

## Appendix F Drainage Calculations

Calculated by:

Site name:

Site location:

## Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Runoff estimation approach

## Site characteristics

Total site area (ha):

## Methodology

Q<sub>BAR</sub> estimation method:

SPR estimation method:

## Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

## Hydrological characteristics

	Default	Edited
SAAR (mm):	680	680
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

## Notes

### (1) Is Q<sub>BAR</sub> < 2.0 l/s/ha?

When Q<sub>BAR</sub> is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

### (2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

	Default	Edited
Q <sub>BAR</sub> (l/s):	4.47	4.47
1 in 1 year (l/s):	3.8	3.8
1 in 30 years (l/s):	10.28	10.28
1 in 100 year (l/s):	14.26	14.26
1 in 200 years (l/s):	16.72	16.72



**Design Settings**

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	10	Maximum Rainfall (mm/hr)	250.0
Additional Flow (%)	10	Minimum Velocity (m/s)	0.75
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.450
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

**Nodes**

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
36		5.00	5.550	1200	482326.801	97442.064	0.550
35	0.008	5.00	5.550	1200	482352.860	97438.040	0.802
34	0.009	5.00	5.500	1200	482350.443	97422.382	0.903
33			5.400	1200	482351.699	97418.544	0.843
32	0.010	5.00	5.550	1200	482321.378	97403.776	0.550
31	0.003	5.00	5.550	1200	482332.855	97400.523	0.664
30	0.004	5.00	5.500	1200	482336.229	97412.428	0.732
29			5.400	1200	482344.251	97417.051	0.843
28	0.005	5.00	5.550	1200	482359.661	97457.202	0.550
27	0.004	5.00	5.550	1200	482337.635	97476.033	0.550
26	0.010	5.00	5.550	1200	482337.661	97456.532	0.550
25	0.004	5.00	5.500	1200	482338.498	97466.818	0.599
24	0.006	5.00	5.500	1200	482348.028	97470.436	0.747
23	0.006	5.00	5.450	1200	482358.332	97471.400	0.756
22			5.400	1200	482367.776	97476.026	0.842
21	0.014	5.00	5.450	1200	482369.191	97510.117	0.600
20	0.006	5.00	5.500	1200	482336.899	97512.003	0.600
19	0.006	5.00	5.450	1200	482338.687	97492.906	0.658
18	0.014	5.00	5.400	1200	482367.600	97490.570	0.771
17			5.400	1200	482369.150	97478.865	0.842
16	0.008	5.00	5.450	1200	482383.507	97572.706	0.600
15	0.008	5.00	5.550	1200	482363.353	97556.563	0.550
14	0.008	5.00	5.550	1200	482374.657	97556.260	0.658
13	0.004	5.00	5.550	1200	482350.477	97550.745	0.550
12	0.008	5.00	5.450	1200	482376.357	97544.725	0.754
11	0.008	5.00	5.400	1200	482387.745	97546.420	0.769
10			5.400	1200	482392.899	97544.949	0.843
9		5.00	5.400	1200	482354.594	97415.959	0.850
8			5.200	1200	482358.691	97412.636	0.701
7			4.800	1200	482373.730	97408.440	0.550
6		5.00	5.400	1200	482378.050	97477.184	0.850
5			5.200	1200	482383.662	97476.233	0.705
4			4.800	1200	482395.490	97472.336	0.550
3		5.00	5.400	1200	482402.066	97541.384	0.850
2			5.200	1200	482405.911	97541.134	0.687
1			4.800	1200	482414.361	97538.663	0.550



**Links**

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
13.001	2	1	8.804	0.600	4.513	4.250	0.263	33.5	100	5.19	86.8
13.000	3	2	3.853	0.600	4.550	4.513	0.037	104.1	100	5.09	87.6
12.001	5	4	12.453	0.600	4.495	4.250	0.245	50.8	100	5.32	86.0
12.000	6	5	5.692	0.600	4.550	4.495	0.055	103.5	100	5.13	87.3
11.001	8	7	15.613	0.600	4.499	4.250	0.249	62.7	100	5.38	85.5
11.000	9	8	5.275	0.600	4.550	4.499	0.051	103.4	100	5.12	87.4
4.002	11	10	5.360	0.600	4.631	4.600	0.031	172.9	150	5.96	81.8
6.000	16	11	26.625	0.600	4.850	4.631	0.219	121.6	150	5.49	84.8
4.001	12	11	11.513	0.600	4.696	4.631	0.065	177.1	150	5.84	82.5
5.001	14	12	11.660	0.600	4.892	4.746	0.146	79.9	100	5.48	84.9
4.000	13	12	26.571	0.600	5.000	4.746	0.254	104.6	100	5.59	84.2
5.000	15	14	11.308	0.600	5.000	4.892	0.108	104.7	100	5.25	86.4
1.002	18	17	11.807	0.600	4.629	4.562	0.067	176.2	150	6.33	79.7
2.000	21	18	19.612	0.600	4.850	4.629	0.221	88.7	150	5.31	86.0
1.001	19	18	29.007	0.600	4.792	4.629	0.163	178.0	150	6.07	81.2
1.000	20	19	19.181	0.600	4.900	4.792	0.108	177.6	150	5.43	85.2
7.003	23	22	10.516	0.600	4.694	4.634	0.060	175.3	150	5.91	82.1
9.000	28	23	14.260	0.600	5.000	4.744	0.256	55.7	100	5.23	86.6
7.002	24	23	10.349	0.600	4.753	4.694	0.059	175.4	150	5.68	83.6
7.001	25	24	10.194	0.600	4.901	4.803	0.098	104.0	100	5.45	85.0
8.000	27	25	9.255	0.600	5.000	4.901	0.099	93.5	100	5.19	86.8
7.000	26	25	10.320	0.600	5.000	4.901	0.099	104.2	100	5.23	86.6
10.002	30	29	9.259	0.600	4.768	4.679	0.089	104.0	100	5.74	83.2
10.001	31	30	12.374	0.600	4.886	4.768	0.118	104.9	100	5.54	84.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
13.001	1.338	10.5	0.0	0.587	0.450	0.000	0.0	0	0.000
13.000	0.753	5.9	0.0	0.750	0.587	0.000	0.0	0	0.000
12.001	1.083	8.5	0.0	0.605	0.450	0.000	0.0	0	0.000
12.000	0.755	5.9	0.0	0.750	0.605	0.000	0.0	0	0.000
11.001	0.974	7.6	0.0	0.601	0.450	0.000	0.0	0	0.000
11.000	0.756	5.9	0.0	0.750	0.601	0.000	0.0	0	0.000
4.002	0.761	13.4	10.7	0.619	0.650	0.044	0.0	102	0.844
6.000	0.910	16.1	2.0	0.450	0.619	0.008	0.0	36	0.624
4.001	0.752	13.3	6.9	0.604	0.619	0.028	0.0	76	0.758
5.001	0.862	6.8	4.0	0.558	0.604	0.016	0.0	56	0.901
4.000	0.751	5.9	1.0	0.450	0.604	0.004	0.0	28	0.556
5.000	0.751	5.9	2.1	0.450	0.558	0.008	0.0	41	0.686
1.002	0.754	13.3	9.5	0.621	0.688	0.040	0.0	93	0.817
2.000	1.067	18.9	3.6	0.450	0.621	0.014	0.0	44	0.823
1.001	0.750	13.3	2.9	0.508	0.621	0.012	0.0	48	0.602
1.000	0.751	13.3	1.5	0.450	0.508	0.006	0.0	34	0.500
7.003	0.756	13.4	8.6	0.606	0.616	0.035	0.0	88	0.802
9.000	1.034	8.1	1.3	0.450	0.606	0.005	0.0	27	0.755
7.002	0.756	13.4	6.0	0.597	0.606	0.024	0.0	71	0.736
7.001	0.753	5.9	4.6	0.499	0.597	0.018	0.0	66	0.831
8.000	0.795	6.2	1.0	0.450	0.499	0.004	0.0	28	0.589
7.000	0.753	5.9	2.6	0.450	0.499	0.010	0.0	46	0.729
10.002	0.753	5.9	4.2	0.632	0.621	0.017	0.0	62	0.817
10.001	0.750	5.9	3.3	0.564	0.632	0.013	0.0	54	0.772



**Links**

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
10.000	32	31	11.929	0.600	5.000	4.886	0.114	104.6	100	5.26	86.3
3.002	34	33	4.038	0.600	4.597	4.558	0.039	103.5	100	6.03	81.4
3.001	35	34	15.843	0.600	4.748	4.597	0.151	104.9	100	5.94	82.0
3.000	36	35	26.368	0.600	5.000	4.748	0.252	104.6	100	5.59	84.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
10.000	0.751	5.9	2.6	0.450	0.564	0.010	0.0	46	0.728
3.002	0.755	5.9	4.1	0.803	0.742	0.017	0.0	61	0.816
3.001	0.750	5.9	2.0	0.702	0.803	0.008	0.0	39	0.672
3.000	0.751	5.9	0.0	0.450	0.702	0.000	0.0	0	0.000

**Pipeline Schedule**

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
13.001	8.804	33.5	100	Circular	5.200	4.513	0.587	4.800	4.250	0.450
13.000	3.853	104.1	100	Circular	5.400	4.550	0.750	5.200	4.513	0.587
12.001	12.453	50.8	100	Circular	5.200	4.495	0.605	4.800	4.250	0.450
12.000	5.692	103.5	100	Circular	5.400	4.550	0.750	5.200	4.495	0.605
11.001	15.613	62.7	100	Circular	5.200	4.499	0.601	4.800	4.250	0.450
11.000	5.275	103.4	100	Circular	5.400	4.550	0.750	5.200	4.499	0.601
4.002	5.360	172.9	150	Circular	5.400	4.631	0.619	5.400	4.600	0.650
6.000	26.625	121.6	150	Circular	5.450	4.850	0.450	5.400	4.631	0.619
4.001	11.513	177.1	150	Circular	5.450	4.696	0.604	5.400	4.631	0.619
5.001	11.660	79.9	100	Circular	5.550	4.892	0.558	5.450	4.746	0.604
4.000	26.571	104.6	100	Circular	5.550	5.000	0.450	5.450	4.746	0.604
5.000	11.308	104.7	100	Circular	5.550	5.000	0.450	5.550	4.892	0.558
1.002	11.807	176.2	150	Circular	5.400	4.629	0.621	5.400	4.562	0.688
2.000	19.612	88.7	150	Circular	5.450	4.850	0.450	5.400	4.629	0.621
1.001	29.007	178.0	150	Circular	5.450	4.792	0.508	5.400	4.629	0.621
1.000	19.181	177.6	150	Circular	5.500	4.900	0.450	5.450	4.792	0.508

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
13.001	2	1200	Manhole	Adoptable	1	1200	Manhole	Adoptable
13.000	3	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
12.001	5	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
12.000	6	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
11.001	8	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
11.000	9	1200	Manhole	Adoptable	8	1200	Manhole	Adoptable
4.002	11	1200	Manhole	Adoptable	10	1200	Manhole	Adoptable
6.000	16	1200	Manhole	Adoptable	11	1200	Manhole	Adoptable
4.001	12	1200	Manhole	Adoptable	11	1200	Manhole	Adoptable
5.001	14	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
4.000	13	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
5.000	15	1200	Manhole	Adoptable	14	1200	Manhole	Adoptable
1.002	18	1200	Manhole	Adoptable	17	1200	Manhole	Adoptable
2.000	21	1200	Manhole	Adoptable	18	1200	Manhole	Adoptable
1.001	19	1200	Manhole	Adoptable	18	1200	Manhole	Adoptable
1.000	20	1200	Manhole	Adoptable	19	1200	Manhole	Adoptable



**Pipeline Schedule**

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
7.003	10.516	175.3	150	Circular	5.450	4.694	0.606	5.400	4.634	0.616
9.000	14.260	55.7	100	Circular	5.550	5.000	0.450	5.450	4.744	0.606
7.002	10.349	175.4	150	Circular	5.500	4.753	0.597	5.450	4.694	0.606
7.001	10.194	104.0	100	Circular	5.500	4.901	0.499	5.500	4.803	0.597
8.000	9.255	93.5	100	Circular	5.550	5.000	0.450	5.500	4.901	0.499
7.000	10.320	104.2	100	Circular	5.550	5.000	0.450	5.500	4.901	0.499
10.002	9.259	104.0	100	Circular	5.500	4.768	0.632	5.400	4.679	0.621
10.001	12.374	104.9	100	Circular	5.550	4.886	0.564	5.500	4.768	0.632
10.000	11.929	104.6	100	Circular	5.550	5.000	0.450	5.550	4.886	0.564
3.002	4.038	103.5	100	Circular	5.500	4.597	0.803	5.400	4.558	0.742
3.001	15.843	104.9	100	Circular	5.550	4.748	0.702	5.500	4.597	0.803
3.000	26.368	104.6	100	Circular	5.550	5.000	0.450	5.550	4.748	0.702














Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7.003	23	1200	Manhole	Adoptable	22	1200	Manhole	Adoptable
9.000	28	1200	Manhole	Adoptable	23	1200	Manhole	Adoptable
7.002	24	1200	Manhole	Adoptable	23	1200	Manhole	Adoptable
7.001	25	1200	Manhole	Adoptable	24	1200	Manhole	Adoptable
8.000	27	1200	Manhole	Adoptable	25	1200	Manhole	Adoptable
7.000	26	1200	Manhole	Adoptable	25	1200	Manhole	Adoptable
10.002	30	1200	Manhole	Adoptable	29	1200	Manhole	Adoptable
10.001	31	1200	Manhole	Adoptable	30	1200	Manhole	Adoptable
10.000	32	1200	Manhole	Adoptable	31	1200	Manhole	Adoptable
3.002	34	1200	Manhole	Adoptable	33	1200	Manhole	Adoptable
3.001	35	1200	Manhole	Adoptable	34	1200	Manhole	Adoptable
3.000	36	1200	Manhole	Adoptable	35	1200	Manhole	Adoptable

**Manhole Schedule**

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
36	482326.801	97442.064	5.550	0.550	1200				
						0	3.000	5.000	100
35	482352.860	97438.040	5.550	0.802	1200				
						1	3.000	4.748	100
34	482350.443	97422.382	5.500	0.903	1200				
						1	3.001	4.597	100
33	482351.699	97418.544	5.400	0.843	1200				
						0	3.002	4.597	100
32	482321.378	97403.776	5.550	0.550	1200				
						1	3.002	4.558	100
						0	10.000	5.000	100

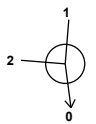





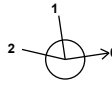
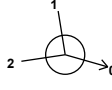


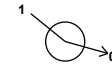




**Manhole Schedule**

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
31	482332.855	97400.523	5.550	0.664	1200		1	10.000	4.886	100
30	482336.229	97412.428	5.500	0.732	1200		0	10.001	4.886	100
29	482344.251	97417.051	5.400	0.843	1200		1	10.001	4.768	100
28	482359.661	97457.202	5.550	0.550	1200		0	10.002	4.768	100
27	482337.635	97476.033	5.550	0.550	1200		1	10.002	4.679	100
26	482337.661	97456.532	5.550	0.550	1200		0	9.000	5.000	100
25	482338.498	97466.818	5.500	0.599	1200		0	8.000	5.000	100
24	482348.028	97470.436	5.500	0.747	1200		1	8.000	4.901	100
23	482358.332	97471.400	5.450	0.756	1200		2	7.000	4.901	100
22	482367.776	97476.026	5.400	0.842	1200		0	7.001	4.901	100
21	482369.191	97510.117	5.450	0.600	1200		1	7.001	4.803	100
20	482336.899	97512.003	5.500	0.600	1200		0	7.002	4.753	150
19	482338.687	97492.906	5.450	0.658	1200		1	9.000	4.744	100
							2	7.002	4.694	150
							0	7.003	4.694	150
							1	7.003	4.634	150
							0	2.000	4.850	150
							0	1.000	4.900	150
							1	1.000	4.792	150
							0	1.001	4.792	150








**Manhole Schedule**

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
18	482367.600	97490.570	5.400	0.771	1200		1	2.000	4.629	150
						2	1.001	4.629	150	
						0	1.002	4.629	150	
17	482369.150	97478.865	5.400	0.842	1200		1	1.002	4.562	150
16	482383.507	97572.706	5.450	0.600	1200		0	6.000	4.850	150
15	482363.353	97556.563	5.550	0.550	1200		0	5.000	5.000	100
14	482374.657	97556.260	5.550	0.658	1200		1	5.000	4.892	100
13	482350.477	97550.745	5.550	0.550	1200		0	4.000	5.000	100
						0	4.000	4.746	100	
12	482376.357	97544.725	5.450	0.754	1200		1	5.001	4.746	100
						2	4.000	4.746	100	
						0	4.001	4.696	150	
11	482387.745	97546.420	5.400	0.769	1200		1	6.000	4.631	150
						2	4.001	4.631	150	
						0	4.002	4.631	150	
10	482392.899	97544.949	5.400	0.843	1200		1	4.002	4.600	150
9	482354.594	97415.959	5.400	0.850	1200		0	11.000	4.550	100
8	482358.691	97412.636	5.200	0.701	1200		1	11.000	4.499	100
						0	11.001	4.499	100	
7	482373.730	97408.440	4.800	0.550	1200		1	11.001	4.250	100
6	482378.050	97477.184	5.400	0.850	1200		0	12.000	4.550	100





**Manhole Schedule**

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
5	482383.662	97476.233	5.200	0.705	1200	1 	12.000	4.495	100
4	482395.490	97472.336	4.800	0.550	1200	0 	12.001	4.495	100
3	482402.066	97541.384	5.400	0.850	1200	1 	12.001	4.250	100
2	482405.911	97541.134	5.200	0.687	1200	0 	13.000	4.550	100
1	482414.361	97538.663	4.800	0.550	1200	1 	13.000	4.513	100

**Simulation Settings**

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	17.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

**Storm Durations**

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	40	10	0

**Node 2 Online Hydro-Brake® Control**

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	4.513	Product Number	CTL-SHE-0072-2000-0700-2000
Design Depth (m)	0.700	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200



**Node 5 Online Hydro-Brake® Control**

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	4.495	Product Number	CTL-SHE-0070-2000-0800-2000
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

**Node 8 Online Hydro-Brake® Control**

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	4.499	Product Number	CTL-SHE-0070-2000-0800-2000
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

**Node 3 Flow through Pond Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	7.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	4.550	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)	67	Main Channel n	0.025

**Inlets**

10

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	5.6	0.0	0.850	38.3	0.0

**Node 6 Flow through Pond Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	8.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	4.550	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)	212	Main Channel n	0.025

**Inlets**

22 | 17

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	22.7	0.0	0.850	66.0	0.0

**Node 9 Flow through Pond Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	7.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	4.550	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)	39	Main Channel n	0.025

**Inlets**

29 | 33

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	0.5	0.0	0.850	29.0	0.0



**Results for 2 year Critical Storm Duration. Lowest mass balance: 97.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute summer	36	1	5.000	0.000	0.0	0.0000	0.0000	OK
480 minute winter	35	344	4.870	0.122	0.1	0.1620	0.0000	SURCHARGED
480 minute winter	34	344	4.870	0.273	0.3	0.3633	0.0000	SURCHARGED
480 minute winter	33	344	4.871	0.314	0.5	0.3546	0.0000	OK
15 minute winter	32	10	5.035	0.035	1.5	0.0518	0.0000	OK
15 minute winter	31	11	4.926	0.040	2.0	0.0486	0.0000	OK
480 minute winter	30	344	4.870	0.102	0.4	0.1260	0.0000	SURCHARGED
480 minute winter	29	344	4.872	0.315	0.4	0.3558	0.0000	OK
15 minute winter	28	10	5.021	0.021	0.8	0.0272	0.0000	OK
15 minute winter	27	11	5.021	0.021	0.6	0.0267	0.0000	OK
15 minute winter	26	11	5.034	0.034	1.5	0.0513	0.0000	OK
15 minute winter	25	11	4.950	0.049	2.7	0.0621	0.0000	OK
600 minute winter	24	450	4.846	0.093	0.4	0.1205	0.0000	OK
600 minute winter	23	450	4.846	0.152	0.6	0.1965	0.0000	SURCHARGED
600 minute winter	22	450	4.847	0.289	1.0	0.3266	0.0000	OK
15 minute winter	21	10	4.884	0.034	2.2	0.0542	0.0000	OK
15 minute winter	20	11	4.926	0.026	0.9	0.0351	0.0000	OK
600 minute winter	19	450	4.846	0.054	0.2	0.0712	0.0000	OK
600 minute winter	18	450	4.847	0.218	0.6	0.3257	0.0000	SURCHARGED
600 minute winter	17	450	4.847	0.289	1.1	0.3270	0.0000	OK
15 minute winter	16	11	4.878	0.028	1.2	0.0387	0.0000	OK
15 minute winter	15	11	5.031	0.031	1.2	0.0435	0.0000	OK
15 minute winter	14	11	4.934	0.042	2.4	0.0583	0.0000	OK
15 minute winter	13	11	5.021	0.021	0.6	0.0272	0.0000	OK
600 minute winter	12	405	4.874	0.178	0.4	0.2393	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute summer	36	3.000	35	0.0	0.000	0.000	0.0256	
480 minute winter	35	3.001	34	0.1	0.219	0.017	0.1240	
480 minute winter	34	3.002	33	0.3	0.251	0.045	0.0316	
480 minute winter	33	Flow through pond	9	0.8	0.096	0.001	1.8467	
15 minute winter	32	10.000	31	1.5	0.565	0.254	0.0317	
15 minute winter	31	10.001	30	1.9	0.596	0.329	0.0407	
480 minute winter	30	10.002	29	0.4	0.376	0.068	0.0724	
480 minute winter	29	Flow through pond	9	0.8	0.096	0.001	1.8467	
15 minute winter	28	9.000	23	0.7	0.641	0.091	0.0165	
15 minute winter	27	8.000	25	0.6	0.254	0.096	0.0232	
15 minute winter	26	7.000	25	1.5	0.497	0.254	0.0320	
15 minute winter	25	7.001	24	2.7	0.719	0.453	0.0380	
600 minute winter	24	7.002	23	0.4	0.294	0.030	0.1507	
600 minute winter	23	7.003	22	0.6	0.356	0.045	0.1851	
600 minute winter	22	Flow through pond	6	2.3	0.011	0.001	8.8204	
15 minute winter	21	2.000	18	2.1	0.405	0.112	0.1104	
15 minute winter	20	1.000	19	0.9	0.339	0.068	0.0518	
600 minute winter	19	1.001	18	0.3	0.212	0.023	0.3386	
600 minute winter	18	1.002	17	0.6	0.281	0.043	0.2079	
600 minute winter	17	Flow through pond	6	2.3	0.011	0.001	8.8204	
15 minute winter	16	6.000	11	1.2	0.228	0.074	0.1557	
15 minute winter	15	5.000	14	1.2	0.467	0.203	0.0293	
15 minute winter	14	5.001	12	2.4	0.774	0.353	0.0360	
15 minute winter	13	4.000	12	0.6	0.479	0.098	0.0322	
600 minute winter	12	4.001	11	0.4	0.259	0.028	0.2027	



**Results for 2 year Critical Storm Duration. Lowest mass balance: 97.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
600 minute winter	11	405	4.874	0.243	0.6	0.3255	0.0000	SURCHARGED
600 minute winter	10	405	4.874	0.317	0.5	0.3586	0.0000	OK
480 minute winter	9	344	4.870	0.320	0.8	0.3616	0.0000	SURCHARGED
480 minute winter	8	344	4.870	0.371	0.3	0.4194	0.0000	SURCHARGED
120 minute summer	7	302	4.850	0.600	1.3	0.0000	0.0000	OK
600 minute winter	6	450	4.846	0.296	2.3	0.3349	0.0000	SURCHARGED
600 minute winter	5	450	4.846	0.351	0.7	0.3969	0.0000	SURCHARGED
120 minute summer	4	302	4.850	0.600	1.1	0.0000	0.0000	OK
600 minute winter	3	405	4.874	0.324	0.3	0.3665	0.0000	SURCHARGED
600 minute winter	2	405	4.874	0.361	0.3	0.4082	0.0000	SURCHARGED
120 minute summer	1	302	4.850	0.600	1.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
600 minute winter	11	4.002	10	0.5	0.360	0.037	0.0944	
600 minute winter	10	Flow through pond	3	0.3	0.039	0.000	3.7790	
480 minute winter	9	11.000	8	0.3	0.181	0.054	0.0413	
480 minute winter	8	Hydro-Brake®	7	0.3				4.5
600 minute winter	6	12.000	5	0.7	0.114	0.117	0.0445	
600 minute winter	5	Hydro-Brake®	4	0.7				11.1
600 minute winter	3	13.000	2	0.3	0.366	0.058	0.0301	
600 minute winter	2	Hydro-Brake®	1	0.4				6.3



**Results for 30 year Critical Storm Duration. Lowest mass balance: 97.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute summer	36	1	5.000	0.000	0.0	0.0000	0.0000	OK
600 minute summer	35	345	4.902	0.154	0.3	0.2051	0.0000	SURCHARGED
600 minute summer	34	345	4.902	0.305	0.5	0.4062	0.0000	SURCHARGED
600 minute summer	33	330	4.902	0.345	0.7	0.3907	0.0000	OK
15 minute winter	32	10	5.050	0.050	2.9	0.0751	0.0000	OK
15 minute winter	31	11	4.944	0.058	3.7	0.0708	0.0000	OK
600 minute summer	30	345	4.903	0.135	0.6	0.1671	0.0000	SURCHARGED
600 minute summer	29	345	4.904	0.347	0.5	0.3921	0.0000	OK
15 minute winter	28	10	5.029	0.029	1.5	0.0378	0.0000	OK
15 minute winter	27	10	5.029	0.029	1.2	0.0373	0.0000	OK
15 minute winter	26	10	5.049	0.049	2.9	0.0728	0.0000	OK
15 minute winter	25	11	4.977	0.076	5.2	0.0962	0.0000	OK
600 minute winter	24	390	4.924	0.171	0.7	0.2210	0.0000	SURCHARGED
600 minute winter	23	390	4.924	0.230	1.0	0.2967	0.0000	SURCHARGED
600 minute winter	22	390	4.925	0.367	0.9	0.4150	0.0000	OK
600 minute winter	21	390	4.924	0.074	0.4	0.1181	0.0000	OK
15 minute winter	20	10	4.936	0.036	1.7	0.0474	0.0000	OK
600 minute winter	19	390	4.924	0.132	0.4	0.1732	0.0000	OK
600 minute winter	18	390	4.924	0.295	1.0	0.4403	0.0000	SURCHARGED
600 minute winter	17	405	4.925	0.367	1.1	0.4149	0.0000	OK
720 minute winter	16	420	4.909	0.059	0.2	0.0820	0.0000	OK
15 minute winter	15	10	5.043	0.043	2.3	0.0610	0.0000	OK
15 minute winter	14	11	4.954	0.062	4.6	0.0858	0.0000	OK
15 minute winter	13	11	5.030	0.030	1.2	0.0379	0.0000	OK
720 minute winter	12	420	4.909	0.213	0.7	0.2859	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute summer	36	3.000	35	0.0	0.000	0.000	0.0452	
600 minute summer	35	3.001	34	0.2	0.206	0.037	0.1240	
600 minute summer	34	3.002	33	0.5	0.144	0.078	0.0316	
600 minute summer	33	Flow through pond	9	1.7	0.086	0.002	2.2145	
15 minute winter	32	10.000	31	2.8	0.654	0.478	0.0515	
15 minute winter	31	10.001	30	3.7	0.680	0.623	0.0669	
600 minute summer	30	10.002	29	0.5	0.344	0.085	0.0724	
600 minute summer	29	Flow through pond	9	1.7	0.086	0.002	2.2145	
15 minute winter	28	9.000	23	1.5	0.682	0.180	0.0418	
15 minute winter	27	8.000	25	1.2	0.285	0.186	0.0382	
15 minute winter	26	7.000	25	2.8	0.568	0.479	0.0521	
15 minute winter	25	7.001	24	5.1	0.822	0.858	0.0629	
600 minute winter	24	7.002	23	0.7	0.318	0.052	0.1822	
600 minute winter	23	7.003	22	0.9	0.338	0.069	0.1851	
600 minute winter	22	Flow through pond	6	3.2	0.011	0.001	11.8618	
600 minute winter	21	2.000	18	0.4	0.195	0.021	0.2574	
15 minute winter	20	1.000	19	1.6	0.401	0.124	0.0803	
600 minute winter	19	1.001	18	0.3	0.195	0.023	0.4934	
600 minute winter	18	1.002	17	1.0	0.281	0.074	0.2079	
600 minute winter	17	Flow through pond	6	3.2	0.011	0.001	11.8618	
720 minute winter	16	6.000	11	0.2	0.120	0.012	0.3193	
15 minute winter	15	5.000	14	2.3	0.544	0.383	0.0470	
15 minute winter	14	5.001	12	4.5	0.899	0.663	0.0582	
15 minute winter	13	4.000	12	1.1	0.533	0.192	0.0829	
720 minute winter	12	4.001	11	0.7	0.259	0.053	0.2027	



**Results for 30 year Critical Storm Duration. Lowest mass balance: 97.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
720 minute winter	11	420	4.909	0.278	1.1	0.3718	0.0000	SURCHARGED
720 minute winter	10	420	4.909	0.352	1.1	0.3976	0.0000	OK
600 minute summer	9	345	4.902	0.352	1.7	0.3976	0.0000	SURCHARGED
600 minute summer	8	345	4.900	0.401	0.9	0.4535	0.0000	SURCHARGED
120 minute summer	7	302	4.850	0.600	1.9	0.0000	0.0000	OK
600 minute winter	6	390	4.923	0.373	3.2	0.4216	0.0000	SURCHARGED
600 minute winter	5	390	4.919	0.424	1.4	0.4797	0.0000	FLOOD RISK
120 minute summer	4	302	4.850	0.600	2.0	0.0000	0.0000	OK
720 minute winter	3	420	4.908	0.358	1.1	0.4050	0.0000	SURCHARGED
720 minute winter	2	420	4.906	0.393	1.2	0.4450	0.0000	FLOOD RISK
120 minute summer	1	302	4.850	0.600	2.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
720 minute winter	11	4.002	10	1.1	0.360	0.082	0.0944	
720 minute winter	10	Flow through pond	3	1.1	0.039	0.001	4.4191	
600 minute summer	9	11.000	8	0.9	0.164	0.151	0.0413	
600 minute summer	8	Hydro-Brake®	7	0.9				9.2
600 minute winter	6	12.000	5	1.4	0.173	0.228	0.0445	
600 minute winter	5	Hydro-Brake®	4	1.4				25.8
720 minute winter	3	13.000	2	1.2	0.366	0.196	0.0301	
720 minute winter	2	Hydro-Brake®	1	1.2				15.1



**Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 97.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
60 minute winter	36	52	5.067	0.067	0.4	0.0758	0.0000	OK
60 minute winter	35	52	5.067	0.319	2.4	0.4302	0.0000	SURCHARGED
60 minute winter	34	51	5.066	0.469	4.4	0.6329	0.0000	SURCHARGED
60 minute winter	33	55	5.065	0.508	4.0	0.5749	0.0000	OK
15 minute winter	32	12	5.188	0.188	5.8	0.2880	0.0000	SURCHARGED
15 minute winter	31	13	5.133	0.247	6.7	0.3033	0.0000	SURCHARGED
60 minute winter	30	49	5.067	0.299	4.7	0.3744	0.0000	SURCHARGED
60 minute winter	29	55	5.065	0.508	4.0	0.5749	0.0000	OK
180 minute winter	28	148	5.129	0.129	0.7	0.1716	0.0000	SURCHARGED
15 minute winter	27	13	5.160	0.160	2.3	0.2071	0.0000	SURCHARGED
15 minute winter	26	12	5.208	0.208	5.8	0.3181	0.0000	SURCHARGED
15 minute winter	25	13	5.153	0.252	8.2	0.3224	0.0000	SURCHARGED
180 minute winter	24	148	5.129	0.376	3.3	0.4919	0.0000	SURCHARGED
180 minute winter	23	148	5.129	0.435	4.6	0.5678	0.0000	SURCHARGED
180 minute winter	22	148	5.130	0.572	4.4	0.6464	0.0000	OK
180 minute winter	21	148	5.129	0.279	1.9	0.4586	0.0000	SURCHARGED
180 minute winter	20	152	5.130	0.230	0.8	0.3103	0.0000	SURCHARGED
180 minute winter	19	148	5.129	0.337	1.6	0.4489	0.0000	SURCHARGED
180 minute winter	18	148	5.129	0.500	4.5	0.7647	0.0000	FLOOD RISK
180 minute winter	17	148	5.129	0.571	4.3	0.6463	0.0000	OK
60 minute winter	16	60	5.112	0.262	2.4	0.3727	0.0000	SURCHARGED
15 minute winter	15	12	5.202	0.202	4.6	0.2934	0.0000	SURCHARGED
15 minute winter	14	13	5.166	0.274	8.5	0.3826	0.0000	SURCHARGED
60 minute winter	13	59	5.112	0.112	1.2	0.1447	0.0000	SURCHARGED
60 minute winter	12	58	5.112	0.416	7.6	0.5670	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
60 minute winter	36	3.000	35	-0.4	-0.078	-0.064	0.1766	
60 minute winter	35	3.001	34	1.7	0.314	0.293	0.1240	
60 minute winter	34	3.002	33	4.0	0.507	0.668	0.0316	
60 minute winter	33	Flow through pond	9	4.8	0.201	0.006	4.6099	
15 minute winter	32	10.000	31	5.1	0.714	0.870	0.0933	
15 minute winter	31	10.001	30	5.0	0.729	0.850	0.0968	
60 minute winter	30	10.002	29	4.0	0.670	0.680	0.0724	
60 minute winter	29	Flow through pond	9	4.8	0.201	0.006	4.6099	
180 minute winter	28	9.000	23	0.7	0.527	0.086	0.1116	
15 minute winter	27	8.000	25	1.6	0.304	0.262	0.0724	
15 minute winter	26	7.000	25	4.5	0.627	0.759	0.0807	
15 minute winter	25	7.001	24	7.1	0.906	1.198	0.0798	
180 minute winter	24	7.002	23	3.1	0.448	0.233	0.1822	
180 minute winter	23	7.003	22	4.4	0.441	0.327	0.1851	
180 minute winter	22	Flow through pond	6	8.1	0.040	0.003	21.3836	
180 minute winter	21	2.000	18	1.7	0.251	0.090	0.3453	
180 minute winter	20	1.000	19	0.8	0.294	0.059	0.3377	
180 minute winter	19	1.001	18	1.1	0.219	0.086	0.5107	
180 minute winter	18	1.002	17	4.3	0.412	0.326	0.2079	
180 minute winter	17	Flow through pond	6	8.1	0.040	0.003	21.3836	
60 minute winter	16	6.000	11	2.3	0.203	0.140	0.4687	
15 minute winter	15	5.000	14	4.1	0.600	0.704	0.0885	
15 minute winter	14	5.001	12	6.4	0.934	0.939	0.0912	
60 minute winter	13	4.000	12	1.2	0.503	0.203	0.2079	
60 minute winter	12	4.001	11	6.9	0.455	0.520	0.2027	



**Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 97.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
60 minute winter	11	60	5.111	0.480	11.2	0.6530	0.0000	FLOOD RISK
60 minute winter	10	60	5.110	0.553	10.2	0.6259	0.0000	OK
60 minute winter	9	54	5.062	0.512	4.8	0.5794	0.0000	SURCHARGED
60 minute winter	8	54	5.055	0.556	2.4	0.6290	0.0000	FLOOD RISK
120 minute summer	7	302	4.850	0.600	2.0	0.0000	0.0000	OK
180 minute winter	6	152	5.128	0.578	8.1	0.6536	0.0000	FLOOD RISK
180 minute winter	5	156	5.119	0.624	2.2	0.7058	0.0000	FLOOD RISK
120 minute summer	4	302	4.850	0.600	2.0	0.0000	0.0000	OK
60 minute winter	3	60	5.110	0.560	27.4	0.6338	0.0000	FLOOD RISK
60 minute winter	2	60	5.106	0.593	2.5	0.6709	0.0000	FLOOD RISK
120 minute summer	1	302	4.850	0.600	2.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
60 minute winter	11	4.002	10	10.2	0.582	0.761	0.0944	
60 minute winter	10	Flow through pond	3	27.4	0.087	0.021	9.1029	
60 minute winter	9	11.000	8	2.4	0.557	0.403	0.0413	
60 minute winter	8	Hydro-Brake®	7	2.0				13.0
180 minute winter	6	12.000	5	2.2	0.435	0.364	0.0445	
180 minute winter	5	Hydro-Brake®	4	2.0				30.7
60 minute winter	3	13.000	2	2.5	0.574	0.415	0.0301	
60 minute winter	2	Hydro-Brake®	1	2.0				16.0