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Barton Arcade Manchester M3 2BH		
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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)	30	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.355	Minimum Backdrop Height (m)	0.600
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	3.000
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)	1.00
Volumetric Runoff Coeff.	0.850	Min Slope for Optimisation (1:X)	400

Designed with Level Soffits

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)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	57.670	0.144	400.5	0.141	5.00	0.0	0.600	o	1200	Pipe/Conduit	
1.001	13.884	0.036	385.7	0.413	0.00	0.0	0.600	o	1200	Pipe/Conduit	
1.002	12.538	0.070	179.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	17.119	0.150	114.1	0.031	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	12.383	0.089	139.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	58.251	0.260	224.0	0.060	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	59.534	0.149	399.6	0.246	0.00	0.0	0.600	o	1200	Pipe/Conduit	
1.005	21.533	0.054	398.8	0.220	0.00	0.0	0.600	o	1200	Pipe/Conduit	
1.006	15.944	0.037	430.9	0.000	0.00	0.0	0.600	o	1200	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	100.00	5.52	72.180	0.141	0.0	0.0	0.0	1.86	2107.3	43.3
1.001	100.00	5.64	72.036	0.554	0.0	0.0	0.0	1.90	2147.7	170.0
1.002	100.00	5.82	72.000	0.554	0.0	0.0	0.0	1.17	82.8«	170.0
2.000	100.00	5.19	72.189	0.031	0.0	0.0	0.0	1.47	104.0	9.5
2.001	100.00	5.35	72.039	0.031	0.0	0.0	0.0	1.33	94.1	9.5
1.003	96.20	6.74	71.930	0.645	0.0	0.0	0.0	1.05	74.0«	190.5
1.004	93.12	7.28	70.770	0.891	0.0	0.0	0.0	1.87	2109.8	254.7
1.005	92.06	7.47	70.621	1.111	0.0	0.0	0.0	1.87	2111.9	313.9
1.006	91.27	7.62	70.567	1.111	0.0	0.0	0.0	1.80	2031.0	313.9

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Network Design Table for SW

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
1.007	34.849	0.835	41.7	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)
1.007	89.79	7.90	70.530	1.111	0.0	0.0	0.0	2.03	80.7«	313.9

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Manhole Schedules for SW

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)
SW1	76.483	4.303	Open Manhole	2400	1.000	72.180	1200			
SW2	75.660	3.624	Open Manhole	2400	1.001	72.036	1200	1.000	72.036	1200
SW2A	75.432	3.432	Open Manhole	2400	1.002	72.000	300	1.001	72.000	1200
SW9	73.648	1.459	Open Manhole	1800	2.000	72.189	300			
SW10	74.611	2.572	Open Manhole	1800	2.001	72.039	300	2.000	72.039	300
SW3	75.066	3.136	Open Manhole	1500	1.003	71.930	300	1.002	71.930	300
								2.001	71.950	300
SW5	75.038	4.268	Open Manhole	3000	1.004	70.770	1200	1.003	71.670	300
SW6	74.000	3.379	Open Manhole	3000	1.005	70.621	1200	1.004	70.621	1200
SW7	73.750	3.183	Open Manhole	3000	1.006	70.567	1200	1.005	70.567	1200
SW8	73.650	3.120	Open Manhole	3000	1.007	70.530	225	1.006	70.530	1200
Structure - (12)	72.000	2.305	Open Manhole	1200		OUTFALL		1.007	69.695	225

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SW1	385891.694	405532.699	385891.694	405532.699	Required	
SW2	385868.961	405479.764	385868.961	405479.764	Required	
SW2A	385863.496	405467.001	385863.496	405467.001	Required	
SW9	385863.413	405427.284	385863.413	405427.284	Required	
SW10	385857.560	405443.371	385857.560	405443.371	Required	
SW3	385857.967	405455.748	385804.226	405478.222	Required	
SW5	385804.226	405478.222	385804.226	405478.222	Required	
SW6	385779.916	405423.878	385779.916	405423.878	Required	



Micro
Drainage

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SW7	385773.002	405403.485	385773.002	405403.485	Required	
SW8	385771.465	405387.615	385771.465	405387.615	Required	
Structure - (12)	385737.676	405379.087			No Entry	

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<u>Online Controls for SW</u> <u>Orifice Manhole: SW2A, DS/PN: 1.002, Volume (m³): 28.5</u> Diameter (m) 0.145 Discharge Coefficient 0.600 Invert Level (m) 72.000 <u>Depth/Flow Relationship Manhole: SW8, DS/PN: 1.007, Volume (m³): 36.7</u> Invert Level (m) 70.530 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.120</td><td>9.3200</td><td>1.090</td><td>16.8200</td><td>2.070</td><td>15.8500</td><td>3.040</td><td>18.2900</td></tr><tr><td>0.240</td><td>13.8200</td><td>1.220</td><td>15.7300</td><td>2.190</td><td>16.2000</td><td>3.160</td><td>18.5500</td></tr><tr><td>0.360</td><td>16.5500</td><td>1.340</td><td>14.1400</td><td>2.310</td><td>16.5400</td><td>3.280</td><td>18.7900</td></tr><tr><td>0.490</td><td>17.8500</td><td>1.460</td><td>13.7600</td><td>2.430</td><td>16.8600</td><td>3.400</td><td>19.0300</td></tr><tr><td>0.610</td><td>18.0800</td><td>1.580</td><td>14.2300</td><td>2.550</td><td>17.1700</td><td>3.520</td><td>19.2600</td></tr><tr><td>0.730</td><td>18.0400</td><td>1.700</td><td>14.6700</td><td>2.680</td><td>17.4700</td><td></td><td></td></tr><tr><td>0.850</td><td>17.8800</td><td>1.820</td><td>15.0800</td><td>2.800</td><td>17.7600</td><td></td><td></td></tr><tr><td>0.970</td><td>17.5100</td><td>1.950</td><td>15.4700</td><td>2.920</td><td>18.0300</td><td></td><td></td></tr></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.120	9.3200	1.090	16.8200	2.070	15.8500	3.040	18.2900	0.240	13.8200	1.220	15.7300	2.190	16.2000	3.160	18.5500	0.360	16.5500	1.340	14.1400	2.310	16.5400	3.280	18.7900	0.490	17.8500	1.460	13.7600	2.430	16.8600	3.400	19.0300	0.610	18.0800	1.580	14.2300	2.550	17.1700	3.520	19.2600	0.730	18.0400	1.700	14.6700	2.680	17.4700			0.850	17.8800	1.820	15.0800	2.800	17.7600			0.970	17.5100	1.950	15.4700	2.920	18.0300		
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
0.120	9.3200	1.090	16.8200	2.070	15.8500	3.040	18.2900																																																																			
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Storage Structures for SW

Cellular Storage Manhole: SW3, DS/PN: 1.003

Invert Level (m) 72.750 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	335.0	0.0	0.670	0.0	0.0
0.660	335.0	0.0			

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Micro Drainage

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

for SW

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 Coeffiecient 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 2

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 OFF

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

Return Period(s) (years) 2, 30, 100

Climate Change (%) 0, 0, 45

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
	PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
								Act.	(m)
1.000	SW1	30	Winter	2	+0%	100/15	Summer		72.536
1.001	SW2	30	Winter	2	+0%	100/15	Summer		72.536
1.002	SW2A	30	Winter	2	+0%	2/15	Summer		72.531
2.000	SW9	15	Winter	2	+0%	30/120	Winter		72.234
2.001	SW10	15	Winter	2	+0%	30/60	Winter		72.095
1.003	SW3	15	Winter	2	+0%	30/60	Winter		72.073
1.004	SW5	120	Winter	2	+0%	30/60	Summer		71.397
1.005	SW6	120	Winter	2	+0%	30/60	Summer		71.388
1.006	SW7	120	Winter	2	+0%	30/30	Winter		71.382
1.007	SW8	120	Winter	2	+0%	2/15	Summer		71.376

Surcharged

Flooded

Half Drain

Pipe

US/MH

Depth

Volume

Flow /

Overflow

Time

Flow

Level

PN

Name

(m)

(m³)

Cap.

(l/s)

(mins)

(l/s)

Status

Exceeded

1.000

SW1

-0.844

0.000

0.01

14.2

OK

1.001

SW2

-0.700

0.000

0.03

29.5

OK

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

PN	US/MH Name	Surcharged	Flooded	Flow / Overflow		Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)	Cap.	(l/s)	Time (mins)	Flow (l/s)		
1.002	SW2A	0.231	0.000	0.38			25.1	SURCHARGED	
2.000	SW9	-0.255	0.000	0.05			4.8	OK	
2.001	SW10	-0.244	0.000	0.06			4.6	OK	
1.003	SW3	-0.157	0.000	0.46		20	32.2	OK	
1.004	SW5	-0.573	0.000	0.02			34.6	OK	
1.005	SW6	-0.433	0.000	0.02			28.6	OK	
1.006	SW7	-0.385	0.000	0.02			22.1	OK	
1.007	SW8	0.621	0.000	0.24			18.0	SURCHARGED	

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Micro Drainage

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

for SW

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 Coeffiecient 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 2

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 OFF

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

Return Period(s) (years) 2, 30, 100

Climate Change (%) 0, 0, 45

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
	PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
								Act.	(m)
1.000	SW1	30 Winter	30	+0%	100/15 Summer				72.905
1.001	SW2	30 Winter	30	+0%	100/15 Summer				72.901
1.002	SW2A	30 Winter	30	+0%	2/15 Summer				72.892
2.000	SW9	120 Winter	30	+0%	30/120 Winter				72.704
2.001	SW10	120 Winter	30	+0%	30/60 Winter				72.704
1.003	SW3	120 Winter	30	+0%	30/60 Winter				72.704
1.004	SW5	120 Winter	30	+0%	30/60 Summer				72.689
1.005	SW6	120 Winter	30	+0%	30/60 Summer				72.689
1.006	SW7	120 Winter	30	+0%	30/30 Winter				72.688
1.007	SW8	120 Winter	30	+0%	2/15 Summer				72.688

Surcharged Flooded

Half Drain Pipe

US/MH

Depth

Volume

Flow / Overflow

Time

Flow

Level

PN

Name

(m)

(m³)

Cap.

(l/s)

(mins)

(l/s)

Status

Exceeded

1.000

SW1

-0.475

0.000

0.02

26.8

OK

1.001

SW2

-0.335

0.000

0.05

48.7

OK

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Micro Drainage

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

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 Coeffiecient 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 2

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 OFF

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

Return Period(s) (years) 2, 30, 100

Climate Change (%) 0, 0, 45

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	SW1	60 Winter	100	+45%	100/15 Summer				75.352
1.001	SW2	60 Winter	100	+45%	100/15 Summer				75.352
1.002	SW2A	60 Winter	100	+45%	2/15 Summer				75.350
2.000	SW9	180 Winter	100	+45%	30/120 Winter				73.503
2.001	SW10	180 Winter	100	+45%	30/60 Winter				73.503
1.003	SW3	180 Winter	100	+45%	30/60 Winter				73.503
1.004	SW5	180 Winter	100	+45%	30/60 Summer				73.485
1.005	SW6	180 Winter	100	+45%	30/60 Summer				73.485
1.006	SW7	180 Winter	100	+45%	30/30 Winter				73.485
1.007	SW8	180 Winter	100	+45%	2/15 Summer				73.484

Surcharged Flooded

Half Drain Pipe

PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
1.000	SW1	1.972	0.000	0.02			32.0	SURCHARGED	
1.001	SW2	2.116	0.000	0.08			79.9	SURCHARGED	

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

PN	US/MH Name	Surcharged		Flooded		Half Drain		Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Flow		
1.002	SW2A	3.050	0.000	1.02			67.4	FLOOD RISK		
2.000	SW9	1.014	0.000	0.05			4.3	FLOOD RISK		
2.001	SW10	1.164	0.000	0.05			3.9	SURCHARGED		
1.003	SW3	1.273	0.000	0.64		143	44.9	SURCHARGED		
1.004	SW5	1.515	0.000	0.04			72.1	SURCHARGED		
1.005	SW6	1.664	0.000	0.05			58.3	SURCHARGED		
1.006	SW7	1.718	0.000	0.04			38.2	FLOOD RISK		
1.007	SW8	2.729	0.000	0.24			18.1	FLOOD RISK		