

CTP House, Knapp Road
Cheltenham
Gloucestershire, GL50 3QQ

SW Calculations
Land at Hempton Road
Deddington - Rev C



Date 28/07/2021
File SW Network Model.mdx

Designed by PG
Checked by KR

Innovyze

Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW Network

Pipe Sizes CTP Manhole Sizes CTP

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	10
Ratio R	0.409	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 SW Network

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.372	4-8	0.199

Total Area Contributing (ha) = 0.571

Total Pipe Volume (m³) = 15.335

Network Design Table for SW Network

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	28.106	0.432	65.1	0.052	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	12.296	0.118	104.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	15.735	0.200	78.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	25.466	0.525	48.5	0.035	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	10.119	0.583	17.4	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	20.078	0.135	148.7	0.247	5.00	0.0	0.600	o	375	Pipe/Conduit	
2.001	42.445	0.283	150.0	0.082	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.002	20.985	0.140	149.9	0.077	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	23.673	0.118	200.6	0.013	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	10.680	0.053	201.5	0.052	0.00	0.0	0.600	o	375	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	5.38	137.350	0.052	0.0	0.0	0.7	1.25	22.1	7.7
1.001	50.00	5.58	136.918	0.052	0.0	0.0	0.7	0.98	17.4	7.7
1.002	50.00	5.81	136.800	0.052	0.0	0.0	0.7	1.13	20.0	7.7
1.003	50.00	6.11	136.600	0.087	0.0	0.0	1.2	1.45	25.6	13.0
1.004	50.00	6.16	136.000	0.100	0.0	0.0	1.4	3.16	125.5	14.9
2.000	50.00	5.23	135.825	0.247	0.0	0.0	3.3	1.48	163.8	36.8
2.001	50.00	5.70	135.690	0.329	0.0	0.0	4.5	1.48	163.2	49.0
2.002	50.00	5.94	135.407	0.406	0.0	0.0	5.5	1.48	163.2	60.5
1.005	50.00	6.47	135.267	0.519	0.0	0.0	7.0	1.28	140.9	77.3
1.006	50.00	6.61	135.149	0.571	0.0	0.0	7.7	1.27	140.6	85.1

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Network Design Table for SW Network

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
1.007	4.287	0.043	100.0	0.000	0.00	0.0	0.600	o	375	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)
1.007	50.00	6.65	134.900	0.571	0.0	0.0	7.7	1.81	200.1	85.1

Simulation Criteria for SW Network

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	10.000
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 Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	1
		Number of Time/Area Diagrams	0
		Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.409		

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Online Controls for SW Network

Weir Manhole: S12, DS/PN: 1.007, Volume (m³): 3.0

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 136.600

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Storage Structures for SW Network

Infiltration Basin Manhole: S12, DS/PN: 1.007

Invert Level (m) 134.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 2.79700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	66.0	0.400	126.0	0.800	205.0	1.200	309.0	1.600	444.0
0.100	80.0	0.500	144.0	0.900	229.0	1.300	340.0	1.700	560.0
0.200	94.0	0.600	166.0	1.000	254.0	1.400	373.0		
0.300	109.0	0.700	184.0	1.100	281.0	1.500	407.0		

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 10.000
 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.410 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 OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.
1.000	S2	15 Winter	1	+0%	100/15	Summer			137.414	-0.086	0.000	0.37
1.001	S3	15 Winter	1	+0%	30/15	Summer			136.994	-0.074	0.000	0.50
1.002	S4	15 Winter	1	+0%	30/15	Summer			136.869	-0.081	0.000	0.43
1.003	S5	15 Winter	1	+0%	30/15	Summer			136.676	-0.074	0.000	0.51
1.004	S6	15 Winter	1	+0%	100/15	Summer			136.055	-0.170	0.000	0.13
2.000	S7	15 Winter	1	+0%	30/15	Summer			135.960	-0.240	0.000	0.28
2.001	S8	15 Winter	1	+0%	30/15	Summer			135.838	-0.227	0.000	0.32
2.002	S8A	15 Winter	1	+0%	30/15	Summer			135.576	-0.206	0.000	0.42
1.005	S9	15 Winter	1	+0%	30/15	Summer			135.479	-0.163	0.000	0.60
1.006	S11	15 Winter	1	+0%	30/15	Summer			135.393	-0.131	0.000	0.75
1.007	S12	30 Winter	1	+0%	30/15	Summer			135.263	-0.012	0.000	0.00

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Level Exceeded Status
1.000	S2			7.9	OK
1.001	S3			8.0	OK
1.002	S4			8.0	OK
1.003	S5			12.4	OK
1.004	S6			14.0	OK
2.000	S7			38.0	OK
2.001	S8			48.3	OK
2.002	S8A			57.6	OK
1.005	S9			73.2	OK
1.006	S11			78.8	OK
1.007	S12		24	0.0	OK

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 10.000
 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.410 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 OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

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)	Flooded Volume (m ³)	Flow / Cap.
1.000	S2 15	Winter	30	+0%	100/15	Summer			137.485	-0.015	0.000	0.91
1.001	S3 15	Winter	30	+0%	30/15	Summer			137.175	0.107	0.000	1.10
1.002	S4 15	Winter	30	+0%	30/15	Summer			137.032	0.082	0.000	0.97
1.003	S5 15	Winter	30	+0%	30/15	Summer			136.871	0.121	0.000	1.11
1.004	S6 15	Winter	30	+0%	100/15	Summer			136.085	-0.140	0.000	0.30
2.000	S7 15	Winter	30	+0%	30/15	Summer			136.272	0.072	0.000	0.65
2.001	S8 15	Winter	30	+0%	30/15	Summer			136.157	0.092	0.000	0.73
2.002	S8A 15	Winter	30	+0%	30/15	Summer			136.002	0.220	0.000	0.93
1.005	S9 15	Winter	30	+0%	30/15	Summer			135.878	0.236	0.000	1.34
1.006	S11 15	Winter	30	+0%	30/15	Summer			135.663	0.139	0.000	1.68
1.007	S12 30	Winter	30	+0%	30/15	Summer			135.562	0.287	0.000	0.00

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2			19.1	OK	
1.001	S3			17.3	SURCHARGED	
1.002	S4			18.0	SURCHARGED	
1.003	S5			27.0	SURCHARGED	
1.004	S6			31.4	OK	
2.000	S7			89.1	SURCHARGED	
2.001	S8			108.4	SURCHARGED	
2.002	S8A			127.7	SURCHARGED	
1.005	S9			162.6	SURCHARGED	
1.006	S11			176.6	SURCHARGED	
1.007	S12		31	0.0	SURCHARGED	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 10.000
 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.410 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 OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.
1.000	S2	15 Winter	100	+40%	100/15 Summer				138.701	1.201	0.000	1.17
1.001	S3	15 Winter	100	+40%	30/15 Summer				138.205	1.137	0.000	1.41
1.002	S4	15 Winter	100	+40%	30/15 Summer				137.970	1.020	0.000	1.35
1.003	S5	15 Winter	100	+40%	30/15 Summer				137.710	0.960	0.000	1.43
1.004	S6	15 Winter	100	+40%	100/15 Summer				136.802	0.577	0.000	0.42
2.000	S7	15 Winter	100	+40%	30/15 Summer				137.793	1.593	0.000	1.10
2.001	S8	15 Winter	100	+40%	30/15 Summer				137.628	1.563	0.000	1.30
2.002	S8A	15 Winter	100	+40%	30/15 Summer				137.130	1.348	0.000	1.69
1.005	S9	15 Winter	100	+40%	30/15 Summer				136.727	1.085	0.000	2.28
1.006	S11	15 Winter	100	+40%	30/15 Summer				136.141	0.617	0.000	2.84
1.007	S12	60 Winter	100	+40%	30/15 Summer				135.914	0.639	0.000	0.00

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2			24.6	FLOOD RISK	
1.001	S3			22.3	FLOOD RISK	
1.002	S4			25.1	FLOOD RISK	
1.003	S5			34.9	FLOOD RISK	
1.004	S6			43.9	SURCHARGED	
2.000	S7			151.6	SURCHARGED	
2.001	S8			193.2	SURCHARGED	
2.002	S8A			233.2	SURCHARGED	
1.005	S9			275.6	SURCHARGED	
1.006	S11			298.8	SURCHARGED	
1.007	S12		37	0.0	SURCHARGED	