

WYG		Page 0
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Date 19/06/2017 14:35 File SouthernBypass 170619.mdx		
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.200	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Surface Network 1

« - 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)	Auto Design
1.000	7.257	0.098	74.1	0.139	5.00	0.0	0.600	o	225	
2.000	2.335	0.411	5.7	0.139	5.00	0.0	0.600	o	225	
1.001	81.951	4.012	20.4	0.034	0.00	0.0	0.600	o	225	
1.002	103.954	0.139	750.0	0.128	0.00	0.0	0.600	o	1350	
1.003	115.001	0.153	750.2	0.162	0.00	0.0	0.600	o	1350	
1.004	42.565	0.207	205.6	0.000	0.00	0.0	0.600	o	225	

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	48.83	5.08	9.152	0.139	0.0	0.0	0.0	1.52	60.5	18.4
2.000	49.12	5.01	9.390	0.139	0.0	0.0	0.0	5.53	219.7	18.5
1.001	47.02	5.55	8.979	0.312	0.0	0.0	0.0	2.91	115.6	39.7
1.002	43.08	6.74	3.842	0.440	0.0	0.0	0.0	1.46	2090.6	51.3
1.003	39.52	8.05	3.703	0.602	0.0	0.0	0.0	1.46	2090.4	64.4
1.004	37.71	8.83	3.550	0.602	0.0	0.0	0.0	0.91	36.1«	64.4

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Page 1



Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S9	10.502	1.350	Open Manhole	1200	1.000	9.152	225				
S2	10.400	1.010	Open Manhole	1200	2.000	9.390	225				
S7	10.404	1.425	Open Manhole	1200	1.001	8.979	225	1.000	9.054	225	75
								2.000	8.979	225	
S3	7.066	3.224	Open Manhole	2250	1.002	3.842	1350	1.001	4.967	225	
S4	6.838	3.135	Open Manhole	2250	1.003	3.703	1350	1.002	3.703	1350	
S5	5.988	2.439	Open Manhole	2250	1.004	3.550	225	1.003	3.550	1350	
S6	5.978	2.635	Open Manhole	1200		OUTFALL		1.004	3.343	225	

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WYG		Page 2																																																																																																																														
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PIPELINE SCHEDULES for Surface Network 1 Upstream Manhole <table><thead><tr><th>PN</th><th>Hyd Sect</th><th>Diam (mm)</th><th>MH Name</th><th>C.Level (m)</th><th>I.Level (m)</th><th>D.Depth (m)</th><th>MH Connection</th><th>MH DIAM., L*W (mm)</th></tr></thead><tbody><tr><td>1.000</td><td>o</td><td>225</td><td>S9</td><td>10.502</td><td>9.152</td><td>1.125</td><td>Open Manhole</td><td>1200</td></tr><tr><td>2.000</td><td>o</td><td>225</td><td>S2</td><td>10.400</td><td>9.390</td><td>0.785</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.001</td><td>o</td><td>225</td><td>S7</td><td>10.404</td><td>8.979</td><td>1.200</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.002</td><td>o</td><td>1350</td><td>S3</td><td>7.066</td><td>3.842</td><td>1.874</td><td>Open Manhole</td><td>2250</td></tr><tr><td>1.003</td><td>o</td><td>1350</td><td>S4</td><td>6.838</td><td>3.703</td><td>1.785</td><td>Open Manhole</td><td>2250</td></tr><tr><td>1.004</td><td>o</td><td>225</td><td>S5</td><td>5.988</td><td>3.550</td><td>2.213</td><td>Open Manhole</td><td>2250</td></tr></tbody></table> Downstream Manhole <table><thead><tr><th>PN</th><th>Length (m)</th><th>Slope (1:X)</th><th>MH Name</th><th>C.Level (m)</th><th>I.Level (m)</th><th>D.Depth (m)</th><th>MH Connection</th><th>MH DIAM., L*W (mm)</th></tr></thead><tbody><tr><td>1.000</td><td>7.257</td><td>74.1</td><td>S7</td><td>10.404</td><td>9.054</td><td>1.125</td><td>Open Manhole</td><td>1200</td></tr><tr><td>2.000</td><td>2.335</td><td>5.7</td><td>S7</td><td>10.404</td><td>8.979</td><td>1.200</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.001</td><td>81.951</td><td>20.4</td><td>S3</td><td>7.066</td><td>4.967</td><td>1.874</td><td>Open Manhole</td><td>2250</td></tr><tr><td>1.002</td><td>103.954</td><td>750.0</td><td>S4</td><td>6.838</td><td>3.703</td><td>1.785</td><td>Open Manhole</td><td>2250</td></tr><tr><td>1.003</td><td>115.001</td><td>750.2</td><td>S5</td><td>5.988</td><td>3.550</td><td>1.089</td><td>Open Manhole</td><td>2250</td></tr><tr><td>1.004</td><td>42.565</td><td>205.6</td><td>S6</td><td>5.978</td><td>3.343</td><td>2.410</td><td>Open Manhole</td><td>1200</td></tr></tbody></table>			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	S9	10.502	9.152	1.125	Open Manhole	1200	2.000	o	225	S2	10.400	9.390	0.785	Open Manhole	1200	1.001	o	225	S7	10.404	8.979	1.200	Open Manhole	1200	1.002	o	1350	S3	7.066	3.842	1.874	Open Manhole	2250	1.003	o	1350	S4	6.838	3.703	1.785	Open Manhole	2250	1.004	o	225	S5	5.988	3.550	2.213	Open Manhole	2250	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	7.257	74.1	S7	10.404	9.054	1.125	Open Manhole	1200	2.000	2.335	5.7	S7	10.404	8.979	1.200	Open Manhole	1200	1.001	81.951	20.4	S3	7.066	4.967	1.874	Open Manhole	2250	1.002	103.954	750.0	S4	6.838	3.703	1.785	Open Manhole	2250	1.003	115.001	750.2	S5	5.988	3.550	1.089	Open Manhole	2250	1.004	42.565	205.6	S6	5.978	3.343	2.410	Open Manhole	1200
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WYG				Page 3			
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Setting Out Information - True Coordinates (Surface Network 1)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
1.000	S9	1200		503117.514	103739.426	
2.000	S2	1200		503108.344	103741.243	
1.001	S7	1200		503110.274	103739.928	
1.002	S3	2250		503093.771	103659.656	
1.003	S4	2250		503088.138	103555.855	
1.004	S5	2250		503099.289	103441.396	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.004	S6	1200		503104.887	103399.201	

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	S6	5.978	3.343	0.000	1200	0

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WYG		Page 4
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Date 19/06/2017 14:35	Designed by paul.graham	
File SouthernBypass 170619.mdx	Checked by	
Micro Drainage		Network 2015.1

Online Controls for Surface Network 1

Hydro-Brake Optimum® Manhole: S5, DS/PN: 1.004, Volume (m³): 171.1

Unit Reference	MD-SHE-0097-5000-1600-5000
Design Head (m)	1.600
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	97
Invert Level (m)	3.550
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	5.0	Kick-Flo®	0.865	3.8
Flush-Flo™	0.425	4.7	Mean Flow over Head Range	-	4.2

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	3.1	1.200	4.4	3.000	6.7	7.000	10.0
0.200	4.3	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.6	1.600	5.0	4.000	7.7	8.000	10.7
0.400	4.7	1.800	5.3	4.500	8.1	8.500	11.0
0.500	4.7	2.000	5.5	5.000	8.5	9.000	11.3
0.600	4.6	2.200	5.8	5.500	8.9	9.500	11.6
0.800	4.1	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.3	6.500	9.7		

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WYG		Page 5
5th Floor, Longcross Court 47 Newport Road Cardiff CF24 0AD		
Date 19/06/2017 14:35	Designed by paul.graham	
File SouthernBypass 170619.mdx	Checked by	
Micro Drainage		Network 2015.1

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)

Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440	Summer and Winter
Return Period(s) (years)	1, 30, 100	
Climate Change (%)	0, 0, 30	

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	S9	15 Winter	1	+0%	100/15 Summer				9.252
2.000	S2	15 Winter	1	+0%	100/15 Summer				9.458
1.001	S7	15 Winter	1	+0%	100/15 Summer				9.071
1.002	S3	120 Winter	1	+0%					4.031
1.003	S4	120 Winter	1	+0%	100/240 Winter				4.031
1.004	S5	120 Winter	1	+0%	1/15 Summer				4.031

PN	US/MH Name	Surcharged Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)		
1.000	S9	-0.125	0.000	0.40	17.6	OK	
2.000	S2	-0.157	0.000	0.20	17.7	OK	
1.001	S7	-0.133	0.000	0.35	39.2	OK	
1.002	S3	-1.161	0.000	0.01	19.3	OK	
1.003	S4	-1.022	0.000	0.01	20.3	OK	
1.004	S5	0.256	0.000	0.14	4.7	SURCHARGED	

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WYG		Page 6
5th Floor, Longcross Court 47 Newport Road Cardiff CF24 0AD		
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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 30

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	S9	15 Winter	30	+0%	100/15 Summer				9.333
2.000	S2	15 Winter	30	+0%	100/15 Summer				9.501
1.001	S7	15 Winter	30	+0%	100/15 Summer				9.143
1.002	S3	240 Winter	30	+0%					4.448
1.003	S4	240 Winter	30	+0%	100/240 Winter				4.449
1.004	S5	240 Winter	30	+0%	1/15 Summer				4.449

PN	US/MH Name	Surcharged Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)		
1.000	S9	-0.044	0.000	0.98	43.2	OK	
2.000	S2	-0.114	0.000	0.48	43.4	OK	
1.001	S7	-0.061	0.000	0.87	97.5	OK	
1.002	S3	-0.744	0.000	0.02	27.9	OK	
1.003	S4	-0.604	0.000	0.01	23.0	OK	
1.004	S5	0.674	0.000	0.14	4.7	SURCHARGED	

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WYG		Page 7
5th Floor, Longcross Court 47 Newport Road Cardiff CF24 0AD		
Date 19/06/2017 14:35	Designed by paul.graham	
File SouthernBypass 170619.mdx	Checked by	
Micro Drainage		Network 2015.1

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

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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

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	S9	15 Winter	100	+30%	100/15 Summer				10.236
2.000	S2	15 Winter	100	+30%	100/15 Summer				10.234
1.001	S7	15 Winter	100	+30%	100/15 Summer				10.074
1.002	S3	360 Winter	100	+30%					5.184
1.003	S4	360 Winter	100	+30%	100/240 Winter				5.181
1.004	S5	360 Winter	100	+30%	1/15 Summer				5.182

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow Cap.	Overflow (l/s)	Flow (l/s)		
1.000	S9	0.859	0.000	1.31		57.7	FLOOD RISK	
2.000	S2	0.619	0.000	0.62		55.8	FLOOD RISK	
1.001	S7	0.870	0.000	1.10		124.1	SURCHARGED	
1.002	S3	-0.008	0.000	0.02		34.8	OK	
1.003	S4	0.128	0.000	0.02		26.9	SURCHARGED	
1.004	S5	1.407	0.000	0.15		5.0	SURCHARGED	

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