Qube Report Q1104/26

May 2026

Flow Estimate for The River Great Ouse at E:561196, N:318500

WSP

Flow Estimate for The River Great Ouse at E:561196, N:318500

For and on behalf of Wallingford HydroSolutions Ltd.

Client	WSP
Prepared by	Joseph Bentley
Approved by Position	Daniel Hamilton *Principal Consultant*
Invoice value	£270 (excl. VAT)

The WHS Quality & Environmental Management system is certified as meeting the requirements of ISO 9001:2015 and ISO 14001:2015 providing environmental consultancy (including monitoring and surveying), the development of hydrological software and associated training.

Registered Office Stables 4, Howbery Business Park, Wallingford, OX10 8BA
www.hydrosolutions.co.uk

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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 4 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.

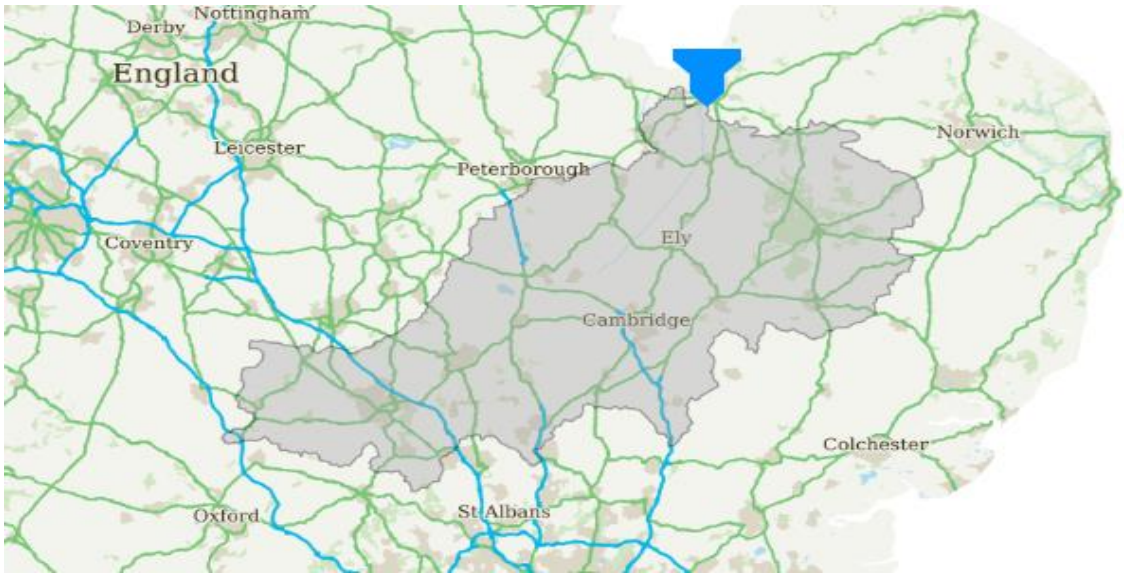
3 Flow Results for The River Great Ouse at E:561196, N:318500

3.1 Catchment Characteristics

The catchment characteristics and map for this catchment are presented in the table and figure below. The catchment is beyond the tidal boundary and therefore it was not possible to automatically define it in the Qube software. The catchment boundary has been manually derived using LiDAR topography data and associated sub catchments automatically defined in Qube. Whilst the river is tidally influenced in the location specified, the flows listed only include the terrestrial (fluvial) component of flow. The catchment is underlain by bedrock consisting largely of clay and mudstone. The most prevalent superficial deposits within the catchment are peat, till and tidal flat deposits.

Thirteen gauges (detailed in the local data gauges table below) located along the same river network as the target site were flagged as a source of local data and were used to improve the flow estimates.

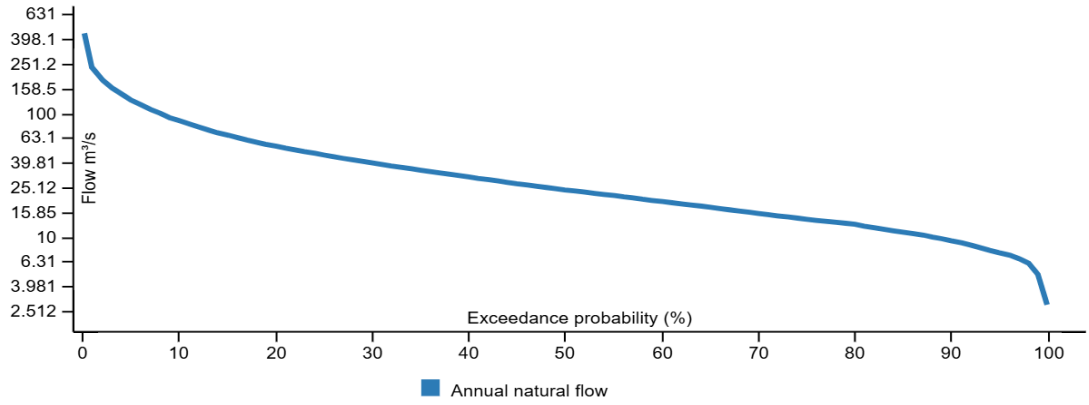
Catchment name	User uploaded catchment at 561196,318500	Catchment area	7927.9 km²
Location	561196, 318500	Hydrometric area	33



Catchment Boundary Map (Contains Ordnance Survey data © Crown copyright and database right 2026)

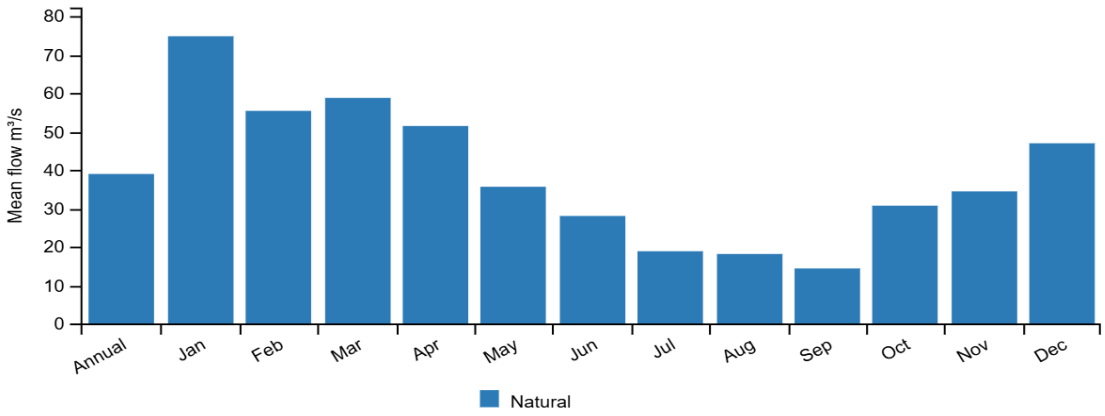
3.2 Long Term Flow Statistics

Period of record	Full period of record	Runoff (Period of record)	144.6 mm
BFIHOST	0.609		



Annual Flow Duration Curve

Flow Estimate Q1104/26



Annual and Monthly Mean Flow

Annual Flow Duration Curve Statistics (m³/s)

Percentile	Natural Flow
5	128
10	87.12
20	53.81
30	39.48
40	30.44
50	23.88
60	19.23
70	15.41
80	12.6
90	9.273
95	7.416
99	4.958

Annual and Monthly Mean Flows (m³/s)

	Natural Flow
Annual	38.84
January	74.6
February	55.23
March	58.6
April	51.3
May	35.52
June	27.93
July	18.77
August	18.06
September	14.3
October	30.6
November	34.32
December	46.8

Region of Influence Stations

Reference number	Weight (%)	Q95 % MF
33013	22.1	17.1
30012	21	2.761
39105	19.3	22.02
33044	19.1	23.89
33027	18.3	12.51

Local Data Gauges - On

Gauge	Location	Area km²	MF m³/s	Q95 m³/s
Stringside at Whitebridge	upstream	95.41	0.604	0.169
Wissey at Northwold Total	upstream	259.4	2.166	0.507
Lea Brook at Beck Bridge	upstream	131.6	0.271	0.0514
Cam at Dernford	upstream	199.6	0.943	0.323
Swaffham Lode at Swaffham Bulbeck	upstream	21.34	0.145	0.0397

Quy Water at Lode	upstream	92.55	0.417	0.144
Snail at Fordham	upstream	57.88	0.319	0.123
Rhee at Burnt Mill	upstream	308	1.241	0.303
Lark at Temple	upstream	274	1.341	0.458
Bedford Ouse at Offord	upstream	2566.3	15.07	1.657
Little Ouse at Abbey Heath	upstream	707.8	3.765	1.008
Granta at Stapleford	upstream	114	0.33	0.0475
Burwell	upstream	26.25	0.202	0.0587

Lake Adjustment - Off

Local data gauge(s) have been used to improve the flow estimate, therefore only lakes in the incremental area are considered. No lakes were found in the incremental catchment area.

Natural Monthly Flow Duration Curve Statistics (m^3/s)

Percentile	January	February	March	April	May	June
5	184.9	139.6	148.6	144.8	89.53	74.82
10	147.3	105.4	108.1	109.5	61.63	51.5
20	104.8	75.47	74.17	71.02	45.93	33.64
30	78.96	58.57	59.54	52.96	35.9	28.48
40	61.86	47.8	49.9	42.57	30.11	24.47
50	50.83	41	43.49	34.44	25.78	21.7
60	42.96	35.12	39.1	28.85	22.78	19.22
70	35.19	29.78	34.22	25.01	19.92	16.68
80	28.92	24.51	28.54	21.17	16.56	13.93
90	22.22	19.26	22.69	17.07	13.97	11.63
95	17.62	17.94	19.79	14.76	12.69	9.057
99	13.63	15.05	17.49	12.91	10.1	7.057

Percentile	July	August	September	October	November	December
5	45.12	39.94	38.82	117.4	124.3	126.5
10	34.52	28.79	22.82	64.16	82.53	100.1
20	23.57	20.44	15.47	35.27	48.7	69.23
30	19.4	16.65	13.42	24.69	30.05	51.77
40	17.14	14.57	11.99	18.42	21.85	40.41
50	15.28	13.19	10.72	15.3	17.74	31.28
60	13.59	11.38	9.744	12.93	14.41	25.06
70	12.4	10.36	8.268	11.06	12.8	20.77
80	10.68	8.966	7.206	9.353	10.59	17
90	8.688	7.426	6.321	7.537	8.103	10.92
95	7.178	6.448	4.703	6.569	6.915	9.146
99	5.058	4.571	3.467	5.658	5.374	7.482

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 the below table. 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.

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 May 2026 2:59 PM

To: Lyons, Conor <Conor.Lyons@wsp.com>

Cc: Derbyshire, Matt <Matthew.Derbyshire@wsp.com>; Lee, Claudia <Claudia.Lee1@wsp.com>

Subject: Re: WHS Website enquiry - Thu, 21 May 2026 07:13:28 +0000

Hello Conor,

Yes it will include the Q95. Whilst we state a 10-working day delivery timeframes, almost all of our reports are delivered within 5-working days, so the report should be with you by the middle of next week.

Kind regards,

Dan

From: Lyons, Conor <Conor.Lyons@wsp.com>

Date: Fri, 22 May 2026 at 13:38

Subject: Re: WHS Website enquiry - Thu, 21 May 2026 07:13:28 +0000

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

Cc: Derbyshire, Matt <Matthew.Derbyshire@wsp.com>, Lee, Claudia <Claudia.Lee1@wsp.com>

Thank you for the reply

Can I please confirm this includes the Q95 for the watercourse?

If so, could you please start progressing the report and we will pay by credit through the 'pay now' option.

Is there any way to expedite this as we are hoping to receive this asap!

Could you also please include my colleague Matt and Claudia (CC'd) in this email.

Have a nice weekend!

Kind regards,

Conor Lyons

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

Sent: Thursday, May 21, 2026 10:49 AM

To: Lyons, Conor <Conor.Lyons@wsp.com>

Subject: Re: WHS Website enquiry - Thu, 21 May 2026 07:13:28 +0000

Hello Conor,

Thanks for your email. In terms of the flow estimate I can advise that this will cost £270 +VAT at 20% in total. This includes an additional £75 for manual catchment defintion. The watercourse cannot be automatically defined by the software because it lies beyond the tidal boundary. Note, the software will estimate only the natural flows draining from the catchment and cannot account for the influence of the tide. Please let us know if you are happy to proceed on that basis.

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,

WHS Qube Estimation Service

---------- Forwarded message ---------

From: WHS Website Enquiry <noreply@hydrosolutions.co.uk>

Date: Thu, 21 May 2026 at 08:13

Subject: WHS Website enquiry - Thu, 21 May 2026 07:13:28 +0000

To: <software@hydrosolutions.co.uk>

Name: Conor Lyons

Email: Conor.Lyons@wsp.com

Good morning,

I hope you're well. I am interested in purchasing a flow estimate and I was hoping you could provide me with a quote.

The point of interest is Grid Reference TF 61221 18505 from the River Great Ouse. I have attached a screenshot of this location.

Thank you in advance