

Jenna Lowe

From: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Sent: 09 March 2022 12:56
To: Anna Mierzejewska
Cc: Wastewater Developer Services; LK SuDS & Floods
Subject: Pre Development Enquiry for : Holly Mount Farm, Greenmount, Bury , BL8 4HPUU reference Number : 4200047798

Good afternoon Anna,

Pre Development Enquiry for : Holly Mount Farm, Greenmount, Bury , BL8 4HPUU reference Number : 4200047798

We have carried out an assessment of your application which is based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your drainage strategy will need to be reviewed by other competent authorities as part of the planning process, and we advise that you carry out the necessary site investigations to confirm the viability of your proposals.

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 6723 723 or refer to the link below:

<https://www.unitedutilities.com/builders-developers/working-near-our-assets/>

Foul Water

Foul flow from this site will be allowed to drain into the public foul water/combined sewer system.

Our preferred point of discharge would be to the 150mm diameter public combined sewer within the site boundary at an unrestricted rate.

If you are able to identify an alternative, more suitable point of discharge, we request that you contact us at your earliest convenience so that we can assess suitability.

In accordance with our infrastructure plans we may ask you to change your point of connection. Therefore please contact us when you are ready to formalise your drainage proposals, we would suggest before you submit for Full Planning.

Surface Water

All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80, (Reference ID: 7-080-20150323), of the National Planning Practice Guidance. We also recommend you prioritise the use of multi-functional sustainable drainage systems for the management of surface water in accordance with national planning policy.

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.

This is outlined as follows, in order of priority:

- 1. into the ground (infiltration);**
- 2. to a surface waterbody;**

3. to a surface water sewer or highway drain;

4. to a combined sewer.

For guidance, The [North West SuDS Pro-Forma](#) provides information on the appropriate evidence required at each stage of the hierarchy, to demonstrate how each level has been discounted.

The Lead Local Flood Authority has responsibility for all surface water drainage concerns and their input to your proposal is critical. You should also consider whether it is necessary to discuss your proposal with the Environment Agency, or Internal Drainage Board (if operating in your area).

The Local Planning Authority are the determining authority for any application for planning permission and the appropriate authority for determining cost viability of a proposed drainage scheme, such assessments are outside of the jurisdiction of United Utilities.

Infiltration

Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible.

A detailed evidence based feasibility assessment must be carried out in line with Chapter 25 of the CIRIA SuDS Manual 2015 to determine whether infiltration is a suitable method of surface water disposal.

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:

<https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs>

If your site is in a Groundwater Source Protection Zone, you should have regard to the Environment Agency's approach to Groundwater Protection. Information on this is available via the link below:

<https://www.gov.uk/government/publications/groundwater-protection-position-statements>

Please note that such a location could have implications for the principle of your development and the need for additional mitigating measures to protect the groundwater environment and public water supply in the detailed design of your site.

Waterbody

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you contact the Lead Local Flood Authority and/or Environment Agency to discuss a point of discharge to the watercourse located in 100m South of the proposed site.

We would encourage you to identify and engage with any third party landowner and riparian owner to agree access and discharge rights to the water body if this is not in your ownership.

Highway Drainage

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you investigate the possibility of draining surface water to the highway drain where this ultimately discharges to a watercourse, by contacting the relevant Highway Authority.

Public Sewer

In accordance with the hierarchy of drainage options within the National Planning Practice Guidance, both discharge to ground via infiltration and discharge to a waterbody should be discounted prior to consideration of discharging surface water to the public sewer system. Evidence should be provided to demonstrate how these have been discounted, as outlined in the North West SuDS pro-forma.

Once evidence is provided as outlined above, United Utilities will consider a connection to the 150mm diameter public combined sewer within the site boundary of the proposed site at a pass forward flow to be agreed by the Lead Local Flood Authority. United Utilities request that any agreed rate does not exceed 6l/s.

As a Water Company, we have no obligation to accept highway drainage into our public sewer network. However, should your proposals include runoff from highways, we would request that consideration is given to SuDS components that deliver source control are incorporated within the design of the scheme to reduce the volume and frequency of discharges of these flows to the public sewer.

Levels

For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist, we recommend that you contact us to discuss further. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.

Land drainage / Overland flows / track drainage

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage into the public sewerage network under any circumstances

Existing Wastewater Assets Crossing the Site

According to our public sewer records there are public sewers located within your site boundary. We will require unrestricted access to the sewer for maintenance purposes, we would ask that you maintain a minimum clearance of 6m which is measured 3m from the centre line of the pipe unless there happens to be a formal easement agreement in place, in which case the specified easement width would apply. If you cannot achieve this then you may wish to consider diverting and or abandoning the public sewer.

Please be aware that any proposed diversion may require modelling. This process may take up to 6 months in order to reach an acceptable design.

Please refer to the link below to obtain full details of the processes involved with sewer diversions:

<https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-diversions/>

Existing Water Assets Crossing the Site

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address:

DeveloperServicesWater@uuplc.co.uk. Further information for this service can be found on our website via the link below:

<https://www.unitedutilities.com/builders-developers/larger-developments/pre-development/water-pre-dev/>

Connection Application

Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

<https://www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/sewer-connection/>

We recommend that the detailed design should confirm the locations of all utilities in the area and ensure that any proposed drainage solution considers routing and clash checks where required.

If we can be of any further assistance please don't hesitate to contact us further.

Kind regards,
Ashleigh



Ashleigh Bellerby
Assistant Developer Engineer
Developer Services & Metering
Customer Services
T: 07826891650
unitedutilities.com

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Jenna Lowe

From: Anna Mierzejewska
Sent: 25 March 2022 13:51
To: Jenna Lowe
Subject: FW: SuDS Enquiry - FRA22 1030 Holly Mount Farm, Bury
Attachments: 108-02_-.pdf; Holly Mount Farm Site location.png

From: Anna Mierzejewska
Sent: 04 March 2022 10:34
To: a.m.southgate@bury.gov.uk; Smith, Frances <F.Smith@bury.gov.uk>
Cc: LK SuDS & Floods <flooding@thelkgroup.com>
Subject: SuDS Enquiry - FRA22 1030 Holly Mount Farm, Bury

Dear All,

LK Consult Ltd. has been commissioned to undertake a Sustainable Drainage (SuDS) Strategy for a site located at Holly Mount Farm, Greenmount, Bury, BL8 4HP, centred at approximate National Grid Reference 377275E, 414005N. The proposal is to construct 6 dwellings on the farm hard standing footprint.

The area of interest appears to be within Flood Zone 1.

BGS data indicates that the site is underlain by Till, Devensian (Diamicton) superficial deposits in the west and by River Terrace Deposits (Sand and Gravel) in the east of the site over Sandstone bedrock.

To complete the SuDS, we would be grateful if you could supply us with the following, if available, for the vicinity of the site:

- Any restrictions applied to ordinary watercourses in the area.
- Any records of culverted watercourses in the vicinity of the site.
- Highway drainage restrictions and records.
- Indications if the site is within the Critical Drainage Area.
- Suggestions on the potential discharges from the proposed development.
- Policies that may relate to Sustainable Drainage Systems (SuDS).

The site location plan and the existing site layout are attached to this email.

If you have any queries, please do not hesitate to get in touch.

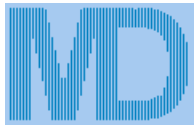
We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available, what the charge will be, and we will pay the relevant fees by debit card as soon as possible.

Any advice or recommendations you may have regarding the potential discharges from the development of this site would also be appreciated.

We will be in contact with all other relevant authorities to get a more complete understanding of the issues in the area.

APPENDIX D

CALCULATIONS



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Eton Hill Road,
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email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 22/04/22		
By	Checked	Reviewed

Project **Existing Qbar Runoff Hollymount Farm, Bury**

Title **Existing Qbar Runoff Hollymount Farm, Bury**

Area data:-

FSR data

M5-60 = 19.5

Soil index = 0.45

WRAP value = 4

$r = 0.27$

SAAR = 1300

Nat grid = SD 7713

Site data:-

Ret. period (yrs) = 2.33

Time of entry = 7.00

Impervious area drained = 5100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 7.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 400 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 77.0%

Rainfall rate = 54.6 mm/Hr

UCWI = 126.0

Runoff rate (gross) = 64.2 l/s

Methods

Runoff factor (RF) = 77.0, calculated from:-

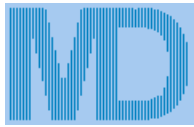
Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Job No.		
Sheet no. 1		
Date 22/04/22		
By	Checked	Reviewed

Project **1 Year Existing Runoff Hollymount Farm, Bury**

Title **1 Year Existing Runoff Hollymount Farm, Bury**

Area data:-

FSR data

M5-60 = 19.5

Soil index = 0.45

WRAP value = 4

$r = 0.27$

SAAR = 1300

Nat grid = SD 7713

Site data:-

Ret. period (yrs) = 1

Time of entry = 10.00

Impervious area drained = 5100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 10.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 400 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 77.0%

Rainfall rate = 39.0 mm/Hr

UCWI = 126.0

Runoff rate (gross) = 45.9 l/s

Methods

Runoff factor (RF) = 77.0, calculated from:-

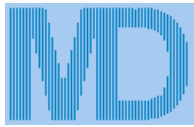
Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Job No.		
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Project **30 Years Existing Runoff Hollymount Farm, Bury**

Title **30 Years Existing Runoff Hollymount Farm, Bury**

Area data:-

FSR data

M5-60 = 19.5

Soil index = 0.45

WRAP value = 4

$r = 0.27$

SAAR = 1300

Nat grid = SD 7713

Site data:-

Ret. period (yrs) = 30

Time of entry = 6.00

Impervious area drained = 5100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 6.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 400 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 77.0%

Rainfall rate = 95.4 mm/Hr

UCWI = 126.0

Runoff rate (gross) = 112.3 l/s

Methods

Runoff factor (RF) = 77.0, calculated from:-

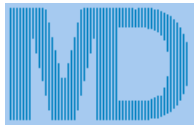
Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Date 22/04/22		
By	Checked	Reviewed

Project **100 Years Existing Runoff Hollymount Farm, Bury**

Title **100 Years Existing Runoff Hollymount Farm, Bury**

Area data:-

FSR data

M5-60 = 19.5

Soil index = 0.45

WRAP value = 4

$r = 0.27$

SAAR = 1300

Nat grid = SD 7713

Site data:-

Ret. period (yrs) = 100

Time of entry = 6.00

Impervious area drained = 5100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 6.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 400 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 77.0%

Rainfall rate = 120.5 mm/Hr

UCWI = 126.0

Runoff rate (gross) = 141.7 l/s

Methods

Runoff factor (RF) = 77.0, calculated from:-

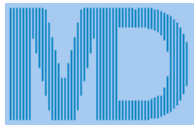
Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Date 22/04/22		
By	Checked	Reviewed

Project **30 Year Storage Event Hollymount Farm, Bury**

Title **30 Year Storage Event Hollymount Farm, Bury**

Data:-

FSR Hydrology:-

Location = HOLLYMOUNT FARM

M5-60 (mm) = 19.5

Soil index = 0.45

Return period = 30

UCWI = 129.0

Grid reference = SD 7713

r = 0.27

SAAR (mm/yr) = 1300

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 = $\frac{\text{Impervious Area} \times 100}{(\text{Impervious Area} + \text{Pervious Area})}$

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2135 m²

Total area (TA) = 5500 m²

Mean pump disch. rate = 56.150 l/s

Additional flow = 0.00 l/s

Pervious area = 3365 m²

Equiv area = 2200 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 0

Calculated data:-

Time to max = 3.0 mins

Rainfall at max = 118.43 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 2.9 m³

Allowed discharge rate = 56.150 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 9.00 mm/hr

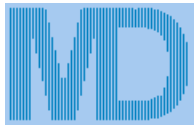
Calculated storage volume = 0.0 m³

Allowed discharge rate = 56.150 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	372.0	1125	2.9	400 x 600	16.2	500 x 500	11.7
150	165.3	1200	2.6	600 x 900	7.1	500 x 750	7.8
225	73.5	1275	2.3	800 x 1200	4.0	500 x 1000	5.8
300	41.3	1350	2.0			750 x 1000	3.9
375	26.5	1425	1.8			750 x 1200	3.2
450	18.4	1500	1.7			750 x 1500	2.6
525	13.5	1575	1.5			1000 x 1000	2.9
600	10.3	1650	1.4			1000 x 1200	2.4
675	8.2	1725	1.3			1000 x 1500	1.9
750	6.6	1800	1.1			1000 x 1800	1.6
825	5.5	1875	1.1			1000 x 2000	1.5
900	4.6	1950	1.0			1500 x 1500	1.3
975	3.9	2025	0.9			1500 x 1800	1.1
1050	3.4	2100	0.8			1500 x 2000	1.0



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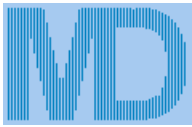
Project **30 Year Storage Event Hollymount Farm, Bury**

Title **30 Year Storage Event Hollymount Farm, Bury**

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	78.0	28.594	33.690	0.000
20	56.0	41.092	67.380	0.000
30	45.0	49.511	101.070	0.000
40	38.0	56.039	134.760	0.000
50	34.0	61.433	168.450	0.000
60	30.0	66.057	202.140	0.000
70	27.0	70.119	235.830	0.000
80	25.0	73.748	269.520	0.000
90	23.0	77.033	303.210	0.000
100	22.0	80.034	336.900	0.000
110	21.0	82.798	370.590	0.000
120	19.0	85.360	404.280	0.000
130	18.0	87.745	437.970	0.000
140	18.0	89.977	471.660	0.000
150	17.0	92.073	505.350	0.000
160	16.0	94.047	539.040	0.000
170	15.0	95.912	572.730	0.000
180	15.0	97.678	606.420	0.000
190	14.0	99.354	640.110	0.000
200	14.0	101.029	673.800	0.000
210	13.0	102.647	707.490	0.000
220	13.0	104.209	741.180	0.000
230	13.0	105.720	774.870	0.000
240	12.0	107.183	808.560	0.000
250	12.0	108.602	842.250	0.000
260	12.0	109.979	875.940	0.000
270	11.0	111.319	909.630	0.000
280	11.0	112.622	943.320	0.000
290	11.0	113.891	977.010	0.000
300	10.0	115.128	1010.700	0.000
310	10.0	116.336	1044.390	0.000
320	10.0	117.515	1078.080	0.000
330	10.0	118.667	1111.770	0.000
340	10.0	119.794	1145.460	0.000
350	9.0	120.897	1179.150	0.000
360	9.0	121.976	1212.840	0.000
370	9.0	123.034	1246.530	0.000
380	9.0	124.071	1280.220	0.000
390	9.0	125.088	1313.910	0.000
400	9.0	126.086	1347.600	0.000
410	8.0	127.066	1381.290	0.000
420	8.0	128.028	1414.980	0.000
430	8.0	128.974	1448.670	0.000
440	8.0	129.904	1482.360	0.000
450	8.0	130.818	1516.050	0.000
460	8.0	131.717	1549.740	0.000
470	8.0	132.602	1583.430	0.000
480	8.0	133.473	1617.120	0.000
490	7.0	134.330	1650.810	0.000
500	7.0	135.175	1684.500	0.000
510	7.0	136.008	1718.190	0.000
520	7.0	136.828	1751.880	0.000
530	7.0	137.637	1785.570	0.000
540	7.0	138.435	1819.260	0.000
550	7.0	139.222	1852.950	0.000
560	7.0	139.999	1886.640	0.000
570	7.0	140.765	1920.330	0.000
580	7.0	141.521	1954.020	0.000
590	7.0	142.268	1987.710	0.000
600	7.0	143.006	2021.400	0.000

Storage volume (m³) = 2.9 m³



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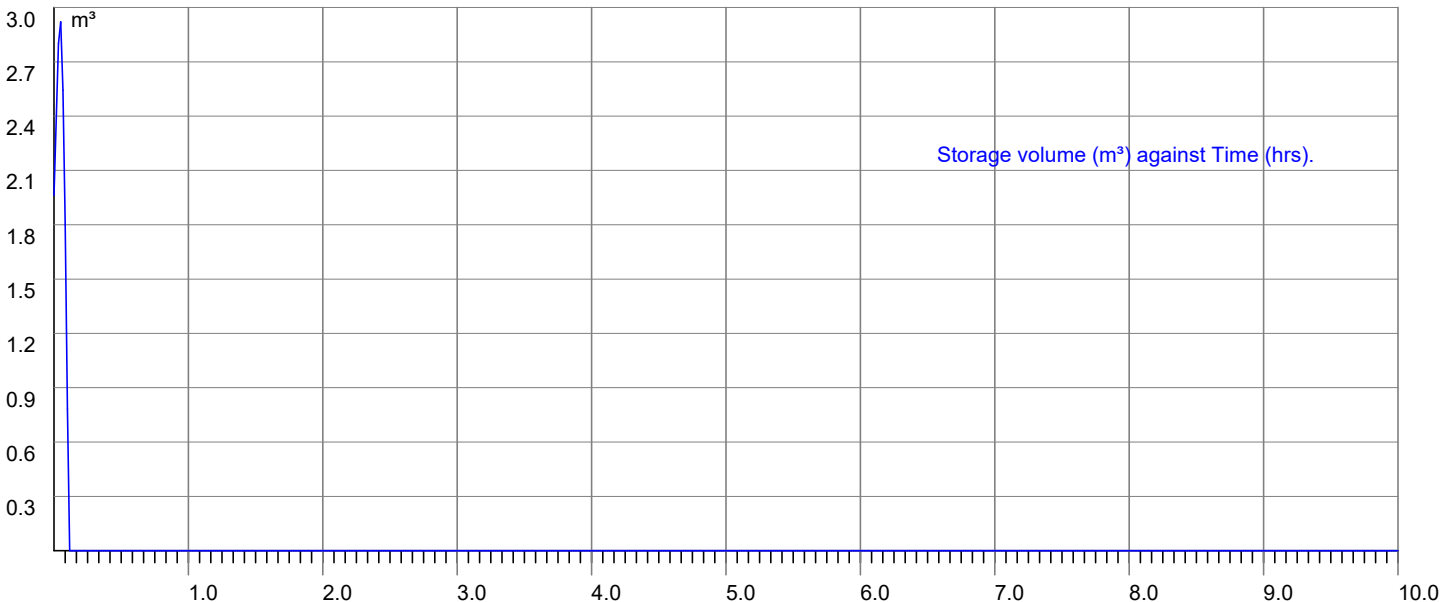
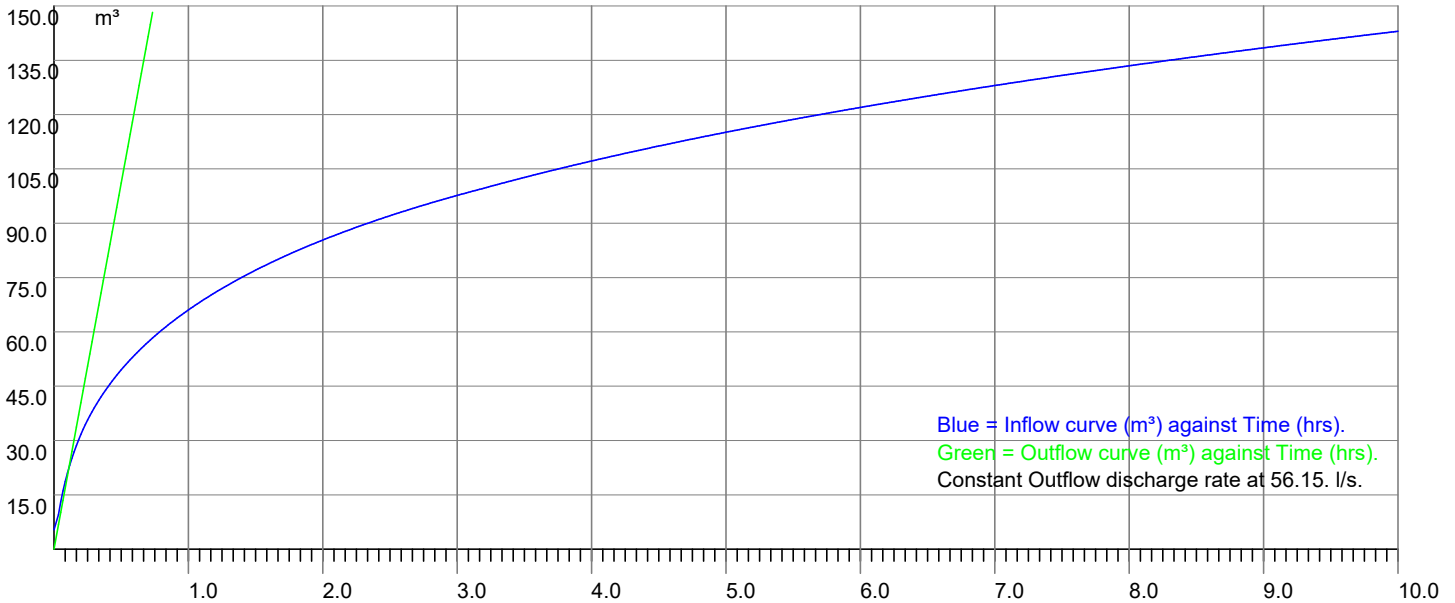
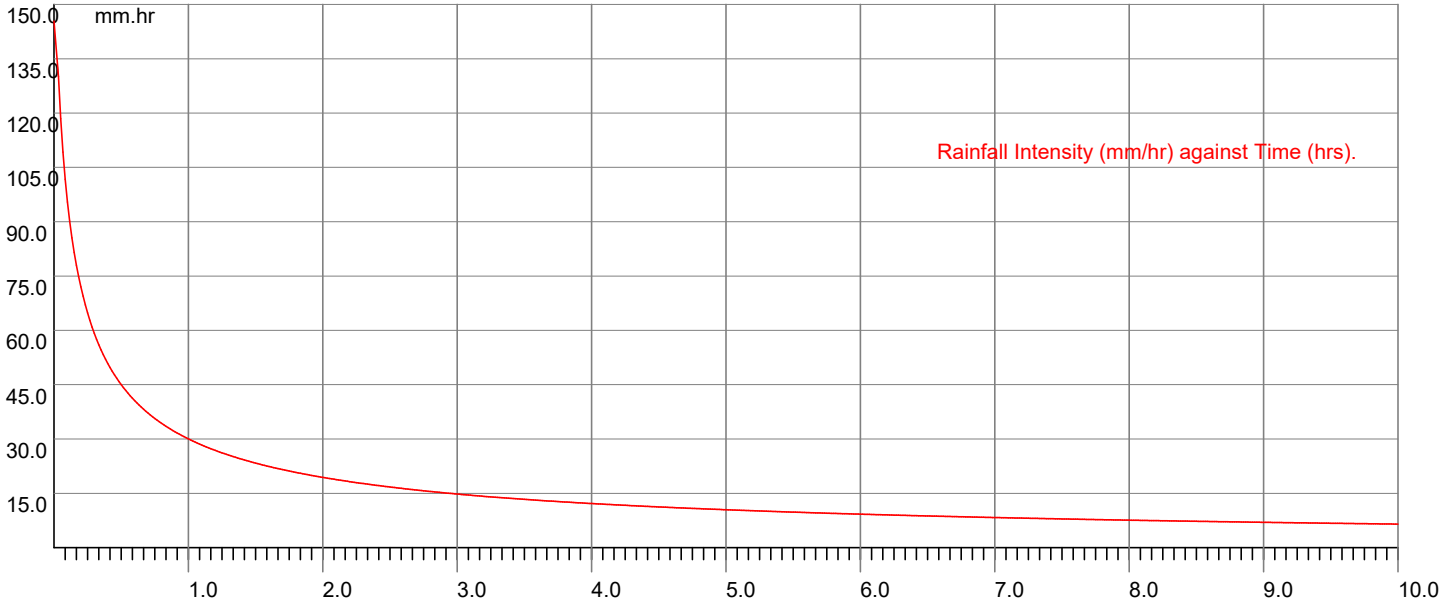
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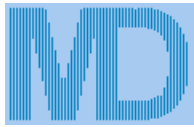
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Job No.		
Sheet no. 4		
Date 22/04/22		
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Project **30 Year Storage Event Hollymount Farm, Bury**

Title **30 Year Storage Event Hollymount Farm, Bury**

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.

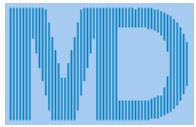
Why do the two methods give different results?

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.



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Job No.		
Sheet no. 1		
Date 22/04/22		
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Project **100 Year Storage Event + 20% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 20% CC Hollymount Farm, Bury**

Data:-

FSR Hydrology:-

Location = HOLLYMOUNT FARM

M5-60 (mm) = 19.5

Soil index = 0.45

Return period = 100

UCWI = 129.0

Grid reference = SD 7713

r = 0.27

SAAR (mm/yr) = 1300

WRAP = 4

Climate change = 20

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 = $\frac{\text{Impervious Area} \times 100}{(\text{Impervious Area} + \text{Pervious Area})}$

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2135 m²

Total area (TA) = 5500 m²

Mean pump disch. rate = 70.850 l/s

Additional flow = 0.00 l/s

Pervious area = 3365 m²

Equiv area = 2200 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 20

Calculated data:-

Time to max = 4.0 mins

Rainfall at max = 164.19 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 7.1 m³

Allowed discharge rate = 70.850 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 14.00 mm/hr

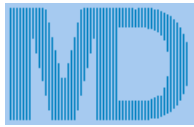
Calculated storage volume = 0.0 m³

Allowed discharge rate = 70.850 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	901.2	1125	7.1	400 x 600	39.3	500 x 500	28.3
150	400.5	1200	6.3	600 x 900	17.1	500 x 750	18.9
225	178.0	1275	5.5	800 x 1200	9.6	500 x 1000	14.2
300	100.1	1350	4.9			750 x 1000	9.4
375	64.1	1425	4.4			750 x 1200	7.9
450	44.5	1500	4.0			750 x 1500	6.3
525	32.7	1575	3.6			1000 x 1000	7.1
600	25.0	1650	3.3			1000 x 1200	5.9
675	19.8	1725	3.0			1000 x 1500	4.7
750	16.0	1800	2.8			1000 x 1800	3.9
825	13.2	1875	2.6			1000 x 2000	3.5
900	11.1	1950	2.4			1500 x 1500	3.1
975	9.5	2025	2.2			1500 x 1800	2.6
1050	8.2	2100	2.0			1500 x 2000	2.4



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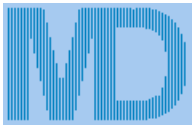
Project **100 Year Storage Event + 20% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 20% CC Hollymount Farm, Bury**

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	120.0	43.840	42.510	1.330
20	87.0	63.957	85.020	0.000
30	70.0	77.547	127.530	0.000
40	60.0	88.088	170.040	0.000
50	53.0	96.773	212.550	0.000
60	47.0	104.186	255.060	0.000
70	43.0	110.661	297.570	0.000
80	40.0	116.410	340.080	0.000
90	37.0	121.574	382.590	0.000
100	34.0	126.258	425.100	0.000
110	32.0	130.535	467.610	0.000
120	31.0	134.465	510.120	0.000
130	29.0	138.093	552.630	0.000
140	28.0	141.456	595.140	0.000
150	26.0	144.584	637.650	0.000
160	25.0	147.501	680.160	0.000
170	24.0	150.228	722.670	0.000
180	23.0	152.784	765.180	0.000
190	22.0	155.183	807.690	0.000
200	21.0	157.646	850.200	0.000
210	21.0	160.025	892.710	0.000
220	20.0	162.317	935.220	0.000
230	20.0	164.530	977.730	0.000
240	19.0	166.669	1020.240	0.000
250	18.0	168.740	1062.750	0.000
260	18.0	170.748	1105.260	0.000
270	17.0	172.696	1147.770	0.000
280	17.0	174.589	1190.280	0.000
290	17.0	176.430	1232.790	0.000
300	16.0	178.222	1275.300	0.000
310	16.0	179.969	1317.810	0.000
320	15.0	181.671	1360.320	0.000
330	15.0	183.333	1402.830	0.000
340	15.0	184.956	1445.340	0.000
350	15.0	186.542	1487.850	0.000
360	14.0	188.093	1530.360	0.000
370	14.0	189.611	1572.870	0.000
380	14.0	191.097	1615.380	0.000
390	13.0	192.552	1657.890	0.000
400	13.0	193.979	1700.400	0.000
410	13.0	195.378	1742.910	0.000
420	13.0	196.750	1785.420	0.000
430	13.0	198.097	1827.930	0.000
440	12.0	199.420	1870.440	0.000
450	12.0	200.719	1912.950	0.000
460	12.0	201.996	1955.460	0.000
470	12.0	203.251	1997.970	0.000
480	12.0	204.485	2040.480	0.000
490	11.0	205.699	2082.990	0.000
500	11.0	206.893	2125.500	0.000
510	11.0	208.069	2168.010	0.000
520	11.0	209.227	2210.520	0.000
530	11.0	210.368	2253.030	0.000
540	11.0	211.492	2295.540	0.000
550	11.0	212.599	2338.050	0.000
560	10.0	213.690	2380.560	0.000
570	10.0	214.767	2423.070	0.000
580	10.0	215.828	2465.580	0.000
590	10.0	216.875	2508.090	0.000
600	10.0	217.908	2550.600	0.000

Storage volume (m³) = 7.1 m³



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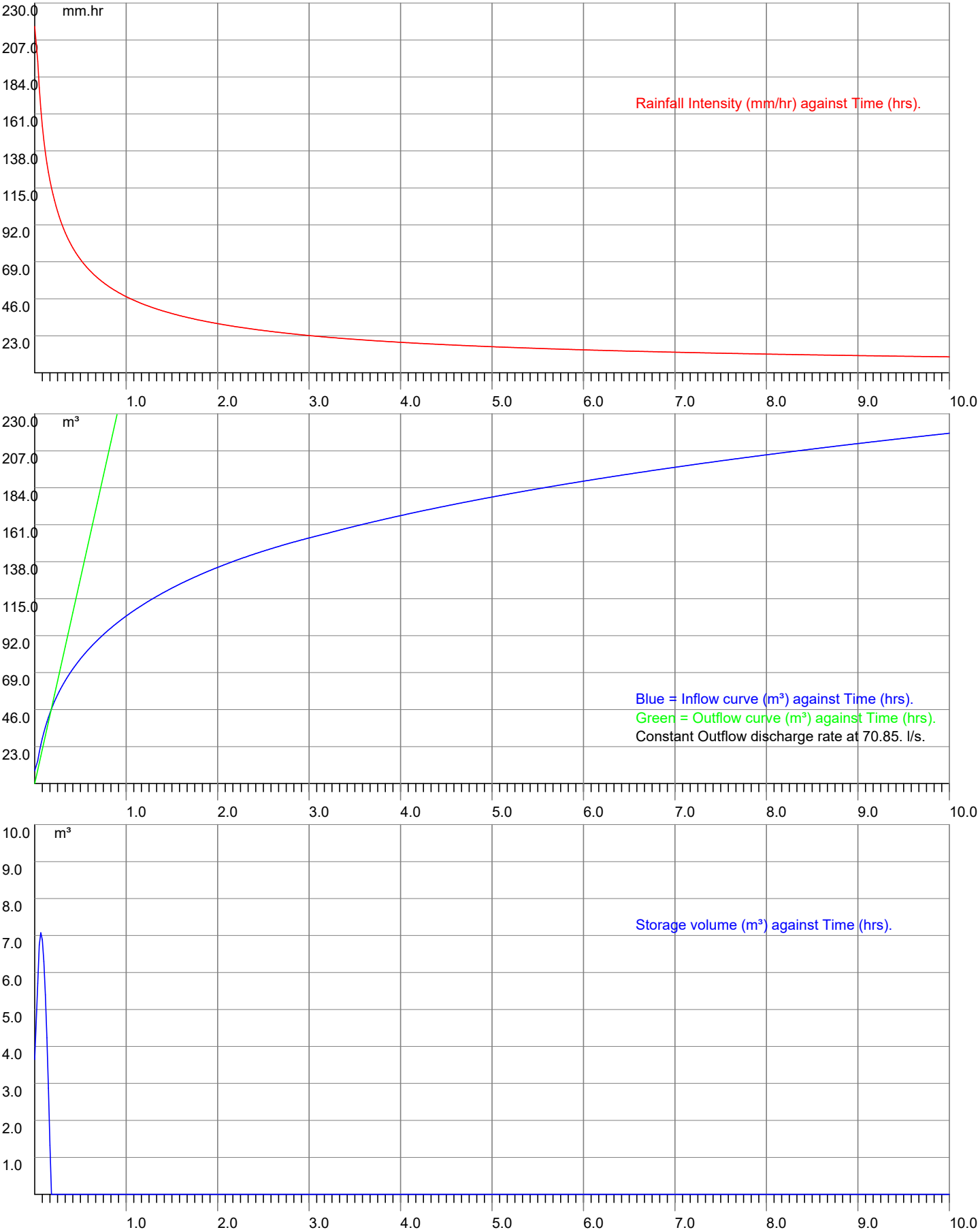
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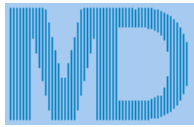
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Project **100 Year Storage Event + 20% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 20% CC Hollymount Farm, Bury**





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Project **100 Year Storage Event + 20% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 20% CC Hollymount Farm, Bury**

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.
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- 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.
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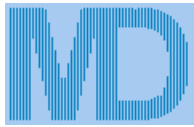
Why do the two methods give different results?

The rainfall characteristics for each method are very different.

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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.

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Project **100 Year Storage Event + 40% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 40% CC Hollymount Farm, Bury**

Data:-

FSR Hydrology:-

Location = HOLLYMOUNT FARM

M5-60 (mm) = 19.5

Soil index = 0.45

Return period = 100

UCWI = 129.0

Grid reference = SD 7713

r = 0.27

SAAR (mm/yr) = 1300

WRAP = 4

Climate change = 40

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 = $\frac{\text{Impervious Area} \times 100}{(\text{Impervious Area} + \text{Pervious Area})}$

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2135 m²

Total area (TA) = 5500 m²

Mean pump disch. rate = 70.850 l/s

Additional flow = 0.00 l/s

Pervious area = 3365 m²

Equiv area = 2200 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 40

Calculated data:-

Time to max = 6.0 mins

Rainfall at max = 168.64 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 11.6 m³

Allowed discharge rate = 70.850 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 16.00 mm/hr

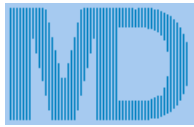
Calculated storage volume = 0.0 m³

Allowed discharge rate = 70.850 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	1476.7	1125	11.7	400 x 600	64.4	500 x 500	46.4
150	656.3	1200	10.3	600 x 900	28.0	500 x 750	30.9
225	291.7	1275	9.1	800 x 1200	15.8	500 x 1000	23.2
300	164.1	1350	8.1			750 x 1000	15.5
375	105.0	1425	7.3			750 x 1200	12.9
450	72.9	1500	6.6			750 x 1500	10.3
525	53.6	1575	6.0			1000 x 1000	11.6
600	41.0	1650	5.4			1000 x 1200	9.7
675	32.4	1725	5.0			1000 x 1500	7.7
750	26.3	1800	4.6			1000 x 1800	6.4
825	21.7	1875	4.2			1000 x 2000	5.8
900	18.2	1950	3.9			1500 x 1500	5.2
975	15.5	2025	3.6			1500 x 1800	4.3
1050	13.4	2100	3.3			1500 x 2000	3.9



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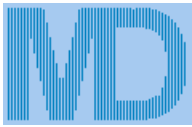
Project **100 Year Storage Event + 40% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 40% CC Hollymount Farm, Bury**

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	139.0	51.147	42.510	8.637
20	102.0	74.616	85.020	0.000
30	82.0	90.472	127.530	0.000
40	70.0	102.770	170.040	0.000
50	62.0	112.902	212.550	0.000
60	55.0	121.551	255.060	0.000
70	50.0	129.105	297.570	0.000
80	46.0	135.811	340.080	0.000
90	43.0	141.837	382.590	0.000
100	40.0	147.301	425.100	0.000
110	38.0	152.291	467.610	0.000
120	36.0	156.876	510.120	0.000
130	34.0	161.109	552.630	0.000
140	32.0	165.032	595.140	0.000
150	31.0	168.681	637.650	0.000
160	29.0	172.084	680.160	0.000
170	28.0	175.266	722.670	0.000
180	27.0	178.248	765.180	0.000
190	26.0	181.046	807.690	0.000
200	25.0	183.920	850.200	0.000
210	24.0	186.695	892.710	0.000
220	23.0	189.370	935.220	0.000
230	23.0	191.951	977.730	0.000
240	22.0	194.447	1020.240	0.000
250	21.0	196.863	1062.750	0.000
260	21.0	199.206	1105.260	0.000
270	20.0	201.479	1147.770	0.000
280	20.0	203.687	1190.280	0.000
290	19.0	205.835	1232.790	0.000
300	19.0	207.926	1275.300	0.000
310	18.0	209.963	1317.810	0.000
320	18.0	211.950	1360.320	0.000
330	18.0	213.889	1402.830	0.000
340	17.0	215.782	1445.340	0.000
350	17.0	217.633	1487.850	0.000
360	17.0	219.442	1530.360	0.000
370	16.0	221.213	1572.870	0.000
380	16.0	222.946	1615.380	0.000
390	16.0	224.644	1657.890	0.000
400	15.0	226.309	1700.400	0.000
410	15.0	227.941	1742.910	0.000
420	15.0	229.542	1785.420	0.000
430	15.0	231.113	1827.930	0.000
440	14.0	232.656	1870.440	0.000
450	14.0	234.172	1912.950	0.000
460	14.0	235.661	1955.460	0.000
470	14.0	237.126	1997.970	0.000
480	14.0	238.565	2040.480	0.000
490	13.0	239.982	2082.990	0.000
500	13.0	241.376	2125.500	0.000
510	13.0	242.748	2168.010	0.000
520	13.0	244.099	2210.520	0.000
530	13.0	245.429	2253.030	0.000
540	12.0	246.740	2295.540	0.000
550	12.0	248.032	2338.050	0.000
560	12.0	249.305	2380.560	0.000
570	12.0	250.561	2423.070	0.000
580	12.0	251.799	2465.580	0.000
590	12.0	253.021	2508.090	0.000
600	12.0	254.226	2550.600	0.000

Storage volume (m³) = 11.6 m³



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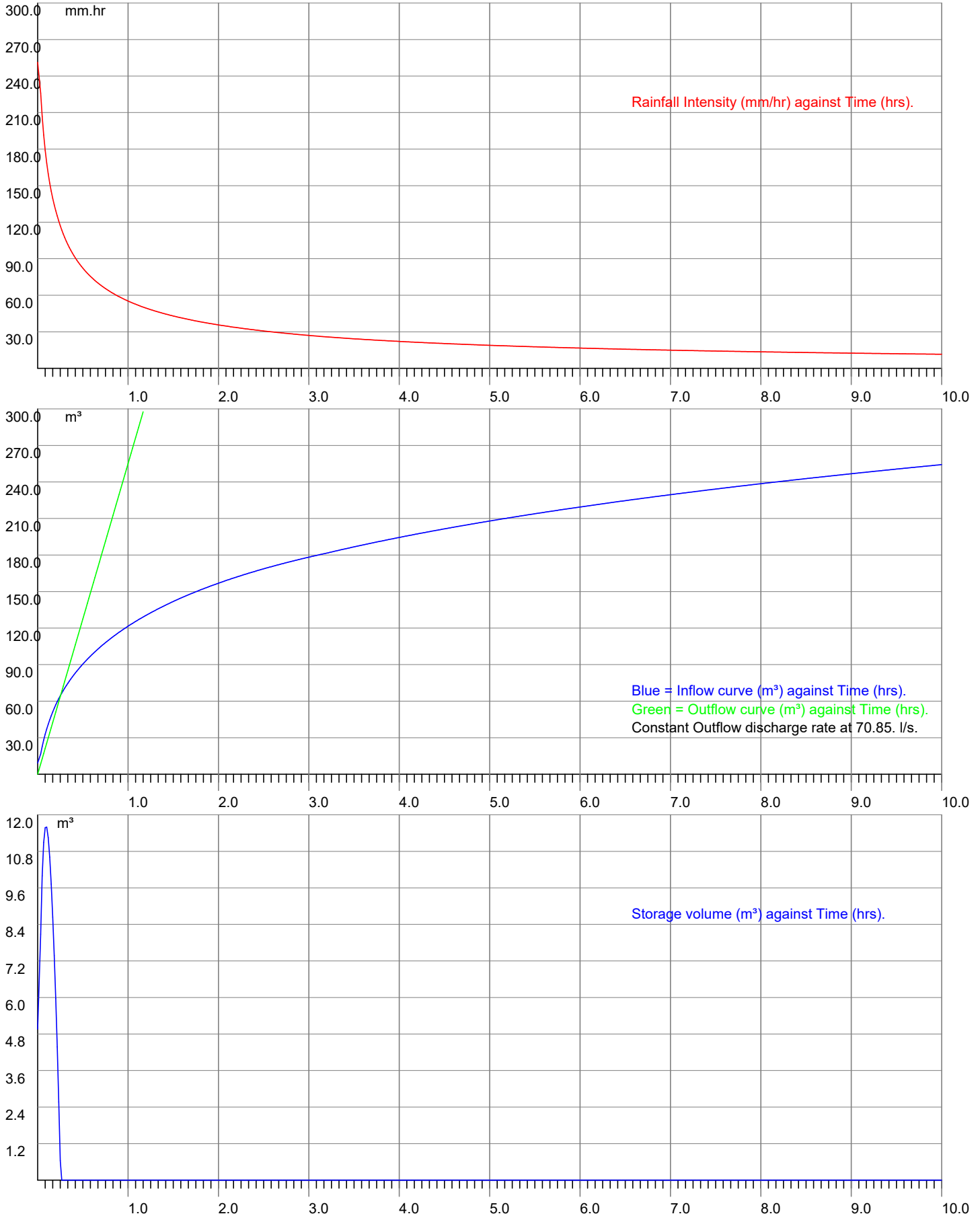
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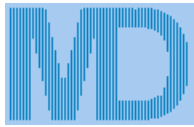
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Project **100 Year Storage Event + 40% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 40% CC Hollymount Farm, Bury**





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Project **100 Year Storage Event + 40% CC Hollymount Farm, Bury**

Title **100 Year Storage Event + 40% CC Hollymount Farm, Bury**

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
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- 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.

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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.

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