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Date 01/01/0001 File 7387 SW03.MDX	Designed by lworthington Checked by	
Micro Drainage	Network 2018.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 7387 SW01.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.314	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	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)	400

Designed with Level Soffits

Network Design Table for 7387 SW01.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
1.000	17.747	0.044	403.3	0.128	5.00	12.0	0.600	o	900	Pipe/Conduit	
1.001	20.808	0.052	400.2	0.042	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.002	10.013	0.025	400.5	0.042	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.003	19.080	0.048	397.5	0.042	0.00	0.0	0.600	o	900	Pipe/Conduit	
2.000	16.801	0.042	400.0	0.042	5.00	0.0	0.600	o	900	Pipe/Conduit	
1.004	11.914	0.030	397.1	0.042	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.005	13.030	0.033	394.8	0.042	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.006	11.494	0.029	396.3	0.042	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.007	11.237	0.112	100.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	8.924	0.089	100.3	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)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	5.19	82.209	0.128	12.0	0.0	0.0	1.55	988.6	12.0
1.001	0.00	5.41	82.165	0.170	12.0	0.0	0.0	1.56	992.5	12.0
1.002	0.00	5.52	82.113	0.212	12.0	0.0	0.0	1.56	992.1	12.0
1.003	0.00	5.72	82.088	0.254	12.0	0.0	0.0	1.57	995.8	12.0
2.000	0.00	5.18	82.082	0.042	0.0	0.0	0.0	1.56	992.7	0.0
1.004	0.00	5.85	82.040	0.338	12.0	0.0	0.0	1.57	996.3	12.0
1.005	0.00	5.99	82.010	0.380	12.0	0.0	0.0	1.57	999.2	12.0
1.006	0.00	6.11	81.977	0.422	12.0	0.0	0.0	1.57	997.3	12.0
1.007	0.00	6.25	81.948	0.422	12.0	0.0	0.0	1.31	51.9	12.0
1.008	0.00	6.37	81.836	0.422	12.0	0.0	0.0	1.31	51.9	12.0

Manhole Schedules for 7387 SW01.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)
1	85.259	3.050	Open Manhole	1800	1.000	82.209	900				
2	85.288	3.123	Open Manhole	1800	1.001	82.165	900	1.000	82.165	900	
3	85.187	3.074	Open Manhole	1800	1.002	82.113	900	1.001	82.113	900	
4	85.286	3.198	Open Manhole	1800	1.003	82.088	900	1.002	82.088	900	
5	85.401	3.319	Open Manhole	1800	2.000	82.082	900				
6	85.567	3.527	Open Manhole	1800	1.004	82.040	900	1.003	82.040	900	
								2.000	82.040	900	
7	85.421	3.411	Open Manhole	1800	1.005	82.010	900	1.004	82.010	900	
8	85.699	3.722	Open Manhole	1800	1.006	81.977	900	1.005	81.977	900	
9	85.350	3.402	Open Manhole	2400	1.007	81.948	225	1.006	81.948	900	
10	84.269	2.433	Open Manhole	1200	1.008	81.836	225	1.007	81.836	225	
11	84.238	2.491	Open Manhole	0		OUTFALL		1.008	81.747	225	

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PIPELINE SCHEDULES for 7387 SW01.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	1	85.259	82.209	2.150	Open Manhole	1800
1.001	o	900	2	85.288	82.165	2.223	Open Manhole	1800
1.002	o	900	3	85.187	82.113	2.174	Open Manhole	1800
1.003	o	900	4	85.286	82.088	2.298	Open Manhole	1800
2.000	o	900	5	85.401	82.082	2.419	Open Manhole	1800
1.004	o	900	6	85.567	82.040	2.627	Open Manhole	1800
1.005	o	900	7	85.421	82.010	2.511	Open Manhole	1800
1.006	o	900	8	85.699	81.977	2.822	Open Manhole	1800
1.007	o	225	9	85.350	81.948	3.177	Open Manhole	2400
1.008	o	225	10	84.269	81.836	2.208	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	17.747	403.3	2	85.288	82.165	2.223	Open Manhole	1800
1.001	20.808	400.2	3	85.187	82.113	2.174	Open Manhole	1800
1.002	10.013	400.5	4	85.286	82.088	2.298	Open Manhole	1800
1.003	19.080	397.5	6	85.567	82.040	2.627	Open Manhole	1800
2.000	16.801	400.0	6	85.567	82.040	2.627	Open Manhole	1800
1.004	11.914	397.1	7	85.421	82.010	2.511	Open Manhole	1800
1.005	13.030	394.8	8	85.699	81.977	2.822	Open Manhole	1800
1.006	11.494	396.3	9	85.350	81.948	2.502	Open Manhole	2400
1.007	11.237	100.3	10	84.269	81.836	2.208	Open Manhole	1200
1.008	8.924	100.3	11	84.238	81.747	2.266	Open Manhole	0

Free Flowing Outfall Details for 7387 SW01.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.008	11	84.238	81.747	0.000	0	0
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Simulation Criteria for 7387 SW01.SWS

Volumetric Runoff Coeff	0.750	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

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

Synthetic Rainfall Details

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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)	18.000	Storm Duration (mins)	30
Ratio R	0.314		

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Online Controls for 7387 SW01.SWS

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.007, Volume (m³): 21.4

Unit Reference	MD-SHE-0169-1700-2050-1700
Design Head (m)	2.050
Design Flow (l/s)	17.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	169
Invert Level (m)	81.948
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.050	17.0	Kick-Flo®	1.239	13.4
Flush-Flo™	0.593	16.9	Mean Flow over Head Range	-	14.8

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)	Depth (m)	Flow (l/s)
0.100	6.0	0.800	16.6	2.000	16.8	4.000	23.4	7.000	30.6
0.200	14.0	1.000	15.8	2.200	17.6	4.500	24.8	7.500	31.7
0.300	15.6	1.200	14.0	2.400	18.3	5.000	26.0	8.000	32.7
0.400	16.4	1.400	14.2	2.600	19.0	5.500	27.3	8.500	33.6
0.500	16.8	1.600	15.1	3.000	20.4	6.000	28.4	9.000	34.6
0.600	16.9	1.800	16.0	3.500	21.9	6.500	29.5	9.500	35.5

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Storage Structures for 7387 SW01.SWS

Cellular Storage Manhole: 5, DS/PN: 2.000

Invert Level (m) 83.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	130.0	0.0	0.800	130.0	0.0	0.801	0.0	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 7387 SW01.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 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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.312 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

									Water	Surcharged	
PN	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
	Name	Storm		Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)
1.000	1	120	Winter	1	+0%	30/120	Winter			82.487	-0.622
1.001	2	120	Winter	1	+0%	30/120	Winter			82.484	-0.581
1.002	3	120	Winter	1	+0%	30/120	Winter			82.481	-0.532
1.003	4	120	Winter	1	+0%	30/120	Winter			82.480	-0.508
2.000	5	120	Winter	1	+0%	30/120	Winter			82.476	-0.506
1.004	6	120	Winter	1	+0%	30/120	Winter			82.476	-0.464
1.005	7	120	Winter	1	+0%	30/120	Winter			82.473	-0.437
1.006	8	120	Winter	1	+0%	30/120	Winter			82.469	-0.408
1.007	9	120	Winter	1	+0%	1/15	Summer			82.465	0.292
1.008	10	120	Winter	1	+0%					81.934	-0.127

Flooded			Pipe		Level	
PN	US/MH Name	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	0.000	0.03		17.1	OK
1.001	2	0.000	0.03		17.7	OK
1.002	3	0.000	0.04		17.4	OK
1.003	4	0.000	0.03		18.0	OK
2.000	5	0.000	0.00		1.4	OK
1.004	6	0.000	0.04		17.5	OK
1.005	7	0.000	0.04		17.8	OK
1.006	8	0.000	0.04		18.1	OK
1.007	9	0.000	0.38		16.8	SURCHARGED
1.008	10	0.000	0.40		16.8	OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 7387 SW01.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 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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.312 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

									Water	Surcharged	
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.		(m)	(m)
1.000	1	240 Winter	30	+0%	30/120 Winter					83.349	0.240
1.001	2	360 Winter	30	+0%	30/120 Winter					83.337	0.272
1.002	3	360 Winter	30	+0%	30/120 Winter					83.332	0.319
1.003	4	240 Winter	30	+0%	30/120 Winter					83.335	0.347
2.000	5	240 Winter	30	+0%	30/120 Winter					83.313	0.331
1.004	6	240 Winter	30	+0%	30/120 Winter					83.341	0.401
1.005	7	240 Winter	30	+0%	30/120 Winter					83.350	0.440
1.006	8	240 Winter	30	+0%	30/120 Winter					83.359	0.482
1.007	9	240 Winter	30	+0%	1/15 Summer					83.363	1.190
1.008	10	600 Summer	30	+0%						81.935	-0.126

Flooded				Pipe		Level	
PN	US/MH Name	Volume (m ³)	Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Exceeded	
1.000	1	0.000	0.03	19.5	SURCHARGED		
1.001	2	0.000	0.03	21.7	SURCHARGED		
1.002	3	0.000	0.05	24.5	SURCHARGED		
1.003	4	0.000	0.05	29.4	SURCHARGED		
2.000	5	0.000	0.06	32.3	SURCHARGED		
1.004	6	0.000	0.11	54.8	SURCHARGED		
1.005	7	0.000	0.08	42.3	SURCHARGED		
1.006	8	0.000	0.07	32.3	SURCHARGED		
1.007	9	0.000	0.38	16.8	SURCHARGED		
1.008	10	0.000	0.40	16.8	OK		

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 7387 SW01.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 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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.312 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

									Water	Surcharged	
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.		(m)	(m)
1.000	1	240 Winter	100	+40%	30/120 Winter					84.270	1.161
1.001	2	240 Winter	100	+40%	30/120 Winter					84.269	1.204
1.002	3	240 Winter	100	+40%	30/120 Winter					84.268	1.255
1.003	4	240 Winter	100	+40%	30/120 Winter					84.267	1.279
2.000	5	240 Winter	100	+40%	30/120 Winter					84.266	1.284
1.004	6	240 Winter	100	+40%	30/120 Winter					84.266	1.326
1.005	7	240 Winter	100	+40%	30/120 Winter					84.265	1.355
1.006	8	240 Winter	100	+40%	30/120 Winter					84.264	1.387
1.007	9	240 Winter	100	+40%	1/15 Summer					84.263	2.090
1.008	10	240 Winter	100	+40%						81.938	-0.123

		Flooded		Pipe			
PN	US/MH Name	Volume (m ³)	Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Level Exceeded	
1.000	1	0.000	0.06	36.0	SURCHARGED		
1.001	2	0.000	0.06	43.2	SURCHARGED		
1.002	3	0.000	0.11	52.6	SURCHARGED		
1.003	4	0.000	0.09	56.9	SURCHARGED		
2.000	5	0.000	0.06	32.6	SURCHARGED		
1.004	6	0.000	0.16	80.5	SURCHARGED		
1.005	7	0.000	0.12	61.7	SURCHARGED		
1.006	8	0.000	0.10	47.5	SURCHARGED		
1.007	9	0.000	0.41	18.0	SURCHARGED		
1.008	10	0.000	0.43	18.0	OK		