



MasterDrain
SW

Muir Associates (UK) Limited

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Trinity Chambers,
18 Ivy Street,
Birkenhead CH41 5EF
Tel: 0151 650 1200 Mob: 07813 7770514
email: design@muir-associates.co.uk

Job No. 18-1022		
Sheet no. 1		
Date 01/08/18		
By	Checked	Reviewed

Project	Bridge Road North Wrexham
Title	Preliminary Attenuation Calculations 1 in 30 + 0% 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 = 0%

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 = 381.1 m³ Discharge rate = 3.830 l/s
Storage (m³) = 263.7 m³ (Sum of all balance quantities)
Total rainfall depth = 55.3 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.100	20.0	1.1	0.762	1.379	0.000	0.000
0.200	20.0	1.1	0.762	1.379	0.000	0.000
0.300	21.0	1.2	0.800	1.379	0.000	0.000
0.400	21.0	1.2	0.800	1.379	0.000	0.000
0.500	22.0	1.2	0.838	1.379	0.000	0.000
0.600	23.0	1.3	0.876	1.379	0.000	0.000
0.700	24.0	1.3	0.915	1.379	0.000	0.000
0.800	26.0	1.4	0.991	1.379	0.000	0.000
0.900	27.0	1.5	1.029	1.379	0.000	0.000
1.000	29.0	1.6	1.105	1.379	0.000	0.000
1.100	31.0	1.7	1.181	1.379	0.000	0.000
1.200	32.0	1.8	1.219	1.379	0.000	0.000
1.300	33.0	1.8	1.258	1.379	0.000	0.000
1.400	34.0	1.9	1.296	1.379	0.000	0.000
1.500	36.0	2.0	1.372	1.379	0.000	0.000
1.600	38.0	2.1	1.448	1.379	0.069	0.069
1.700	39.0	2.2	1.486	1.379	0.107	0.177
1.800	40.0	2.2	1.524	1.379	0.145	0.322
1.900	42.0	2.3	1.601	1.379	0.222	0.544
2.000	45.0	2.5	1.715	1.379	0.336	0.880
2.100	49.0	2.7	1.867	1.379	0.488	1.368
2.200	53.0	2.9	2.020	1.379	0.641	2.009
2.300	57.0	3.2	2.172	1.379	0.793	2.803
2.400	62.0	3.4	2.363	1.379	0.984	3.786
2.500	66.0	3.7	2.515	1.379	1.136	4.923
2.600	71.0	3.9	2.706	1.379	1.327	6.250
2.700	77.0	4.3	2.934	1.379	1.555	7.805
2.800	84.0	4.6	3.201	1.379	1.822	9.627
2.900	91.0	5.0	3.468	1.379	2.089	11.716
3.000	98.0	5.4	3.735	1.379	2.356	14.072
3.100	105.0	5.8	4.001	1.379	2.622	16.694
3.200	114.0	6.3	4.344	1.379	2.965	19.660
3.300	125.0	6.9	4.763	1.379	3.385	23.045
3.400	135.0	7.5	5.145	1.379	3.766	26.810
3.500	143.0	7.9	5.449	1.379	4.071	30.881
3.600	154.0	8.5	5.869	1.379	4.490	35.371
3.700	164.0	9.1	6.250	1.379	4.871	40.241
3.800	173.0	9.6	6.593	1.379	5.214	45.455
3.900	183.0	10.1	6.974	1.379	5.595	51.050
4.000	194.0	10.7	7.393	1.379	6.014	57.064



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Project **Bridge Road North Wrexham**

Title **Preliminary Attenuation Calculations 1 in 30 + 0% Climate change**

Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
4.100	204.0	11.3	7.774	1.379	6.395	63.459
4.200	212.0	11.7	8.079	1.379	6.700	70.159
4.300	219.0	12.1	8.346	1.379	6.967	77.126
4.400	226.0	12.5	8.612	1.379	7.233	84.359
4.500	233.0	12.9	8.879	1.379	7.500	91.860
4.600	239.0	13.2	9.108	1.379	7.729	99.589
4.700	244.0	13.5	9.298	1.379	7.919	107.508
4.800	248.0	13.7	9.451	1.379	8.072	115.580
4.900	249.0	13.8	9.489	1.379	8.110	123.690
5.000	250.0	13.8	9.527	1.379	8.148	131.838
5.100	250.0	13.8	9.527	1.379	8.148	139.986
5.200	249.0	13.8	9.489	1.379	8.110	148.096
5.300	248.0	13.7	9.451	1.379	8.072	156.168
5.400	244.0	13.5	9.298	1.379	7.919	164.087
5.500	239.0	13.2	9.108	1.379	7.729	171.816
5.600	233.0	12.9	8.879	1.379	7.500	179.316
5.700	226.0	12.5	8.612	1.379	7.233	186.550
5.800	219.0	12.1	8.346	1.379	6.967	193.516
5.900	212.0	11.7	8.079	1.379	6.700	200.216
6.000	204.0	11.3	7.774	1.379	6.395	206.611
6.100	194.0	10.7	7.393	1.379	6.014	212.626
6.200	183.0	10.1	6.974	1.379	5.595	218.220
6.300	173.0	9.6	6.593	1.379	5.214	223.434
6.400	164.0	9.1	6.250	1.379	4.871	228.305
6.500	154.0	8.5	5.869	1.379	4.490	232.795
6.600	143.0	7.9	5.449	1.379	4.071	236.865
6.700	135.0	7.5	5.145	1.379	3.766	240.631
6.800	125.0	6.9	4.763	1.379	3.385	244.016
6.900	114.0	6.3	4.344	1.379	2.965	246.981
7.000	105.0	5.8	4.001	1.379	2.622	249.604
7.100	98.0	5.4	3.735	1.379	2.356	251.959
7.200	91.0	5.0	3.468	1.379	2.089	254.048
7.300	84.0	4.6	3.201	1.379	1.822	255.870
7.400	77.0	4.3	2.934	1.379	1.555	257.426
7.500	71.0	3.9	2.706	1.379	1.327	258.753
7.600	66.0	3.7	2.515	1.379	1.136	259.889
7.700	62.0	3.4	2.363	1.379	0.984	260.873
7.800	57.0	3.2	2.172	1.379	0.793	261.666
7.900	53.0	2.9	2.020	1.379	0.641	262.307
8.000	49.0	2.7	1.867	1.379	0.488	262.796
8.100	45.0	2.5	1.715	1.379	0.336	263.132
8.200	42.0	2.3	1.601	1.379	0.222	263.353
8.300	40.0	2.2	1.524	1.379	0.145	263.499
8.400	39.0	2.2	1.486	1.379	0.107	263.606
8.500	38.0	2.1	1.448	1.379	0.069	263.676
8.600	36.0	2.0	1.372	1.379	0.000	263.669
8.700	34.0	1.9	1.296	1.379	0.000	263.585
8.800	33.0	1.8	1.258	1.379	0.000	263.464
8.900	32.0	1.8	1.219	1.379	0.000	263.305
9.000	31.0	1.7	1.181	1.379	0.000	263.107
9.100	29.0	1.6	1.105	1.379	0.000	262.834
9.200	27.0	1.5	1.029	1.379	0.000	262.484
9.300	26.0	1.4	0.991	1.379	0.000	262.096
9.400	24.0	1.3	0.915	1.379	0.000	261.632
9.500	23.0	1.3	0.876	1.379	0.000	261.129
9.600	22.0	1.2	0.838	1.379	0.000	260.589
9.700	21.0	1.2	0.800	1.379	0.000	260.010
9.800	21.0	1.2	0.800	1.379	0.000	259.432
9.900	20.0	1.1	0.762	1.379	0.000	258.815
10.000	20.0	1.1	0.762	1.379	0.000	258.198

Storage volume (m³) = 263.7 m³ (Sum of all balance quantities)



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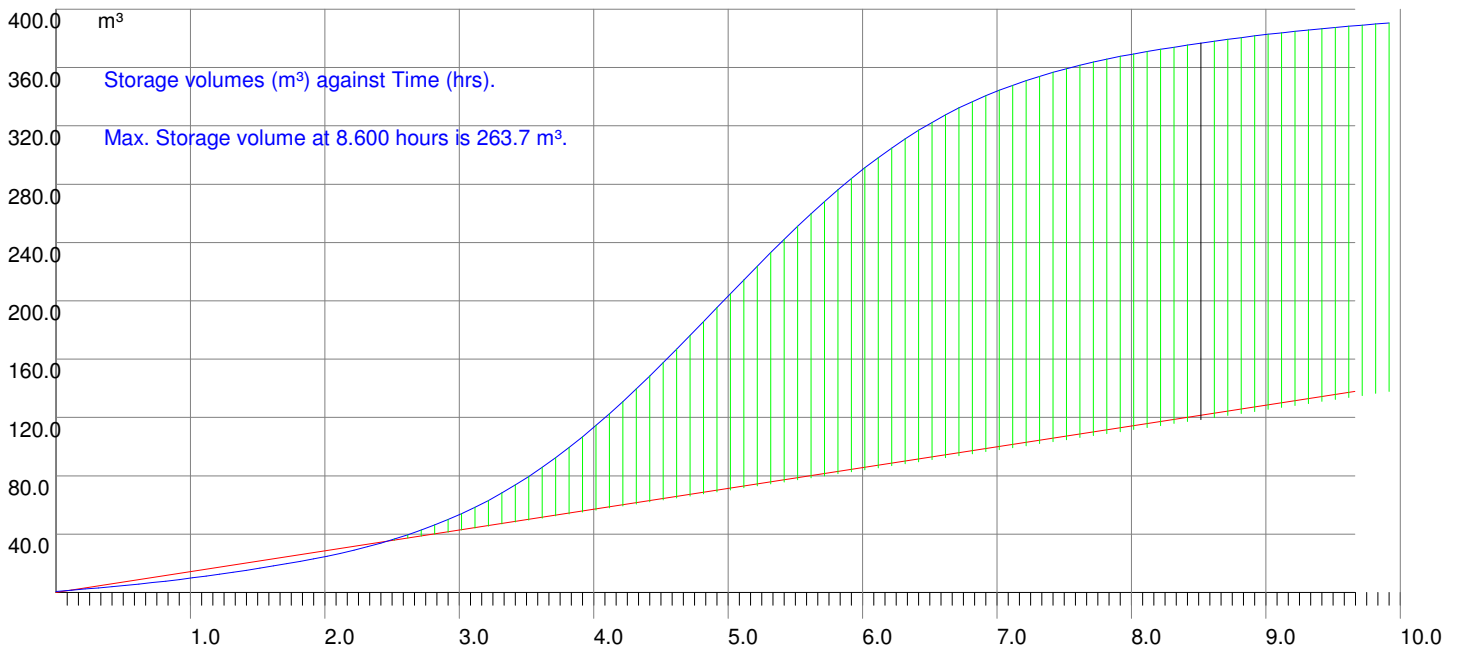
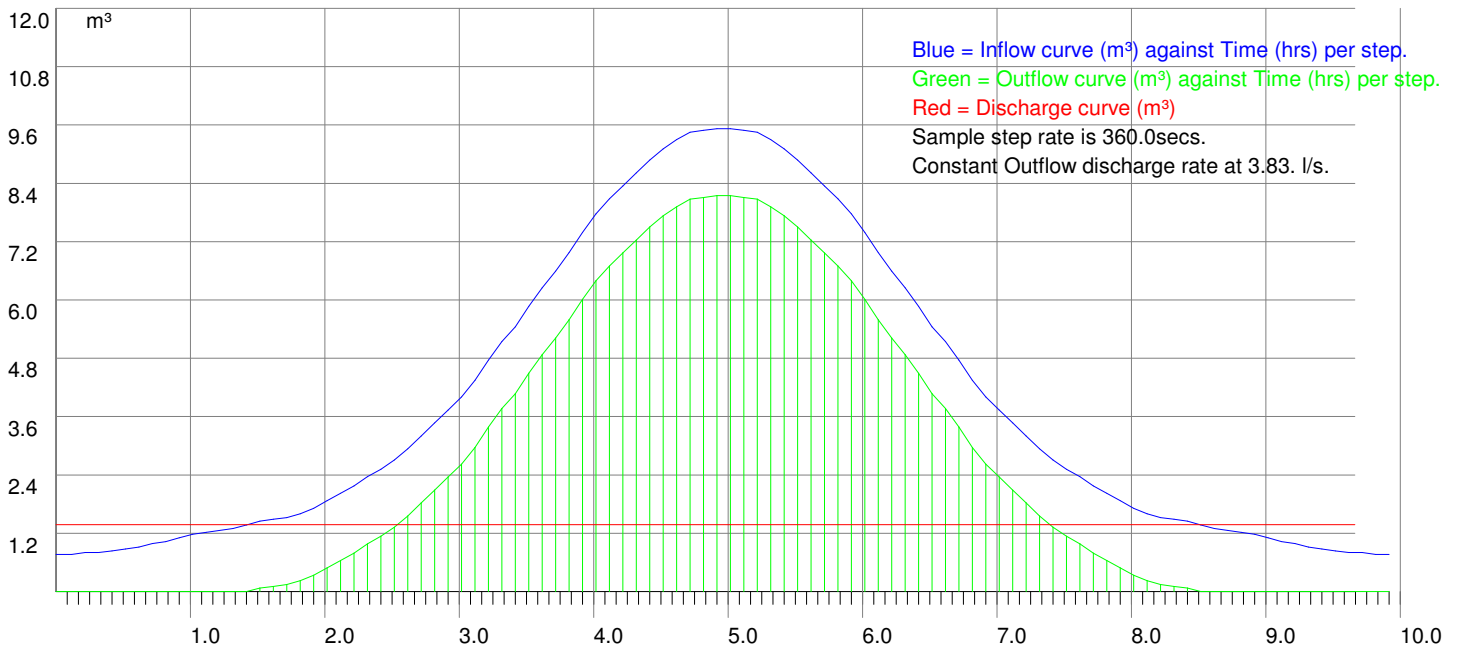
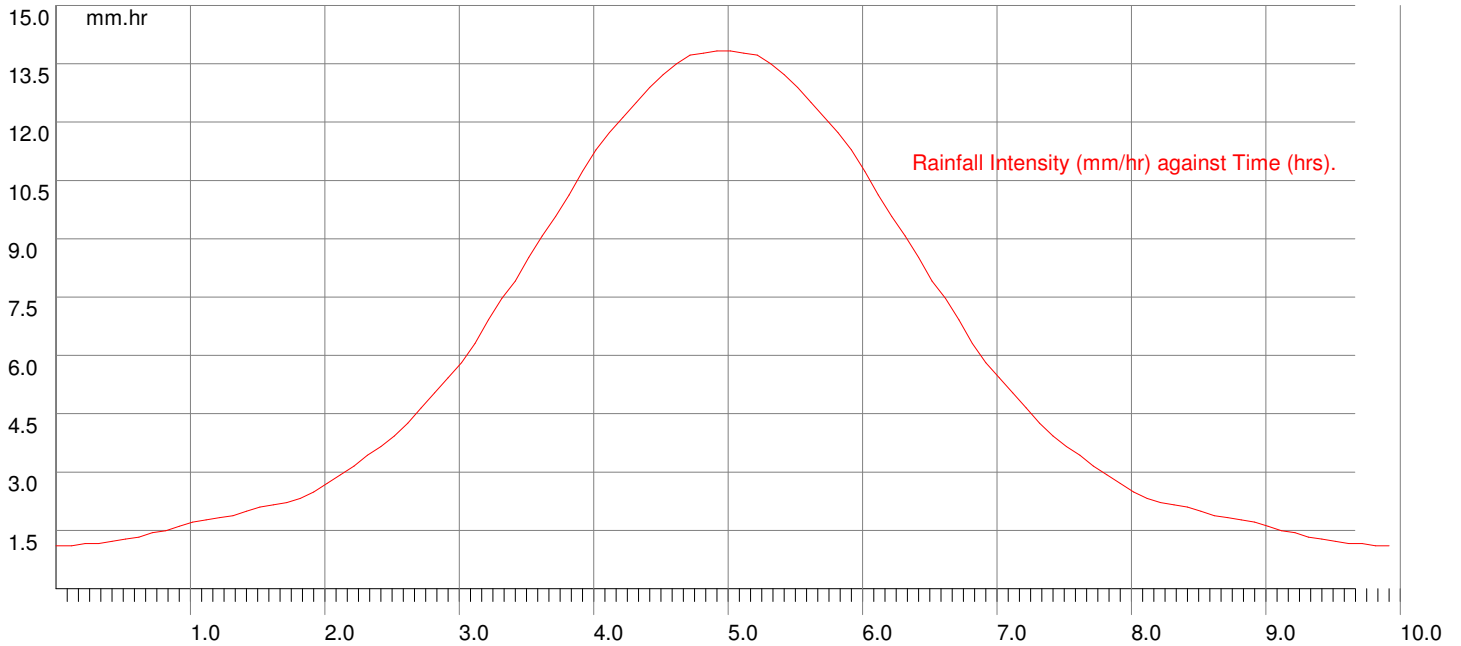
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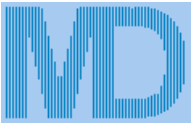
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Maximum storage volumes for varying duration storms.

Storm length (hrs)	Max. Vol (m ³)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	107.85	0.25	63.06	0.2	
0.5	143.54	0.50	42.62	0.3	
1	181.44	1.00	27.65	0.6	
2	218.65	2.00	17.44	1.2	
3	237.50	3.00	13.17	1.8	
4	247.88	4.00	10.73	2.4	
5	253.73	5.00	9.13	3.0	
6	258.09	6.00	8.01	3.6	
7	260.86	7.00	7.17	4.2	
8	262.47	8.00	6.51	4.8	
9	263.32	9.00	5.97	5.4	
10	263.68	10.00	5.53	6.0	Peak found
12	263.23	----	4.84	7.2	
15	260.52	----	4.12	9.0	
18	255.74	----	3.60	10.8	
20	251.79	----	3.33	12.0	
24	242.70	----	2.92	14.4	
30	227.37	----	2.47	18.0	
36	210.73	----	2.16	21.6	
42	193.69	----	1.93	25.2	
48	176.67	----	1.75	28.8	
54	159.62	----	1.60	32.4	
60	142.78	----	1.48	36.0	
66	126.60	----	1.38	39.6	
72	110.83	----	1.29	43.2	
84	81.40	----	1.15	50.4	
96	55.23	----	1.04	57.6	
120	14.45	----	0.88	72.0	
150	0.00	----	0.75	90.0	
175	0.00	----	0.66	105.0	
200	0.00	----	0.60	120.0	
250	0.00	----	0.51	150.0	
300	0.00	----	0.45	180.0	
375	0.00	----	0.38	225.0	
500	0.00	----	0.31	300.0	
750	0.00	----	0.23	450.0	
1000	0.00	----	0.19	600.0	
1250	0.00	----	0.16	750.0	
1500	0.00	----	0.14	900.0	
1570	0.00	----	0.13	942.0	
2000	0.00	----	0.11	1200.0	
2500	0.00	----	0.10	1500.0	
3000	0.00	----	0.08	1800.0	
3500	0.00	----	0.08	2100.0	
4000	0.00	----	0.07	2400.0	



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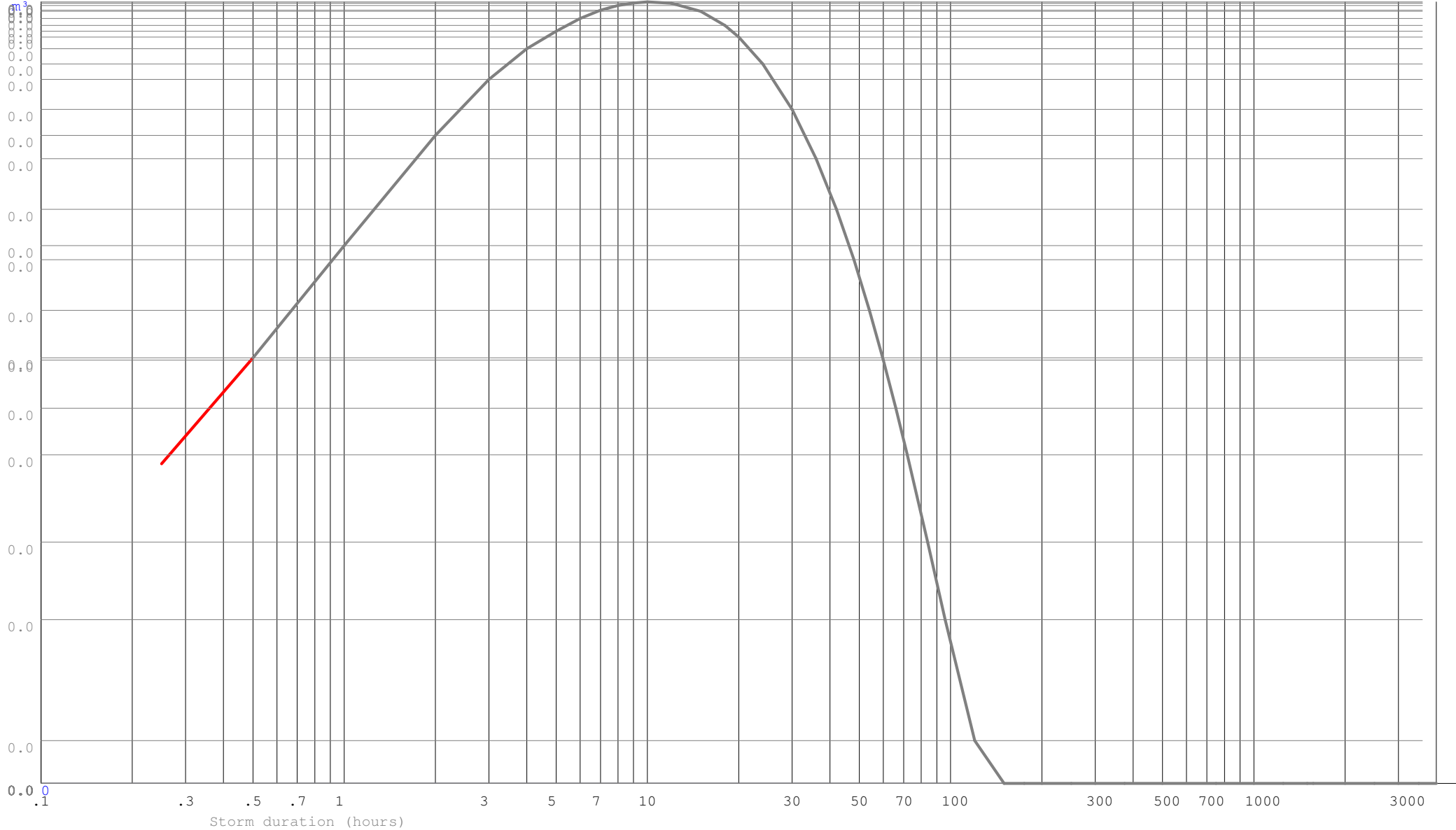
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Sequential storage volume at specific storm durations.





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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.