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7 Regents Court Far Moor Lane Redditch B98 0SD		
Date 13/01/2020 09:41 File Storm-Net 2E-100.MDX	Designed by ravindralivera Checked by	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for STORM-NET2.SWS

Pipe Sizes STORM-NET2 Manhole Sizes STORM-NET2

FSR Rainfall Model - England and Wales			
Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for STORM-NET2.SWS

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.558	4-8	0.680	8-12	0.007

Total Area Contributing (ha) = 1.245

Total Pipe Volume (m³) = 208.895

Network Design Table for STORM-NET2.SWS

« - Indicates pipe capacity < flow

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	51.866	0.130	399.0	0.151	5.00	0.0	0.600	o	900	Pipe/Conduit	
1.001	26.352	0.066	399.3	0.075	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.002	20.284	0.051	397.7	0.093	0.00	0.0	0.600	o	900	Pipe/Conduit	
2.000	28.287	0.103	274.6	0.155	5.00	0.0	0.600	o	900	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	5.55	61.400	0.151	0.0	0.0	0.0	1.56	994.0	20.4
1.001	50.00	5.83	61.270	0.226	0.0	0.0	0.0	1.56	993.6	30.6
1.002	50.00	6.05	61.204	0.319	0.0	0.0	0.0	1.56	995.6	43.2
2.000	50.00	5.25	61.285	0.155	0.0	0.0	0.0	1.89	1199.7	21.0

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Network Design Table for STORM-NET2.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	
3.000	35.429	0.103	344.0	0.095	5.00	0.0	0.600	o	900	Pipe/Conduit		
2.001	10.494	0.029	361.9	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.003	13.837	0.035	395.3	0.083	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.004	40.974	0.105	390.2	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.005	13.341	0.030	444.7	0.253	0.00	0.0	0.600	o	900	Pipe/Conduit		
1.006	80.597	0.202	399.0	0.340	0.00	0.0	0.600	o	900	Pipe/Conduit		
4.000	8.500	0.050	170.0	0.000	5.00	0.0	0.600	o	375	Pipe/Conduit		
1.007	48.819	0.354	137.9	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)		
3.000	50.00	5.35	61.285	0.095	0.0	0.0	0.0	1.68	1071.1	12.9		
2.001	50.00	5.46	61.182	0.250	0.0	0.0	0.0	1.64	1044.1	33.9		
1.003	50.00	6.20	61.153	0.652	0.0	0.0	0.0	1.57	998.6	88.3		
1.004	50.00	6.63	61.118	0.652	0.0	0.0	0.0	1.58	1005.2	88.3		
1.005	50.00	6.78	61.013	0.905	0.0	0.0	0.0	1.48	941.1	122.5		
1.006	50.00	7.64	60.983	1.245	0.0	0.0	0.0	1.56	994.0	168.6		
4.000	50.00	5.10	61.050	0.000	0.0	0.0	0.0	1.39	153.2	0.0		
1.007	50.00	8.25	60.781	1.245	0.0	0.0	0.0	1.34	94.5«	168.6		

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Manhole Schedules for STORM-NET2.SWS

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)
44	63.411	2.011	Open Manhole	2400	1.000	61.400	900				
42	63.377	2.107	Open Manhole	2400	1.001	61.270	900	1.000	61.270	900	
43	62.989	1.785	Open Manhole	2400	1.002	61.204	900	1.001	61.204	900	
30	63.062	1.777	Open Manhole	2400	2.000	61.285	900				
38	63.509	2.224	Open Manhole	2400	3.000	61.285	900				
31	63.219	2.037	Open Manhole	2400	2.001	61.182	900	2.000	61.182	900	
								3.000	61.182	900	
32	63.068	1.915	Open Manhole	2400	1.003	61.153	900	1.002	61.153	900	
								2.001	61.153	900	
33	63.165	2.047	Open Manhole	2400	1.004	61.118	900	1.003	61.118	900	
34	62.993	1.980	Open Manhole	2400	1.005	61.013	900	1.004	61.013	900	
35	63.111	2.128	Open Manhole	2400	1.006	60.983	900	1.005	60.983	900	
12	67.650	6.600	Open Manhole	1350	4.000	61.050	375				
36	62.949	2.168	Open Manhole	1800	1.007	60.781	300	1.006	60.781	900	
								4.000	61.000	375	
37	62.361	1.934	Open Manhole	0		OUTFALL		1.007	60.427	300	294

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PIPELINE SCHEDULES for STORM-NET2.SWS

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	900	44	63.411	61.400	1.111	Open Manhole	2400
1.001	o	900	42	63.377	61.270	1.207	Open Manhole	2400
1.002	o	900	43	62.989	61.204	0.885	Open Manhole	2400
2.000	o	900	30	63.062	61.285	0.877	Open Manhole	2400
3.000	o	900	38	63.509	61.285	1.324	Open Manhole	2400
2.001	o	900	31	63.219	61.182	1.137	Open Manhole	2400
1.003	o	900	32	63.068	61.153	1.015	Open Manhole	2400
1.004	o	900	33	63.165	61.118	1.147	Open Manhole	2400
1.005	o	900	34	62.993	61.013	1.080	Open Manhole	2400
1.006	o	900	35	63.111	60.983	1.228	Open Manhole	2400
4.000	o	375	12	67.650	61.050	6.225	Open Manhole	1350
1.007	o	300	36	62.949	60.781	1.868	Open Manhole	1800

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	51.866	399.0	42	63.377	61.270	1.207	Open Manhole	2400
1.001	26.352	399.3	43	62.989	61.204	0.885	Open Manhole	2400
1.002	20.284	397.7	32	63.068	61.153	1.015	Open Manhole	2400
2.000	28.287	274.6	31	63.219	61.182	1.137	Open Manhole	2400
3.000	35.429	344.0	31	63.219	61.182	1.137	Open Manhole	2400
2.001	10.494	361.9	32	63.068	61.153	1.015	Open Manhole	2400
1.003	13.837	395.3	33	63.165	61.118	1.147	Open Manhole	2400
1.004	40.974	390.2	34	62.993	61.013	1.080	Open Manhole	2400
1.005	13.341	444.7	35	63.111	60.983	1.228	Open Manhole	2400
1.006	80.597	399.0	36	62.949	60.781	1.268	Open Manhole	1800
4.000	8.500	170.0	36	62.949	61.000	1.574	Open Manhole	1800
1.007	48.819	137.9	37	62.361	60.427	1.634	Open Manhole	0

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Free Flowing Outfall Details for STORM-NET2.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	37	62.361	60.427	0.000	0	0

Simulation Criteria for STORM-NET2.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
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 Storage Structures	1
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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for STORM-NET2.SWS

Hydro-Brake® Optimum Manhole: 36, DS/PN: 1.007, Volume (m³): 56.2

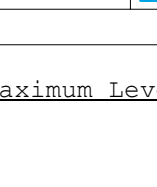
Unit Reference	MD-SCL-0270-5190-1500-5190
Design Head (m)	1.500
Design Flow (l/s)	51.9
Flush-Flo™	Calculated
Objective	Minimise blockage risk
Application	Surface
Sump Available	Yes
Diameter (mm)	270
Invert Level (m)	60.781
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	51.9
Flush-Flo™	0.378	51.9
Kick-Flo®	0.917	41.0
Mean Flow over Head Range	-	42.4

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	9.4	1.200	46.6	3.000	72.5	7.000	109.4
0.200	30.6	1.400	50.2	3.500	78.1	7.500	113.1
0.300	48.9	1.600	53.5	4.000	83.3	8.000	116.7
0.400	51.8	1.800	56.6	4.500	88.2	8.500	120.2
0.500	51.0	2.000	59.6	5.000	92.9	9.000	123.6
0.600	49.6	2.200	62.4	5.500	97.3	9.500	126.9
0.800	45.7	2.400	65.1	6.000	101.5		
1.000	42.7	2.600	67.6	6.500	105.5		

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<u>Storage Structures for STORM-NET2.SWS</u> <u>Cellular Storage Manhole: 12, DS/PN: 4.000</u> Invert Level (m) 61.050 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>200.0</td><td>0.0</td><td>0.801</td><td>0.0</td><td>0.0</td></tr><tr><td>0.800</td><td>200.0</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Manhole Headloss for STORM-NET2.SWS</u> <table><tr><th>PN</th><th>US/MH</th><th>US/MH</th></tr><tr><th></th><th>Name</th><th>Headloss</th></tr><tr><td>1.000</td><td>44</td><td>0.500</td></tr><tr><td>1.001</td><td>42</td><td>0.500</td></tr><tr><td>1.002</td><td>43</td><td>0.500</td></tr><tr><td>2.000</td><td>30</td><td>0.500</td></tr><tr><td>3.000</td><td>38</td><td>0.500</td></tr><tr><td>2.001</td><td>31</td><td>0.500</td></tr><tr><td>1.003</td><td>32</td><td>0.500</td></tr><tr><td>1.004</td><td>33</td><td>0.500</td></tr><tr><td>1.005</td><td>34</td><td>0.500</td></tr><tr><td>1.006</td><td>35</td><td>0.500</td></tr><tr><td>4.000</td><td>12</td><td>0.500</td></tr><tr><td>1.007</td><td>36</td><td>0.500</td></tr></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	200.0	0.0	0.801	0.0	0.0	0.800	200.0	0.0				PN	US/MH	US/MH		Name	Headloss	1.000	44	0.500	1.001	42	0.500	1.002	43	0.500	2.000	30	0.500	3.000	38	0.500	2.001	31	0.500	1.003	32	0.500	1.004	33	0.500	1.005	34	0.500	1.006	35	0.500	4.000	12	0.500	1.007	36	0.500
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																									
0.000	200.0	0.0	0.801	0.0	0.0																																																									
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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for STORM-NET2.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 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	1
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	0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	44	60 Winter	100	+40%					62.140
1.001	42	60 Winter	100	+40%					62.131
1.002	43	60 Winter	100	+40%					62.104
2.000	30	60 Winter	100	+40%					62.098
3.000	38	60 Winter	100	+40%					62.090
2.001	31	60 Winter	100	+40%					62.082
1.003	32	60 Winter	100	+40%	100/60 Winter				62.053
1.004	33	60 Winter	100	+40%					62.018
1.005	34	120 Winter	100	+40%	100/120 Winter				61.913
1.006	35	180 Winter	100	+40%	100/120 Winter				61.884
4.000	12	60 Winter	100	+40%	100/15 Summer				61.841
1.007	36	60 Winter	100	+40%	100/15 Summer				61.848

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for STORM-NET2.SWS

PN	US/MH	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level
	Name	Depth (m)	Volume (m³)			Flow (l/s)		Exceeded
1.000	44	-0.160	0.000	0.05		39.7		OK
1.001	42	-0.039	0.000	0.05		38.6		OK
1.002	43	0.000	0.000	0.08		52.6		OK
2.000	30	-0.087	0.000	0.05		41.2		OK
3.000	38	-0.095	0.000	0.03		24.5		OK
2.001	31	0.000	0.000	0.09		44.1		OK
1.003	32	0.000	0.000	0.21		107.4	SURCHARGED	
1.004	33	0.000	0.000	0.12		98.9		OK
1.005	34	0.000	0.000	0.29		129.7	SURCHARGED	
1.006	35	0.001	0.000	0.17		149.5	SURCHARGED	
4.000	12	0.416	0.000	0.18		19.8	SURCHARGED	
1.007	36	0.767	0.000	0.57		50.7	SURCHARGED	