British Hydrological Society

1983-2024

Circulation

No. 162

November 2024

The newsletter of the British Hydrological Society



BHS membership

To join the British Hydrological Society, please use the form at https://www.hydrology.org.uk/join_bhs_rev.php, or scan this QR code.

SCAN ME

The British Hydrological Society gratefully acknowledges the financial support of UKCEH in the production of Circulation.

Cover photo: River Tyne under ice (David Archer)

Circulation is published quarterly; free to members of the British Hydrological Society, or £25 to non-members on annual subscription. Articles published reflect the views of the authors and do not represent official BHS policy.

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Web pages: http://www.hydrology.org.uk/

Circulation is indexed in Geosystems' Hydrotitles & GeoArchive & NISC HydroROM

Copy deadline for Circulation 163 is 26th January 2025.
Please email your material to bhs-circulation@outlook.com—contributions may be edited for length or clarity (**maximum** 1,000 words, or 750 with figures). Hydrological photos very welcome.

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UK Hydrological Bulletin, August-October 2024

Words for water

In between issues of Circulation, you can keep up with the **British Hydrological Society** on LinkedIn and X (formerly Twitter):

LinkedIn—search for British Hydrological Society

@britishhydrosoc

President's perspective

Duncan Faulkner

Following the AGM during the superb Oxford symposium in September (report on page 14) we have welcomed four new trustees. BHS's board of trustees now looks like this:

Duncan Faulkner – President (bhs-president@outlook.com)

Joe Pearce – new President Elect, Chair of Education, Careers and Members sub-committee (bhs_education@outlook.com)

Victoria Coates - Hon Secretary (bhshonsec@outlook.com)

Tim Hess - Hon Treasurer, Chair of Finance sub-committee (bhs-treasurer@outlook.com)

Gemma Coxon - Chair of Meetings and events sub-committee (BHS_events@outlook.com)

Liv Burns - Chair of Communications sub-committee (BHSCommsCtee@gmail.com)

Amy Green – new early career representative (bhs_earlycareers@outlook.com)

Chris White – IAHS representative

Ordinary members: **William Rust, Katy Peat, Lisa Chatterjee** (newly elected) and **Emma Cross** (newly elected).

Joining the trustees on the main committee are two co-opted members: **Gareth Old** - UKCEH representative and **Adam Comerford** - CIWEM representative.

Thank you to all these volunteers, and to other members who have enthusiastically offered their services to help out on sub -committees. If you would like to contribute ideas, energy or talents to help fulfil BHS's charitable purposes, please contact the Chair of the relevant sub-committee.

With a cluster of major BHS events in the last year, we're now focusing on some other aspects of our Society's life. One is the rather varied remit covered by the Education, Careers and Members sub-committee, which includes how BHS might:

- Promote hydrology as a career;
- Support people starting out in hydrology, either studying or in their first few years of work;
- Attract more members, from sectors or organisations currently under-represented, or people who have an interest in or interaction with hydrology, without necessarily thinking of themselves as a hydrologist;
- Provide more benefits to members, and opportunities to develop their skills, connections etc;
- Reach members who can't attend in-person events;
- Encourage more uptake of travel grants, via general BHS funds and also via the Exeter Fund for IAHS meetings;
- Address some of the issues raised in the UK Hydrology Skills and Satisfaction Survey (see Circulation 160);
- Strengthen links with other disciplines and organisations.

Ideas are welcome on any of the above. On the last topic, I'm pleased to say we are developing plans for joint meetings, events or webinars during 2025 with CIWEM, the Royal Meteorological Society, the British Dam Society and the UK Committee on International Hydrology.

The devastating and tragic flooding in Valencia in October, and widespread flooding the previous month in Central Europe, are a reminder of the profound importance of hydrology and its interface with other disciplines, including meteorology and emergency planning. Let us hope that we can learn better how to prepare for and forecast such extremes.

Broughton Sanctuary NFM evening event

Chris Allman & Ellen Broad, Mott MacDonald

The BHS Pennines Group and JBA Consulting organised a summer evening event (13th June) comprising of an evening stroll around the Broughton Sanctuary, Skipton, to see some existing natural flood management (NFM) features, and hear about future plans for the estate and wider links to flood risk management in the River Aire catchment.

One third of the 3,000-acre Broughton Sanctuary is being returned to nature to help visitors reconnect with the wild environment and boost biodiversity. Intensive sheep grazing is being reduced, peat bogs and waterways are being restored and tens of thousands of newly planted saplings will boost tree cover from 6% to over 20%. For all this, and other things, it has even been named as one of National Geographic's 30 coolest destinations in the world for 2024!

Duncan Faulkner (BHS President (and biscuit baker)) introduced BHS and the event. Summarising his experiences of the changes he has seen working within the Sanctuary boundary for the last 25 years, he emphasised that people hold many viewpoints on NFM, not all of which were represented by attendees – a reminder to keep an open mind and consider others' perspectives.

Emma Wren (Technical Principal in Nature Based Solutions at Mott MacDonald) introduced the concept of NFM, provided an overview of the CIRIA NFM manual, and how work at the Broughton Sanctuary has fitted into works carried out in the River Aire catchment as part of the wider Leeds Flood Alleviation Scheme. The NFM manual emphasises the importance of working with as many different people as possible to understand all perspectives, and this event was a good example of people from various backgrounds coming together to discuss NFM and other hydrological topics.

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Kelly Hollick (Project Manager for the planting works at Broughton Sanctuary) introduced the changes being made throughout the estate. Lots of the land was previously farmed for sheep and dairy and is now being rewilded and/or farmed in combination with nature, such as bringing in Iron Age pigs to regenerate the degraded soil.

Angie McKinney (Technical Director at JBA Consulting) described her role in leading the design of some of the NFM measures implemented throughout the estate, before leading us out on a walk to view some of them.

The event had been organised for mid-June to take advantage of the long evenings and great sunshine; this was not to be, as we stared out the window into a heavy rainstorm. You can't stop hydrologists with a bit of rain though, so we headed out on our walk with full wet weather gear, some umbrellas and a sense of anticipation.

We started the walk in a couple of fields where nothing had changed, which was intentional so that there was an obvious comparison and baseline for the rest of the walk.



Tree planting at Broughton Sanctuary

The majority of the walk led us through numerous fields of tree planting and rewilding, and we also visited some leaky barriers. These seem to have been a bit of an experiment as some were working well and others were not!

Once we were thoroughly soaked and had our fill of seeing and hearing about these NFM measures out on the estate, we retreated back to the JBA Consulting office for some pizza, further networking and a chance to dry out. This allowed us to continue our conversations about this important topic in a more comfortable environment and it was really interesting to meet and talk to such a wide variety of people from different organisations and backgrounds.

This was a key benefit of a face-to-face event, which have been severely lacking since the COVID pandemic, and served as a reminder of why we should make the effort to meet in person more often to discuss hot topics. The event also showed how broad the scope of 'hydrology' is and the cross-disciplinary nature of the BHS. There was a lot of positive feedback from many attendees about how interesting and useful the event was, with comments particularly focussing on the joy of getting together, especially outdoors (despite the weather!).

Thank you to the BHS for providing financial support for this event, and to JBA Consulting for being our hosts. Duncan has asked us to remind everyone that BHS are keen to encourage more face-to-face events and can provide support to ensure these types of events can still go ahead. My experiences of this event and feedback from others has really highlighted the positive benefits of getting together in one place to foster ideas and see other viewpoints.

Measuring flows on the River Tyne: how can models help measure floods?

I-Hsien Porter[1], Kate Bradbrook[1], Rachel Merrix[2], Ian Downs[2] ([1]JBA Consulting, [2]Environment Agency)

We have been experimenting with Computational Fluid Dynamics (CFD) models to predict rating curves. The technique shows promise for filling in gaps where observations are lacking, and adds confidence to predicting flows in extreme, infrequently observed events. It also allows a quick assessment of changes in rating relationships following geomorphic change, while waiting for a range of flow observations in the new channel conditions.

However, CFD is not a substitute for direct flow measurement using equipment such as velocity meters or Acoustic Doppler Current Profilers (ADCP), as observations are still needed to validate the models.

Floods can happen rapidly, giving little time to take measurements of them. Many readers will know that

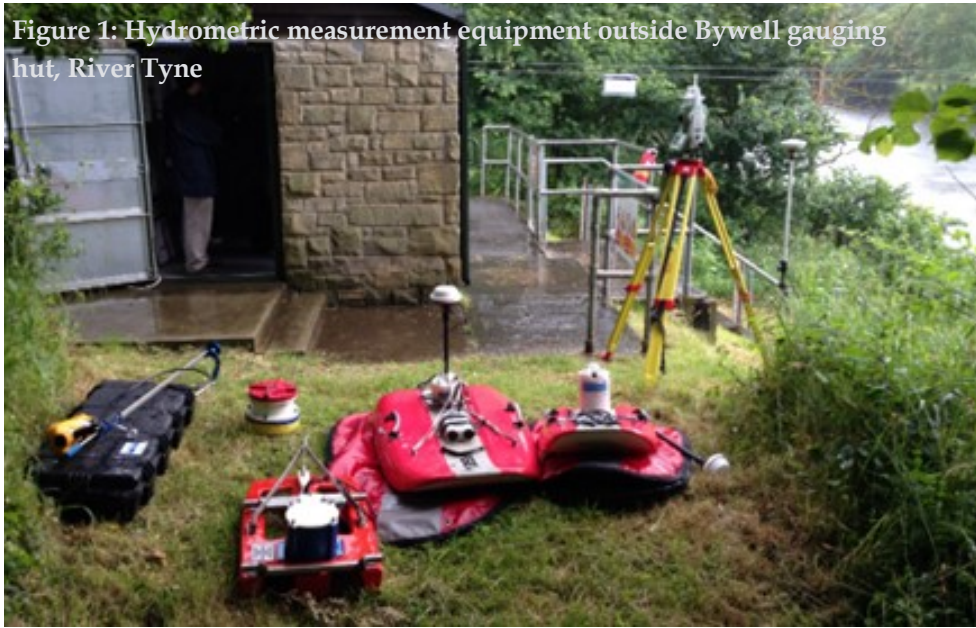


Figure 1: Hydrometric measurement equipment outside Bywell gauging hut, River Tyne

deriving a rating curve from observations can be a lengthy process, requiring successive measurements under different flow conditions. For flood risk management, where we are often concerned with the most extreme events, these flows are rare. With finite resources and many gauges in remote locations, it is not possible to reach every site of interest during a flood. Travelling to the gauge, setting up the equipment and taking the measurements all take time. It may even be impossible if conditions are too dangerous.

Ultrasonic gauges can directly measure flow, but are costly to install and maintain, and can face problems where the water column is highly aerated. As a result, they are only available in a small proportion of locations.

We tested a CFD model to predict the rating curve at Bywell gauge, on the River Tyne. At Bywell, there is confidence in the rating thanks to many years of observations, which makes it an ideal location to test new approaches.

CFD uses a detailed 3D model of the topography and predicts the movement of water by solving the Navier-Stokes equations, which describe fluid flow. To build the model, we collected a bathymetry survey of the river channel using a remote-controlled boat equipped with a sonar (Figure 1). This was supplemented with control points along the banks. We had to wait for the right conditions to collect the survey: flows that were too fast risked causing a loss of control of the boat, while flows that were too low could lead to damaging the boat on rocks on the river bed.

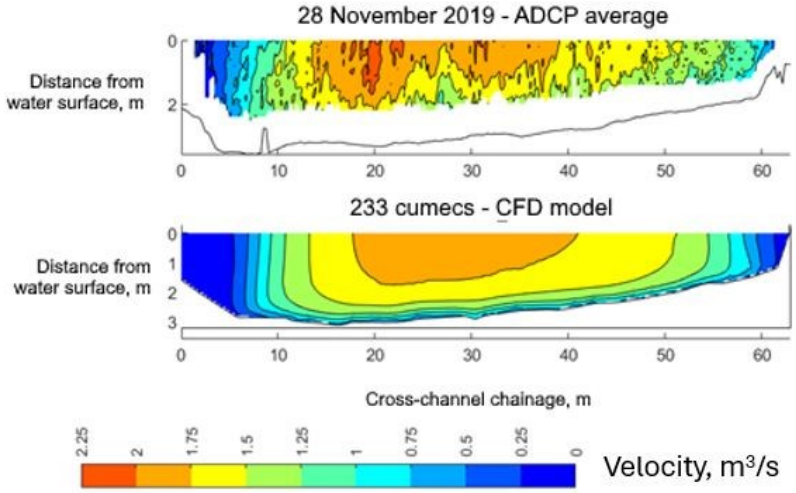
The survey was then entered into the open source CFD software package OpenFoam. Unlike gaugings, which are a snapshot of the time the observation is made, the CFD model can be run multiple times to simulate a range of flows. measure in the field.

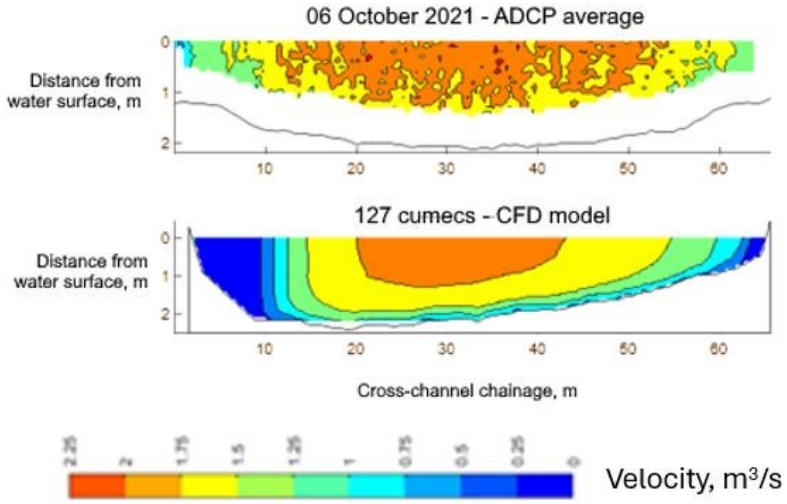
CFD can complement ADCP observations, but observations are still needed to validate the model. Observations from the ADCP were used to check the CFD model results. The modelling replicated the ADCP well, supporting the idea of using CFD to estimate flows.

At Bywell, the significant bankside vegetation was represented using a porosity parameter. The ADCP observations were therefore still needed to validate the choice of parameter values. However, once the model had been validated, the good match meant CFD could be used predictively to infill or extrapolate beyond the available observations.

The model was run using the observed flow at the time of the ADCP reading. It accurately reproduced the distribution of fast and slower water within the channel, as well as the absolute velocity values. This was the case across a range of different flow magnitudes, from8-399m3/s. Figure 2 shows two of the larger events.

Figure 2: Velocity profiles from ADCP and CFD modelling





We are beginning to explore wider applications of CFD models to support hydrometric measurement. Our Bywell project investigated how CFD could help hydrometric data collection. Since then, we have trialled the approach at various sites, to gather evidence for how CFD could be used more widely.

Further investigation is needed to refine modelling decisions, such as how to represent vegetation, and to determine the circumstances where 3D CFD models offer significant benefit over simpler models or theoretical calculations. However, CFD shows promise in complementing hydrometric measurement, particularly when observations are rare or difficult to obtain.

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Integrated and sustainable solutions for the urban management of water resources

Anita Raimondi, Research Assistant at Politecnico di Milano

In June, Dr Raimondi spoke at the early career networking event jointly organized with the Young Hydrologic Society.

Urban areas are facing important challenges from growing populations, surface sealing, increased demand for domestic water supply and an increase in wastewater and stormwater runoff to be collected and treated. Climate change adds complexity to urban water management, being characterized by extreme events of high-intensity rainfall and droughts.

Traditional hydraulic infrastructures are often insufficient, and fail to meet these challenges. In this context, sustainable urban drainage systems can be of support and integration with the existing networks, providing several benefits to the environment and communities. They contribute to the achievement of some of the 17 Sustainable Development Goals of UN Agenda 2030, making cities more sustainable and resilient.

This seminar focused on the integration of different systems for surface runoff control, non-drinking water supply, and natural water cycle restoration. An analytical-probabilistic approach for the modelling and sizing of sustainable urban drainage systems was proposed. Some applications and validations of the approach to different projects and case studies were presented, as well as integration with a predictive model and smart monitoring technologies to optimize the management of the systems under different climatic and working scenarios. Finally, Dr Raimondi described some public engagement experiences to raise awareness in new generations about the importance of these topics for the future were share.

British Hydrological Society national symposium, 23-24th September, University of Oxford

Gemma Coxon & Kirstie Murphy

Over 200 hydrologists gathered at the University of Oxford for the British Hydrological Society's 2024 National Symposium. Fittingly, severe weather warnings and torrential rain greeted us on our arrival to Oxford, with the Radcliffe Meteorological Observatory (situated next door to the conference centre) recording its highest ever two-day accumulated rainfall total of 118.9mm. Despite the rain, we had a fantastic two days in Oxford.

BHS president Duncan Faulkner opened the symposium with a welcome address, acknowledging the long history of hydrology in the UK and the particular significance of Oxfordshire given the research communities in Wallingford and at the University. He left the audience with a quote from Roger Deakin; 'All water, river, sea, pond, lake, holds memory and the space to think'.



'Penrose' aperiodic tiling outside the BHS symposium venue (university mathematics department, Andrew Wiles Building)

The Penman Keynote lecture was delivered by Professor Berit Arheimer, currently Professor of Hydrology at the Swedish Meteorological and Hydrological Institute (SMHI). Professor Berit discussed the Science for Solutions Decade, and Hydrology Engaging Local People IN one GLOBAL world

(HELPING—more information at iahs.info). Berit provided an interesting insight into management of extreme events and integrated water resource management, particularly complex due to the number of lakes in Sweden.

Across the two-days, 58 presentations and 70 posters showcased hydrology and practice across the community with topics ranging from operational flood hydrology, drought impacts on Scottish distilleries, drone based streamflow methods, smart sewer interventions and rescuing orphan hydrometric data. There was also a series of workshops and community gatherings on surface-water flood forecasting, science into practice for flood hydrology, the Floods and Droughts Research Infrastructure and 'Hydrology: More than Numbers'.

Highlights included a magnificent dinner at Christ Church College and a field trip to the Oxford Flood Alleviation Scheme led by Ali Rudd (UKCEH), Richard Harding (Environment Agency) Simon Collings (Oxford Flood Alliance member) and David Macdonald (British Geological Survey).

Many thanks to all presenters and attendees at the symposium for a fantastic meeting. A special thank you to convenors, workshop organisers and lead organisers; Gemma Coxon (University of Bristol), Simon Dadson (Oxford University), Kirstie Murphy (JBA Consulting), Rebecca Oldfield (Oxford University), Will Rust (Cranfield University) and Ali Rudd (UKCEH).

BHS is proud to have supported four early career researchers to attend the National Symposium—Yanchen Zheng (University of Bristol), Xiaobin Qiu (Newcastle University), Qiuyu Zhu (University of Leeds) and Harley Dixey (Newcastle University). All four presented posters about their current research.

Summary of the AGM proceedings

BHS's 42nd AGM was held during the Oxford symposium. The meeting began with a recap of last year's AGM, followed by the President's report in which Duncan Faulkner summarised some recent changes to the Society's structure:

- BHS is changing from a charity to a Charitable Incorporated Organisation. This is part of a wider change in governance, separating management / operations (e.g. running events, communicating with members, promoting hydrology careers) from governance - latter involving things like compliance with law, public benefit, financial, open, risk, decision-making.
- Following this change, the Society could have a trustee who is not a member, and not from a hydrological background, bringing in specialist skills in governance. In practice, though, most/all trustees are also involved in operational roles within BHS.
- The Society now has a number of sub-committees, which are led by the Trustees but also open to other members.

Duncan thanked all the members of the Executive Committee, the elected Ordinary Committee Members, the co -opted members, sub-committee members, the ICE Secretary and the Regional representatives for their work during the past year.

Members completing their term of office are Hayley Fowler (Past President), Scott McGrane (Honorary Treasurer), Chris Skinner (Chair of the Communications sub-committee), Giuseppe Degan Di Dieco (Early Careers Representative) and Anita Asadullah (Education and Careers sub-committee).

BHS has a new President Elect, Joe Pearce. Joe has been actively involved with BHS since the mid-1990s, previously worked for the National Rivers Authority and is now a project manager at the Environment Agency. He is keen to focus on bringing together people at all stages of their career, from students to retired professionals.

A new Honorary Treasurer (Tim Hess, Cranfield University (retired)) and Honorary Secretary (Victoria Coates, Environment Agency) have been elected. Also, a new Early Career Representative (Amy Green, Newcastle University), and new ordinary committee members (Emma Cross, Environment Agency, and Lisa Chatterjee, JBA Consulting).

BHS maintains links with other hydrological bodies through several representatives: IAHS (Chris White), UK Committee for International Hydrology, and the Surface and Groundwater Archive Committee (Duncan Faulkner), CIWEM Water Resources Committee (Will Rust) and the UK Flood Hydrology Roadmap governance board (Hayley Fowler, handing over to Duncan Faulkner).

ICE continues to provide financial, administrative and secretarial support (through Moira Doherty and Janet Homer) to BHS. UKCEH provides financial support for Circulation as well as representation on the BHS main committee and other committees.

Honorary Treasurer's report

Our annual budget has supported a lot of excellent activity. At May 2024 our accumulated funds were £86,448. Subscription income was £25,000, slightly down on last year. Income from meetings has increased post-COVID, and BHS offers £500 to each region to support in-person meetings.

The benefits of BHS membership were re-iterated, these being the quarterly newletter Circulation, lower meeting fees, access

to travel grants, enrolment in the Mailbase and being part of a friendly hydrological network.

Exeter fund. This fund provides grants for participation in the IAHS and International Union of Geodesy and Geophysics (IUGG) assemblies. To apply, you must be a BHS or IAHS member, and need to complete the form at www.hydrology.org.uk/Travel_Grants.php.

BHS travel grants. These are available to BHS members to foster their involvement in activities directed at promoting, advancing, and building esteem of hydrology, such as attendance at the EGU or AGU conferences. Recipients must provide a short report for Circulation – to apply, complete the form at www.hydrology.org.uk/Travel_Grants.php.

Membership fees. Currently, standard membership is £30, concessions are £15 and undergraduate/apprentice free. The President proposed that standard membership be increased to £45, with the extra income used to support more students and early career members. A vote was taken in the room and online, and the proposal carried.

MSc studentships. In partnership with JBA Trust, BHS is delighted to announce that six awards of £2,500 have been made to support Masters students at UK universities for this academic year. Subjects include Water Science, Policy and Management (two students); Hydrogeology; River Environments and their Management; Environmental Geoscience; Sustainable Water Management.

BHS Undergraduate Dissertation prizes. There were 10 excellent entries this year. First prize goes to Claudia Alvardo, School of Geography, Earth and Environmental Sciences, University of Birmingham for her dissertation "Weathering the storm: the impact of Cyclone Bola (1988) on three lake ecological communities in Hawke's Bay, New Zealand". Runners up were Ellie Micklewright (Oxford) and Aimee Lenthall (Bristol). Congratulations all three!

Early Careers sub-committee. Giuseppe Degan di Dieco provided an overview of a busy year, summing up with a message in a bottle: "BHS is different from other structured gatherings of professionals, because it is creatively centred on those beginning their career, to whom the organisation belongs. Volunteering changed me forever".

Communications and publications sub-committee. This year the committee has a new team and structure, a new publications policy, and a social media presence (LinkedIn, X). For next year, it aims to have a new BHS website. Thankyou to contributors to Circulation.

Events sub-committee. It has been a busy year for events, which included the 40th anniversary meeting in London, the Peter Wolf symposium, a Royal Society meeting in June, a field visit for the Pennines group and this symposium, as well as six webinars. Webinar videos will be availabe on the BHS YouTube channel soon.

BHS sub-committee reports

Education and Careers sub-committee (Joe Pearce). In the last issue our President emphasised BHS' important role supporting people into hydrological careers and promoting hydrologists' professional development. This helps frame what's needed from the Education and Careers sub-committee. We are pleased to welcome new volunteers to the committee alongside existing members. From October 2024 the committee includes Joe Pearce (Chair), Katy Peat, Chris White, Alex Scott, Emma Cross and Guillaume Chagnaud.

Our new group will shape a plan, building on the committee's previous work. We'll seek to include new ideas as well as promote the Society's already successful events and actions including the Peter Wolf Symposium, dissertation competition and MSc studentships. We welcome thoughts and ideas from BHS members, and I'm happy to respond to questions or contacts. Please get in touch using bhs_education@outlook.com.

Meetings and events sub-committee (Gemma Coxon). This sub-committee manages the national meeting programme of BHS. We are Gemma Coxon (lead), Kirstie Murphy and Will Rust (webinar co-leads), Victoria Coates (regional group liaison), Liv Burns and Alannah Killeen (Peter Wolf Symposium co-leads).

We had a busy Summer and Autumn organising meetings. We are now turning our attention to next year's events - an exciting programme of webinars, the Peter Wolf Symposium and joint meetings with the Royal Meteorological Society.

If you have an idea for a webinar, we are keen to hear from you. We are looking for a host organisation for the BHS National Symposium in Autumn 2026 - a fantastic opportunity to lead a nationally important symposium and bring hydrologists together. To contact the committee, please email bhs_events@outlook.com.

What is hydrology?

Barry Barton

In the November 2022 edition of Circulation, Anthony Hammond wrote a very perceptive and thought provoking article entitled "What is Hydrology?" Anthony had recently attended the BHS 2022 Symposium and was clearly concerned about the narrow and restricted definition of hydrology expressed by some BHS members present. Some even seemed to be of the opinion that flood warning "wasn't necessarily hydrology because it can be done with an entirely empirical approach – with no process understanding". Anthony went on to note that an eminent member of our community suggested that even hydrometry was separate from hydrology, presumably because it was also considered to be based on deterministic hydraulic relationships. I share Anthony's concerns.

I doubt whether any hydrologist practising in the 1970s would have made that assumption about hydrometry. In those days nearly all river flow (i.e. water level) gauging stations would have been visited weekly by a hydrometric assistant to change the tape in the punched paper tape recorder and the autographic (pen and ink) chart. The tape and chart would have been taken back to the office for processing, but not before the assistant had manually


Eastern England gauge in October 2023


….and August 2024

annotated the chart to highlight any obvious anomalies caused by (e.g.) debris or algal growth on the weir crest. The assistant would, if possible, have attempted to dislodge the debris and would report to the office any weed growth in the channel or algal growth on the weir that might be adversely affecting the station's flow modularity.

A not uncommon situation in one ex-River Board area at that time was the "bank holiday phenomenon", a particular problem where gauging stations consisted of a central flume separated from two flanking weirs by concrete piers. The local children discovered that two or three 'borrowed' scaffolding boards, placed so as to span between the piers, would block the flume and create for the whole weekend their very own swimming pool upstream. The effect was not obvious on the tape but was readily apparent on the chart, especially where annotated by the assistant. Even if the assistant did not dislodge the boards himself, a gang from the local rivers depot would do so the next working day.

But how often are gauging stations visited by hydrometric operatives today, when modern technology has enabled the whole process to be streamlined and water level data can be automatically telemetered to an office which may be many miles remote from the gauge? Hydrometric telemetry did exist in the 1970s (remember "teletones" and "telerains"?) but it was a clunky, time consuming and one-way procedure, albeit with a high degree of manual supervision.

The two photos shown, one taken in October 2023 and the other in August 2024 suggest that a site inspection - by a competent person who realises and understands what should be readily apparent - may be a rare event. Since the gauging station's water level data is used with the station's theoretical –presumably modular flow - stage/discharge relationship to produce the station's archived real-time flow record, one is entitled to ask just how reliable is the archive record.

Was anyone 'back in the office' where the river level data was processed, aware of the deplorable state of the weed growth in the river channel, both upstream and downstream of the gauging weir, let alone realise its hydrometric significance? When visiting other areas of England I try, just out of interest, to visit a few local gauging stations (old habits die hard) and I am often disturbed to find that the example illustrated in these two photos is not by any means exceptional. At many stations routine channel and gauging weir maintenance seems to be thing of the past. Do those now responsible for river flow data processing and archiving realise how inapplicable the station's rating curve (stage/discharge equation) may have become over a wide range of water levels?

Back in the 1980s the expression "gigo" (garbage in, garbage out) was common among computer users although, rather ominously, I have not heard it at all in recent decades. No matter how powerful your computer and how sophisticated your computer model, if the data you input is rubbish so will be your results. This brings me back to the "is hydrometry really hydrology" question which concerned Anthony Hammond at the start of this article. In the 1970s, when there was an intelligent manual intervention built in to the water-level-data-to-flow record transformation process, the answer to the question was clearly "yes". Which is what I firmly believe it should be. But today, where the process appears to be essentially automatic and a mere mechanistic number-crunching exercise, I'm not so sure.

Reflections from the Swiss Climate Summer School, Grindelwald

Ruth Dunn

In early September, I had the privilege of attending the 22nd Swiss Climate Summer School in Grindelwald, Switzerland, set against the dramatic backdrop of the Bernese Alps. This stunning location was fitting for an intense week of learning and discussion on climate change, bringing together early career researchers and renowned keynote speakers from across the globe. The central theme was "Climate Change: From the Dawn of the Anthropocene to Options for the Future."

The programme covered many important topics relating to climate change, and posed numerous insightful questions such as what changes in climate are detected and how are they attributed? how unusual is the present climate? is the historic and current science-policy interface effective? what options remain viable for the future? From workshops addressing the legislative and political responses to climate change to lectures on topics such as sea level rise, the path to net zero, and event detection and attribution, there was a comprehensive overview of the various dimensions of climate change. The discussions raised crucial questions about the effectiveness of existing approaches and emphasised the need for innovative strategies and research.



Grindelwald, from the glacier walk (Photo: Ruth Dunn)

A highlight was sharing my research on the underestimation of rainfall by rain gauge networks. I gave a brief verbal summary and presented a poster, which sparked insightful dialogues. These discussions gave me valuable feedback on how to refine my research, and highlighted ways in which my findings could be applied by others in their own work. The collaborative atmosphere encouraged the exchange of ideas and the establishment of new and lasting connections.

Beyond the academic sessions, Grindelwald itself demonstrated the impacts of a changing climate. Dwarfed by the surrounding mountains, the venue had dramatic views of the retreating Lower Grindelwald Glacier, an undeniable effect of a warming climate. Midweek, we embarked on a hike to Baregg Hut (Bäregghütte), a remote refuge 1,755 meters above sea level. From there, we enjoyed Swiss refreshments and stunning views of the Ischmeer Glacier, a major tributary of the Lower Grindelwald Glacier, and an aerial view of the Grindelwald Valley. Later, we passed the site of a 2006 rockfall, where more than 20 million cubic feet of stone tumbled from the Eiger mountain, destabilised by melting glacial ice. These powerful visual reminders of climate change sparked conversations about the tangible effects we are witnessing in real time, and the future of these remarkable and vulnerable natural features, making the experience thought-provoking and memorable.

Summer School not only broadened my understanding of climate change but also reinforced the need for action and deeper collaboration across fields, disciplines and nations. As we continue to tackle the challenges of our warming world, the insights and connections I gained from this experience will influence my future work and professional collaborations. Thank you to BHS for supporting my attendance at this event through the Travel Grant.

Letter to the editor — from Julia Knapp, Durham University

Dear Editor,

In "Should Old Water be taken with a Pinch of Salt?" (Circulation 161), the author challenges the validity of hydrograph separation methods, questioning reports of high "old" water proportions in runoff events. I would like to highlight a critical flaw in the article: the incorrect assumption that steady-state conditions are required for the validity of the mixing equations (eqs 1-3 in the article).

*This is a misconception. The author draws an analogy to constant-rate tracer injections for dilution gauging, in which the equations are also used. In dilution gauging, steady-state conditions are indeed crucial because only plateau concentrations allow for an accurate calculation of stream discharge. Hence, the presented mixing equations are only **meaningful** during steady-state conditions. This requirement arises not from the mixing equations themselves, but from the need to quantify discharge – which is only possible at steadystate. The equations simply describe the mixing process and are valid at all times – even during the rising limb of a tracer curve, where they characterise the faster tracer contributions that result from dispersive transport.*

In contrast, hydrograph separation does not assume steady-state conditions. On the contrary, it quantifies the time-varying mixing processes that occur throughout a runoff event, capturing the dynamics of changing contributions from older and newer water. Thus, the steady-state requirement of dilution gauging is irrelevant for hydrograph separation, as both approaches calculate fundamentally different quantities.

*Secondly, the author interprets sharp changes in streamflow conductivity as "proof" that the scientific understanding of high proportions of old water in streamflow during runoff events is flawed. This, too, is a misconception. Extensive research using isotope-based hydrograph separation has shown that recent precipitation **does** contribute to streamflow during runoff events – leading to the observed variability in streamwater chemistry. However, these contributions are generally small. Exact proportions can vary significantly across catchments and events, requiring a quantitative analysis that compares pre-event, storm event, and precipitation signals (and the changes in associated volumes) to reach valid conclusions.*

Further evidence supporting limited contributions of event precipitation to streamflow comes from studies examining solute concentration changes during runoff events.

For example, we can consider bedrock-derived base cations, which exhibit high concentrations in baseflow, but near-zero concentrations in precipitation. While these can also show seemingly "sharp changes" in streamflow concentrations during storm events, quantitative analysis reveals that precipitation contributions remain small: if stormflow were primarily composed of recent precipitation, a doubling in stream discharge would theoretically result in a halving of streamflow concentrations of these base cations. In practice, however, their streamflow concentrations only decrease marginally during storm events, reinforcing the concept that stormflow consists largely of "old" water. Thus, while qualitative observations of variability in streamwater chemistry may indicate that event precipitation contributes to stormflow, a quantitative analysis is essential to accurately determine the extent of this contribution.

In conclusion, while hydrograph separation has limitations – as widely acknowledged in the relevant literature – the issues raised by the author are not among them, and hydrograph separation techniques remain a useful tool to understand runoff generation mechanisms.

New Wales & Southwest BHS group

Exciting plans are developing to launch a new regional BHS group for Wales and Southwest England, led by a collaboration of hydrologists from Arcadis, Environment Agency, UKCEH and NRW. If you would like to support this, you can contact those leading the plans at bhs_southwest@outlook.com

Circulation archive:

Thanks to the further generosity of our members, missing issues 49 and 53 have now been donated to complete the Circulation archive in the ICE library in London. Check with the ICE Librarian before travelling (tel. 020 7665 2244).

UK Hydrological Bulletin, August-October 2024

Terry Marsh, UKCEH Fellow

The August-October period served to underline the increasing impact of climate change on hydrological conditions across the UK. It was the 4th warmest for the featured three-months in the Met Office series from 1885; 15 out of the 19 warmest now cluster in the post-1995 period. At the national scale rainfall over the three months was modestly above average but regional contrasts were remarkably large – with corresponding hydrological responses. These achieved an extreme expression in September when rainfall for England greatly exceeded that for Scotland – a rare circumstance. Correspondingly, flooding was significant and sustained particularly in central and southern England. Notably high groundwater levels were an aggravating factor in many areas. Considering a more extended timeframe, the England rainfall total for the 2023/24 October-September period was substantially greater than for any earlier water-year in the Met Office rainfall series which begins in 1837 (Figure 1).

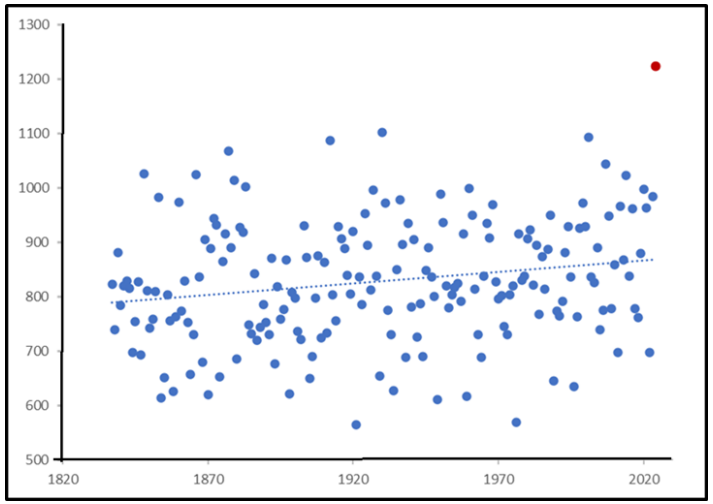


Figure 1: Water-year rainfall totals for England (source: UK Met Office)

A distinguishing feature of the August rainfall pattern was a very notable exaggeration in the normal NW-SE gradient across the UK. This was directly reflected in river flow patterns but catchment geology was also influential, particularly in England. Much of western Scotland (the Lake District and parts of Northern Ireland also) recorded more than twice the average monthly rainfall. On Skye, Allt Dearg House raingauge registered an exceptional monthly total of 719 mm and, on the Isle of Lewis, the River Creed recorded its highest late-August flow on record. Seasonally exceptional flows were also registered on the River Clyde.

In contrast, rainfall totals across large parts of eastern England fell below 30% of average. Correspondingly, river flows declined steeply - particularly so in those draining largely impermeable catchments. In Essex, the River Crouch approached its lowest flow on record for the time of year. By contrast, seasonally exceptionally high groundwater levels continued to be recorded in many index wells and boreholes. In the Permo-Triassic sandstones of the west Midlands, late summer levels exceeded previous late-summer maxima by a wide margin (Figure 2).

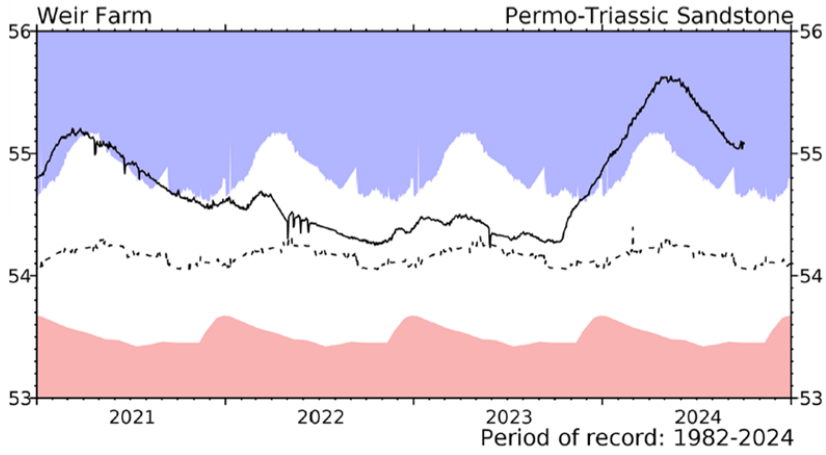


Figure 2: Weir Farm groundwater level (solid black), long-term average (dashed) and pre-2021 max and min levels (blue, red)

Similarly exceptional water table levels in the Chalk ensured that flows in many permeable catchments, including the Rivers Itchen (Hampshire) and Wensum (Norfolk) - although in recession - remained notably high for the time of year.

In sharp contrast to August, September featured a remarkable reversal in the normal rainfall distribution across the UK. Rainfall for Scotland was only around 60% of the total for England – the lowest ratio since 1894. In contrast, England recorded its wettest September since the drought-breaking downpours of 1976. The Thames region, together with some other central and southern catchments, recorded over three times the monthly average rainfall, with over a third of this falling in just two days (22nd-23rd). Stokenchurch, in the Chilterns, recorded 93.2 mm on the 22nd and a 48-hr total of 72.2 mm was recorded in Nottingham. Floodplain inundations and localised surface flooding were very extensive and disruptive, particularly for transport. Month-end flows on the River Thames at Kingston closely matched the highest on record for the time of year in a series from 1883 (Figure 3).

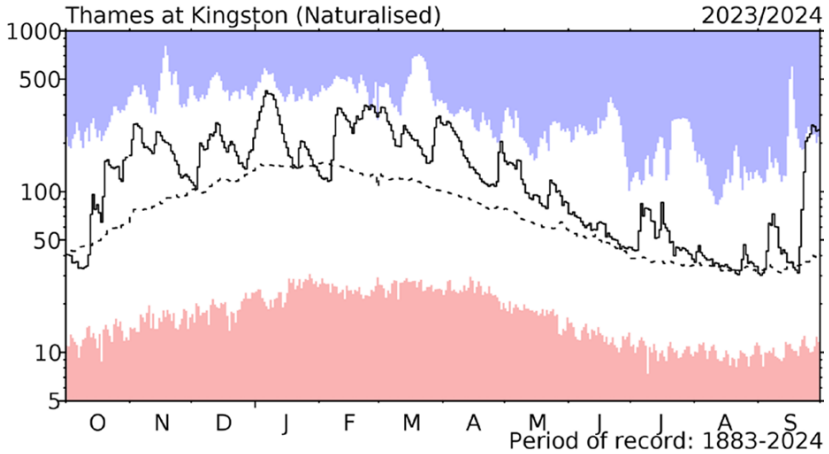


Figure 3: River Thames daily flows (solid black), with long-term average (dashed) and daily extremes (blue, red)

Also notably, well over half the index rivers in England, from the River Coquet (Northumberland) to the River Tamar (Cornwall), registered new September maximum runoff totals. Groundwater replenishment was also remarkable with new record September levels recorded - for example in the Permo-Triassic sandstones at Skirwith (Cumbria) and at Westdean in the Chalk of East Sussex – the latter having an 82-year record.

October was a further notably mild month with moderately below average rainfall for the UK as a whole. Regional contrasts were again very marked and impacted directly on runoff patterns. Rainfall for Scotland was considerably below average but, more notably, runoff for a substantial proportion of index catchments fell below 60% of the October average; the River Clyde registering only 52%. In England, most major rivers remained in high spate early in the month and further notable peak flows were registered during the third week when some parts of the South-West and Wales recorded 24-hour rainfall totals of around 60mm on the 15th-16th. Exceptional mid-month peak flows were reported from the River Tyne in north-east England to the River Exe in Devon and around 170 Flood Alerts were in operation across the country. A substantial proportion were coastal due to high winds driving up sea levels. Thereafter, steep recessions became established in most rivers draining impermeable catchments. In stark contrast, flows in groundwater-fed streams and rivers remained remarkably high. Flows in the River Itchen (Hampshire) have remained close to, or above, the daily average since February, and the Dorset Stour and the Cotswold Coln were among index catchments establishing record October runoff totals. In Somerset, runoff for the River Brue, which has very little baseflow support, also eclipsed previous October maxima.

The October rainfall helped ensure that month-end reservoir stocks for England and Wales as a whole were substantially above average entering November. Correspondingly, the water resources outlook is encouraging.

NOTE OF THANKS

The Hydrological Bulletins have been written by Terry Marsh since *Circulation* was first published. After at least 160 bulletins, this is Terry's last one. All at BHS would like to express sincere thanks for this incredible service—*thankyou Terry.*

The Hydrological Bulletins draw primarily on data and information from the UK Met Office and the CEH/BGS National Hydrological Monitoring Programme—the latter comprising data supplied by the Environment Agency, SEPA, NRW and Northern Ireland Environment Agency, as well as the UK water companies.

Flooding at Day's Lock, River Thames, September 2024



Forthcoming events

CIWEM Fresh Water Future conference

This conference establishes a platform for senior-level convening on water quality, resource-resilience and integrated catchment-delivery and innovation issues .

3rd December 2024, at 1 Birdcage Walk, London. To book your place, go to https:// www.ciwem.org/events/a-fresh-water-future-conference-2024

The Karst and The Curious

The hydrogeology group of the Geological Society of London will host this conference dedicated to the unpredictable world of karstification.

27th February 2025, at Burlington House, London. To submit an abstract or book, go to https://www.hydrogroup.org.uk/the-karst-and-the-curious/

Summer School—Runoff Prediction in Ungauged Basins. Learn methods of estimating runoff characteristics in the absence of local observations.

30th June—4th July 2025, Wien, Vienna, Austria. Flyer at https://iahs.info/uploads/Meetings/2025/Flyer_Summer_School_PUB_2025_Electronic.pdf

Words for water

A collection of (UK) words for flowing watercourses, compiled from entries at the BHS symposium quiz, Duncan Faulkner and 'Landmarks' by Robert McFarlane. If you know of others, please let us know!

aber abhainn adder afon allt aqueduct avon

bala beck bourne broad brook burn bwych bywash bywater

canal caol catchwater channel chine clough creek currel cut

derwent ditch don dott drain dyke

eas eau force forel

ghyll gill gully gutter

issue lade lea leam leat lee leith let linn lllednant lode

mill-race nailbourne nant navigation

ouse piddle pill

race reach rhyne rife rill river rivulet

seabhainn sewer sheugh sough spate spillway spring stream syke

torrent wash water waterfall wem winterbourne wye yeo

You might also like https://www.atlasobscura.com/articles/stream-name-maps-united-kingdom

Enjoying high flows on the lower River Tummel, Scotland (T. Boase)

