



MasterDrain
SW

Muir Associates (UK) Limited

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Job No. 18-1022		
Sheet no. 1		
Date 31/07/18		
By	Checked	Reviewed

Project **Bridge Road North Wrexham**

Title **Preliminary Attenuation Calculations 1 in 30 + 30% Climate Change**

Data:-

Location = WREXHAM Grid reference = SJ3349
M5-60 (mm) = 18 r = 0.32
Soil index = 0.45 SAAR (mm/yr) = 800
Return period = 30 WRAP = 4
UCWI = 0.0 Climate change = 30%

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Pipeline storage = 0.0 m³ Available MH storage = 0.0 m³
Offline storage = 0.0 m³

Percentage runoff = 95.0% (manual setting)

Imperv. area = 7250 m² Pervious area = 0 m²
Total area = 7250 m² Equiv area = 6888 m² (Tot. area x % runoff).
Total runoff = 495.4 m³ Discharge rate = 5.000 l/s
Storage (m³) = 342.2 m³ (Sum of all balance quantities)
Total rainfall depth = 71.9 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.100	20.0	1.4	0.991	1.800	0.000	0.000
0.200	20.0	1.4	0.991	1.800	0.000	0.000
0.300	21.0	1.5	1.040	1.800	0.000	0.000
0.400	21.0	1.5	1.040	1.800	0.000	0.000
0.500	22.0	1.6	1.090	1.800	0.000	0.000
0.600	23.0	1.7	1.139	1.800	0.000	0.000
0.700	24.0	1.7	1.189	1.800	0.000	0.000
0.800	26.0	1.9	1.288	1.800	0.000	0.000
0.900	27.0	1.9	1.338	1.800	0.000	0.000
1.000	29.0	2.1	1.437	1.800	0.000	0.000
1.100	31.0	2.2	1.536	1.800	0.000	0.000
1.200	32.0	2.3	1.585	1.800	0.000	0.000
1.300	33.0	2.4	1.635	1.800	0.000	0.000
1.400	34.0	2.4	1.684	1.800	0.000	0.000
1.500	36.0	2.6	1.783	1.800	0.000	0.000
1.600	38.0	2.7	1.883	1.800	0.083	0.083
1.700	39.0	2.8	1.932	1.800	0.132	0.215
1.800	40.0	2.9	1.982	1.800	0.182	0.396
1.900	42.0	3.0	2.081	1.800	0.281	0.677
2.000	45.0	3.2	2.229	1.800	0.429	1.106
2.100	49.0	3.5	2.427	1.800	0.627	1.734
2.200	53.0	3.8	2.626	1.800	0.826	2.559
2.300	57.0	4.1	2.824	1.800	1.024	3.583
2.400	62.0	4.5	3.071	1.800	1.271	4.854
2.500	66.0	4.7	3.270	1.800	1.470	6.324
2.600	71.0	5.1	3.517	1.800	1.717	8.041
2.700	77.0	5.5	3.815	1.800	2.015	10.056
2.800	84.0	6.0	4.161	1.800	2.361	12.417
2.900	91.0	6.5	4.508	1.800	2.708	15.125
3.000	98.0	7.0	4.855	1.800	3.055	18.180
3.100	105.0	7.6	5.202	1.800	3.402	21.582
3.200	114.0	8.2	5.648	1.800	3.848	25.429
3.300	125.0	9.0	6.192	1.800	4.392	29.822
3.400	135.0	9.7	6.688	1.800	4.888	34.710
3.500	143.0	10.3	7.084	1.800	5.284	39.994
3.600	154.0	11.1	7.629	1.800	5.829	45.823
3.700	164.0	11.8	8.125	1.800	6.325	52.147
3.800	173.0	12.4	8.570	1.800	6.770	58.918
3.900	183.0	13.2	9.066	1.800	7.266	66.184
4.000	194.0	14.0	9.611	1.800	7.811	73.994



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Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
4.100	204.0	14.7	10.106	1.800	8.306	82.300
4.200	212.0	15.2	10.502	1.800	8.702	91.003
4.300	219.0	15.8	10.849	1.800	9.049	100.052
4.400	226.0	16.3	11.196	1.800	9.396	109.448
4.500	233.0	16.8	11.543	1.800	9.743	119.191
4.600	239.0	17.2	11.840	1.800	10.040	129.231
4.700	244.0	17.6	12.088	1.800	10.288	139.518
4.800	248.0	17.8	12.286	1.800	10.486	150.004
4.900	249.0	17.9	12.335	1.800	10.535	160.540
5.000	250.0	18.0	12.385	1.800	10.585	171.124
5.100	250.0	18.0	12.385	1.800	10.585	181.709
5.200	249.0	17.9	12.335	1.800	10.535	192.245
5.300	248.0	17.8	12.286	1.800	10.486	202.731
5.400	244.0	17.6	12.088	1.800	10.288	213.018
5.500	239.0	17.2	11.840	1.800	10.040	223.058
5.600	233.0	16.8	11.543	1.800	9.743	232.801
5.700	226.0	16.3	11.196	1.800	9.396	242.197
5.800	219.0	15.8	10.849	1.800	9.049	251.246
5.900	212.0	15.2	10.502	1.800	8.702	259.949
6.000	204.0	14.7	10.106	1.800	8.306	268.255
6.100	194.0	14.0	9.611	1.800	7.811	276.065
6.200	183.0	13.2	9.066	1.800	7.266	283.331
6.300	173.0	12.4	8.570	1.800	6.770	290.101
6.400	164.0	11.8	8.125	1.800	6.325	296.426
6.500	154.0	11.1	7.629	1.800	5.829	302.255
6.600	143.0	10.3	7.084	1.800	5.284	307.539
6.700	135.0	9.7	6.688	1.800	4.888	312.427
6.800	125.0	9.0	6.192	1.800	4.392	316.820
6.900	114.0	8.2	5.648	1.800	3.848	320.667
7.000	105.0	7.6	5.202	1.800	3.402	324.069
7.100	98.0	7.0	4.855	1.800	3.055	327.124
7.200	91.0	6.5	4.508	1.800	2.708	329.832
7.300	84.0	6.0	4.161	1.800	2.361	332.193
7.400	77.0	5.5	3.815	1.800	2.015	334.208
7.500	71.0	5.1	3.517	1.800	1.717	335.925
7.600	66.0	4.7	3.270	1.800	1.470	337.395
7.700	62.0	4.5	3.071	1.800	1.271	338.666
7.800	57.0	4.1	2.824	1.800	1.024	339.690
7.900	53.0	3.8	2.626	1.800	0.826	340.515
8.000	49.0	3.5	2.427	1.800	0.627	341.143
8.100	45.0	3.2	2.229	1.800	0.429	341.572
8.200	42.0	3.0	2.081	1.800	0.281	341.853
8.300	40.0	2.9	1.982	1.800	0.182	342.034
8.400	39.0	2.8	1.932	1.800	0.132	342.166
8.500	38.0	2.7	1.883	1.800	0.083	342.249
8.600	36.0	2.6	1.783	1.800	0.000	342.232
8.700	34.0	2.4	1.684	1.800	0.000	342.117
8.800	33.0	2.4	1.635	1.800	0.000	341.952
8.900	32.0	2.3	1.585	1.800	0.000	341.737
9.000	31.0	2.2	1.536	1.800	0.000	341.473
9.100	29.0	2.1	1.437	1.800	0.000	341.109
9.200	27.0	1.9	1.338	1.800	0.000	340.647
9.300	26.0	1.9	1.288	1.800	0.000	340.135
9.400	24.0	1.7	1.189	1.800	0.000	339.524
9.500	23.0	1.7	1.139	1.800	0.000	338.863
9.600	22.0	1.6	1.090	1.800	0.000	338.153
9.700	21.0	1.5	1.040	1.800	0.000	337.393
9.800	21.0	1.5	1.040	1.800	0.000	336.634
9.900	20.0	1.4	0.991	1.800	0.000	335.824
10.000	20.0	1.4	0.991	1.800	0.000	335.015

Storage volume (m³) = 342.2 m³ (Sum of all balance quantities)



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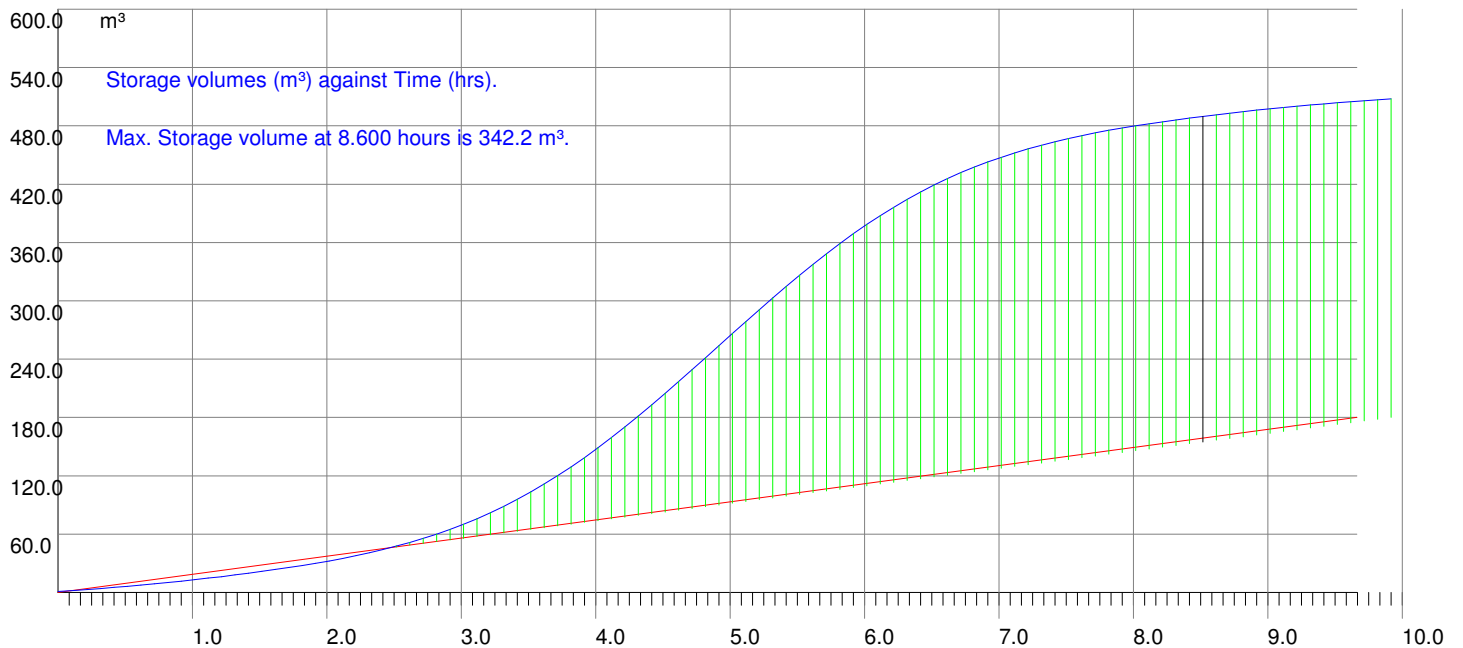
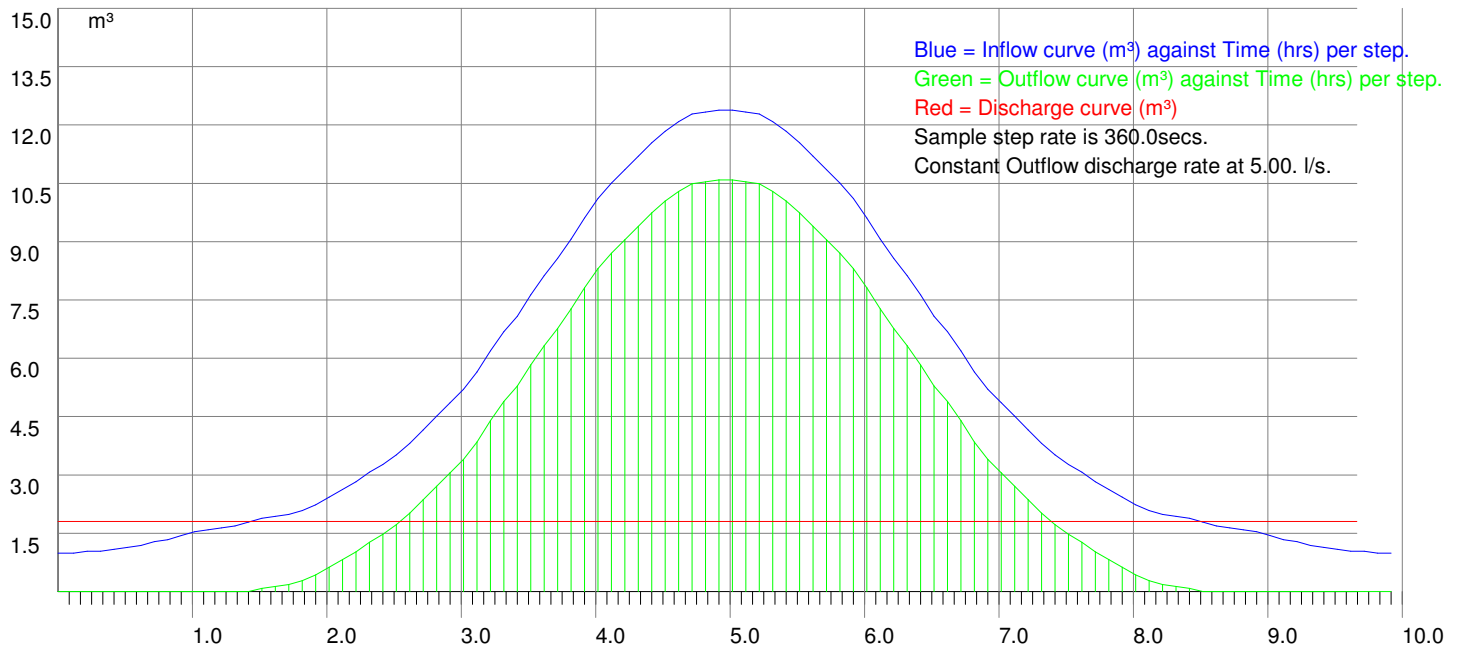
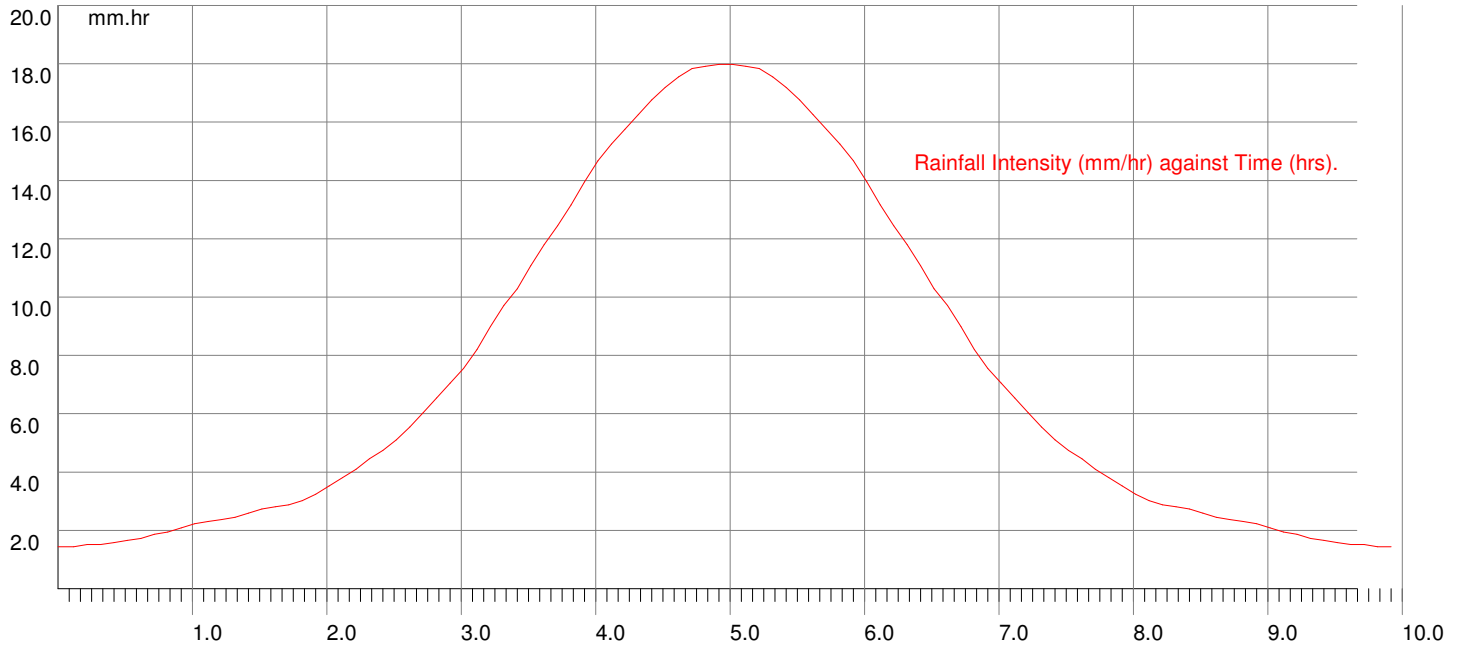
Sheet no.
3

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Maximum storage volumes for varying duration storms.

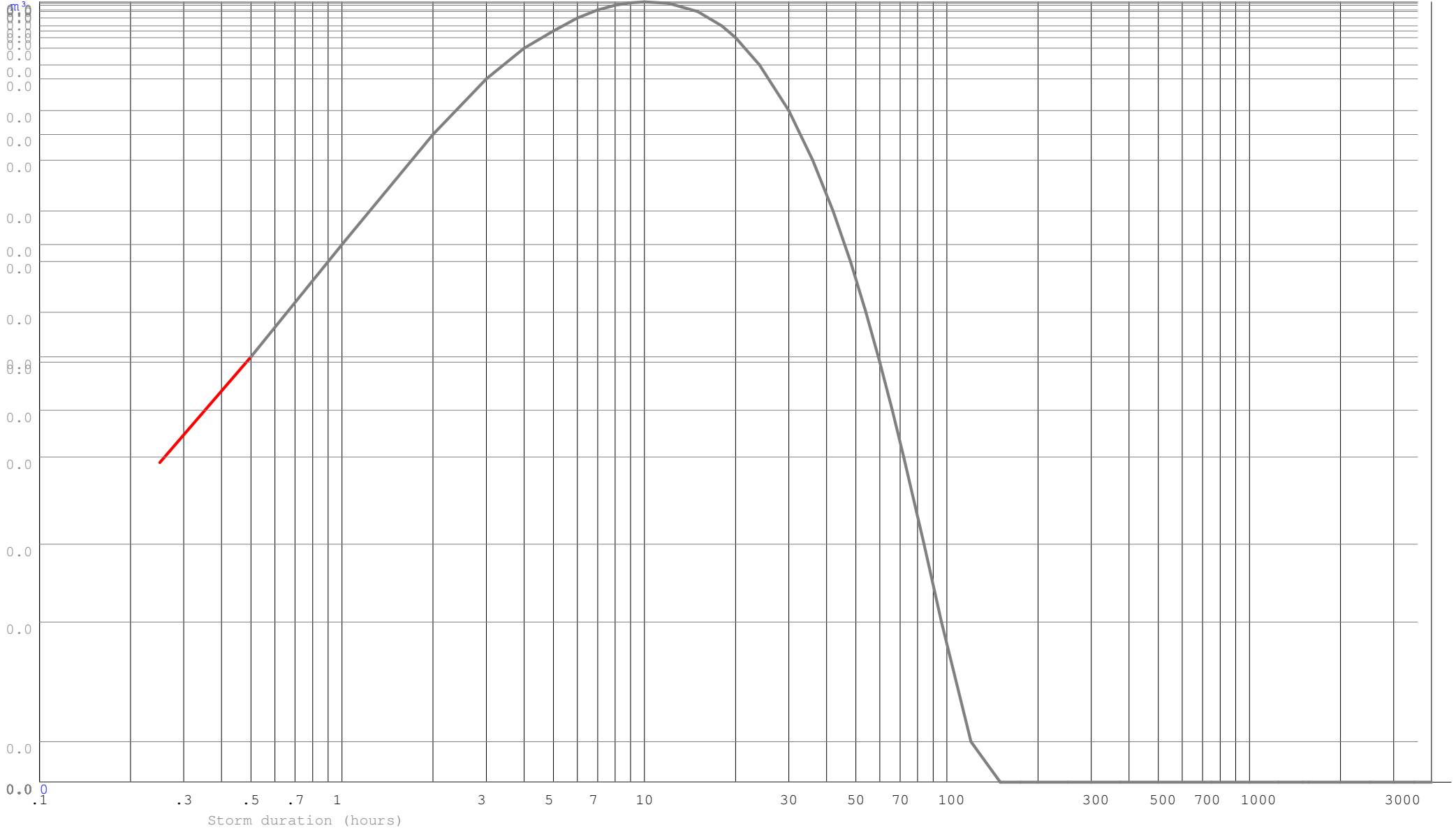
Storm length (hrs)	Max. Vol (m ³)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	140.19	0.25	81.98	0.2	
0.5	186.57	0.50	55.40	0.3	
1	235.79	1.00	35.95	0.6	
2	284.09	2.00	22.67	1.2	
3	308.53	3.00	17.12	1.8	
4	321.94	4.00	13.95	2.4	
5	329.50	5.00	11.87	3.0	
6	335.13	6.00	10.41	3.6	
7	338.69	7.00	9.32	4.2	
8	340.73	8.00	8.46	4.8	
9	341.81	9.00	7.76	5.4	
10	342.25	10.00	7.19	6.0	Peak found
12	341.62	----	6.30	7.2	
15	337.99	----	5.35	9.0	
18	331.70	----	4.68	10.8	
20	326.51	----	4.33	12.0	
24	314.61	----	3.79	14.4	
30	294.54	----	3.21	18.0	
36	272.80	----	2.81	21.6	
42	250.53	----	2.51	25.2	
48	228.36	----	2.27	28.8	
54	206.12	----	2.08	32.4	
60	184.17	----	1.92	36.0	
66	163.08	----	1.79	39.6	
72	142.56	----	1.68	43.2	
84	104.30	----	1.49	50.4	
96	70.20	----	1.35	57.6	
120	17.70	----	1.14	72.0	
150	0.00	----	0.97	90.0	
175	0.00	----	0.86	105.0	
200	0.00	----	0.78	120.0	
250	0.00	----	0.66	150.0	
300	0.00	----	0.58	180.0	
375	0.00	----	0.49	225.0	
500	0.00	----	0.40	300.0	
750	0.00	----	0.30	450.0	
1000	0.00	----	0.24	600.0	
1250	0.00	----	0.21	750.0	
1500	0.00	----	0.18	900.0	
1570	0.00	----	0.17	942.0	
2000	0.00	----	0.15	1200.0	
2500	0.00	----	0.12	1500.0	
3000	0.00	----	0.11	1800.0	
3500	0.00	----	0.10	2100.0	
4000	0.00	----	0.09	2400.0	



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Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.