

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW

Pipe Sizes STANDARD								Manhole Sizes STANDARD	
FSR Rainfall Model - England and Wales									
Return Period (years)	2	Foul Sewage (l/s/ha)			0.000	Maximum Backdrop Height (m)		0.000	
M5-60 (mm)	19.000	Volumetric Runoff Coeff.			0.750	Min Design Depth for Optimisation (m)		1.200	
Ratio R	0.400	PIMP (%)			100	Min Vel for Auto Design only (m/s)		1.00	
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)			0	Min Slope for Optimisation (1:X)		500	
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)			0.000				
Designed with Level Soffits									

Time Area Diagram for SW

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.077	4-8	0.564	8-12	0.089
Total Area Contributing (ha) = 0.731					
Total Pipe Volume (m³) = 61.994					

Network Design Table for SW

« - Indicates pipe capacity < flow

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	32.756	0.100	327.6	0.092	5.00	0.0	0.600		o	375	Pipe/Conduit		
1.001	66.047	0.202	327.0	0.291	0.00	0.0	0.600		o	375	Pipe/Conduit		
1.002	10.537	0.033	319.3	0.041	0.00	0.0	0.600		o	375	Pipe/Conduit		
1.003	16.305	0.150	108.7	0.041	0.00	0.0	0.600		o	375	Pipe/Conduit		
2.000	43.069	0.135	320.0	0.153	5.00	0.0	0.600		o	375	Pipe/Conduit		
2.001	13.350	0.042	317.9	0.000	0.00	0.0	0.600		o	375	Pipe/Conduit		
2.002	45.001	0.023	1956.6	0.000	0.00	0.0	0.600		o	375	Pipe/Conduit		
3.000	14.692	0.088	167.0	0.079	5.00	0.0	0.600		o	225	Pipe/Conduit		
3.001	8.310	0.052	159.8	0.034	0.00	0.0	0.600		o	225	Pipe/Conduit		
3.002	10.858	0.150	72.4	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit		
1.004	3.184	0.010	318.4	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit		
1.005	12.748	0.085	150.0	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit		
1.006	25.624	0.051	502.4	0.000	0.00	0.0		0.045 3 \=/		500	1:3 Swale		

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	5.55	3.110	0.092	0.0	0.0	0.0	1.00	110.0	12.5
1.001	50.00	6.65	3.010	0.383	0.0	0.0	0.0	1.00	110.1	51.9
1.002	50.00	6.83	2.808	0.424	0.0	0.0	0.0	1.01	111.4	57.4
1.003	50.00	6.98	2.775	0.465	0.0	0.0	0.0	1.74	191.9	63.0
2.000	50.00	5.71	2.825	0.153	0.0	0.0	0.0	1.01	111.3	20.7
2.001	50.00	5.93	2.690	0.153	0.0	0.0	0.0	1.01	111.6	20.7
2.002	50.00	7.80	2.648	0.153	0.0	0.0	0.0	0.40	44.2	20.7
3.000	50.00	5.24	2.915	0.079	0.0	0.0	0.0	1.01	40.1	10.7
3.001	50.00	5.38	2.827	0.113	0.0	0.0	0.0	1.03	41.0	15.3
3.002	50.00	5.49	2.775	0.113	0.0	0.0	0.0	1.54	61.2	15.3
1.004	50.00	7.85	2.625	0.731	0.0	0.0	0.0	1.13	180.3	99.0
1.005	50.00	8.11	2.615	0.731	0.0	0.0	0.0	0.82	14.5«	99.0
1.006	47.37	10.13	2.380	0.731	0.0	0.0	0.0	0.21	30.1«	99.0

Manhole Schedules for SW

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	4.600	1.490	Open Manhole	1350	1.000	3.110	375				
2	4.450	1.440	Open Manhole	1800	1.001	3.010	375	1.000	3.010	375	
3	4.185	1.377	Open Manhole	1350	1.002	2.808	375	1.001	2.808	375	
HW1	3.625	0.850	Open Manhole	500	1.003	2.775	375	1.002	2.775	375	
7	4.185	1.360	Open Manhole	1800	2.000	2.825	375				
8	4.000	1.310	Open Manhole	1350	2.001	2.690	375	2.000	2.690	375	
HW2	3.625	0.977	Open Manhole	500	2.002	2.648	375	2.001	2.648	375	
4	4.205	1.290	Open Manhole	1500	3.000	2.915	225				
5	4.050	1.223	Open Manhole	1350	3.001	2.827	225	3.000	2.827	225	
HW3	3.625	0.850	Open Manhole	500	3.002	2.775	225	3.001	2.775	225	
HW4	3.625	1.000	Open Manhole	500	1.004	2.625	450	1.003	2.625	375	
								2.002	2.625	375	
								3.002	2.625	225	
6 (FC)	3.915	1.300	Open Manhole	1800	1.005	2.615	150	1.004	2.615	450	
HW5	2.975	0.595	Open Manhole	500	1.006	2.380	500	1.005	2.530	150	150
Ditch	2.840	0.511	Open Manhole	0		OUTFALL		1.006	2.329	500	

PIPELINE SCHEDULES for SW

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	375	1	4.600	3.110	1.115	Open Manhole	1350
1.001	o	375	2	4.450	3.010	1.065	Open Manhole	1800
1.002	o	375	3	4.185	2.808	1.002	Open Manhole	1350
1.003	o	375	HW1	3.625	2.775	0.475	Open Manhole	500
2.000	o	375	7	4.185	2.825	0.985	Open Manhole	1800
2.001	o	375	8	4.000	2.690	0.935	Open Manhole	1350
2.002	o	375	HW2	3.625	2.648	0.602	Open Manhole	500
3.000	o	225	4	4.205	2.915	1.065	Open Manhole	1500
3.001	o	225	5	4.050	2.827	0.998	Open Manhole	1350
3.002	o	225	HW3	3.625	2.775	0.625	Open Manhole	500
1.004	o	450	HW4	3.625	2.625	0.550	Open Manhole	500
1.005	o	150	6 (FC)	3.915	2.615	1.150	Open Manhole	1800
1.006	3 \=/	500	HW5	2.975	2.380	0.445	Open Manhole	500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	32.756	327.6	2	4.450	3.010	1.065	Open Manhole	1800
1.001	66.047	327.0	3	4.185	2.808	1.002	Open Manhole	1350
1.002	10.537	319.3	HW1	3.625	2.775	0.475	Open Manhole	500
1.003	16.305	108.7	HW4	3.625	2.625	0.625	Open Manhole	500
2.000	43.069	320.0	8	4.000	2.690	0.935	Open Manhole	1350
2.001	13.350	317.9	HW2	3.625	2.648	0.602	Open Manhole	500
2.002	45.001	1956.6	HW4	3.625	2.625	0.625	Open Manhole	500
3.000	14.692	167.0	5	4.050	2.827	0.998	Open Manhole	1350
3.001	8.310	159.8	HW3	3.625	2.775	0.625	Open Manhole	500
3.002	10.858	72.4	HW4	3.625	2.625	0.775	Open Manhole	500
1.004	3.184	318.4	6 (FC)	3.915	2.615	0.850	Open Manhole	1800
1.005	12.748	150.0	HW5	2.975	2.530	0.295	Open Manhole	500
1.006	25.624	502.4	Ditch	2.840	2.329	0.361	Open Manhole	0

Area Summary for SW

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.092	0.092	0.092
1.001	-	-	100	0.291	0.291	0.291
1.002	-	-	100	0.041	0.041	0.041
1.003	-	-	100	0.041	0.041	0.041
2.000	-	-	100	0.153	0.153	0.153
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.079	0.079	0.079
3.001	-	-	100	0.034	0.034	0.034
3.002	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.731	0.731	0.731

Free Flowing Outfall Details for SW

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.006	Ditch	2.840	2.329	0.000	0	0

Simulation Criteria for SW

Volumetric Runoff Coeff 0.750 Manhole Headloss Coeff (Global) 0.500 Inlet Coefficient 0.800
Areal Reduction Factor 1.000 Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 60
Hot Start Level (mm) 0 MADD Factor * 10m³/ha Storage 1.000 Output Interval (mins) 1

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) 19.000 Cv (Summer) 0.750
Return Period (years) 2 Ratio R 0.400 Cv (Winter) 0.840
Region England and Wales Profile Type Summer Storm Duration (mins) 30

Online Controls for SW

Hydro-Brake® Optimum Manhole: 6 (FC), DS/PN: 1.005, Volume (m³): 3.6

Unit Reference	MD-SHE-0073-2000-0600-2000	Sump Available	Yes
Design Head (m)	0.600	Diameter (mm)	73
Design Flow (l/s)	2.0	Invert Level (m)	2.615
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	100
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	2.0	Kick-Flo®	0.397	1.7
Flush-Flo™	0.177	2.0	Mean Flow over Head Range	-	1.7

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)	Depth (m)	Flow (l/s)
0.100	1.9	0.600	2.0	1.600	3.1	2.600	3.9	5.000	5.3	7.500	6.5
0.200	2.0	0.800	2.3	1.800	3.3	3.000	4.2	5.500	5.6	8.000	6.7
0.300	1.9	1.000	2.5	2.000	3.5	3.500	4.5	6.000	5.8	8.500	6.9
0.400	1.7	1.200	2.7	2.200	3.6	4.000	4.8	6.500	6.0	9.000	7.1
0.500	1.8	1.400	2.9	2.400	3.8	4.500	5.1	7.000	6.3	9.500	7.3

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Date 05/09/2023 File 26043 - SW and FW.MDX	Designed by SH Checked by LC	
Innovyze	Network 2017.1.2	

Storage Structures for SW

Tank or Pond Manhole: HW4, DS/PN: 1.004

Invert Level (m) 2.625

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	915.0	1.000	1320.0

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 1.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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) 19.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

									Water	Surcharged	Flooded				Pipe
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Flow
PN	Name	Storm	Period	Change		Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)
1.000	1	15 Winter		2	+0%	30/15 Summer				3.239	-0.246	0.000	0.16		15.2
1.001	2	15 Winter		2	+0%	30/15 Summer				3.208	-0.177	0.000	0.52		53.9
1.002	3	15 Winter		2	+0%	30/15 Summer				3.043	-0.140	0.000	0.71		57.4
1.003	HW1	15 Winter		2	+0%	100/15 Summer				2.942	-0.208	0.000	0.41		62.0
2.000	7	15 Winter		2	+0%	100/15 Winter				2.954	-0.246	0.000	0.25		25.4
2.001	8	15 Winter		2	+0%	100/15 Summer				2.846	-0.219	0.000	0.28		23.8
2.002	HW2	15 Winter		2	+0%	100/15 Summer				2.821	-0.202	0.000	0.44		23.7
3.000	4	15 Winter		2	+0%	100/15 Summer				3.012	-0.128	0.000	0.38		13.3
3.001	5	15 Winter		2	+0%	30/15 Summer				2.950	-0.102	0.000	0.57		18.3
3.002	HW3	15 Winter		2	+0%	100/15 Summer				2.868	-0.132	0.000	0.36		18.3
1.004	HW4	960 Winter		2	+0%	100/360 Winter				2.764	-0.311	0.000	0.02		2.3
1.005	6 (FC)	960 Winter		2	+0%	2/480 Winter				2.768	0.003	0.000	0.15		2.0
1.006	HW5	960 Winter		2	+0%					2.425	-0.550	0.000	0.00		2.0

US/MH		Level	
PN	Name	Status	Exceeded
1.000	1	OK	
1.001	2	OK	
1.002	3	OK	
1.003	HW1	OK	
2.000	7	OK	
2.001	8	OK	
2.002	HW2	OK	
3.000	4	OK	
3.001	5	OK	
3.002	HW3	OK	
1.004	HW4	OK	
1.005	6 (FC)	SURCHARGED	
1.006	HW5	OK	

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 1.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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) 19.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

					Water				Surcharged		Flooded	Pipe		
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)
1.000	1	15 Winter	30	+0%	30/15 Summer				3.548	0.063	0.000	0.28		27.2
1.001	2	15 Winter	30	+0%	30/15 Summer				3.466	0.081	0.000	1.03		107.1
1.002	3	15 Winter	30	+0%	30/15 Summer				3.233	0.050	0.000	1.49		120.1
1.003	HW1	15 Winter	30	+0%	100/15 Summer				3.046	-0.104	0.000	0.85		129.4
2.000	7	15 Winter	30	+0%	100/15 Winter				3.011	-0.189	0.000	0.47		48.1
2.001	8	15 Winter	30	+0%	100/15 Summer				2.928	-0.138	0.000	0.52		44.3
2.002	HW2	15 Winter	30	+0%	100/15 Summer				2.905	-0.118	0.000	0.79		42.9
3.000	4	15 Winter	30	+0%	100/15 Summer				3.132	-0.008	0.000	0.68		23.8
3.001	5	15 Winter	30	+0%	30/15 Summer				3.073	0.021	0.000	1.06		34.2
3.002	HW3	15 Winter	30	+0%	100/15 Summer				2.909	-0.091	0.000	0.66		34.0
1.004	HW4	960 Winter	30	+0%	100/360 Winter				2.898	-0.177	0.000	0.02		2.4
1.005	6 (FC)	960 Winter	30	+0%	2/480 Winter				2.905	0.140	0.000	0.15		2.0
1.006	HW5	30 Winter	30	+0%					2.425	-0.550	0.000	0.00		2.0

US/MH		Level	
PN	Name	Status	Exceeded
1.000	1	SURCHARGED	
1.001	2	SURCHARGED	
1.002	3	SURCHARGED	
1.003	HW1	OK	
2.000	7	OK	
2.001	8	OK	
2.002	HW2	OK	
3.000	4	OK	
3.001	5	SURCHARGED	
3.002	HW3	OK	
1.004	HW4	OK	
1.005	6 (FC)	SURCHARGED	
1.006	HW5	OK	

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 1.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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) 19.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

									Water	Surcharged	Flooded			Pipe
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)
1.000	1	15 Winter	100	+40%	30/15 Summer				4.486	1.001	0.000	0.51		50.2
1.001	2	15 Winter	100	+40%	30/15 Summer				4.411	1.026	0.000	1.86		193.0
1.002	3	15 Winter	100	+40%	30/15 Summer				3.653	0.470	0.000	2.64		212.2
1.003	HW1	15 Winter	100	+40%	100/15 Summer				3.348	0.198	0.000	1.52		230.0
2.000	7	15 Winter	100	+40%	100/15 Winter				3.208	0.008	0.000	0.82		83.1
2.001	8	1440 Winter	100	+40%	100/15 Summer				3.145	0.080	0.000	0.05		3.9
2.002	HW2	1440 Winter	100	+40%	100/15 Summer				3.145	0.122	0.000	0.07		3.8
3.000	4	15 Winter	100	+40%	100/15 Summer				3.420	0.280	0.000	1.27		44.7
3.001	5	15 Winter	100	+40%	30/15 Summer				3.280	0.228	0.000	1.97		63.4
3.002	HW3	1440 Winter	100	+40%	100/15 Summer				3.146	0.146	0.000	0.06		3.0
1.004	HW4	1440 Winter	100	+40%	100/360 Winter				3.146	0.071	0.000	0.02		2.4
1.005	6 (FC)	1440 Winter	100	+40%	2/480 Winter				3.159	0.394	0.000	0.15		2.0
1.006	HW5	960 Winter	100	+40%					2.425	-0.550	0.000	0.00		2.0

US/MH		Level	
PN	Name	Status	Exceeded
1.000	1	FLOOD RISK	
1.001	2	FLOOD RISK	
1.002	3	SURCHARGED	
1.003	HW1	FLOOD RISK	
2.000	7	SURCHARGED	
2.001	8	SURCHARGED	
2.002	HW2	SURCHARGED	
3.000	4	SURCHARGED	
3.001	5	SURCHARGED	
3.002	HW3	SURCHARGED	
1.004	HW4	SURCHARGED	
1.005	6 (FC)	SURCHARGED	
1.006	HW5	OK	