

Company Remote Engineering Design Services				Project Big Green Farm Penley	
Item Hydrograph storage calcs (Summer profile) for Big Green Farm Penley				Job Ref RED-EDL-001	Sheet no. 1
MasterDrain	Calc. by JGW	Date 27/11/20	Checked by KB	Date	Approved by Date

Data:-

Location = WREXHAM Grid reference = SJ3349
 M5-60 (mm) = 18 r = 0.32
 Soil index = 0.45 SAAR (mm/yr) = 800
 Return period = 100 WRAP = 4
 UCWI = 86.0 Climate change = 40%

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 = 38.0% calculated from:-

Percentage runoff = (0.829*PIMP) + (25*SOIL) + (0.078*UCWI) - 20.7

where

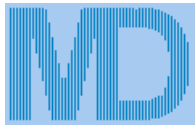
PIMP = ImpervArea*100/(ImpervArea+PervArea) = 48.7

UCWI = Calculated value for Wetness Index = 86.0

Imperv. area = 1850 m² Pervious area = 1950 m²
 Total area = 3800 m² Equiv area = 1444 m² (Tot. area x % runoff).
 Total runoff = 92.7 m³ Discharge rate = 16.692 l/s
 Storage (m³) = 26.5 m³ (Sum of all balance quantities)
 Total rainfall depth = 64.2 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.020	32.0	10.3	0.297	1.202	0.000	0.000
0.040	33.0	10.6	0.306	1.202	0.000	0.000
0.060	33.0	10.6	0.306	1.202	0.000	0.000
0.080	34.0	10.9	0.315	1.202	0.000	0.000
0.100	34.0	10.9	0.315	1.202	0.000	0.000
0.120	35.0	11.2	0.325	1.202	0.000	0.000
0.140	35.0	11.2	0.325	1.202	0.000	0.000
0.160	36.0	11.6	0.334	1.202	0.000	0.000
0.180	36.0	11.6	0.334	1.202	0.000	0.000
0.200	37.0	11.9	0.343	1.202	0.000	0.000
0.220	37.0	11.9	0.343	1.202	0.000	0.000
0.240	38.0	12.2	0.352	1.202	0.000	0.000
0.260	38.0	12.2	0.352	1.202	0.000	0.000
0.280	39.0	12.5	0.362	1.202	0.000	0.000
0.300	40.0	12.8	0.371	1.202	0.000	0.000
0.320	42.0	13.5	0.389	1.202	0.000	0.000
0.340	42.0	13.5	0.389	1.202	0.000	0.000
0.360	43.0	13.8	0.399	1.202	0.000	0.000
0.380	44.0	14.1	0.408	1.202	0.000	0.000
0.400	45.0	14.4	0.417	1.202	0.000	0.000
0.420	46.0	14.8	0.427	1.202	0.000	0.000
0.440	48.0	15.4	0.445	1.202	0.000	0.000
0.460	49.0	15.7	0.454	1.202	0.000	0.000
0.480	51.0	16.4	0.473	1.202	0.000	0.000
0.500	52.0	16.7	0.482	1.202	0.000	0.000
0.520	54.0	17.3	0.501	1.202	0.000	0.000
0.540	56.0	18.0	0.519	1.202	0.000	0.000
0.560	58.0	18.6	0.538	1.202	0.000	0.000
0.580	61.0	19.6	0.566	1.202	0.000	0.000
0.600	64.0	20.6	0.593	1.202	0.000	0.000
0.620	68.0	21.8	0.631	1.202	0.000	0.000
0.640	72.0	23.1	0.668	1.202	0.000	0.000
0.660	78.0	25.0	0.723	1.202	0.000	0.000
0.680	84.0	27.0	0.779	1.202	0.000	0.000
0.700	91.0	29.2	0.844	1.202	0.000	0.000
0.720	99.0	31.8	0.918	1.202	0.000	0.000
0.740	110.0	35.3	1.020	1.202	0.000	0.000

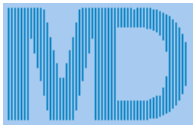


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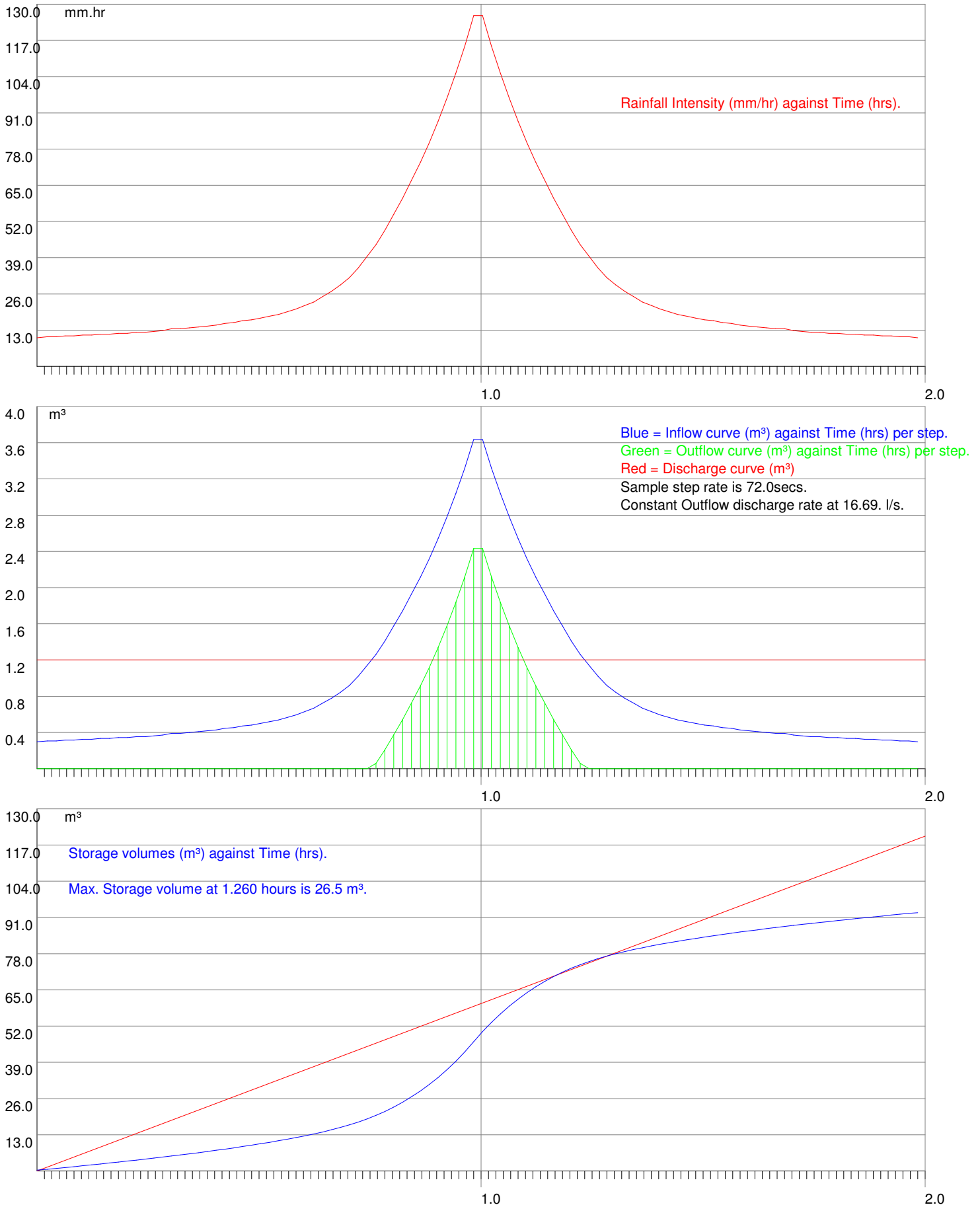
Calculations (cont.) :-

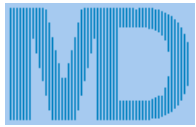
Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.820	170.0	54.6	1.576	1.202	0.375	0.642
0.840	188.0	60.4	1.743	1.202	0.542	1.183
0.860	208.0	66.8	1.929	1.202	0.727	1.910
0.880	228.0	73.2	2.114	1.202	0.913	2.823
0.900	250.0	80.3	2.318	1.202	1.117	3.939
0.920	274.0	88.0	2.541	1.202	1.339	5.278
0.940	300.0	96.3	2.782	1.202	1.580	6.859
0.960	328.0	105.3	3.042	1.202	1.840	8.699
0.980	358.0	115.0	3.320	1.202	2.118	10.817
1.000	392.0	125.9	3.635	1.202	2.433	13.250
1.020	392.0	125.9	3.635	1.202	2.433	15.683
1.040	358.0	115.0	3.320	1.202	2.118	17.801
1.060	328.0	105.3	3.042	1.202	1.840	19.641
1.080	300.0	96.3	2.782	1.202	1.580	21.221
1.100	274.0	88.0	2.541	1.202	1.339	22.560
1.120	250.0	80.3	2.318	1.202	1.117	23.677
1.140	228.0	73.2	2.114	1.202	0.913	24.589
1.160	208.0	66.8	1.929	1.202	0.727	25.317
1.180	188.0	60.4	1.743	1.202	0.542	25.858
1.200	170.0	54.6	1.576	1.202	0.375	26.233
1.220	152.0	48.8	1.410	1.202	0.208	26.440
1.240	136.0	43.7	1.261	1.202	0.059	26.500
1.260	123.0	39.5	1.141	1.202	0.000	26.439
1.280	110.0	35.3	1.020	1.202	0.000	26.257
1.300	99.0	31.8	0.918	1.202	0.000	25.973
1.320	91.0	29.2	0.844	1.202	0.000	25.615
1.340	84.0	27.0	0.779	1.202	0.000	25.192
1.360	78.0	25.0	0.723	1.202	0.000	24.714
1.380	72.0	23.1	0.668	1.202	0.000	24.180
1.400	68.0	21.8	0.631	1.202	0.000	23.608
1.420	64.0	20.6	0.593	1.202	0.000	23.000
1.440	61.0	19.6	0.566	1.202	0.000	22.364
1.460	58.0	18.6	0.538	1.202	0.000	21.700
1.480	56.0	18.0	0.519	1.202	0.000	21.018
1.500	54.0	17.3	0.501	1.202	0.000	20.316
1.520	52.0	16.7	0.482	1.202	0.000	19.597
1.540	51.0	16.4	0.473	1.202	0.000	18.868
1.560	49.0	15.7	0.454	1.202	0.000	18.121
1.580	48.0	15.4	0.445	1.202	0.000	17.364
1.600	46.0	14.8	0.427	1.202	0.000	16.589
1.620	45.0	14.4	0.417	1.202	0.000	15.804
1.640	44.0	14.1	0.408	1.202	0.000	15.010
1.660	43.0	13.8	0.399	1.202	0.000	14.207
1.680	42.0	13.5	0.389	1.202	0.000	13.395
1.700	42.0	13.5	0.389	1.202	0.000	12.583
1.720	40.0	12.8	0.371	1.202	0.000	11.752
1.740	39.0	12.5	0.362	1.202	0.000	10.911
1.760	38.0	12.2	0.352	1.202	0.000	10.062
1.780	38.0	12.2	0.352	1.202	0.000	9.213
1.800	37.0	11.9	0.343	1.202	0.000	8.354
1.820	37.0	11.9	0.343	1.202	0.000	7.495
1.840	36.0	11.6	0.334	1.202	0.000	6.627
1.860	36.0	11.6	0.334	1.202	0.000	5.759
1.880	35.0	11.2	0.325	1.202	0.000	4.882
1.900	35.0	11.2	0.325	1.202	0.000	4.005
1.920	34.0	10.9	0.315	1.202	0.000	3.118
1.940	34.0	10.9	0.315	1.202	0.000	2.232
1.960	33.0	10.6	0.306	1.202	0.000	1.336
1.980	33.0	10.6	0.306	1.202	0.000	0.440
2.000	32.0	10.3	0.297	1.202	0.000	0.000

Storage volume (m³) = 26.5 m³ (Sum of all balance quantities)



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MasterDrain

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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.