Appendix F – Proposed Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes pipesize Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 533126 189013 TQ 33126 89013
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.950
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
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	0.099	4-8	0.049

Total Area Contributing (ha) = 0.148

Total Pipe Volume (m³) = 5.935

Network Design Table for Storm

« - 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	5.434	0.054	100.6	0.015	5.00	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	5.09	12.500	0.015	0.0	0.0	0.0	1.00	17.7	2.6

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Network Design Table for Storm

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
1.001	13.374	0.134	99.8	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	3.303	0.041	80.6	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	3.964	0.050	79.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	3.328	0.088	37.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	22.312	0.279	80.0	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	3.630	0.045	80.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	31.069	0.388	80.1	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	6.836	0.085	80.4	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	3.832	0.048	79.8	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	5.417	0.068	79.7	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
3.002	4.182	0.086	48.6	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.006	24.973	0.416	60.0	0.002	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	9.575	0.160	59.8	0.008	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	5.725	0.072	79.5	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
4.001	3.035	0.038	79.9	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
4.002	4.153	0.112	37.1	0.000	0.00	0.0	0.600	o	100	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)
1.001	50.00	5.31	12.446	0.019	0.0	0.0	0.0	1.01	17.8	3.3
2.000	50.00	5.05	19.000	0.000	0.0	0.0	0.0	1.12	19.8	0.0
2.001	50.00	5.11	18.959	0.000	0.0	0.0	0.0	1.13	20.0	0.0
2.002	50.00	5.14	12.400	0.000	0.0	0.0	0.0	1.64	29.0	0.0
1.002	50.00	5.64	12.312	0.025	0.0	0.0	0.0	1.13	19.9	4.3
1.003	50.00	5.70	12.033	0.025	0.0	0.0	0.0	1.12	19.8	4.3
1.004	50.00	6.16	11.988	0.032	0.0	0.0	0.0	1.12	19.9	5.5
1.005	50.00	6.26	11.599	0.039	0.0	0.0	0.0	1.12	19.8	6.7
3.000	50.00	5.07	19.000	0.000	0.0	0.0	0.0	0.86	6.8	0.0
3.001	50.00	5.18	18.952	0.000	0.0	0.0	0.0	0.86	6.8	0.0
3.002	50.00	5.24	11.600	0.000	0.0	0.0	0.0	1.11	8.7	0.0
1.006	50.00	6.58	11.514	0.041	0.0	0.0	0.0	1.30	23.0	7.0
1.007	50.00	6.70	11.098	0.049	0.0	0.0	0.0	1.30	23.0	8.4
4.000	50.00	5.11	19.000	0.000	0.0	0.0	0.0	0.86	6.8	0.0
4.001	50.00	5.17	18.928	0.000	0.0	0.0	0.0	0.86	6.8	0.0
4.002	50.00	5.22	11.050	0.000	0.0	0.0	0.0	1.27	10.0	0.0

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	13.580	1.080	Open Manhole	1200	1.000	12.500	150				
2	13.470	1.024	Open Manhole	1200	1.001	12.446	150	1.000	12.446	150	
3	20.000	1.000	Open Manhole	100	2.000	19.000	150				
4	20.000	1.041	Open Manhole	100	2.001	18.959	150	2.000	18.959	150	
5	20.000	7.600	Open Manhole	100	2.002	12.400	150	2.001	18.909	150	6509
3	13.270	0.958	Open Manhole	1200	1.002	12.312	150	1.001	12.312	150	
								2.002	12.312	150	
4	13.350	1.317	Open Manhole	1200	1.003	12.033	150	1.002	12.033	150	
5	13.350	1.362	Open Manhole	1200	1.004	11.988	150	1.003	11.988	150	
6	13.220	1.621	Open Manhole	1200	1.005	11.599	150	1.004	11.600	150	1
10	20.000	1.000	Open Manhole	100	3.000	19.000	100				
11	20.000	1.048	Open Manhole	100	3.001	18.952	100	3.000	18.952	100	
12	20.000	8.400	Open Manhole	100	3.002	11.600	100	3.001	18.884	100	7284
7	13.150	1.636	Open Manhole	1200	1.006	11.514	150	1.005	11.514	150	
								3.002	11.514	100	
9	13.110	2.012	Open Manhole	1200	1.007	11.098	150	1.006	11.098	150	
15	20.000	1.000	Open Manhole	100	4.000	19.000	100				
16	20.000	1.072	Open Manhole	100	4.001	18.928	100	4.000	18.928	100	
17	20.000	8.950	Open Manhole	100	4.002	11.050	100	4.001	18.890	100	7840
10	13.000	2.062	Open Manhole	1200	1.008	10.938	150	1.007	10.938	150	
								4.002	10.938	100	
11	12.900	2.900	Open Manhole	100	1.009	10.000	225	1.008	10.000	150	
20	20.000	1.000	Open Manhole	100	5.000	19.000	100				
21	20.000	1.089	Open Manhole	100	5.001	18.911	100	5.000	18.911	100	
22	20.000	10.000	Open Manhole	100	5.002	10.000	100	5.001	18.866	100	8866
13	12.550	2.785	Open Manhole	1200	1.010	9.765	225	1.009	9.765	225	
								5.002	9.765	100	
14	12.450	2.851	Open Manhole	1200	1.011	9.599	225	1.010	9.599	225	
25	20.000	1.000	Open Manhole	100	6.000	19.000	100				
26	20.000	1.091	Open Manhole	100	6.001	18.909	100	6.000	18.909	100	
27	20.000	10.150	Open Manhole	100	6.002	9.850	100	6.001	18.851	100	9001
15	12.080	2.567	Open Manhole	1200	1.012	9.513	225	1.011	9.513	225	
								6.002	9.513	100	
16	11.420	2.053	Open Manhole	1200	1.013	9.367	150	1.012	9.367	225	
17	10.600	1.431	Open Manhole	1200	1.014	9.169	150	1.013	9.169	150	
	10.550	1.590	Open Manhole	0		OUTFALL		1.014	8.960	150	

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Network Design Table for Storm

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
1.008	17.755	0.938	18.9	0.015	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.009	23.517	0.235	100.1	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	7.146	0.089	80.3	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
5.001	3.596	0.045	79.9	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
5.002	2.357	0.235	10.0	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.010	16.573	0.166	99.8	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.011	8.557	0.086	99.5	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.000	7.245	0.091	79.6	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
6.001	4.619	0.058	79.6	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
6.002	4.229	0.337	12.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.012	14.562	0.146	99.7	0.017	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.013	19.805	0.198	100.0	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.014	3.593	0.209	17.2	0.000	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)
1.008	50.00	6.83	10.938	0.064	0.0	0.0	0.0	2.33	41.1	11.0
1.009	50.00	7.13	10.000	0.078	0.0	0.0	0.0	1.31	52.0	13.4
5.000	50.00	5.14	19.000	0.000	0.0	0.0	0.0	0.86	6.8	0.0
5.001	50.00	5.21	18.911	0.000	0.0	0.0	0.0	0.86	6.8	0.0
5.002	50.00	5.22	10.000	0.000	0.0	0.0	0.0	2.45	19.3	0.0
1.010	50.00	7.34	9.765	0.103	0.0	0.0	0.0	1.31	52.0	17.7
1.011	50.00	7.45	9.599	0.113	0.0	0.0	0.0	1.31	52.1	19.4
6.000	50.00	5.14	19.000	0.000	0.0	0.0	0.0	0.86	6.8	0.0
6.001	50.00	5.23	18.909	0.000	0.0	0.0	0.0	0.86	6.8	0.0
6.002	50.00	5.26	9.850	0.000	0.0	0.0	0.0	2.19	17.2	0.0
1.012	50.00	7.63	9.513	0.130	0.0	0.0	0.0	1.31	52.1	22.3
1.013	50.00	7.96	9.367	0.148	0.0	0.0	0.0	1.00	17.8«	25.4
1.014	50.00	7.99	9.169	0.148	0.0	0.0	0.0	2.44	43.1	25.4

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	533025.598	189042.819	533025.598	189042.819	Required	
2	533031.032	189042.870	533031.032	189042.870	Required	
3	533021.493	189027.363	533021.493	189027.363	Required	
4	533024.796	189027.363	533024.796	189027.363	Required	
5	533028.640	189028.328	533028.640	189028.328	Required	
3	533031.750	189029.515	533031.750	189029.515	Required	
4	533054.055	189028.987	533054.055	189028.987	Required	
5	533055.614	189032.265	533055.614	189032.265	Required	
6	533086.683	189032.322	533086.683	189032.322	Required	
10	533073.206	189025.728	533073.206	189025.728	Required	
11	533077.038	189025.728	533077.038	189025.728	Required	
12	533082.454	189025.677	533082.454	189025.677	Required	
7	533086.632	189025.487	533086.632	189025.487	Required	
9	533111.602	189025.088	533111.602	189025.088	Required	
15	533110.907	189018.561	533110.907	189018.561	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
16	533116.630	189018.443	533116.630	189018.443	Required	
17	533117.987	189021.157	533117.987	189021.157	Required	
10	533121.103	189023.903	533121.103	189023.903	Required	
11	533135.841	189014.001	533135.841	189014.001	Required	
20	533149.972	189005.550	533149.972	189005.550	Required	
21	533157.012	189004.320	533157.012	189004.320	Required	
22	533157.559	189007.873	533157.559	189007.873	Required	
13	533158.972	189009.759	533158.972	189009.759	Required	
14	533175.280	189006.807	533175.280	189006.807	Required	
25	533189.212	188998.766	533189.212	188998.766	Required	
26	533182.067	188999.966	533182.067	188999.966	Required	
27	533183.039	189004.482	533183.039	189004.482	Required	
15	533183.632	189008.669	533183.632	189008.669	Required	
16	533197.990	189006.238	533197.990	189006.238	Required	
17	533200.915	188986.650	533200.915	188986.650	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
	533203.525	188984.182			No Entry	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.015	0.015	0.015
1.001	-	-	100	0.004	0.004	0.004
2.000	-	-	100	0.000	0.000	0.000
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.006	0.006	0.006
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.007	0.007	0.007
1.005	-	-	100	0.007	0.007	0.007
3.000	-	-	100	0.000	0.000	0.000
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.002	0.002	0.002
1.007	-	-	100	0.008	0.008	0.008
4.000	-	-	100	0.000	0.000	0.000
4.001	-	-	100	0.000	0.000	0.000
4.002	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.015	0.015	0.015
1.009	-	-	100	0.014	0.014	0.014
5.000	-	-	100	0.000	0.000	0.000
5.001	-	-	100	0.000	0.000	0.000
5.002	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.025	0.025	0.025
1.011	-	-	100	0.010	0.010	0.010
6.000	-	-	100	0.000	0.000	0.000
6.001	-	-	100	0.000	0.000	0.000
6.002	-	-	100	0.000	0.000	0.000
1.012	-	-	100	0.017	0.017	0.017
1.013	-	-	100	0.018	0.018	0.018
1.014	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.148	0.148	0.148

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)
1.014		10.550	8.960	0.000	0	0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.950	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	10
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 533126 189013 TQ 33126 89013
Data Type	Point
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.950
Cv (Winter)	0.840
Storm Duration (mins)	30

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Online Controls for Storm

Orifice Manhole: 7, DS/PN: 1.006, Volume (m³): 2.0

Diameter (m) 0.023 Discharge Coefficient 0.600 Invert Level (m) 11.514

Hydro-Brake® Optimum Manhole: 16, DS/PN: 1.013, Volume (m³): 2.9

Unit Reference	MD-SHE-0062-2500-2300-2500
Design Head (m)	2.300
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	62
Invert Level (m)	9.367
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.300	2.5
Flush-Flo™	0.271	1.6
Kick-Flo®	0.550	1.3
Mean Flow over Head Range	-	1.8

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)
0.100	1.4	1.200	1.9	3.000	2.8	7.000	4.2
0.200	1.6	1.400	2.0	3.500	3.0	7.500	4.3
0.300	1.6	1.600	2.1	4.000	3.2	8.000	4.5
0.400	1.6	1.800	2.2	4.500	3.4	8.500	4.6
0.500	1.4	2.000	2.3	5.000	3.6	9.000	4.7
0.600	1.4	2.200	2.4	5.500	3.7	9.500	4.8
0.800	1.5	2.400	2.5	6.000	3.9		
1.000	1.7	2.600	2.6	6.500	4.0		

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Storage Structures for Storm

Cellular Storage Manhole: 7, DS/PN: 1.006

Invert Level (m) 11.514 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)
0.000	55.0	0.0	0.800	55.0	0.0

Cellular Storage Manhole: 11, DS/PN: 1.009

Invert Level (m) 10.000 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)
0.000	135.0	0.0	1.200	135.0	0.0

Time Area Diagram for Green Roof at Pipe Number 2.000 (Storm)

Area (m³) 173 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003144	32	36	0.000635	64	68	0.000128	96	100	0.000026
4	8	0.002574	36	40	0.000520	68	72	0.000105	100	104	0.000021
8	12	0.002107	40	44	0.000425	72	76	0.000086	104	108	0.000017
12	16	0.001725	44	48	0.000348	76	80	0.000070	108	112	0.000014
16	20	0.001413	48	52	0.000285	80	84	0.000058	112	116	0.000012
20	24	0.001157	52	56	0.000233	84	88	0.000047	116	120	0.000010
24	28	0.000947	56	60	0.000191	88	92	0.000039			
28	32	0.000775	60	64	0.000157	92	96	0.000032			

Time Area Diagram at Pipe Number 2.000 for Storm

Total Area (ha) 0.018

Time (mins) From:	To:	Area (ha)
0	4	0.018

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Time Area Diagram for Green Roof at Pipe Number 3.000 (Storm)

Area (m³) 213 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003871	32	36	0.000781	64	68	0.000158	96	100	0.000032
4	8	0.003169	36	40	0.000640	68	72	0.000129	100	104	0.000026
8	12	0.002595	40	44	0.000524	72	76	0.000106	104	108	0.000021
12	16	0.002124	44	48	0.000429	76	80	0.000087	108	112	0.000017
16	20	0.001739	48	52	0.000351	80	84	0.000071	112	116	0.000014
20	24	0.001424	52	56	0.000287	84	88	0.000058	116	120	0.000012
24	28	0.001166	56	60	0.000235	88	92	0.000048			
28	32	0.000954	60	64	0.000193	92	96	0.000039			

Time Area Diagram at Pipe Number 3.000 for Storm

Total Area (ha) 0.011

Time (mins) From:	To:	Area (ha)
0	4	0.011

Time Area Diagram for Green Roof at Pipe Number 4.000 (Storm)

Area (m³) 213 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003871	32	36	0.000781	64	68	0.000158	96	100	0.000032
4	8	0.003169	36	40	0.000640	68	72	0.000129	100	104	0.000026
8	12	0.002595	40	44	0.000524	72	76	0.000106	104	108	0.000021
12	16	0.002124	44	48	0.000429	76	80	0.000087	108	112	0.000017
16	20	0.001739	48	52	0.000351	80	84	0.000071	112	116	0.000014
20	24	0.001424	52	56	0.000287	84	88	0.000058	116	120	0.000012
24	28	0.001166	56	60	0.000235	88	92	0.000048			
28	32	0.000954	60	64	0.000193	92	96	0.000039			

Time Area Diagram at Pipe Number 4.000 for Storm

Total Area (ha) 0.011

Time (mins) From:	To:	Area (ha)
0	4	0.011

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Time Area Diagram for Green Roof at Pipe Number 5.000 (Storm)

Area (m³) 215 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003907	32	36	0.000789	64	68	0.000159	96	100	0.000032
4	8	0.003199	36	40	0.000646	68	72	0.000130	100	104	0.000026
8	12	0.002619	40	44	0.000529	72	76	0.000107	104	108	0.000022
12	16	0.002144	44	48	0.000433	76	80	0.000087	108	112	0.000018
16	20	0.001756	48	52	0.000354	80	84	0.000072	112	116	0.000014
20	24	0.001437	52	56	0.000290	84	88	0.000059	116	120	0.000012
24	28	0.001177	56	60	0.000238	88	92	0.000048			
28	32	0.000963	60	64	0.000195	92	96	0.000039			

Time Area Diagram at Pipe Number 5.000 for Storm

Total Area (ha) 0.008

Time (mins) From:	To:	Area (ha)
0	4	0.008

Time Area Diagram for Green Roof at Pipe Number 6.000 (Storm)

Area (m³) 114 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.002072	32	36	0.000418	64	68	0.000084	96	100	0.000017
4	8	0.001696	36	40	0.000342	68	72	0.000069	100	104	0.000014
8	12	0.001389	40	44	0.000280	72	76	0.000057	104	108	0.000011
12	16	0.001137	44	48	0.000230	76	80	0.000046	108	112	0.000009
16	20	0.000931	48	52	0.000188	80	84	0.000038	112	116	0.000008
20	24	0.000762	52	56	0.000154	84	88	0.000031	116	120	0.000006
24	28	0.000624	56	60	0.000126	88	92	0.000025			
28	32	0.000511	60	64	0.000103	92	96	0.000021			

Time Area Diagram at Pipe Number 6.000 for Storm

Total Area (ha) 0.011

Time (mins) From:	To:	Area (ha)
0	4	0.011

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

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 Coeffiecient 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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 10
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 533126 189013 TQ 33126 89013
Data Type Point
Cv (Summer) 0.900
Cv (Winter) 0.900

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, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	2	+0%	100/15 Summer				12.545
1.001	2	15 Summer	2	+0%	100/15 Summer				12.493
2.000	3	15 Summer	2	+0%	100/15 Summer				19.056
2.001	4	15 Summer	2	+0%	100/15 Summer				19.012
2.002	5	15 Summer	2	+0%	30/15 Summer				12.446
1.002	3	15 Summer	2	+0%	30/15 Summer				12.381
1.003	4	15 Summer	2	+0%	30/15 Summer				12.117
1.004	5	15 Summer	2	+0%	30/15 Summer				12.061
1.005	6	480 Summer	2	+0%	2/120 Summer				11.860
3.000	10	15 Summer	2	+0%	30/30 Summer				19.044
3.001	11	15 Summer	2	+0%	100/15 Summer				18.995
3.002	12	480 Summer	2	+0%	2/120 Summer				11.860
1.006	7	480 Summer	2	+0%	2/60 Summer				11.859
1.007	9	15 Summer	2	+0%	100/360 Summer				11.124
4.000	15	15 Summer	2	+0%	30/30 Summer				19.043
4.001	16	15 Summer	2	+0%	30/15 Summer				18.974

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.105	0.000	0.19			2.8	OK	
1.001	2	-0.103	0.000	0.21			3.4	OK	
2.000	3	-0.094	0.000	0.30			3.8	OK	
2.001	4	-0.097	0.000	0.27			3.8	OK	
2.002	5	-0.104	0.000	0.20			3.8	OK	
1.002	3	-0.081	0.000	0.43			8.0	OK	
1.003	4	-0.066	0.000	0.61			8.1	OK	
1.004	5	-0.077	0.000	0.46			8.9	OK	
1.005	6	0.111	0.000	0.16			2.6	SURCHARGED	
3.000	10	-0.056	0.000	0.40			2.3	OK	
3.001	11	-0.057	0.000	0.39			2.3	OK	
3.002	12	0.160	0.000	0.15			1.1	SURCHARGED	
1.006	7	0.195	0.000	0.03		390	0.6	SURCHARGED	
1.007	9	-0.124	0.000	0.07			1.4	OK	
4.000	15	-0.057	0.000	0.38			2.3	OK	
4.001	16	-0.054	0.000	0.42			2.3	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
4.002	17	15 Summer	2	+0%	100/15 Summer				11.086
1.008	10	15 Summer	2	+0%	100/240 Summer				10.978
1.009	11	360 Summer	2	+0%	30/30 Summer				10.186
5.000	20	120 Summer	2	+0%	100/15 Summer				19.038
5.001	21	120 Summer	2	+0%	100/15 Summer				18.950
5.002	22	120 Summer	2	+0%	2/15 Summer				10.215
1.010	13	120 Summer	2	+0%	2/15 Summer				10.210
1.011	14	120 Summer	2	+0%	2/15 Summer				10.220
6.000	25	15 Summer	2	+0%	100/15 Summer				19.042
6.001	26	15 Summer	2	+0%	100/15 Summer				18.952
6.002	27	120 Summer	2	+0%	2/15 Summer				10.231
1.012	15	120 Summer	2	+0%	2/15 Summer				10.225
1.013	16	120 Summer	2	+0%	2/15 Summer				10.224
1.014	17	1440 Winter	2	+0%					9.192

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.002	17	-0.064	0.000	0.27			2.3	OK	
1.008	10	-0.110	0.000	0.16			6.0	OK	
1.009	11	-0.039	0.000	0.03		264	1.5	OK	
5.000	20	-0.062	0.000	0.29			1.8	OK	
5.001	21	-0.061	0.000	0.31			1.7	OK	
5.002	22	0.115	0.000	0.13			1.7	SURCHARGED	
1.010	13	0.220	0.000	0.05			2.4	SURCHARGED	
1.011	14	0.396	0.000	0.04			1.8	SURCHARGED	
6.000	25	-0.058	0.000	0.37			2.3	OK	
6.001	26	-0.057	0.000	0.39			2.3	OK	
6.002	27	0.281	0.000	0.10			1.5	SURCHARGED	
1.012	15	0.487	0.000	0.05			2.1	SURCHARGED	
1.013	16	0.707	0.000	0.10			1.6	SURCHARGED	
1.014	17	-0.127	0.000	0.06			1.6	OK	

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

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 Coeffiecient 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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 10
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 533126 189013 TQ 33126 89013
Data Type Point
Cv (Summer) 0.900
Cv (Winter) 0.900

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, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	30	+0%	100/15 Summer				12.597
1.001	2	15 Summer	30	+0%	100/15 Summer				12.582
2.000	3	15 Summer	30	+0%	100/15 Summer				19.097
2.001	4	15 Summer	30	+0%	100/15 Summer				19.050
2.002	5	15 Summer	30	+0%	30/15 Summer				12.557
1.002	3	15 Summer	30	+0%	30/15 Summer				12.546
1.003	4	360 Winter	30	+0%	30/15 Summer				12.304
1.004	5	360 Winter	30	+0%	30/15 Summer				12.303
1.005	6	360 Winter	30	+0%	2/120 Summer				12.299
3.000	10	30 Summer	30	+0%	30/30 Summer				19.115
3.001	11	30 Summer	30	+0%	100/15 Summer				19.033
3.002	12	360 Winter	30	+0%	2/120 Summer				12.300
1.006	7	360 Winter	30	+0%	2/60 Summer				12.298

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.053	0.000	0.49			7.1	OK	
1.001	2	-0.014	0.000	0.52			8.5	OK	
2.000	3	-0.053	0.000	0.75			9.5	OK	
2.001	4	-0.059	0.000	0.68			9.6	OK	
2.002	5	0.007	0.000	0.51			9.5	SURCHARGED	
1.002	3	0.084	0.000	0.99			18.6	SURCHARGED	
1.003	4	0.121	0.000	0.28			3.7	SURCHARGED	
1.004	5	0.165	0.000	0.22			4.2	SURCHARGED	
1.005	6	0.550	0.000	0.26			4.3	SURCHARGED	
3.000	10	0.015	0.000	1.04			5.9	SURCHARGED	
3.001	11	-0.019	0.000	0.98			5.9	OK	
3.002	12	0.600	0.000	0.26			1.9	SURCHARGED	
1.006	7	0.634	0.000	0.04			1.0	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.007	9	15 Summer	30	+0%	100/360 Summer				11.146
4.000	15	30 Summer	30	+0%	30/30 Summer				19.110
4.001	16	60 Summer	30	+0%	30/15 Summer				19.031
4.002	17	60 Summer	30	+0%	100/15 Summer				11.112
1.008	10	15 Summer	30	+0%	100/240 Summer				11.011
1.009	11	360 Winter	30	+0%	30/30 Summer				10.566
5.000	20	30 Summer	30	+0%	100/15 Summer				19.083
5.001	21	30 Summer	30	+0%	100/15 Summer				18.997
5.002	22	360 Winter	30	+0%	2/15 Summer				10.564
1.010	13	360 Winter	30	+0%	2/15 Summer				10.563
1.011	14	360 Winter	30	+0%	2/15 Summer				10.560
6.000	25	15 Summer	30	+0%	100/15 Summer				19.077
6.001	26	15 Summer	30	+0%	100/15 Summer				18.997
6.002	27	15 Summer	30	+0%	2/15 Summer				10.675
1.012	15	15 Summer	30	+0%	2/15 Summer				10.622
1.013	16	15 Summer	30	+0%	2/15 Summer				10.650
1.014	17	15 Summer	30	+0%					9.194

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	9	-0.102	0.000	0.22			4.5	OK	
4.000	15	0.010	0.000	0.98			5.9	SURCHARGED	
4.001	16	0.003	0.000	1.09			5.9	SURCHARGED	
4.002	17	-0.038	0.000	0.69			5.9	OK	
1.008	10	-0.077	0.000	0.47			18.0	OK	
1.009	11	0.341	0.000	0.04			1.8	SURCHARGED	
5.000	20	-0.017	0.000	0.85			5.2	OK	
5.001	21	-0.014	0.000	0.93			5.3	OK	
5.002	22	0.464	0.000	0.13			1.7	SURCHARGED	
1.010	13	0.573	0.000	0.04			2.0	SURCHARGED	
1.011	14	0.736	0.000	0.04			1.8	SURCHARGED	
6.000	25	-0.023	0.000	0.95			5.8	OK	
6.001	26	-0.012	0.000	1.00			5.9	OK	
6.002	27	0.725	0.000	0.40			5.8	SURCHARGED	
1.012	15	0.884	0.000	0.10			4.7	SURCHARGED	
1.013	16	1.133	0.000	0.11			1.9	SURCHARGED	
1.014	17	-0.125	0.000	0.07			1.9	OK	

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

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 Coeffiecient 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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 10
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 533126 189013 TQ 33126 89013
Data Type Point
Cv (Summer) 0.900
Cv (Winter) 0.900

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, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	100	+40%	100/15 Summer				13.373
1.001	2	15 Summer	100	+40%	100/15 Summer				13.345
2.000	3	15 Summer	100	+40%	100/15 Summer				19.260
2.001	4	15 Summer	100	+40%	100/15 Summer				19.147
2.002	5	15 Summer	100	+40%	30/15 Summer				13.353
1.002	3	15 Summer	100	+40%	30/15 Summer				13.264
1.003	4	480 Winter	100	+40%	30/15 Summer				13.120
1.004	5	480 Winter	100	+40%	30/15 Summer				13.118
1.005	6	480 Winter	100	+40%	2/120 Summer				13.113
3.000	10	30 Summer	100	+40%	30/30 Summer				19.601
3.001	11	30 Summer	100	+40%	100/15 Summer				19.329
3.002	12	480 Winter	100	+40%	2/120 Summer				13.112
1.006	7	480 Winter	100	+40%	2/60 Summer				13.110

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.723	0.000	0.62			9.0	FLOOD RISK	
1.001	2	0.749	0.000	0.68			11.1	FLOOD RISK	
2.000	3	0.110	0.000	1.52			19.3	SURCHARGED	
2.001	4	0.038	0.000	1.37			19.2	SURCHARGED	
2.002	5	0.803	0.000	1.02			19.0	SURCHARGED	
1.002	3	0.802	0.000	1.32			24.9	FLOOD RISK	
1.003	4	0.937	0.000	0.39			5.2	FLOOD RISK	
1.004	5	0.980	0.000	0.30			5.7	FLOOD RISK	
1.005	6	1.364	0.000	0.37			6.2	FLOOD RISK	
3.000	10	0.501	0.000	2.33			13.3	SURCHARGED	
3.001	11	0.277	0.000	2.23			13.4	SURCHARGED	
3.002	12	1.412	0.000	0.41			3.0	SURCHARGED	
1.006	7	1.446	0.000	0.06			1.4	FLOOD RISK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.007	9	480 Winter	100	+40%	100/360 Summer				11.329
4.000	15	30 Summer	100	+40%	30/30 Summer				19.595
4.001	16	30 Summer	100	+40%	30/15 Summer				19.225
4.002	17	30 Summer	100	+40%	100/15 Summer				11.327
1.008	10	480 Winter	100	+40%	100/240 Summer				11.324
1.009	11	480 Winter	100	+40%	30/30 Summer				11.316
5.000	20	30 Summer	100	+40%	100/15 Summer				19.455
5.001	21	30 Summer	100	+40%	100/15 Summer				19.144
5.002	22	480 Winter	100	+40%	2/15 Summer				11.314
1.010	13	480 Winter	100	+40%	2/15 Summer				11.313
1.011	14	480 Winter	100	+40%	2/15 Summer				11.309
6.000	25	15 Summer	100	+40%	100/15 Summer				19.496
6.001	26	15 Summer	100	+40%	100/15 Summer				19.173
6.002	27	15 Summer	100	+40%	2/15 Summer				11.351
1.012	15	480 Winter	100	+40%	2/15 Summer				11.307
1.013	16	480 Winter	100	+40%	2/15 Summer				11.303
1.014	17	480 Winter	100	+40%					9.197

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	9	0.081	0.000	0.09			1.8	SURCHARGED	
4.000	15	0.495	0.000	2.22			13.4	SURCHARGED	
4.001	16	0.197	0.000	2.47			13.4	SURCHARGED	
4.002	17	0.177	0.000	1.58			13.4	SURCHARGED	
1.008	10	0.236	0.000	0.16			6.3	SURCHARGED	
1.009	11	1.091	0.000	0.05			2.3	SURCHARGED	
5.000	20	0.355	0.000	1.83			11.2	SURCHARGED	
5.001	21	0.133	0.000	1.99			11.3	SURCHARGED	
5.002	22	1.214	0.000	0.20			2.7	SURCHARGED	
1.010	13	1.323	0.000	0.05			2.3	SURCHARGED	
1.011	14	1.485	0.000	0.05			2.3	SURCHARGED	
6.000	25	0.396	0.000	1.86			11.4	SURCHARGED	
6.001	26	0.164	0.000	1.93			11.3	SURCHARGED	
6.002	27	1.401	0.000	0.76			11.2	SURCHARGED	
1.012	15	1.569	0.000	0.05			2.3	SURCHARGED	
1.013	16	1.786	0.000	0.14			2.3	FLOOD RISK	
1.014	17	-0.122	0.000	0.08			2.3	OK	

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