

Wilde Consultants		Page 1
Brindley Lodge Adcroft Street, Stockport Cheshire, SK1 3HS	LSHTM Tavistock Place Proposed SW drainage system	
Date 22-Mar-19 1:33 PM File PR_SW_28L-S_OCC_1M-SURC...	Designed by EMT Checked by RLG	
Innovyze	Network 2018.1.1	

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)	1	PIMP (%)	100
M5-60 (mm)	20.600	Add Flow / Climate Change (%)	0
Ratio R	0.437	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 Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.263	4-8	0.007

Total Area Contributing (ha) = 0.270

Total Pipe Volume (m³) = 2.505

Network Design Table for Storm

« - 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	8.500	0.115	73.9	0.133	2.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	3.000	-1.770	-1.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	7.000	1.120	6.3	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	2.09	22.000	0.133	0.0	0.0	0.0	1.52	60.5	18.0
1.001	50.00	2.23	20.360	0.133	0.0	0.0	0.0	1.22	85.9	18.0
1.002	50.00	2.77	20.300	0.133	0.0	0.0	0.0	0.09	1.6«	18.0
1.003	50.00	2.80	22.070	0.133	0.0	0.0	0.0	4.06	71.7	18.0

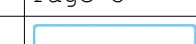
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Network Design Table for Storm

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
2.000	6.750	0.045	150.0	0.010	2.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	13.000	0.635	20.5	0.017	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	8.000	0.267	30.0	0.017	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	8.000	0.460	17.4	0.093	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	7.500	0.037	202.7	0.000	0.00	0.0	0.600	o	225	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)
2.000	50.00	2.14	21.630	0.010	0.0	0.0	0.0	0.82	14.5	1.4
2.001	50.00	2.23	21.585	0.027	0.0	0.0	0.0	2.24	39.5	3.7
1.004	50.00	2.85	20.987	0.177	0.0	0.0	0.0	2.40	95.4	24.0
1.005	50.00	2.90	20.720	0.270	0.0	0.0	0.0	3.15	125.4	36.6
1.006	50.00	3.03	20.260	0.270	0.0	0.0	0.0	0.91	36.4«	36.6

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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	23.765	1.765	Open Manhole	1200	1.000	22.000	225				
1	23.600	3.240	Open Manhole	1200	1.001	20.360	300	1.000	21.885	225	1450
2	23.270	2.970	Open Manhole	1200	1.002	20.300	150	1.001	20.300	300	
3	23.270	1.200	Open Manhole	1200	1.003	22.070	150	1.002	22.070	150	
5	23.750	2.120	Open Manhole	1200	2.000	21.630	150				
4	23.760	2.175	Open Manhole	1200	2.001	21.585	150	2.000	21.585	150	
5	23.240	2.290	Open Manhole	1800	1.004	20.987	225	1.003	20.950	150	
								2.001	20.950	150	
6	21.500	0.780	Open Manhole	1200	1.005	20.720	225	1.004	20.720	225	
7	21.500	1.240	Open Manhole	1200	1.006	20.260	225	1.005	20.260	225	
	24.400	4.177	Open Manhole	1200		OUTFALL		1.006	20.223	225	

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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	225	1	23.765	22.000	1.540	Open Manhole	1200
1.001	o	300	1	23.600	20.360	2.940	Open Manhole	1200
1.002	o	150	2	23.270	20.300	2.820	Open Manhole	1200
1.003	o	150	3	23.270	22.070	1.050	Open Manhole	1200
2.000	o	150	5	23.750	21.630	1.970	Open Manhole	1200
2.001	o	150	4	23.760	21.585	2.025	Open Manhole	1200
1.004	o	225	5	23.240	20.987	2.028	Open Manhole	1800
1.005	o	225	6	21.500	20.720	0.555	Open Manhole	1200
1.006	o	225	7	21.500	20.260	1.015	Open Manhole	1200

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	8.500	73.9	1	23.600	21.885	1.490	Open Manhole	1200
1.001	10.000	166.7	2	23.270	20.300	2.670	Open Manhole	1200
1.002	3.000	-1.7	3	23.270	22.070	1.050	Open Manhole	1200
1.003	7.000	6.3	5	23.240	20.950	2.140	Open Manhole	1800
2.000	6.750	150.0	4	23.760	21.585	2.025	Open Manhole	1200
2.001	13.000	20.5	5	23.240	20.950	2.140	Open Manhole	1800
1.004	8.000	30.0	6	21.500	20.720	0.555	Open Manhole	1200
1.005	8.000	17.4	7	21.500	20.260	1.015	Open Manhole	1200
1.006	7.500	202.7		24.400	20.223	3.952	Open Manhole	1200

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Network Classifications for Storm

PN	USMH	Pipe	Min Cover	Max Cover	Pipe Type	MH	MH	MH Ring	MH Type
	Name	Dia	Depth	Depth		Dia	Width	Depth	
		(mm)	(m)	(m)		(mm)	(mm)	(m)	
1.000	1	225	1.490	1.540	Unclassified	1200	0	1.540	Unclassified
1.001	1	300	2.670	2.940	Unclassified	1200	0	2.940	Unclassified
1.002	2	150	1.050	2.820	Unclassified	1200	0	2.820	Unclassified
1.003	3	150	1.050	2.140	Unclassified	1200	0	1.050	Unclassified
2.000	5	150	1.970	2.025	Unclassified	1200	0	1.970	Unclassified
2.001	4	150	2.025	2.140	Unclassified	1200	0	2.025	Unclassified
1.004	5	225	0.555	2.028	Unclassified	1800	0	2.028	Unclassified
1.005	6	225	0.555	1.015	Unclassified	1200	0	0.555	Unclassified
1.006	7	225	1.015	3.952	Unclassified	1200	0	1.015	Unclassified

Surcharged Outfall Details for Storm

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe	Number	Name	(m)	(m)	I. Level (mm)	(mm)
					(m)	

1.006 24.400 20.223 21.223 1200 0

Datum (m) 20.223 Offset (mins) 0

Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth
(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)
60	1.000	1500	1.000	2940	1.000	4380	1.000	5820	1.000	7260	1.000
120	1.000	1560	1.000	3000	1.000	4440	1.000	5880	1.000	7320	1.000
180	1.000	1620	1.000	3060	1.000	4500	1.000	5940	1.000	7380	1.000
240	1.000	1680	1.000	3120	1.000	4560	1.000	6000	1.000	7440	1.000
300	1.000	1740	1.000	3180	1.000	4620	1.000	6060	1.000	7500	1.000
360	1.000	1800	1.000	3240	1.000	4680	1.000	6120	1.000	7560	1.000
420	1.000	1860	1.000	3300	1.000	4740	1.000	6180	1.000	7620	1.000
480	1.000	1920	1.000	3360	1.000	4800	1.000	6240	1.000	7680	1.000
540	1.000	1980	1.000	3420	1.000	4860	1.000	6300	1.000	7740	1.000
600	1.000	2040	1.000	3480	1.000	4920	1.000	6360	1.000	7800	1.000
660	1.000	2100	1.000	3540	1.000	4980	1.000	6420	1.000	7860	1.000
720	1.000	2160	1.000	3600	1.000	5040	1.000	6480	1.000	7920	1.000
780	1.000	2220	1.000	3660	1.000	5100	1.000	6540	1.000	7980	1.000
840	1.000	2280	1.000	3720	1.000	5160	1.000	6600	1.000	8040	1.000
900	1.000	2340	1.000	3780	1.000	5220	1.000	6660	1.000	8100	1.000
960	1.000	2400	1.000	3840	1.000	5280	1.000	6720	1.000	8160	1.000
1020	1.000	2460	1.000	3900	1.000	5340	1.000	6780	1.000	8220	1.000
1080	1.000	2520	1.000	3960	1.000	5400	1.000	6840	1.000	8280	1.000
1140	1.000	2580	1.000	4020	1.000	5460	1.000	6900	1.000	8340	1.000
1200	1.000	2640	1.000	4080	1.000	5520	1.000	6960	1.000	8400	1.000
1260	1.000	2700	1.000	4140	1.000	5580	1.000	7020	1.000	8460	1.000
1320	1.000	2760	1.000	4200	1.000	5640	1.000	7080	1.000	8520	1.000
1380	1.000	2820	1.000	4260	1.000	5700	1.000	7140	1.000	8580	1.000
1440	1.000	2880	1.000	4320	1.000	5760	1.000	7200	1.000	8640	1.000

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
8700	1.000	10620	1.000	12540	1.000	14460	1.000	16380	1.000	18300	1.000
8760	1.000	10680	1.000	12600	1.000	14520	1.000	16440	1.000	18360	1.000
8820	1.000	10740	1.000	12660	1.000	14580	1.000	16500	1.000	18420	1.000
8880	1.000	10800	1.000	12720	1.000	14640	1.000	16560	1.000	18480	1.000
8940	1.000	10860	1.000	12780	1.000	14700	1.000	16620	1.000	18540	1.000
9000	1.000	10920	1.000	12840	1.000	14760	1.000	16680	1.000	18600	1.000
9060	1.000	10980	1.000	12900	1.000	14820	1.000	16740	1.000	18660	1.000
9120	1.000	11040	1.000	12960	1.000	14880	1.000	16800	1.000	18720	1.000
9180	1.000	11100	1.000	13020	1.000	14940	1.000	16860	1.000	18780	1.000
9240	1.000	11160	1.000	13080	1.000	15000	1.000	16920	1.000	18840	1.000
9300	1.000	11220	1.000	13140	1.000	15060	1.000	16980	1.000	18900	1.000
9360	1.000	11280	1.000	13200	1.000	15120	1.000	17040	1.000	18960	1.000
9420	1.000	11340	1.000	13260	1.000	15180	1.000	17100	1.000	19020	1.000
9480	1.000	11400	1.000	13320	1.000	15240	1.000	17160	1.000	19080	1.000
9540	1.000	11460	1.000	13380	1.000	15300	1.000	17220	1.000	19140	1.000
9600	1.000	11520	1.000	13440	1.000	15360	1.000	17280	1.000	19200	1.000
9660	1.000	11580	1.000	13500	1.000	15420	1.000	17340	1.000	19260	1.000
9720	1.000	11640	1.000	13560	1.000	15480	1.000	17400	1.000	19320	1.000
9780	1.000	11700	1.000	13620	1.000	15540	1.000	17460	1.000	19380	1.000
9840	1.000	11760	1.000	13680	1.000	15600	1.000	17520	1.000	19440	1.000
9900	1.000	11820	1.000	13740	1.000	15660	1.000	17580	1.000	19500	1.000
9960	1.000	11880	1.000	13800	1.000	15720	1.000	17640	1.000	19560	1.000
10020	1.000	11940	1.000	13860	1.000	15780	1.000	17700	1.000	19620	1.000
10080	1.000	12000	1.000	13920	1.000	15840	1.000	17760	1.000	19680	1.000
10140	1.000	12060	1.000	13980	1.000	15900	1.000	17820	1.000	19740	1.000
10200	1.000	12120	1.000	14040	1.000	15960	1.000	17880	1.000	19800	1.000
10260	1.000	12180	1.000	14100	1.000	16020	1.000	17940	1.000	19860	1.000
10320	1.000	12240	1.000	14160	1.000	16080	1.000	18000	1.000	19920	1.000
10380	1.000	12300	1.000	14220	1.000	16140	1.000	18060	1.000	19980	1.000
10440	1.000	12360	1.000	14280	1.000	16200	1.000	18120	1.000	20040	1.000
10500	1.000	12420	1.000	14340	1.000	16260	1.000	18180	1.000	20100	1.000
10560	1.000	12480	1.000	14400	1.000	16320	1.000	18240	1.000	20160	1.000

Simulation Criteria for Storm

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 Return Period (years) 1

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<u>Synthetic Rainfall Details</u> <table> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.600</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>Ratio R</td> <td>0.437</td> <td>Storm Duration (mins)</td> <td>30</td> </tr> <tr> <td>Profile Type</td> <td>Summer</td> <td></td> <td></td> </tr> </table>			Region	England and Wales	Cv (Summer)	0.750	M5-60 (mm)	20.600	Cv (Winter)	0.840	Ratio R	0.437	Storm Duration (mins)	30	Profile Type	Summer		
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Online Controls for Storm

Pump Manhole: 2, DS/PN: 1.002, Volume (m³): 4.0

Invert Level (m) 20.300

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	13.0000	0.900	28.0000	1.700	28.0000	2.500	28.0000
0.200	13.0000	1.000	28.0000	1.800	28.0000	2.600	28.0000
0.300	13.0000	1.100	28.0000	1.900	28.0000	2.700	28.0000
0.400	13.0000	1.200	28.0000	2.000	28.0000	2.800	28.0000
0.500	28.0000	1.300	28.0000	2.100	28.0000	2.900	28.0000
0.600	28.0000	1.400	28.0000	2.200	28.0000	3.000	28.0000
0.700	28.0000	1.500	28.0000	2.300	28.0000		
0.800	28.0000	1.600	28.0000	2.400	28.0000		

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Storage Structures for Storm

Cellular Storage Manhole: 2, DS/PN: 1.002

Invert Level (m) 20.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	12.0	0.0	1.001	0.0	0.0
1.000	12.0	0.0			

Manhole Headloss for Storm

PN	US/MH	US/MH
Name	Headloss	
1.000	1	0.500
1.001	1	0.500
1.002	2	0.500
1.003	3	0.500
2.000	5	0.500
2.001	4	0.500
1.004	5	0.500
1.005	6	0.500
1.006	7	0.500