STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Plot A

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	6.395	0.500	12.8	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	22.451	0.500	44.9	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	7.310	0.089	82.1	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	30.980	0.500	62.0	0.112	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	4.243	0.100	42.4	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	1.617	0.008	200.0	0.002	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	5.549	0.150	37.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	12.564	0.100	125.6	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	3.797	0.140	27.1	0.010	0.00	0.0	0.600	o	150	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	50.00	5.04	24.500	0.000	0.0	0.0	0.0	2.83	50.1	0.0
1.001	50.00	5.29	23.500	0.034	0.0	0.0	0.0	1.51	26.6	6.1
2.000	50.00	5.11	24.500	0.000	0.0	0.0	0.0	1.11	19.6	0.0
2.001	50.00	5.42	23.500	0.112	0.0	0.0	0.0	1.66	66.2	20.2
3.000	50.00	5.05	23.100	0.000	0.0	0.0	0.0	1.55	27.4	0.0
1.002	50.00	5.44	22.260	0.148	0.0	0.0	0.0	1.11	78.3	26.7
4.000	50.00	5.06	22.000	0.000	0.0	0.0	0.0	1.66	29.3	0.0
4.001	50.00	5.29	21.650	0.007	0.0	0.0	0.0	0.90	15.8	1.3
4.002	50.00	5.32	19.500	0.017	0.0	0.0	0.0	1.94	34.3	3.1

Area Summary for Plot A

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.034	0.034	0.034
2.000	-	-	100	0.000	0.000	0.000
2.001	-	-	100	0.112	0.112	0.112
3.000	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.002	0.002	0.002
4.000	-	-	100	0.000	0.000	0.000
4.001	-	-	100	0.007	0.007	0.007
4.002	-	-	100	0.010	0.010	0.010
				Total	Total	Total
				0.165	0.165	0.165

Surcharged Outfall Details for Plot A

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	CRT A	23.600	22.252	0.000	0	0

Datum (m) 0.000 Offset (mins) -9000

Time (mins)	Depth (m)	Time (mins)	Depth (m)
9000	23.163	18000	23.163

Free Flowing Outfall Details for Plot A

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
4.002	5	21.700	19.360	0.000	100	0

Online Controls for Plot A

Depth/Flow Relationship Manhole: 1, DS/PN: 1.001, Volume (m³): 1.8

Invert Level (m) 24.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.010	1.5058	0.025	3.7825	0.040	5.1330
0.015	2.5061	0.030	4.2803	0.045	5.5100
0.020	3.2084	0.035	4.7259	0.049	5.7941

Depth/Flow Relationship Manhole: 4, DS/PN: 2.001, Volume (m³): 1.8

Invert Level (m) 23.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.010	2.9280	0.035	9.1892	0.055	12.0472
0.015	4.8731	0.040	9.9807	0.060	12.6614
0.020	6.2386	0.045	10.7140	0.065	13.2470
0.025	7.3549	0.049	11.2662		
0.030	8.3227	0.050	11.4001		

Orifice Manhole: 5, DS/PN: 4.001, Volume (m³): 0.1

Diameter (m) 0.036 Invert Level (m) 21.650
Discharge Coefficient 0.600

Hydro-Brake® Optimum Manhole: 4, DS/PN: 4.002, Volume (m³): 0.2

Unit Reference	MD-SHE-0064-2000-1250-2000
Design Head (m)	1.250
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	64
Invert Level (m)	19.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.250	2.0
Flush-Flo™	0.279	1.7
Kick-Flo®	0.567	1.4
Mean Flow over Head Range	-	1.6

Hydro-Brake® Optimum Manhole: 4, DS/PN: 4.002, Volume (m³): 0.2

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)
0.100	1.5	1.600	2.2	5.000	3.8
0.200	1.7	1.800	2.4	5.500	4.0
0.300	1.7	2.000	2.5	6.000	4.1
0.400	1.7	2.200	2.6	6.500	4.3
0.500	1.6	2.400	2.7	7.000	4.4
0.600	1.4	2.600	2.8	7.500	4.6
0.800	1.6	3.000	3.0	8.000	4.7
1.000	1.8	3.500	3.2	8.500	4.9
1.200	2.0	4.000	3.4	9.000	5.0
1.400	2.1	4.500	3.6	9.500	5.1

Storage Structures for Plot A

Cellular Storage Manhole: 1, DS/PN: 1.001

Invert Level (m)	24.000
Infiltration Coefficient Base (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000
Safety Factor	2.0
Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	308.0	0.0	0.050	0.0	0.0
0.049	308.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 2.001

Invert Level (m)	23.500
Infiltration Coefficient Base (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000
Safety Factor	2.0
Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	870.0	0.0	0.081	0.0	0.0
0.080	870.0	0.0			

Cellular Storage Manhole: 5, DS/PN: 4.001

Invert Level (m)	21.650
Infiltration Coefficient Base (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000
Safety Factor	2.0
Porosity	0.90

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	27.0	0.0	0.166	0.1	0.0
0.165	27.0	0.0			

Tank or Pond Manhole: 4, DS/PN: 4.002

Invert Level (m) 19.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3.9	0.901	2.8	1.251	0.1
0.900	3.9	1.250	2.8		

Summary of Critical Results by Maximum Level (Rank 1) for Plot A

Simulation Criteria

Areal Reduction Factor	1.000
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coeff (Global)	0.500
Foul Sewage per hectare (l/s)	0.000
Additional Flow - % of Total Flow	0.000
MADD Factor * 10m³/ha Storage	2.000
Inlet Coeffiecient	0.800
Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0 Number of Storage Structures 4
Number of Online Controls 4 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location GB 529623 183745 TQ 29623 83745	
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm) 100.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	120 Winter	100	+40%				
1.001	1	120 Summer	100	+40%	100/15 Summer			
2.000	4	120 Winter	100	+40%				
2.001	4	120 Summer	100	+40%				
3.000	5	120 Summer	100	+40%				
1.002	2	120 Summer	100	+40%	100/15 Summer			
4.000	7	120 Winter	100	+40%				
4.001	5	120 Summer	100	+40%				
4.002	4	120 Summer	100	+40%	100/15 Summer			

Summary of Critical Results by Maximum Level (Rank 1) for Plot A

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	24.500	-0.150	0.000	0.00		0.0	OK	
1.001	1	24.049	0.399	0.000	0.23		5.8	SURCHARGED	
2.000	4	24.500	-0.150	0.000	0.00		0.0	OK	
2.001	4	23.570	-0.155	0.000	0.21		13.2	OK	
3.000	5	23.167	-0.083	0.000	0.00		0.0	OK	
1.002	2	23.167	0.607	0.000	0.35		19.4	SURCHARGED	
4.000	7	22.000	-0.150	0.000	0.00		0.0	OK	
4.001	5	21.793	-0.007	0.000	0.07		1.0	OK	
4.002	4	20.630	0.980	0.000	0.08		1.9	SURCHARGED	