000	8.5
0.600	2.8	1.800	4.0	3.500	5.4	6.500	7.3	9.500	8.7

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Storage Structures for SW.SWS

Cellular Storage Manhole: S13, DS/PN: 1.006

Invert Level (m) 40.650 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	480.0	0.0	1.000	480.0	0.0	1.001	0.0	0.0

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

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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FEH	Data Type Point
FEH Rainfall Version		2013	Cv (Summer) 1.000
Site Location	GB 388329 164175 ST 88329 64175		Cv (Winter) 1.000

Margin for Flood Risk Warning (mm)	300.0
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, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1	30 Summer	2	+0%	100/30 Summer				43.557	-0.168
2.000	S2	30 Summer	2	+0%	100/15 Summer				42.853	-0.172
1.001	S3	15 Summer	2	+0%	100/15 Summer				42.591	-0.179
1.002	S4	15 Summer	2	+0%	30/15 Summer	100/15 Summer			42.034	-0.166
1.003	S5	15 Summer	2	+0%	30/15 Summer				41.912	-0.189
3.000	S6	30 Summer	2	+0%	100/15 Summer				41.929	-0.196
1.004	S7	15 Summer	2	+0%	30/15 Summer	100/15 Summer			41.512	-0.139
1.005	S8	30 Summer	2	+0%	30/15 Summer				41.164	-0.136
4.000	S9	30 Summer	2	+0%					43.640	-0.185
4.001	S10	15 Summer	2	+0%					42.823	-0.156
4.002	S11	15 Summer	2	+0%	100/15 Summer				42.381	-0.153
4.003	S12	15 Summer	2	+0%	100/15 Summer				41.279	-0.132
1.006	S13	600 Summer	2	+0%	30/30 Summer				40.895	-0.043

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.000	0.15			8.5	OK	
2.000	S2	0.000	0.13			5.1	OK	
1.001	S3	0.000	0.33			30.5	OK	
1.002	S4	0.000	0.41			32.3	OK	2
1.003	S5	0.000	0.29			36.1	OK	
3.000	S6	0.000	0.04			2.0	OK	
1.004	S7	0.000	0.54			43.1	OK	2
1.005	S8	0.000	0.57			45.4	OK	
4.000	S9	0.000	0.07			4.2	OK	
4.001	S10	0.000	0.20			10.0	OK	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.002	S11	0.000	0.22			13.7	OK	
4.003	S12	0.000	0.35			19.5	OK	
1.006	S13	0.000	0.04		450	3.0	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW.SWS

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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FEH	Data Type Point
FEH Rainfall Version		2013	Cv (Summer) 1.000
Site Location	GB 388329 164175 ST 88329 64175		Cv (Winter) 1.000

Margin for Flood Risk Warning (mm)	300.0
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, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1	30 Summer	30	+0%	100/30 Summer				43.591	-0.134
2.000	S2	30 Summer	30	+0%	100/15 Summer				42.884	-0.141
1.001	S3	15 Summer	30	+0%	100/15 Summer				42.704	-0.066
1.002	S4	15 Summer	30	+0%	30/15 Summer	100/15 Summer			42.233	0.033
1.003	S5	15 Summer	30	+0%	30/15 Summer				42.141	0.040
3.000	S6	15 Summer	30	+0%	100/15 Summer				41.953	-0.172
1.004	S7	15 Summer	30	+0%	30/15 Summer	100/15 Summer			41.932	0.281
1.005	S8	30 Summer	30	+0%	30/15 Summer				41.447	0.147
4.000	S9	30 Summer	30	+0%					43.663	-0.162
4.001	S10	15 Summer	30	+0%					42.879	-0.100
4.002	S11	15 Summer	30	+0%	100/15 Summer				42.443	-0.091
4.003	S12	15 Summer	30	+0%	100/15 Summer				41.404	-0.007
1.006	S13	600 Winter	30	+0%	30/30 Summer				41.188	0.250

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.000	0.35			20.1	OK	
2.000	S2	0.000	0.30			12.1	OK	
1.001	S3	0.000	0.90			84.5	OK	
1.002	S4	0.000	1.04			81.8	SURCHARGED	2
1.003	S5	0.000	0.70			87.0	SURCHARGED	
3.000	S6	0.000	0.09			4.7	OK	
1.004	S7	0.000	1.21			95.9	SURCHARGED	2
1.005	S8	0.000	1.20			95.3	SURCHARGED	
4.000	S9	0.000	0.17			9.8	OK	
4.001	S10	0.000	0.56			27.8	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW.SWS

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.002	S11	0.000	0.62			39.2	OK	
4.003	S12	0.000	1.00			55.0	OK	
1.006	S13	0.000	0.04		716	3.1	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW.SWS

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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FEH	Data Type Point
FEH Rainfall Version		2013	Cv (Summer) 1.000
Site Location	GB 388329 164175 ST 88329 64175		Cv (Winter) 1.000

Margin for Flood Risk Warning (mm)	300.0
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, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1	30 Summer	100	+25%	100/30 Summer				43.845	0.120
2.000	S2	30 Summer	100	+25%	100/15 Summer				43.635	0.610
1.001	S3	30 Summer	100	+25%	100/15 Summer				43.586	0.816
1.002	S4	30 Summer	100	+25%	30/15 Summer	100/15 Summer			43.050	0.850
1.003	S5	15 Summer	100	+25%	30/15 Summer				42.917	0.816
3.000	S6	30 Summer	100	+25%	100/15 Summer				42.615	0.490
1.004	S7	30 Summer	100	+25%	30/15 Summer	100/15 Summer			42.593	0.942
1.005	S8	30 Summer	100	+25%	30/15 Summer				41.822	0.522
4.000	S9	30 Summer	100	+25%					43.682	-0.143
4.001	S10	15 Summer	100	+25%					42.977	-0.002
4.002	S11	15 Summer	100	+25%	100/15 Summer				42.695	0.161
4.003	S12	15 Summer	100	+25%	100/15 Summer				41.857	0.446
1.006	S13	960 Winter	100	+25%	30/30 Summer				41.734	0.796

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.000	0.62			36.1	SURCHARGED	
2.000	S2	0.000	0.57			23.0	FLOOD RISK	
1.001	S3	0.000	1.06			99.2	SURCHARGED	
1.002	S4	0.169	1.20			94.9	FLOOD	2
1.003	S5	0.000	0.84			103.6	FLOOD RISK	
3.000	S6	0.000	0.20			10.0	SURCHARGED	
1.004	S7	0.856	1.50			119.1	FLOOD	2
1.005	S8	0.000	1.56			124.0	FLOOD RISK	
4.000	S9	0.000	0.29			16.1	OK	
4.001	S10	0.000	0.89			44.0	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW.SWS

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.002	S11	0.000	0.87			54.7	SURCHARGED	
4.003	S12	0.000	1.40			77.2	SURCHARGED	
1.006	S13	0.000	0.04		1476	3.2	FLOOD RISK	

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