

Scott White and Hookins		Page 1
St Nicholas House St Nicholas Road Sutton SM1 1EL		
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Micro Drainage	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 - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.100	Add Flow / Climate Change (%)	0
Ratio R	0.350	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

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
S1.000	76.531	1.255	61.0	0.062	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	7.520	0.235	32.0	0.164	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	64.127	1.515	42.3	0.122	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	39.872	1.250	31.9	0.122	5.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	14.067	1.125	12.5	0.020	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	51.888	0.825	62.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	31.960	0.630	50.7	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	25.520	0.865	29.5	0.082	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	27.470	0.930	29.5	0.062	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)
S1.000	50.00	5.63	37.500	0.062	0.0	0.0	0.0	2.02	142.6	8.4
S2.000	50.00	5.04	38.000	0.164	0.0	0.0	0.0	2.79	197.2	22.2
S2.001	50.00	5.49	37.765	0.286	0.0	0.0	0.0	2.42	171.3	38.7
S3.000	50.00	5.24	37.500	0.122	0.0	0.0	0.0	2.79	197.5	16.5
S4.000	50.00	5.05	37.375	0.020	0.0	0.0	0.0	4.47	316.0	2.7
S1.001	50.00	6.07	36.250	0.490	0.0	0.0	0.0	1.99	140.4	66.4
S1.002	50.00	6.31	35.425	0.512	0.0	0.0	0.0	2.21	156.4	69.3
S1.003	50.00	6.46	34.795	0.594	0.0	0.0	0.0	2.91	205.4	80.4
S1.004	50.00	6.61	33.930	0.656	0.0	0.0	0.0	2.90	205.3	88.8

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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)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	40.500	3.000	Open Manhole	1200	S1.000	37.500	300				
SAT2	40.000	2.000	Open Manhole	1200	S2.000	38.000	300				
S2	40.000	2.235	Open Manhole	1200	S2.001	37.765	300	S2.000	37.765	300	
S3	40.500	3.000	Open Manhole	1200	S3.000	37.500	300				
SAT 1	40.375	3.000	Open Manhole	1200	S4.000	37.375	300				
S4	40.250	4.005	Open Manhole	1200	S1.001	36.250	300	S1.000	36.245	300	
								S2.001	36.250	300	
								S3.000	36.250	300	
								S4.000	36.250	300	
S5	38.000	2.575	Open Manhole	1200	S1.002	35.425	300	S1.001	35.425	300	
S6	39.000	4.205	Open Manhole	1200	S1.003	34.795	300	S1.002	34.795	300	
S7	39.000	5.070	Open Manhole	1200	S1.004	33.930	300	S1.003	33.930	300	
S8	41.000	3.000	Open Manhole	1200	S5.000	38.000	300				
S9	40.750	4.253	Open Manhole	1200	S5.001	36.497	300	S5.000	36.497	300	
S10	40.500	5.506	Open Manhole	1200	S5.002	34.994	300	S5.001	34.994	300	
S11	40.500	5.858	Open Manhole	1200	S5.003	34.642	300	S5.002	34.642	300	
S12	39.000	5.154	Open Manhole	1200	S6.000	33.846	300				
S13	39.000	6.000	Open Manhole	1500	S1.005	33.000	300	S1.004	33.000	300	
								S5.003	33.000	300	
								S6.000	33.000	300	
SPOND1	32.576	3.000	Open Manhole	1200	S1.006	29.576	300	S1.005	32.000	300	2424
S14hb	31.250	3.501	Open Manhole	1500	S1.007	27.749	300	S1.006	27.749	300	
S	24.000	0.530	Open Manhole	0		OUTFALL		S1.007	23.470	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	470698.146	109561.470	470698.146	109561.470	Required	
SAT2	470642.907	109481.759	470642.907	109481.759	Required	
S2	470635.408	109481.182	470635.408	109481.182	Required	
S3	470615.662	109583.287	470615.662	109583.287	Required	



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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SAT 1	470630.200	109556.626	470630.200	109556.626	Required	
S4	470623.587	109544.210	470623.587	109544.210	Required	
S5	470572.576	109534.708	470572.576	109534.708	Required	
S6	470567.044	109566.185	470567.044	109566.185	Required	
S7	470573.000	109591.000	470573.000	109591.000	Required	
S8	470705.282	109638.435	470705.282	109638.435	Required	
S9	470661.848	109626.359	470661.848	109626.359	Required	
S10	470618.413	109614.283	470618.413	109614.283	Required	
S11	470611.437	109606.373	470611.437	109606.373	Required	
S12	470586.678	109594.020	470586.678	109594.020	Required	
S13	470575.739	109618.333	470575.739	109618.333	Required	
SPOND1	470550.662	109628.618	470550.662	109628.618	Required	
S14hb	470522.963	109614.562	470522.963	109614.562	Required	
S	470451.717	109578.461			No Entry	

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S14hb, DS/PN: S1.007, Volume (m³): 8.3

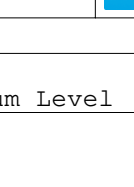
Unit Reference	MD-SHE-0093-5300-2138-5300
Design Head (m)	2.138
Design Flow (l/s)	5.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	93
Invert Level (m)	27.749
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.138	5.3
Flush-Flo™	0.406	4.3
Kick-Flo®	0.828	3.4
Mean Flow over Head Range	-	4.1

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)
0.100	2.9	1.200	4.0	3.000	6.2	7.000	9.3
0.200	3.9	1.400	4.3	3.500	6.7	7.500	9.6
0.300	4.2	1.600	4.6	4.000	7.1	8.000	9.9
0.400	4.3	1.800	4.9	4.500	7.5	8.500	10.2
0.500	4.2	2.000	5.1	5.000	7.9	9.000	10.4
0.600	4.1	2.200	5.4	5.500	8.3	9.500	10.7
0.800	3.6	2.400	5.6	6.000	8.6		
1.000	3.7	2.600	5.8	6.500	8.9		

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Storage Structures for Storm Tank or Pond Manhole: SAT2, DS/PN: S2.000 Invert Level (m) 38.000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>198.0</td><td>0.800</td><td>198.0</td><td>0.801</td><td>0.0</td></tr></tbody></table> Tank or Pond Manhole: SAT 1, DS/PN: S4.000 Invert Level (m) 37.375 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>30.0</td><td>0.800</td><td>30.0</td><td>0.801</td><td>0.0</td></tr></tbody></table> Tank or Pond Manhole: SPOND1, DS/PN: S1.006 Invert Level (m) 29.576 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>74.0</td><td>1.000</td><td>557.0</td><td>3.000</td><td>1241.0</td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	198.0	0.800	198.0	0.801	0.0	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	30.0	0.800	30.0	0.801	0.0	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	74.0	1.000	557.0	3.000	1241.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																																	
0.000	198.0	0.800	198.0	0.801	0.0																																	
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																																	
0.000	30.0	0.800	30.0	0.801	0.0																																	
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0.000	74.0	1.000	557.0	3.000	1241.0																																	
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1 year Return Period 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	3
Number of Online Controls	1	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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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.
S1.000	S1	15 Winter	1	+0%				
S2.000	SAT2	60 Winter	1	+0%				
S2.001	S2	30 Winter	1	+0%	100/15 Winter			
S3.000	S3	15 Winter	1	+0%	100/15 Winter			
S4.000	SAT 1	15 Winter	1	+0%				
S1.001	S4	15 Winter	1	+0%	100/15 Summer			
S1.002	S5	15 Winter	1	+0%	100/15 Summer			
S1.003	S6	15 Winter	1	+0%	100/15 Summer			
S1.004	S7	15 Winter	1	+0%	30/15 Summer			
S5.000	S8	15 Winter	1	+0%				
S5.001	S9	15 Winter	1	+0%				
S5.002	S10	15 Winter	1	+0%	100/15 Summer			
S5.003	S11	15 Winter	1	+0%	100/15 Summer			
S6.000	S12	15 Winter	1	+0%	100/15 Summer			
S1.005	S13	15 Winter	1	+0%	30/15 Summer			
S1.006	SPOND1	240 Winter	1	+0%	1/15 Summer			
S1.007	S14hb	1440 Summer	1	+0%	1/15 Summer	1/480 Summer		

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30 year Return Period 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 3
Number of Online Controls 1 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 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
720, 960, 1440, 2160, 2880, 4320, 5760,
7200, 8640, 10080
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.
S1.000	S1	15 Winter	30	+0%				
S2.000	SAT2	30 Winter	30	+0%				
S2.001	S2	15 Winter	30	+0%	100/15 Winter			
S3.000	S3	15 Winter	30	+0%	100/15 Winter			
S4.000	SAT 1	15 Winter	30	+0%				
S1.001	S4	15 Winter	30	+0%	100/15 Summer			
S1.002	S5	15 Winter	30	+0%	100/15 Summer			
S1.003	S6	15 Winter	30	+0%	100/15 Summer			
S1.004	S7	15 Winter	30	+0%	30/15 Summer			
S5.000	S8	15 Winter	30	+0%				
S5.001	S9	15 Winter	30	+0%				
S5.002	S10	15 Winter	30	+0%	100/15 Summer			
S5.003	S11	15 Winter	30	+0%	100/15 Summer			
S6.000	S12	15 Winter	30	+0%	100/15 Summer			
S1.005	S13	15 Winter	30	+0%	30/15 Summer			
S1.006	SPOND1	960 Winter	30	+0%	1/15 Summer			
S1.007	S14hb	1440 Summer	30	+0%	1/15 Summer	1/480 Summer		

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100 year Return Period 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 3
Number of Online Controls 1 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 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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.
S1.000	S1	15 Winter	100	+40%				
S2.000	SAT2	30 Winter	100	+40%				
S2.001	S2	15 Winter	100	+40%	100/15 Winter			
S3.000	S3	15 Winter	100	+40%	100/15 Winter			
S4.000	SAT 1	15 Winter	100	+40%				
S1.001	S4	15 Winter	100	+40%	100/15 Summer			
S1.002	S5	15 Winter	100	+40%	100/15 Summer			
S1.003	S6	15 Winter	100	+40%	100/15 Summer			
S1.004	S7	15 Winter	100	+40%	30/15 Summer			
S5.000	S8	15 Winter	100	+40%				
S5.001	S9	15 Winter	100	+40%				
S5.002	S10	15 Winter	100	+40%	100/15 Summer			
S5.003	S11	15 Winter	100	+40%	100/15 Summer			
S6.000	S12	15 Winter	100	+40%	100/15 Summer			
S1.005	S13	15 Winter	100	+40%	30/15 Summer			
S1.006	SPOND1	600 Winter	100	+40%	1/15 Summer			
S1.007	S14hb	2880 Winter	100	+40%	1/15 Summer	1/480 Summer		

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

		Water	Surcharged	Flooded	Half Drain			Pipe	
	US/MH	Level	Depth	Volume	Flow /	Overflow	Time	Flow	
PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status
S1.000	S1	37.795	-0.005	0.000	0.24			33.2	OK
S2.000	SAT2	38.134	-0.166	0.000	0.41			49.9	OK
S2.001	S2	38.116	0.051	0.000	0.57			93.5	SURCHARGED
S3.000	S3	37.851	0.051	0.000	0.37			68.4	SURCHARGED
S4.000	SAT 1	37.662	-0.013	0.000	0.21			55.8	OK
S1.001	S4	37.745	1.195	0.000	1.12			148.1	SURCHARGED
S1.002	S5	37.223	1.498	0.000	1.13			160.8	SURCHARGED
S1.003	S6	36.820	1.725	0.000	0.96			176.4	SURCHARGED
S1.004	S7	36.277	2.047	0.000	1.01			187.1	SURCHARGED
S5.000	S8	38.100	-0.200	0.000	0.24			45.6	OK
S5.001	S9	36.699	-0.098	0.000	0.49			94.3	OK
S5.002	S10	36.454	1.160	0.000	0.77			114.2	SURCHARGED
S5.003	S11	36.262	1.320	0.000	0.69			149.5	SURCHARGED
S6.000	S12	35.546	1.400	0.000	0.20			36.3	SURCHARGED
S1.005	S13	35.504	2.204	0.000	1.79			345.2	SURCHARGED
S1.006	SPOND1	31.187	1.311	0.000	0.04			8.7	SURCHARGED
S1.007	S14hb	31.254	3.205	6.388	0.02			6.2	FLOOD

PN	US/MH Name	Level Exceeded
S1.000	S1	
S2.000	SAT2	
S2.001	S2	
S3.000	S3	
S4.000	SAT 1	
S1.001	S4	
S1.002	S5	
S1.003	S6	
S1.004	S7	
S5.000	S8	
S5.001	S9	
S5.002	S10	
S5.003	S11	
S6.000	S12	
S1.005	S13	
S1.006	SPOND1	
S1.007	S14hb	33