Qube Report 1048/26

July 2025

Flow Estimate for the River Clydach at NGR: 275503, 204353

Ellergreen Hydro

Flow Estimate for the River Clydach at NGR: 275503, 204353

For and on behalf of Wallingford HydroSolutions Ltd.

Client	Ellergreen Hydro
Prepared by	Joseph Bentley
Approved by Position	Sam Pucknell *Senior Consultant*
Invoice value	£195 (excl. VAT)

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Contents

1 Introduction

This report presents the annual and monthly flow statistics for the site(s) requested using the WHS Qube water resource modelling system. The site location(s) have been confirmed using a digital map and copies of the correspondence are contained within Annex 1.

Qube is the online evolution of the LowFlows Enterprise water resource modelling system to move beyond the estimation of natural and influenced flow statistics. Qube enables the seamless modelling of both flow statistics and time series anywhere in the UK and Ireland.

Developed by WHS in partnership with the Environment Agency, Qube is used as a best practice tool for the estimation of flows in ungauged catchments by the Environment Agency, Natural Resources Wales, Scottish Environment Protection Agency, Northern Ireland Environment Agency, Environmental Protection Agency and the UK water industry.

The Qube underpinning science has been widely published in the scientific literature.

Section 2 presents the methods for the derivation of catchment characteristics and the annual and monthly flow estimates. Following the results for each site, Sections 0 and 5 present the assumptions and uncertainties within the flow estimates, followed by the consideration for use in section 6 and the warranty and liability in section 7.

WHS is committed to continuously improving company performance and customer satisfaction. We are proud of our ISO9001 quality certification and ISO14001 environmental management certification for the provision of environmental consultancy services, development of hydrological software and associated training. For further information on all of our services and software, please visit our website www.hydrosolutions.co.uk.

2 Derivation of the Qube Flows Results

The flow statistic estimates contained in this report have been produced by Qube using models and relationships that relate these flow statistics to the climatic and hydrological characteristics of the catchment of interest. Qube is the evolution of LowFlows Enterprise[1]. All flow statistics provided in this report are for natural flows, thus do not contain any artificial influences such as abstractions, discharges or impounding reservoirs.

The following catchment characteristics and flow statistics are provided:

- Catchment Area: The catchment boundary may be derived using either a Digital Terrain Model (DTM) to determine the topographic boundaries of the catchment or imported by the user.
- Annual Mean Flow (MF): The estimation of Mean Flow is based on a 1km grid of long term average annual runoff for the given period of record (POR). The POR runoff grids were modelled using the CERF rainfall runoff model and calibrated to the UK Centre for Ecology and Hydrology 1961-1990 runoff grid (an output of a deterministic water balance model using observed data from over 500 gauged catchments[2]).
- Mean Monthly Flows (MMF): The MMF for each month are derived from the natural MF estimate by distributing the total average flow volume for the year between the months of this year. This distribution is based upon observed data from hydrologically similar gauged catchments.
- Annual Flow Duration Curve (FDC) statistics: The flow duration curve statistics are estimated using a procedure based on measured flow data from hydrologically similar gauged catchments. The methodology was initially developed in 2002[3] and has been subsequently further refined. Where nested local data gauges (LDG) are available, the FDC is improved using naturalised gauged FDCs for the given period of record.
- Mean Monthly Flow Duration Curves (MFDC): The MFDC for each month is estimated using gauged MFDCs from hydrologically and climatologically similar catchments and the estimate of MMF for that month. Where LDG have been used, the MFDC's are adjusted using the LDG improved annual FDC.
- Base-Flow Index (BFI): The proportion of a hydrograph occurring as base flow, hence varying between zero and unity. BFI is indicative of catchment permeability with values approaching unity associated with highly permeable systems. BFI is estimated from a revised form of the BFIHOST multivariate linear regression equation[4].

If these long term natural flow statistics were calculated directly from a gauged flow record the annual statistics would be equivalent to those calculated using all of the daily flow data from all years of record and the monthly statistics for a month equivalent to those calculated from the gauged data for that month from all years.

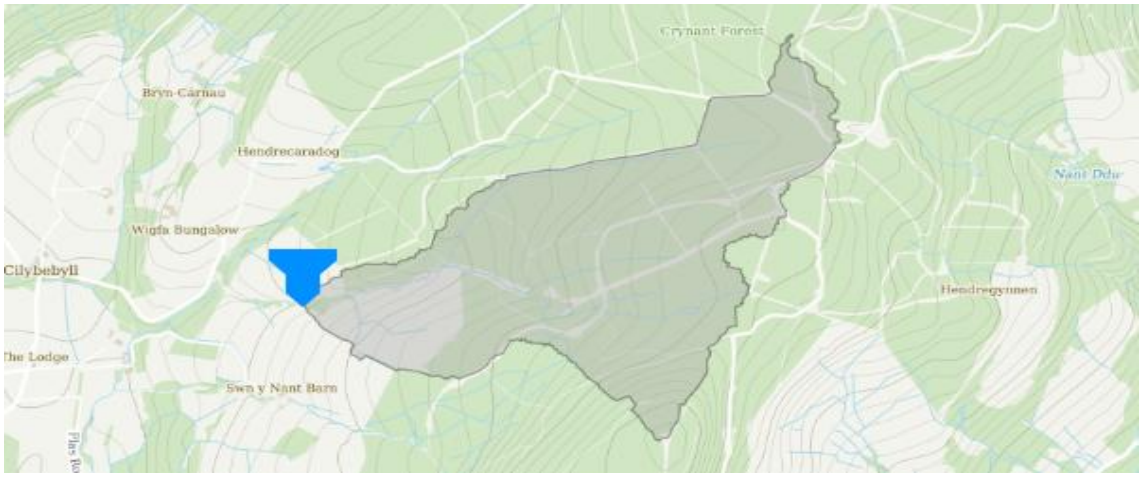
[1] Young A. R., Grew R. and Holmes M.G.R. 2003. Low Flows 2000: A national water resources assessment and decision support. Water Science and Technology, 48 (10).
[2] Holmes, M.G.R., Young, A.R., Gustard, A.G. and Grew, R. 2002. A new approach to estimating Mean Flow in the United Kingdom. Hydrology and Earth System Sciences. 6(4) 709-720.
[3] Holmes, M.G.R., Young, A.R., Gustard, A.G. and Grew, R. 2002. A Region of Influence approach to predicting Flow Duration Curves within ungauged catchments. Hydrology and Earth System Sciences. 6(4) 721-731.
[4] Boorman, D.B., Hollis, J.M. and Lilly, A. 1994. Hydrology of Soil Types: a Hydrologically-based Classification of the Soils of the United Kingdom. IH Report 126.

3 Flow Results for the River Clydach at NGR: 275503, 204353

3.1 Catchment Characteristics

The catchment characteristics and map for this catchment are presented in the table and figure below. The catchment is underlain by bedrock consisting largely of sandstone and mudstone. Superficial deposits of till and peat are also present within the catchment. As this catchment is below 5km^2 in size, the guidance associated with small catchments in section 6 should be consulted. The catchment boundary was unable to be accurately defined using the Qube software. Therefore the catchment boundary has been manually derived using contours extracted from LiDAR topography data in the vicinity of the watercourse.

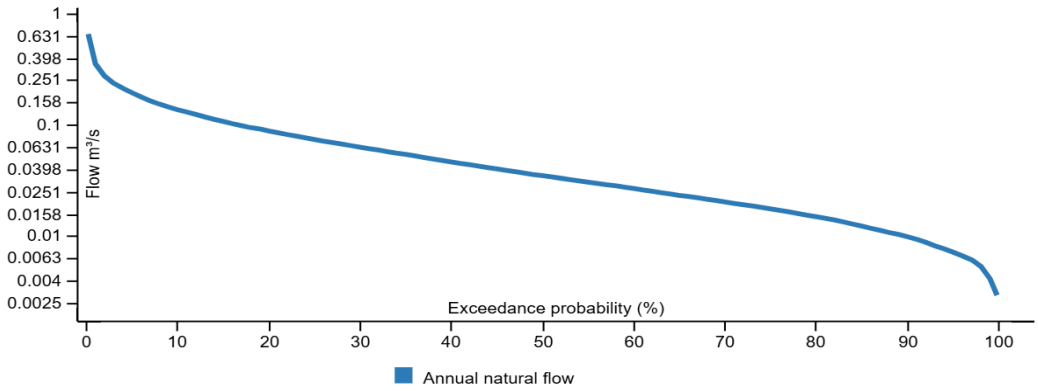
Catchment name	User uploaded catchment at 275503,204353	Catchment area	1.33 km²
Location	275503, 204353	Hydrometric area	58



Catchment Boundary Map (Contains Ordnance Survey data © Crown copyright and database right 2025)

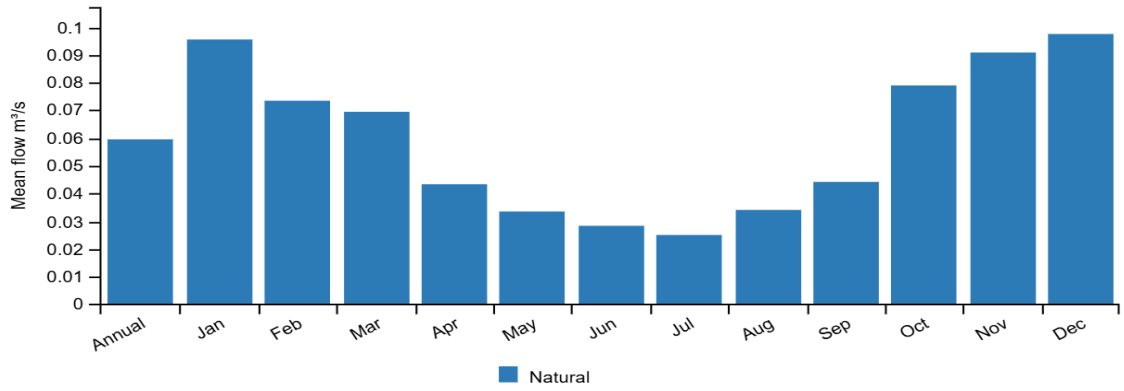
3.2 Long Term Flow Statistics

Period of record	Full period of record	Runoff (Period of record)	1404.8 mm
BFIHOST	0.36		



Annual Flow Duration Curve

Flow Estimate Q1048/26



Annual and Monthly Mean Flow

Annual Flow Duration Curve Statistics (m³/s)

Percentile	Natural Flow
5	0.192
10	0.137
20	0.0874
30	0.0627
40	0.0463
50	0.0348
60	0.0267
70	0.0202
80	0.0149
90	0.0098
95	0.0072
99	0.0042

Annual and Monthly Mean Flows (m³/s)

	Natural Flow
Annual	0.0592
January	0.0952
February	0.0732
March	0.0692
April	0.0431
May	0.0332
June	0.0281
July	0.0248
August	0.0338
September	0.0439
October	0.0787
November	0.0905
December	0.0972

Region of Influence Stations

Reference number	Weight (%)	Q95 % MF
65007	23.1	8.335
67028	20.3	8.218
58008	19.5	12.27
58012	18.7	16.68
28033	18.3	16.54

Local Data Gauges - On

Gauge	Location	Area km²	MF m³/s	Q95 m³/s
No local data gauges.				

Lake Adjustment - Off

No lakes were found in the catchment area.

Natural Monthly Flow Duration Curve Statistics (m³/s)

Percentile	January	February	March	April	May	June
5	0.243	0.204	0.187	0.126	0.0946	0.0819
10	0.19	0.148	0.135	0.0917	0.0681	0.058
20	0.137	0.103	0.0933	0.0603	0.0464	0.0373
30	0.106	0.078	0.0709	0.0451	0.0351	0.0277
40	0.0841	0.0596	0.0579	0.0352	0.0281	0.0214
50	0.0701	0.0466	0.047	0.0291	0.0227	0.0176
60	0.0576	0.0362	0.0375	0.0234	0.0183	0.015
70	0.0456	0.0297	0.0305	0.0191	0.0146	0.012
80	0.0356	0.0244	0.0241	0.0151	0.0109	0.0095
90	0.0257	0.0197	0.0191	0.012	0.0082	0.0072
95	0.0199	0.0172	0.0154	0.0102	0.0068	0.0061
99	0.0144	0.0131	0.0117	0.0078	0.0056	0.0047

Percentile	July	August	September	October	November	December
5	0.0765	0.12	0.151	0.238	0.228	0.246
10	0.0496	0.0789	0.107	0.166	0.183	0.196
20	0.0305	0.0458	0.0638	0.111	0.128	0.14
30	0.0222	0.0325	0.043	0.0814	0.1	0.108
40	0.0179	0.0242	0.0311	0.0624	0.081	0.0863
50	0.0149	0.0174	0.0238	0.0473	0.0667	0.0698
60	0.0124	0.013	0.0183	0.0379	0.0552	0.0563
70	0.0104	0.0103	0.0149	0.0289	0.0418	0.0436
80	0.0085	0.0077	0.0114	0.0219	0.0325	0.0343
90	0.0065	0.0057	0.0078	0.0153	0.0223	0.0261
95	0.0053	0.0044	0.0058	0.0119	0.0163	0.0207
99	0.004	0.0033	0.0035	0.0081	0.0106	0.016

4 Assumptions

Assumptions implicit in the estimated flow estimates are:

- Only natural flow statistics have been estimated and the impact of any artificial influences (for example abstractions, discharges or impounding reservoirs) is not included.
- The topographic catchment area identified is assumed to accurately reflect the true catchment area contributing to flows at the catchment outlet.
- The flow estimates are based on long term average records.

5 Model Uncertainty

The figures for factorial standard error of estimate for long term mean flow and Q95 are shown in Table 3.2.1. So, as an example the uncertainty in the estimate of mean flow in Scotland will generally be less than 11%. These standard errors are presented as a general guide only and should be considered in the context of the information presented within section 6. These errors are broadly comparable to the sampling errors that might be expected if mean flow was calculated from two to three years of error free gauged data and Q95 for in the order of five years error free gauged data.

If these estimates are to be used for high value decision making we would recommend that the estimates are corroborated through appropriate local flow measurement. For advice on flow measurement please contact us at info@hydrosolutions.co.uk.

Table 3.2.1 Model Factorial Standard Error (FSE)

Regions of the UK	FSE Mean Flow	FSE Q95
England and Wales	16	42
Scotland	11	35
Northern Ireland	11	30

6 Consideration for Use

The predictive performance of the Mean Flow and FDC Estimation Models may vary according to local conditions. The following is a list of significant, but not comprehensive, issues that need to be considered when estimating flows within ungauged catchments:

- Care needs to be taken when interpreting the results in smaller groundwater catchments in which river flows may be strongly influenced by point geological controls (such as spring lines and swallow holes).
- A catchment water balance is assumed, which may be incorrect in smaller groundwater fed catchments where part of the regional groundwater flow bypasses the surface water catchment.
- The estimation of Mean Flow is based on a 1km grid of long term average annual runoff, derived using the CERF rainfall runoff model and calibrated using the outputs from a deterministic water balance model using observed data from over 500 gauged catchments. The predictive performance of the model may therefore be reduced in areas of low rainfall gauge density.
- Care needs to be taken when interpreting the result in very small catchments as the size of the catchment approached the spatial resolution of the underlying catchment characteristic datasets (1 km²). For very small catchments it is recommended that the topographic contributing

catchment is confirmed by a site walkover to identify any unmapped features that might modify the catchment area.

- Where available local measured flow data should be used to corroborate the flow estimates, which is good practice when using any generalised hydrological model.

7 Warranty and Liability

1. The assumptions and uncertainties associated with the flow estimation methods must be considered when making use of flow estimates produced by the system.
2. You are responsible for the interpretation of the Results presented within this report and training in the use of the estimation methods is strongly recommended.
3. Subject to 1 and 2 above, WHS do not seek to limit or exclude liability for personal injury or death arising from our negligence.
4. Except for 3 above our entire liability for any breach of our duties, whether or not attributable to our negligence, is limited to the fee that you have paid for this report.
5. Except for 3 and 4 above, in no event will WHS be liable to you for any damages, including lost profits, lost savings or other incidental or consequential damages arising on your use of the results even if we have been advised of the possibility of such damages.
6. Should any of these provisions be ruled invalid under any law or Act of Parliament, they shall be deemed modified or omitted only to the extent necessary to render them valid and the remainder of these provisions shall be upheld.

Annex 1: Copies of key correspondence with the client

From: LowFlows <lowflows@hydrosolutions.co.uk>

Sent: 22 July 2025 16:15

Hi Adam,

Thanks for spotting that, I have had a look and the catchment automatically defined by Qube isn't picking up that tributary and is putting it into the catchment above, see attached. Apologies for not picking up on this, typically this isn't an issue until we get to even smaller catchments that require manual definition. Do you have a catchment boundary we could use? Ideally as a GIS shapefile, we can load this into Qube and get an updated estimate. If not, we could manually define it ourselves.

Kind Regards,

Sam

Qube Estimation Service

From: LowFlows <lowflows@hydrosolutions.co.uk>
Sent: 21 July 2025 11:45
To: Adam Cropper <adam@ellergreen.com>
Cc: WHS Accounts <accounts@hydrosolutions.co.uk>
Subject: Re: low flows study for hydro

Hi there,

I have noticed that the catchment is missing most of one of the main tribs, I get a catchment area of 1.24km2 whereas you only have 0.923km2, this means a lot less water, can you update your findings? See attached with the missing bit of catchment marked up in red, it makes a big different for the hydro station..

Thanks Adam

From: LowFlows <lowflows@hydrosolutions.co.uk>
Sent: 21 July 2025 11:45
To: Adam Cropper <adam@ellergreen.com>
Cc: WHS Accounts <accounts@hydrosolutions.co.uk>
Subject: Re: low flows study for hydro

Hi Adam,

Please find attached the flow estimation report and associated datafile. Let us know if there are any questions.

Kind Regards,

Qube Estimation Service

From: LowFlows <lowflows@hydrosolutions.co.uk>
Sent: Wednesday, July 16, 2025 4:04:34 PM
To: Adam Cropper <adam@ellergreen.com>
Subject: Re: low flows study for hydro

Hi Adam,

Thanks for that, we will proceed with the estimate. I will ask our accounts team to issue a link to pay by debit card. I expect this might not be ready today and will be sent later this week.

Kind Regards,

Qube Estimation Service

On Wed, 16 Jul 2025 at 15:53, Adam Cropper <adam@ellergreen.com> wrote:

Thanks for this I confirm go ahead and I would like to pay by debit card so please send me the link for payment and I will complete this when I return to the office tonight, thanks Adam

From: LowFlows <lowflows@hydrosolutions.co.uk>
Sent: Wednesday, July 16, 2025 3:14:05 PM
To: Adam Cropper <adam@ellergreen.com>
Subject: Re: low flows study for hydro

Hi Adam,

Thanks for your email, yes a flow estimate there will cost £195 + VAT at 20%. If you could confirm you are happy for us to proceed on that basis that would be appreciated.

As an existing customer WHS will require either a formal PO number or formal go ahead in advance before commencing the works. If you wish to make payment of our invoice by credit, debit or AMEX cards, please can you confirm and I can arrange for our accounts team to provide you with a 'PAY NOW' invoice which has an embedded link to the secure Sage Pay portal. Alternatively, payment can be made via BACS by your accounts team:
By BACS Account- Wallingford Hydrosolutions Ltd Sort Code- 40-34-27 Account- 52177145

Once go ahead is received we will begin progressing the report and will look to deliver the report within 10 working days.

Kind Regards,

Qube Estimation Service

On Wed, 16 Jul 2025 at 14:54, Adam Cropper <adam@ellergreen.com> wrote:

Hi There,

Can you do me a low flows study for Cilybebyll Hydro please.

The hydro intake is at SN 75502 04352 (not far from Neath, Swansea) on the River Clydach. General site layout is attached in case wanted.

I assume this costs £195 as usual, please let me know if different.

Many thanks Adam