

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes Pvt\_SW Manhole Sizes Pvt\_MH

FSR Rainfall Model - England and Wales

Return Period (years)	10	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	20.000	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.428	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)	0.200		

Designed with Level Soffits











Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.010	4-8	0.040	8-12	0.001

Total Area Contributing (ha) = 0.052

Total Pipe Volume (m³) = 5.265

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)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	16.999	0.262	64.9	0.008	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	33.022	0.413	80.0	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	13.730	0.875	15.7	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	33.810	0.423	80.0	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	41.670	0.685	60.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	22.701	0.284	80.0	0.009	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	57.585	1.837	31.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.003	50.016	0.716	69.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	22.277	0.191	116.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	50.710	0.652	77.8	0.000	0.00	0.0	0.600	o	150	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	5.23	36.350	0.008	0.0	0.0	0.0	1.25	22.1	1.1
2.000	50.00	5.49	37.375	0.015	0.0	0.0	0.0	1.12	19.9	2.0
2.001	50.00	5.58	36.962	0.030	0.0	0.0	0.0	2.56	45.2	4.0
1.001	50.00	6.08	36.088	0.043	0.0	0.0	0.0	1.12	19.9	5.9
1.002	50.00	6.62	35.665	0.043	0.0	0.0	0.0	1.29	22.8	5.9
3.000	50.00	5.44	37.151	0.009	0.0	0.0	0.0	0.86	6.8	1.2
3.001	50.00	6.13	36.867	0.009	0.0	0.0	0.0	1.38	10.9	1.2
1.003	50.00	7.31	34.980	0.052	0.0	0.0	0.0	1.20	21.3	7.1
1.004	50.00	7.71	34.264	0.052	0.0	0.0	0.0	0.93	16.4	7.1
1.005	50.00	8.45	34.072	0.052	0.0	0.0	0.0	1.14	20.2	7.1

School Lane  
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File 217316 - FOUNDRY PLANT CENTRE DRAINAGE 20...

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	37.289	0.939	Open Manhole	450	1.000	36.350	150				
2	38.475	1.100	Open Manhole	450	2.000	37.375	150				
3	38.150	1.188	Open Manhole	450	2.001	36.962	150	2.000	36.962	150	
2	37.600	1.513	Open Manhole	450	1.001	36.088	150	1.000	36.088	150	
								2.001	36.088	150	
3	36.916	1.251	Open Manhole	450	1.002	35.665	150	1.001	35.665	150	
6	38.451	1.300	Open Manhole	450	3.000	37.151	100				
7	37.620	0.753	Open Manhole	300	3.001	36.867	100	3.000	36.867	100	
6	37.137	2.157	Open Manhole	450	1.003	34.980	150	1.002	34.980	150	
								3.001	35.030	100	
4	35.000	0.736	Open Manhole	450	1.004	34.264	150	1.003	34.264	150	
6	35.000	0.928	Open Manhole	450	1.005	34.072	150	1.004	34.072	150	
	35.000	1.580	Open Manhole	0		OUTFALL		1.005	33.420	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	620840.636	296411.408	620840.636	296411.408	Required	
2	620819.842	296365.003	620819.842	296365.003	Required	
3	620815.334	296397.716	620815.334	296397.716	Required	
2	620823.897	296408.449	620823.897	296408.449	Required	
3	620819.180	296441.928	620819.180	296441.928	Required	
6	620892.340	296397.647	620892.340	296397.647	Required	
7	620870.013	296393.541	620870.013	296393.541	Required	
6	620860.010	296450.251	620860.010	296450.251	Required	
4	620879.379	296496.364	620879.379	296496.364	Required	
6	620874.593	296518.121	620874.593	296518.121	Required	
	620824.039	296514.143			No Entry	

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PIPELINE SCHEDULES for Storm

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	150	1	37.289	36.350	0.789	Open Manhole	450
2.000	o	150	2	38.475	37.375	0.950	Open Manhole	450
2.001	o	150	3	38.150	36.962	1.038	Open Manhole	450
1.001	o	150	2	37.600	36.088	1.363	Open Manhole	450
1.002	o	150	3	36.916	35.665	1.101	Open Manhole	450
3.000	o	100	6	38.451	37.151	1.200	Open Manhole	450
3.001	o	100	7	37.620	36.867	0.653	Open Manhole	300
1.003	o	150	6	37.137	34.980	2.007	Open Manhole	450
1.004	o	150	4	35.000	34.264	0.586	Open Manhole	450
1.005	o	150	6	35.000	34.072	0.778	Open Manhole	450

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	16.999	64.9	2	37.600	36.088	1.362	Open Manhole	450
2.000	33.022	80.0	3	38.150	36.962	1.038	Open Manhole	450
2.001	13.730	15.7	2	37.600	36.088	1.363	Open Manhole	450
1.001	33.810	80.0	3	36.916	35.665	1.101	Open Manhole	450
1.002	41.670	60.9	6	37.137	34.980	2.007	Open Manhole	450
3.000	22.701	80.0	7	37.620	36.867	0.653	Open Manhole	300
3.001	57.585	31.3	6	37.137	35.030	2.007	Open Manhole	450
1.003	50.016	69.8	4	35.000	34.264	0.586	Open Manhole	450
1.004	22.277	116.3	6	35.000	34.072	0.778	Open Manhole	450
1.005	50.710	77.8		35.000	33.420	1.430	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.008	0.008	0.008
2.000	User	-	100	0.015	0.015	0.015
2.001	User	-	100	0.015	0.015	0.015
1.001	User	-	100	0.005	0.005	0.005
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.009	0.009	0.009
3.001	-	-	100	0.000	0.000	0.000
1.003	-	-	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
				Total	Total	Total
				0.052	0.052	0.052

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Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	1	150	0.789	1.362	Unclassified	450	0	0.789	Unclassified
2.000	2	150	0.937	1.038	Unclassified	450	0	0.950	Unclassified
2.001	3	150	1.038	1.363	Unclassified	450	0	1.038	Unclassified
1.001	2	150	1.101	1.363	Unclassified	450	0	1.363	Unclassified
1.002	3	150	1.101	2.007	Unclassified	450	0	1.101	Unclassified
3.000	6	100	0.653	1.200	Unclassified	450	0	1.200	Unclassified
3.001	7	100	0.653	2.007	Unclassified	300	0	0.653	Unclassified
1.003	6	150	0.586	2.010	Unclassified	450	0	2.007	Unclassified
1.004	4	150	0.586	0.778	Unclassified	450	0	0.586	Unclassified
1.005	6	150	0.778	1.430	Unclassified	450	0	0.778	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005		35.000	33.420	0.000	0	0


Simulation Criteria for Storm

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 2.000    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)    20.000    Cv (Summer) 0.750  
 Return Period (years)    10    Ratio R    0.428    Cv (Winter) 0.840  
 Region England and Wales    Profile Type Summer Storm    Duration (mins)    30

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Online Controls for Storm

Orifice Manhole: 6, DS/PN: 1.005, Volume (m³): 0.5

Diameter (m) 0.011 Discharge Coefficient 0.600 Invert Level (m) 34.072

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Storage Structures for Storm

Swale Manhole: 6, DS/PN: 1.005

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Invert Level (m)	33.566	Slope (1:X)	250.0
Infiltration Coefficient Side (m/hr)	0.00000	Base Width (m)	1.0	Cap Volume Depth (m)	0.000
Safety Factor	1.5	Length (m)	10.0	Cap Infiltration Depth (m)	0.000
Porosity	1.00	Side Slope (1:X)	4.0	Include Swale Volume	Yes

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m³/ha Storage 2.000  
 Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 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) 20.000 Cv (Summer) 0.750  
 Region England and Wales Ratio R 0.430 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) 1, 30, 100  
 Climate Change (%) 0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Surcharged Flooded				Half Drain Time (mins)
									Level (m)	Depth (m)	Volume (m³)	Flow / Overflow Cap. (l/s)	
1.000	1	15 Winter	100	+45%	100/15 Summer				36.887	0.387	0.000	0.22	
2.000	2	15 Winter	100	+45%					37.452	-0.073	0.000	0.50	
2.001	3	15 Winter	100	+45%					37.037	-0.075	0.000	0.48	
1.001	2	15 Winter	100	+45%	100/15 Summer				36.864	0.626	0.000	1.34	
1.002	3	15 Winter	100	+45%	100/15 Summer				36.325	0.510	0.000	0.99	
3.000	6	15 Winter	100	+45%					37.226	-0.025	0.000	0.88	
3.001	7	15 Winter	100	+45%					36.920	-0.047	0.000	0.53	
1.003	6	15 Winter	100	+45%	100/15 Summer				35.725	0.595	0.000	1.20	
1.004	4	15 Winter	100	+45%	30/15 Summer				34.694	0.280	0.000	1.58	
1.005	6	1440 Winter	100	+45%	30/960 Winter				34.501	0.279	0.000	0.01	

Pipe				
PN	US/MH Name	Flow (l/s)	Status	Level Exceeded
1.000	1	4.4	FLOOD RISK	
2.000	2	9.6	OK	
2.001	3	20.0	OK	
1.001	2	25.7	SURCHARGED	
1.002	3	22.0	SURCHARGED	
3.000	6	5.8	OK	
3.001	7	5.7	OK	
1.003	6	24.9	SURCHARGED	
1.004	4	24.6	FLOOD RISK	
1.005	6	0.2	SURCHARGED	