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18 Deyley Way Singleton Ashford TN23 5HX	1151-1004 KINGS ROAD SPALDING	
Date MAR 2015 File 1151-1004.mdx	Designed By RAC Checked By	
Micro Drainage	Network W.12.4	

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)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.000
Ratio R	0.350	Maximum Backdrop Height (m)	10.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	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	0.128	4-8	0.033

Total Area Contributing (ha) = 0.161

Total Pipe Volume (m³) = 28.511

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	11.300	0.100	113.0	0.013	5.00	0.0	0.600	o	150
1.001	11.500	0.100	115.0	0.000	0.00	0.0	0.600	o	150
1.002	33.700	0.090	374.4	0.000	0.00	0.0	0.600	o	600
1.003	6.700	0.020	335.0	0.051	0.00	0.0	0.600	o	600
1.004	36.600	0.090	406.7	0.000	0.00	0.0	0.600	o	600
1.005	17.300	0.050	346.0	0.000	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.20	2.700	0.013	0.0	0.0	0.0	0.94	16.7	1.8
1.001	50.00	5.40	2.600	0.013	0.0	0.0	0.0	0.94	16.5	1.8
1.002	50.00	5.85	2.050	0.013	0.0	0.0	0.0	1.25	354.1	1.8
1.003	50.00	5.94	1.960	0.064	0.0	0.0	0.0	1.32	374.6	8.7
1.004	50.00	6.44	1.940	0.064	0.0	0.0	0.0	1.20	339.7	8.7
1.005	50.00	6.67	1.850	0.064	0.0	0.0	0.0	1.30	368.5	8.7

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Manhole Schedules for Storm								
MH Name	MH CL (m)	MH Depth (m)	MH Diam., L*W (mm)	Pipe Out PN Invert Level (m)	Diameter (mm)	Pipes In PN Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	3.750	1.050	1200	1.000	2.700	150		
S2	3.750	1.150	1200	1.001	2.600	150	1.000	2.600
S3	3.750	1.700	1500	1.002	2.050	600	1.001	2.500
S4	3.500	1.540	1800	1.003	1.960	600	1.002	1.960
S5	3.550	1.610	1500	1.004	1.940	600	1.003	1.940
S6	3.500	1.650	1500	1.005	1.850	600	1.004	1.850
S7	3.300	0.800	1500	2.000	2.500	150		
S8	3.250	0.850	1500	2.001	2.400	150	2.000	2.400
S9	3.400	1.600	1250 x 1250	1.006	1.800	300	1.005	1.800
							2.001	2.250
S13	3.400	2.050	1500		OUTFALL		1.006	1.350
								300
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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 DIAM., L*W (mm)
1.000	o	150	S1	3.750	2.700	0.900	1200
1.001	o	150	S2	3.750	2.600	1.000	1200
1.002	o	600	S3	3.750	2.050	1.100	1500
1.003	o	600	S4	3.500	1.960	0.940	1800
1.004	o	600	S5	3.550	1.940	1.010	1500
1.005	o	600	S6	3.500	1.850	1.050	1500
2.000	o	150	S7	3.300	2.500	0.650	1500
2.001	o	150	S8	3.250	2.400	0.700	1500
1.006	o	300	S9	3.400	1.800	1.300	1250 x 1250

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
1.000	11.300	113.0	S2	3.750	2.600	1.000	1200
1.001	11.500	115.0	S3	3.750	2.500	1.100	1500
1.002	33.700	374.4	S4	3.500	1.960	0.940	1800
1.003	6.700	335.0	S5	3.550	1.940	1.010	1500
1.004	36.600	406.7	S6	3.500	1.850	1.050	1500
1.005	17.300	346.0	S9	3.400	1.800	1.000	1250 x 1250
2.000	13.800	138.0	S8	3.250	2.400	0.700	1500
2.001	19.600	130.7	S9	3.400	2.250	1.000	1250 x 1250
1.006	12.100	26.9	S13	3.400	1.350	1.750	1500

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.006	S13	3.400	1.350	1.350	1500	0

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<u>Simulation Criteria for Storm</u> <table> <tr> <td>Volumetric Runoff Coeff</td> <td>0.840</td> <td>Foul Sewage per hectare (l/s)</td> <td>0.000</td> </tr> <tr> <td>PIMP (% impervious)</td> <td>100</td> <td>Additional Flow - % of Total Flow</td> <td>30.000</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.000</td> <td>MADD Factor * 10m³/ha Storage</td> <td>2.000</td> </tr> <tr> <td>Hot Start (mins)</td> <td>0</td> <td>Run Time (mins)</td> <td>240</td> </tr> <tr> <td>Hot Start Level (mm)</td> <td>0</td> <td>Output Interval (mins)</td> <td>4</td> </tr> <tr> <td>Manhole Headloss Coeff (Global)</td> <td>0.500</td> <td></td> <td></td> </tr> </table> <table> <tr> <td>Number of Input Hydrographs</td> <td>0</td> <td>Number of Storage Structures</td> <td>1</td> </tr> <tr> <td>Number of Online Controls</td> <td>1</td> <td>Number of Time/Area Diagrams</td> <td>0</td> </tr> <tr> <td>Number of Offline Controls</td> <td>0</td> <td></td> <td></td> </tr> </table> <u>Synthetic Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Profile Type</td> <td>Winter</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.000</td> <td>Storm Duration (mins)</td> <td>120</td> </tr> <tr> <td>Ratio R</td> <td>0.350</td> <td></td> <td></td> </tr> </table>			Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000	PIMP (% impervious)	100	Additional Flow - % of Total Flow	30.000	Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000	Hot Start (mins)	0	Run Time (mins)	240	Hot Start Level (mm)	0	Output Interval (mins)	4	Manhole Headloss Coeff (Global)	0.500			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			Rainfall Model	FSR	Profile Type	Winter	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	20.000	Storm Duration (mins)	120	Ratio R	0.350		
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<u>Online Controls for Storm</u> <u>Hydro-Brake® Manhole: S9, DS/PN: 1.006, Volume (m³): 7.3</u> Design Head (m) 1.000 Diameter (mm) 94 Design Flow (l/s) 5.0 Invert Level (m) 1.800 Hydro-Brake® Type Md6 SW Only <table border="1"> <thead> <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> </thead> <tbody> <tr> <td>0.100</td> <td>2.8</td> <td>1.200</td> <td>5.5</td> <td>3.000</td> <td>8.8</td> <td>7.000</td> <td>13.4</td> </tr> <tr> <td>0.200</td> <td>4.1</td> <td>1.400</td> <td>6.0</td> <td>3.500</td> <td>9.5</td> <td>7.500</td> <td>13.8</td> </tr> <tr> <td>0.300</td> <td>3.9</td> <td>1.600</td> <td>6.4</td> <td>4.000</td> <td>10.1</td> <td>8.000</td> <td>14.3</td> </tr> <tr> <td>0.400</td> <td>3.8</td> <td>1.800</td> <td>6.8</td> <td>4.500</td> <td>10.7</td> <td>8.500</td> <td>14.7</td> </tr> <tr> <td>0.500</td> <td>3.8</td> <td>2.000</td> <td>7.1</td> <td>5.000</td> <td>11.3</td> <td>9.000</td> <td>15.2</td> </tr> <tr> <td>0.600</td> <td>4.0</td> <td>2.200</td> <td>7.5</td> <td>5.500</td> <td>11.9</td> <td>9.500</td> <td>15.6</td> </tr> <tr> <td>0.800</td> <td>4.5</td> <td>2.400</td> <td>7.8</td> <td>6.000</td> <td>12.4</td> <td></td> <td></td> </tr> <tr> <td>1.000</td> <td>5.1</td> <td>2.600</td> <td>8.1</td> <td>6.500</td> <td>12.9</td> <td></td> <td></td> </tr> </tbody> </table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	2.8	1.200	5.5	3.000	8.8	7.000	13.4	0.200	4.1	1.400	6.0	3.500	9.5	7.500	13.8	0.300	3.9	1.600	6.4	4.000	10.1	8.000	14.3	0.400	3.8	1.800	6.8	4.500	10.7	8.500	14.7	0.500	3.8	2.000	7.1	5.000	11.3	9.000	15.2	0.600	4.0	2.200	7.5	5.500	11.9	9.500	15.6	0.800	4.5	2.400	7.8	6.000	12.4			1.000	5.1	2.600	8.1	6.500	12.9		
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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: 1.005

Invert Level (m)	1.900	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	24.0	24.0	1.001	0.0	43.6
1.000	24.0	43.6			

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<table><tr><th></th><th></th><th>Water</th><th>Surcharged</th><th>Flooded</th><th></th><th></th><th>Pipe</th><th></th></tr><tr><th></th><th>US/MH</th><th>Level</th><th>Depth</th><th>Volume</th><th>Flow /</th><th>Overflow</th><th>Flow</th><th></th></tr><tr><th>PN</th><th>Name</th><th>(m)</th><th>(m)</th><th>(m³)</th><th>Cap.</th><th>(l/s)</th><th>(l/s)</th><th>Status</th></tr><tr><td>1.000</td><td>S1</td><td>2.840</td><td>-0.010</td><td>0.000</td><td>0.16</td><td>0.0</td><td>2.4</td><td>OK</td></tr><tr><td>1.001</td><td>S2</td><td>2.843</td><td>0.093</td><td>0.000</td><td>0.16</td><td>0.0</td><td>2.4</td><td>SURCHARGED</td></tr><tr><td>1.002</td><td>S3</td><td>2.851</td><td>0.201</td><td>0.000</td><td>0.01</td><td>0.0</td><td>1.9</td><td>SURCHARGED</td></tr><tr><td>1.003</td><td>S4</td><td>2.851</td><td>0.291</td><td>0.000</td><td>0.02</td><td>0.0</td><td>4.8</td><td>SURCHARGED</td></tr><tr><td>1.004</td><td>S5</td><td>2.850</td><td>0.310</td><td>0.000</td><td>0.01</td><td>0.0</td><td>4.2</td><td>SURCHARGED</td></tr><tr><td>1.005</td><td>S6</td><td>2.850</td><td>0.400</td><td>0.000</td><td>0.02</td><td>0.0</td><td>4.7</td><td>SURCHARGED</td></tr><tr><td>2.000</td><td>S7</td><td>2.818</td><td>0.168</td><td>0.000</td><td>0.23</td><td>0.0</td><td>3.2</td><td>SURCHARGED</td></tr><tr><td>2.001</td><td>S8</td><td>2.827</td><td>0.277</td><td>0.000</td><td>1.22</td><td>0.0</td><td>17.8</td><td>FLOOD RISK</td></tr><tr><td>1.006</td><td>S9</td><td>2.843</td><td>0.743</td><td>0.000</td><td>0.03</td><td>0.0</td><td>5.0</td><td>SURCHARGED</td></tr></table>													Water	Surcharged	Flooded			Pipe			US/MH	Level	Depth	Volume	Flow /	Overflow	Flow		PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status	1.000	S1	2.840	-0.010	0.000	0.16	0.0	2.4	OK	1.001	S2	2.843	0.093	0.000	0.16	0.0	2.4	SURCHARGED	1.002	S3	2.851	0.201	0.000	0.01	0.0	1.9	SURCHARGED	1.003	S4	2.851	0.291	0.000	0.02	0.0	4.8	SURCHARGED	1.004	S5	2.850	0.310	0.000	0.01	0.0	4.2	SURCHARGED	1.005	S6	2.850	0.400	0.000	0.02	0.0	4.7	SURCHARGED	2.000	S7	2.818	0.168	0.000	0.23	0.0	3.2	SURCHARGED	2.001	S8	2.827	0.277	0.000	1.22	0.0	17.8	FLOOD RISK	1.006	S9	2.843	0.743	0.000	0.03	0.0	5.0	SURCHARGED
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