



Company Remote Engineering Design Services				Project Big Green Farm - Penley	
Item Hydrograph storage calcs (Winter 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

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) = 23.5 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	20.0	6.4	0.185	1.202	0.000	0.000
0.040	20.0	6.4	0.185	1.202	0.000	0.000
0.060	21.0	6.7	0.195	1.202	0.000	0.000
0.080	21.0	6.7	0.195	1.202	0.000	0.000
0.100	22.0	7.1	0.204	1.202	0.000	0.000
0.120	23.0	7.4	0.213	1.202	0.000	0.000
0.140	24.0	7.7	0.223	1.202	0.000	0.000
0.160	26.0	8.3	0.241	1.202	0.000	0.000
0.180	27.0	8.7	0.250	1.202	0.000	0.000
0.200	29.0	9.3	0.269	1.202	0.000	0.000
0.220	31.0	10.0	0.287	1.202	0.000	0.000
0.240	32.0	10.3	0.297	1.202	0.000	0.000
0.260	33.0	10.6	0.306	1.202	0.000	0.000
0.280	34.0	10.9	0.315	1.202	0.000	0.000
0.300	36.0	11.6	0.334	1.202	0.000	0.000
0.320	38.0	12.2	0.352	1.202	0.000	0.000
0.340	39.0	12.5	0.362	1.202	0.000	0.000
0.360	40.0	12.8	0.371	1.202	0.000	0.000
0.380	42.0	13.5	0.389	1.202	0.000	0.000
0.400	45.0	14.4	0.417	1.202	0.000	0.000
0.420	49.0	15.7	0.454	1.202	0.000	0.000
0.440	53.0	17.0	0.491	1.202	0.000	0.000
0.460	57.0	18.3	0.529	1.202	0.000	0.000
0.480	62.0	19.9	0.575	1.202	0.000	0.000
0.500	66.0	21.2	0.612	1.202	0.000	0.000
0.520	71.0	22.8	0.658	1.202	0.000	0.000
0.540	77.0	24.7	0.714	1.202	0.000	0.000
0.560	84.0	27.0	0.779	1.202	0.000	0.000
0.580	91.0	29.2	0.844	1.202	0.000	0.000
0.600	98.0	31.5	0.909	1.202	0.000	0.000
0.620	105.0	33.7	0.974	1.202	0.000	0.000
0.640	114.0	36.6	1.057	1.202	0.000	0.000
0.660	125.0	40.1	1.159	1.202	0.000	0.000
0.680	135.0	43.3	1.252	1.202	0.050	0.050
0.700	143.0	45.9	1.326	1.202	0.124	0.174
0.720	154.0	49.4	1.428	1.202	0.226	0.401
0.740	164.0	52.7	1.521	1.202	0.319	0.720

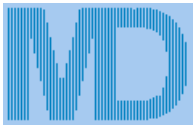


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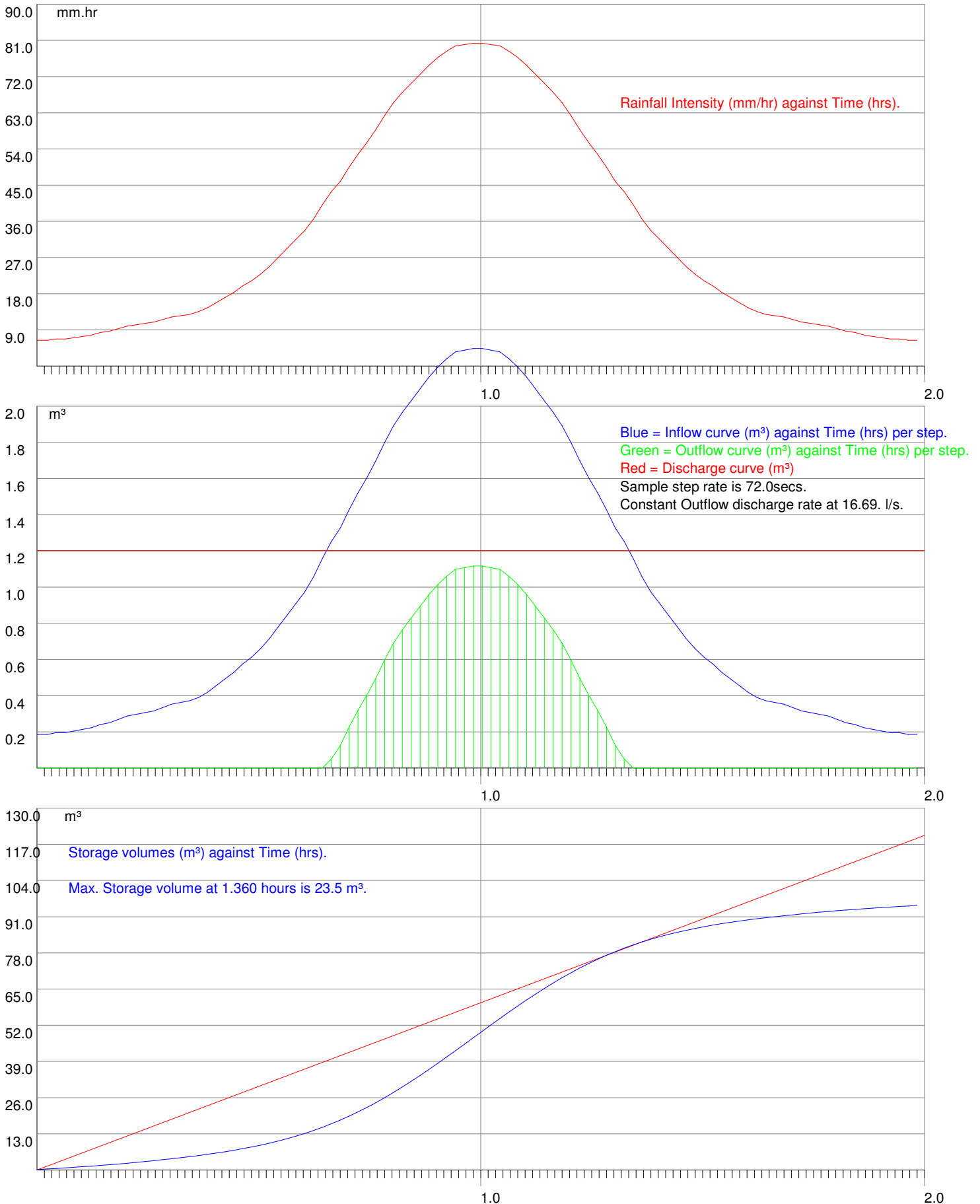
Calculations (cont.) :-

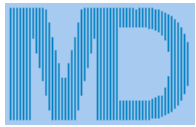
Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.820	204.0	65.5	1.892	1.202	0.690	2.904
0.840	212.0	68.1	1.966	1.202	0.764	3.669
0.860	219.0	70.3	2.031	1.202	0.829	4.498
0.880	226.0	72.6	2.096	1.202	0.894	5.392
0.900	233.0	74.8	2.161	1.202	0.959	6.351
0.920	239.0	76.7	2.216	1.202	1.015	7.365
0.940	244.0	78.3	2.263	1.202	1.061	8.426
0.960	248.0	79.6	2.300	1.202	1.098	9.524
0.980	249.0	80.0	2.309	1.202	1.107	10.631
1.000	250.0	80.3	2.318	1.202	1.117	11.748
1.020	250.0	80.3	2.318	1.202	1.117	12.864
1.040	249.0	80.0	2.309	1.202	1.107	13.971
1.060	248.0	79.6	2.300	1.202	1.098	15.069
1.080	244.0	78.3	2.263	1.202	1.061	16.130
1.100	239.0	76.7	2.216	1.202	1.015	17.145
1.120	233.0	74.8	2.161	1.202	0.959	18.104
1.140	226.0	72.6	2.096	1.202	0.894	18.998
1.160	219.0	70.3	2.031	1.202	0.829	19.827
1.180	212.0	68.1	1.966	1.202	0.764	20.591
1.200	204.0	65.5	1.892	1.202	0.690	21.281
1.220	194.0	62.3	1.799	1.202	0.597	21.878
1.240	183.0	58.8	1.697	1.202	0.495	22.373
1.260	173.0	55.6	1.604	1.202	0.402	22.776
1.280	164.0	52.7	1.521	1.202	0.319	23.095
1.300	154.0	49.4	1.428	1.202	0.226	23.321
1.320	143.0	45.9	1.326	1.202	0.124	23.445
1.340	135.0	43.3	1.252	1.202	0.050	23.495
1.360	125.0	40.1	1.159	1.202	0.000	23.453
1.380	114.0	36.6	1.057	1.202	0.000	23.308
1.400	105.0	33.7	0.974	1.202	0.000	23.080
1.420	98.0	31.5	0.909	1.202	0.000	22.787
1.440	91.0	29.2	0.844	1.202	0.000	22.429
1.460	84.0	27.0	0.779	1.202	0.000	22.006
1.480	77.0	24.7	0.714	1.202	0.000	21.518
1.500	71.0	22.8	0.658	1.202	0.000	20.975
1.520	66.0	21.2	0.612	1.202	0.000	20.385
1.540	62.0	19.9	0.575	1.202	0.000	19.758
1.560	57.0	18.3	0.529	1.202	0.000	19.085
1.580	53.0	17.0	0.491	1.202	0.000	18.375
1.600	49.0	15.7	0.454	1.202	0.000	17.627
1.620	45.0	14.4	0.417	1.202	0.000	16.843
1.640	42.0	13.5	0.389	1.202	0.000	16.030
1.660	40.0	12.8	0.371	1.202	0.000	15.200
1.680	39.0	12.5	0.362	1.202	0.000	14.359
1.700	38.0	12.2	0.352	1.202	0.000	13.510
1.720	36.0	11.6	0.334	1.202	0.000	12.642
1.740	34.0	10.9	0.315	1.202	0.000	11.755
1.760	33.0	10.6	0.306	1.202	0.000	10.860
1.780	32.0	10.3	0.297	1.202	0.000	9.955
1.800	31.0	10.0	0.287	1.202	0.000	9.040
1.820	29.0	9.3	0.269	1.202	0.000	8.107
1.840	27.0	8.7	0.250	1.202	0.000	7.156
1.860	26.0	8.3	0.241	1.202	0.000	6.195
1.880	24.0	7.7	0.223	1.202	0.000	5.216
1.900	23.0	7.4	0.213	1.202	0.000	4.227
1.920	22.0	7.1	0.204	1.202	0.000	3.230
1.940	21.0	6.7	0.195	1.202	0.000	2.222
1.960	21.0	6.7	0.195	1.202	0.000	1.215
1.980	20.0	6.4	0.185	1.202	0.000	0.199
2.000	20.0	6.4	0.185	1.202	0.000	0.000

Storage volume (m³) = 23.5 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.