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Barton Arcade Manchester M3 2BH		
Date 05/06/2023 14:56	Designed by phill	
File SURFACE WATER NETWORK 2.MDX	Checked by	
XP Solutions	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SURFACE WATER NETWORK 2

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	0.358	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)	500

Designed with Level Soffits

Network Design Table for SURFACE WATER NETWORK 2

« - 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	24.558	0.490	50.1	0.086	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	54.627	1.781	30.7	0.137	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	28.280	1.104	25.6	0.191	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	8.631	0.133	64.9	0.090	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	60.487	1.567	38.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	24.209	0.151	160.3	0.083	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	35.778	0.224	159.7	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	18.543	0.530	35.0	0.063	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)
1.000	100.00	5.22	59.833	0.086	0.0	0.0	0.0	1.85	73.6	26.4
1.001	100.00	5.60	59.343	0.223	0.0	0.0	0.0	2.37	94.3	68.4
1.002	100.00	5.76	57.487	0.414	0.0	0.0	0.0	3.12	220.5	127.1
1.003	100.00	5.82	56.308	0.504	0.0	0.0	0.0	2.25	248.8	154.7
1.004	100.00	6.16	56.175	0.504	0.0	0.0	0.0	2.92	323.0	154.7
2.000	100.00	5.39	57.240	0.083	0.0	0.0	0.0	1.03	41.0	25.5
2.001	100.00	5.97	57.089	0.116	0.0	0.0	0.0	1.03	41.0	35.6
2.002	100.00	6.11	56.865	0.179	0.0	0.0	0.0	2.22	88.2	54.9

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Manhole Schedules for SURFACE WATER NETWORK 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SW22	385653.631	400216.997	385653.631	400216.997	Required	
SW23	385656.797	400207.659			No Entry	

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PIPELINE SCHEDULES for SURFACE WATER NETWORK 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
1.000	o	225	SW4	61.258	59.833	1.200	Open Manhole	1350	
1.001	o	225	SW5	60.768	59.343	1.200	Open Manhole	1350	
1.002	o	300	SW6	58.987	57.487	1.200	Open Manhole	1350	
1.003	o	375	SW7	57.883	56.308	1.200	Open Manhole	1350	
1.004	o	375	SW9	57.750	56.175	1.200	Open Manhole	1350	
2.000	o	225	SW13	58.665	57.240	1.200	Open Manhole	1350	
2.001	o	225	SW14	58.991	57.089	1.677	Open Manhole	1350	
2.002	o	225	SW10	58.444	56.865	1.354	Open Manhole	1350	
2.003	o	225	SW11	57.822	56.335	1.262	Open Manhole	1350	
2.004	o	225	SW12	57.108	55.591	1.292	Open Manhole	1350	
1.005	o	450	SW8	56.184	54.533	1.201	Open Manhole	1500	
1.006	o	450	SW16	55.723	53.925	1.348	Open Manhole	1800	
3.000	o	225	SW17	57.357	55.932	1.200	Open Manhole	1350	
3.001	o	300	SW18	56.397	54.787	1.310	Open Manhole	1350	
3.002	o	450	SW19	55.500	53.348	1.702	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., (mm)	L*W
1.000	24.558	50.1	SW5	60.768	59.343	1.200	Open Manhole	1350	
1.001	54.627	30.7	SW6	58.987	57.562	1.200	Open Manhole	1350	
1.002	28.280	25.6	SW7	57.883	56.383	1.200	Open Manhole	1350	
1.003	8.631	64.9	SW9	57.750	56.175	1.200	Open Manhole	1350	
1.004	60.487	38.6	SW8	56.184	54.608	1.201	Open Manhole	1500	
2.000	24.209	160.3	SW14	58.991	57.089	1.677	Open Manhole	1350	
2.001	35.778	159.7	SW10	58.444	56.865	1.354	Open Manhole	1350	
2.002	18.543	35.0	SW11	57.822	56.335	1.262	Open Manhole	1350	
2.003	29.761	40.0	SW12	57.108	55.591	1.292	Open Manhole	1350	
2.004	16.358	19.6	SW8	56.184	54.758	1.201	Open Manhole	1500	
1.005	42.598	69.9	SW16	55.723	53.924	1.349	Open Manhole	1800	
1.006	9.535	6.9	SW21	55.738	52.551	2.737	Open Manhole	1800	
3.000	34.229	32.0	SW18	56.397	54.862	1.310	Open Manhole	1350	
3.001	43.711	33.0	SW19	55.500	53.462	1.738	Open Manhole	1800	
3.002	34.260	398.4	SW20	55.578	53.262	1.866	Open Manhole	1800	

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PIPELINE SCHEDULES for SURFACE WATER NETWORK 2

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)
3.003	o	450	SW20	55.578	53.262	1.866	Open Manhole	1800
1.007	o	450	SW21	55.738	52.206	3.082	Open Manhole	1800
1.008	o	450	SW22	55.951	52.132	3.369	Open Manhole	2100

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)
3.003	39.896	56.1	SW21	55.738	52.551	2.737	Open Manhole	1800
1.007	32.933	445.0	SW22	55.951	52.132	3.369	Open Manhole	2100
1.008	9.860	469.5	SW23	56.071	52.111	3.510	Open Manhole	1350

Surcharged Outfall Details for SURFACE WATER NETWORK 2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	SW23	56.071	52.111	0.000	1350	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
10	1.000	30	1.000	50	1.000	70	1.000	90	1.000	110	1.000
20	1.000	40	1.000	60	1.000	80	1.000	100	1.000	120	1.000

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<p align="center"><u>Simulation Criteria for SURFACE WATER NETWORK 2</u></p> <p> Volumetric Runoff Coeff 0.850 Additional Flow - % of Total Flow 0.000 Areal Reduction Factor 1.000 MADD Factor * 10m³/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 </p> <p> 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 </p> <p align="center"><u>Synthetic Rainfall Details</u></p> <p> Rainfall Model FSR Profile Type Summer Return Period (years) 30 Cv (Summer) 0.850 Region England and Wales Cv (Winter) 0.840 M5-60 (mm) 18.000 Storm Duration (mins) 30 Ratio R 0.358 </p>		
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Online Controls for SURFACE WATER NETWORK 2

Hydro-Brake® Optimum Manhole: SW22, DS/PN: 1.008, Volume (m³): 18.2

Unit Reference	MD-SHE-0195-2400-2400-2400
Design Head (m)	2.400
Design Flow (l/s)	24.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	52.132
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.400	24.0	Kick-Flo®	1.460	18.9
Flush-Flo™	0.697	24.0	Mean Flow over Head Range	-	20.9

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	6.7	1.200	22.3	3.000	26.7	7.000	40.1
0.200	18.1	1.400	20.0	3.500	28.7	7.500	41.5
0.300	21.3	1.600	19.8	4.000	30.6	8.000	42.8
0.400	22.7	1.800	20.9	4.500	32.4	8.500	44.0
0.500	23.5	2.000	22.0	5.000	34.1	9.000	45.3
0.600	23.9	2.200	23.0	5.500	35.7	9.500	46.5
0.800	23.9	2.400	24.0	6.000	37.2		
1.000	23.4	2.600	24.9	6.500	38.7		

Simulation Criteria

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

Rainfall Model	FSR	Ratio R	0.357
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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, 40

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

PN	US/MH Name	Surcharged Flooded		Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Level	
		Depth (m)	Volume (m³)				Status	Exceeded
1.000	SW4	-0.157	0.000	0.20		13.3	OK	
1.001	SW5	-0.133	0.000	0.34		31.2	OK	
1.002	SW6	-0.191	0.000	0.28		56.3	OK	
1.003	SW7	-0.191	0.000	0.48		68.2	OK	
1.004	SW9	-0.255	0.000	0.22		68.0	OK	
2.000	SW13	-0.134	0.000	0.34		12.7	OK	
2.001	SW14	-0.120	0.000	0.43		16.7	OK	
2.002	SW10	-0.138	0.000	0.31		24.7	OK	
2.003	SW11	-0.132	0.000	0.35		27.0	OK	
2.004	SW12	-0.138	0.000	0.32		33.0	OK	
1.005	SW8	-0.274	0.000	0.32		110.5	OK	
1.006	SW16	-0.326	0.000	0.17		111.2	OK	
3.000	SW17	-0.140	0.000	0.30		26.2	OK	
3.001	SW18	-0.193	0.000	0.27		49.4	OK	
3.002	SW19	-0.209	0.000	0.55		76.9	OK	
3.003	SW20	-0.313	0.000	0.20		76.6	OK	

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

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
1.007	SW21	60 Winter	2	+0%	2/15 Summer			53.103
1.008	SW22	60 Winter	2	+0%	2/15 Summer			53.092

US/MH		Surcharged	Flooded	Half Drain		Pipe	Level	
PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status
1.007	SW21	0.447	0.000	0.80			106.3	SURCHARGED
1.008	SW22	0.510	0.000	0.29			24.0	SURCHARGED

Simulation Criteria

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

Rainfall Model	FSR	Ratio R	0.357
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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, 40

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SURFACE WATER NETWORK 2

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
1.000	SW4	-0.130	0.000	0.37			25.2	OK	
1.001	SW5	-0.078	0.000	0.74			67.4	OK	
1.002	SW6	-0.124	0.000	0.64			126.9	OK	
1.003	SW7	0.008	0.000	1.07			152.0	SURCHARGED	
1.004	SW9	-0.184	0.000	0.50			151.8	OK	
2.000	SW13	-0.092	0.000	0.64			24.0	OK	
2.001	SW14	-0.060	0.000	0.86			33.3	OK	
2.002	SW10	-0.091	0.000	0.64			50.8	OK	
2.003	SW11	-0.079	0.000	0.73			56.3	OK	
2.004	SW12	-0.088	0.000	0.67			69.8	OK	
1.005	SW8	-0.166	0.000	0.71			245.8	OK	
1.006	SW16	-0.261	0.000	0.37			245.4	OK	
3.000	SW17	-0.102	0.000	0.57			49.6	OK	
3.001	SW18	-0.134	0.000	0.58			104.8	OK	
3.002	SW19	0.023	0.000	1.18			166.5	SURCHARGED	
3.003	SW20	-0.006	0.000	0.14			54.6	OK	

Simulation Criteria

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

Rainfall Model	FSR	Ratio R	0.357
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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, 40

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