



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 28/11/19		
By	Checked	Reviewed

Project **30 year ashbrow storage**

Title **Pump storage calcs for HUDDERSFIELD**

Data:-

FSR Hydrology:-

Location = HUDDERSFIELD

M5-60 (mm) = 19

Soil index = 0.45

Return period = 30

UCWI = 96.2

Grid reference = SE1416

r = 0.34

SAAR (mm/yr) = 900

WRAP = 4

Climate change = 0

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

Runoff factor (RF) = 40.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = Impervious Area * 100 / (Impervious Area + Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 416 m²

Total area (TA) = 1520 m²

Mean pump disch. rate = 3.500 l/s

Additional flow = 0.00 l/s

Pervious area = 1104 m²

Equiv area = 608 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 0

Calculated data:-

Time to max = 25.0 mins

Rainfall at max = 50.93 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 7.7 m³

Allowed discharge rate = 3.500 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 8.00 mm/hr

Calculated storage volume = 0.0 m³

Allowed discharge rate = 3.500 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	974.4	1125	7.7	400 x 600	42.5	500 x 500	30.6
150	433.1	1200	6.8	600 x 900	18.5	500 x 750	20.4
225	192.5	1275	6.0	800 x 1200	10.4	500 x 1000	15.3
300	108.3	1350	5.3			750 x 1000	10.2
375	69.3	1425	4.8			750 x 1200	8.5
450	48.1	1500	4.3			750 x 1500	6.8
525	35.4	1575	3.9			1000 x 1000	7.7
600	27.1	1650	3.6			1000 x 1200	6.4
675	21.4	1725	3.3			1000 x 1500	5.1
750	17.3	1800	3.0			1000 x 1800	4.3
825	14.3	1875	2.8			1000 x 2000	3.8
900	12.0	1950	2.6			1500 x 1500	3.4
975	10.3	2025	2.4			1500 x 1800	2.8
1050	8.8	2100	2.2			1500 x 2000	2.6



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Sheet no.

2

Date

28/11/19

Project **30 year ashbrow storage**

By

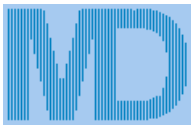
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Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	84.0	8.489	2.100	6.389
20	58.0	11.765	4.200	7.565
30	46.0	13.861	6.300	7.561
40	38.0	15.434	8.400	7.034
50	33.0	16.705	10.500	6.205
60	29.0	17.776	12.600	5.176
70	26.0	18.707	14.700	4.007
80	24.0	19.531	16.800	2.731
90	22.0	20.271	18.900	1.371
100	21.0	20.945	21.000	0.000
110	19.0	21.562	23.100	0.000
120	18.0	22.133	25.200	0.000
130	17.0	22.664	27.300	0.000
140	16.0	23.160	29.400	0.000
150	16.0	23.626	31.500	0.000
160	15.0	24.064	33.600	0.000
170	14.0	24.479	35.700	0.000
180	14.0	24.872	37.800	0.000
190	13.0	25.246	39.900	0.000
200	13.0	25.602	42.000	0.000
210	12.0	25.942	44.100	0.000
220	12.0	26.268	46.200	0.000
230	11.0	26.579	48.300	0.000
240	11.0	26.878	50.400	0.000
250	11.0	27.166	52.500	0.000
260	10.0	27.442	54.600	0.000
270	10.0	27.720	56.700	0.000
280	10.0	27.992	58.800	0.000
290	10.0	28.256	60.900	0.000
300	9.0	28.513	63.000	0.000
310	9.0	28.764	65.100	0.000
320	9.0	29.008	67.200	0.000
330	9.0	29.246	69.300	0.000
340	9.0	29.479	71.400	0.000
350	8.0	29.706	73.500	0.000
360	8.0	29.928	75.600	0.000
370	8.0	30.146	77.700	0.000
380	8.0	30.359	79.800	0.000
390	8.0	30.567	81.900	0.000
400	8.0	30.771	84.000	0.000
410	7.0	30.972	86.100	0.000
420	7.0	31.168	88.200	0.000
430	7.0	31.361	90.300	0.000
440	7.0	31.551	92.400	0.000
450	7.0	31.737	94.500	0.000
460	7.0	31.920	96.600	0.000
470	7.0	32.099	98.700	0.000
480	7.0	32.276	100.800	0.000
490	7.0	32.450	102.900	0.000
500	6.0	32.621	105.000	0.000
510	6.0	32.790	107.100	0.000
520	6.0	32.956	109.200	0.000
530	6.0	33.119	111.300	0.000
540	6.0	33.280	113.400	0.000
550	6.0	33.439	115.500	0.000
560	6.0	33.595	117.600	0.000
570	6.0	33.750	119.700	0.000
580	6.0	33.902	121.800	0.000
590	6.0	34.052	123.900	0.000
600	6.0	34.200	126.000	0.000

Storage volume (m³) = 7.7 m³



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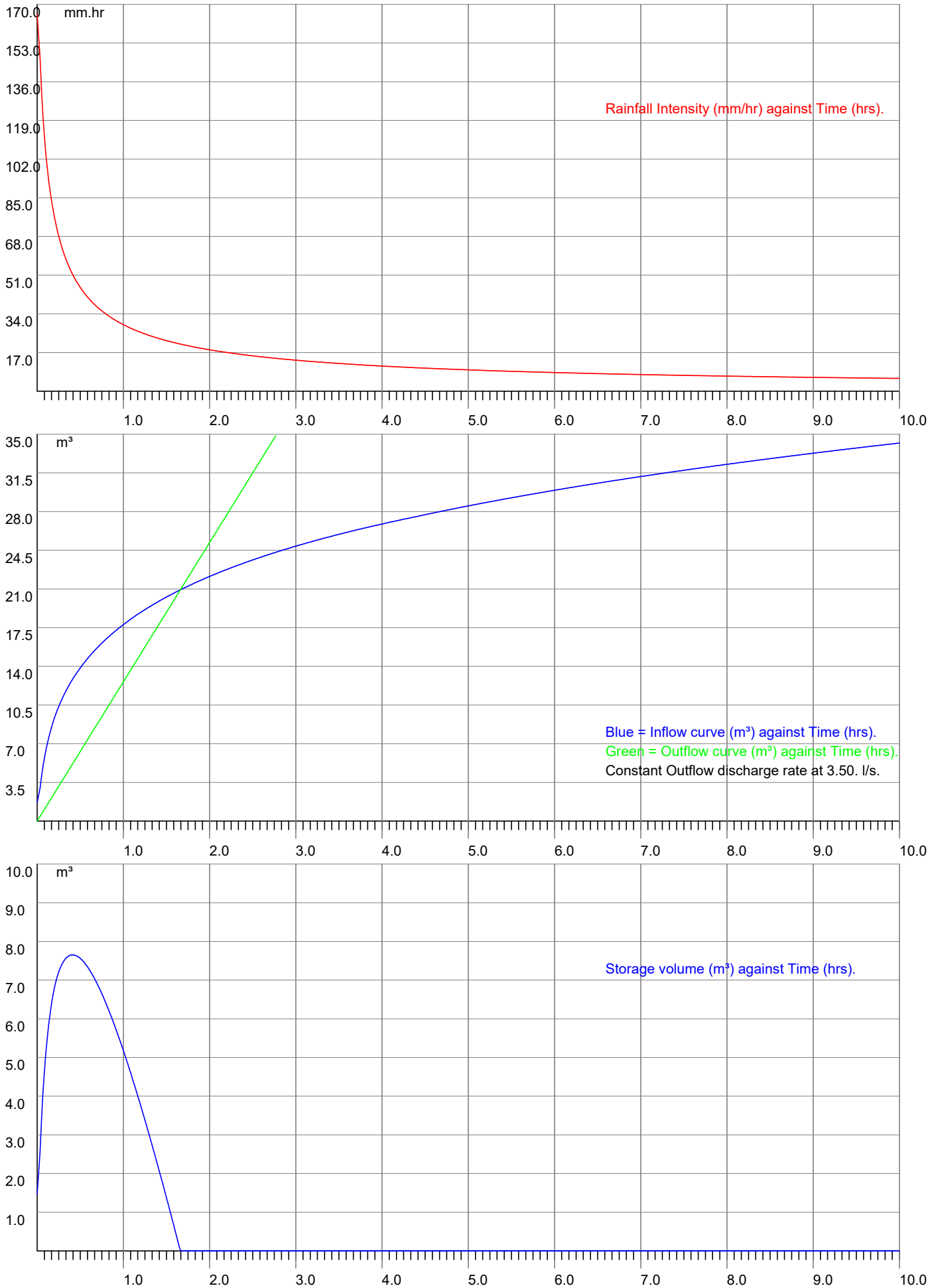
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Explanatory notes for Peak Flow Storage

- 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 outflow volume is constant throughout the process at the specified discharge rate.

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. The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

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.