

Circulation

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The Newsletter of the British Hydrological Society

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Copy deadline for Circulation No. 147 6th November 2020

Would you like to be an Editor for Hydrology Research?

Hydrology Research is the official journal of BHS, the Nordic Association for Hydrology (NHF) and the Italian and German Hydrological Societies. It is published by International Water Association (IWA) Publishing. IWA is the largest membership association in the global water sector. The journal is overseen by two Editors-in-Chief, one each appointed by the two founding societies (BHS and NHF), and a team of 9 Associate Editors. Each Associate Editor has responsibility for their own specialist area of hydrology. Most recently we were delighted to appoint Professor Harry Dixon of UKCEH as the Associate Editor handling hydrometric networks.

Editors will typically see through 5 to 7 papers per annum. If you would like to discuss this opportunity further, please get in touch with the BHS Editor-in-Chief – Nevil Quinn ***(nevil.quinn@uwe.ac.uk)*** – for an informal discussion.

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- **Membership enquiries: Moira Doherty, BHS Secretary, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA. Tel: 0207 665 2234 Email: bhs@ice.org.uk**
- **Editor: Celia Kirby Tel: 01544 230053 Email celia.kirby@btinternet.com**
- **Web pages: http://www.hydrology.org.uk/**

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President's Perspective

We can say that the forests, the rivers, the mountains and plains constitute wealth,

HIM Haile Selassie, 28 Aug 1959 [1]

African pre-eminence

Last month the Ethiopian government completed construction of Africa's largest (6.45 gigawatt) hydropower scheme - the Grand Ethiopian Renaissance Dam. The filling phase has now begun, for what will become the seventh largest reservoir in the world and fourth largest in Africa after Lake Nasser. This is a triumph for the Ethiopian government's ambition to provide a more sustainable electricity supply for its people. Water users downstream in Sudan and Egypt naturally have concerns and are pressing for maintenance of flows along the Blue Nile by limiting the rate of filling.

Ethiopia has a strong community of research hydrologists. In recent months, Dr Seifu Tilahun (Bahir Dar University) published an excellent research paper on the potential of groundwater for crop irrigation [2], while early career scientist Tilashwork Alemie published an equally valuable contribution predicting water tables in the Ethiopian highlands [3]. Groundwater has also featured strongly in recent publications from elsewhere in Africa. Nigerian hydrogeologist Dr Solomon Temidayo Owolabi (University of Fort Hare, S Africa) published work on groundwater contributions to streamflow using recession analyses [4], while early career scientist Retang Mokua (University of the Western Cape) reported on the use of natural tracers for studying water sources elsewhere in South Africa [5].

Also shared internationally are leading recent contributions on modelling African catchments. For example, Dr Stephen Oppong Kwakye (Kumasi Technical University, Ghana) published his findings for the Black Volta catchment [6] and two fascinating simulations of land-cover change impacts on hydrology were produced by Dr Ewane Basil Ewane (University of Buea, Cameroon) for Nyong River basin [7] and Dr Tena Tewodros (Copperbelt University, Zambia) for a tributary of the Zambezi River basin [8]. African hydro-climatology also featured, with Prof Jonathan Matondo (University of Swaziland) publishing an excellent synthesis of research on Climate variability and change in Africa: Perspectives, experiences and



The Grand Ethiopian Renaissance Dam under construction in Nov 2017 (Alamy licenced use for BHS newsletter)

sustainability [9].
Even if your own research or practice does not involve Africa, I encourage you to consider broadening your perspectives by reading some of this significant new hydrological research from the world's second largest continent.

Innovation in UK water sector

On 11 May 2020, the UK's Water Minister Rebecca Pow MP formally thanked key workers in the UK water sector for maintaining our water services through these difficult times.
Not only have people in our water sector kept our vital services running, on 10 July, they launched a bold strategy of innovation and cooperation across the water industry. In the spirit of cooperation, they invite you to contribute your ideas to the draft Water 2050 Innovation Strategy over the next month [10]. Attention on water resources seems particularly timely with drought conditions persisting in areas of SE England [11], and the National Audit Office warning that parts of England are at "serious risk of running out of water within 20 years" (25 March [12]).
Innovation is already happening in the sector - the recent introduction of 7.5 million hollow fibre ultrafiltration membranes at Anglian Water's Heigham Water Treatment Works makes it the largest such system in Europe [13].
Two water companies have started new initiatives to reduce

water loss from the distribution system and consumer pipes.

Yorkshire Water is creating the UK's largest smart water network pilot, installing almost 4000 acoustic, flow, pressure and water quality monitors [14]; while Southern Water has begun widespread





installationof a new leak detection technology based on the so-called Internet-of-Things [15].

Smart thinking for UK flood mitigation

This year, England and Wales experienced the wettest February on record (169.5mm). It was also the wettest February in Northern Ireland and second wettest in Scotland [16]. Several rain-events, including storms Ciara and Dennis, resulted in flooding in the East Midlands, SE England, Wales (e.g., Pontypridd), West Midlands (e.g. Tenbury) and Yorkshire. The doubling of funding for flood mitigation announced in the budget of 11 March (for 2021–27 period compared to 2015–21) was therefore welcome. Equally important was the publication on 14 July of the 30-year Flood & Coastal Risk Management (FCRM) Strategy for England [17]. Associated with this strategy are some Defra policy changes [18], including:

- Incorporating nature-based solutions, such as natural flood management (NFM) measures, within new flood mitigation schemes, and ensuring new environmental schemes (e.g., funded by ELMs) deliver protection against flood risks;
- Directing new development away from areas at risk of flooding, reviewing mitigation required where such construction does take place, and ensuring all new developments have a net environmental gain; also making the existing built environment more resilient to the effects of climate change; and
- Considering changes to the 'Flood Re' scheme to allow post-flood insurance payments to include flood resilience measures.

The incorporation of nature-based solutions also featured strongly in the new FCRM Strategy for Wales, also published in July [19]. Current flood management policies for Scotland [20] and Northern Ireland [21] are also available. You may be interested to listen to Emma Howard Boyd, Sir James Bevan and John Curtin of the Environment Agency respond to questions by the Flooding Select Committee on the new strategy [22]. The draft strategy for England is open for your comments until 30 Sep 2020 [23] - do consider responding.

Active BHS membership

Travel and meeting restrictions over the past four months have meant that we have needed to embrace engagement opportunities offered by live webinars. It was encouraging that so many of you joined the captivating webinars by Prof Reed Maxwell (Colorado School of Mines) and by Richard Maxted (Environment Agency) in July. Thank you to the Hydrogeological Group of the Geological Society of London, and BHS Pennines Section for inviting the UK-wide membership to join these two informative presentations with Q&A.

Over the last few weeks, our Hon Secretary Mike Cranston has been working with other committee members to deliver the first ever BHS Webinar series to support our membership and wider society (see page 5. The first webinar later this month (24 Aug 2020), promises to be both timely and stimulating - Hydrometry for a Climate Emergency is delivered by Nick Everard, who shortly moves from the Agency to UKCEH. For those who cannot join the webinars live, we aim to post them on a new BHS YouTube channel.

Two other opportunities for engagement are on the horizon. Firstly, the BHS Working Group on the Future of Hydrology, ably led by Prof Keith Beven FRS, will soon be asking for your comments on a Working Paper 'Improved observational methods for transformational change in hydrology' (see page 14). Observations are also the focus for a new scoping study exploring what Floods and Droughts Research Infrastructure (FDRI) is needed by UK hydrologists. The study's NERC-funded team, led by UKCEH, will be offering BHS members and other relevant stakeholders the opportunity to input ideas over the next few months. The objective is to develop a strong case for a substantial UK investment in monitoring infrastructure (see page .

A huge thank you to members and their colleagues in the

university sector for submitting 15 first rate undergraduate dissertations to our annual competition for three prizes. It is good to see such high-quality submissions, reflecting very positively on our university members, who often partner with practitioners in the water sector on these projects. We will announce the prize-winners at our AGM, planned for 30 Sept 2020 (via our new Zoom account or MS-Teams).

Thank you also to our early career members for preparing and submitting applications for our annual competition for BHS MSc/MRes Studentships – we received an unprecedented 27 applications this year, which are currently being assessed.

We are very grateful to the JBA Trust and Environment Agency for co-funding these studentships with us. Successful candidates will be announced later in the year.

Despite the on-going health emergency, it is clear that many BHS members have continued to be very active professionally – I hope that you all continue to cope with the sometimes severe organisational and personal challenges that currently face us. My final thought is for those people in southern and eastern China experiencing alarming levels of flooding only half way through their rainy season.

Nick Chappell
President BHS

[1] Page 155 in Speeches delivered by His Imperial Majesty Haile Selassie first emperor of Ethiopia on various occasions May 1957 – December 1959. https://issuu.com/jahrastafari89/docs/speeches_delivered_by_his_imperial_Highness[2] https://doi.org/10.1002/hyp.13659
[3] https://doi.org/10.1029/2019WR025050
[4] https://doi.org/10.1007/s12665-020-08925-4
[5] https://doi.org/10.1080/10256016.2020.1760861
[6] https://doi.org/10.1007/s42452-020-2454-4
[7] https://doi.org/10.1007/s11629-019-5611-8
[8] https://doi.org/10.3390/su11226415
[9] https://www.springer.com/gp/book/9783030315429
[10] https://waterinnovation2050.org.uk
[11] https://eip.ceh.ac.uk/hydrology/water-resources
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[13] https://wwtonline.co.uk/news/largest-water-filtration-system-in-europe-installed-in-norwich
[14] https://www.yorkshirewater.com/news-media/smart-water-network-pilot/
[15] https://www.southernwater.co.uk/the-news-room/the-media-centre/2020/june/world-first-as-southern-water-starts-roll-out-of-new-leak-detection-technology https://www.metoffice.gov.uk/hadobs/hadukp
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[18] https://www.gov.uk/government/publications/flood-and-coastal-erosion-risk-management-policy-statement
[19] https://senedd.wales/laid%20documents/gen-ld13343/gen-ld13343-e.pdf
[20] https://www.gov.scot/policies/water/managing-flood-risk/
[21] https://www.infrastructure-ni.gov.uk/articles/2nd-cycle-flood-risk-management-plan-2021-2027
[22] https://www.bbc.co.uk/iplayer/episode/m000l9pm/select-committees-flooding-committee
[23] https://consult.environment-agency.gov.uk/fcrm/fcerm-national-strategy-info

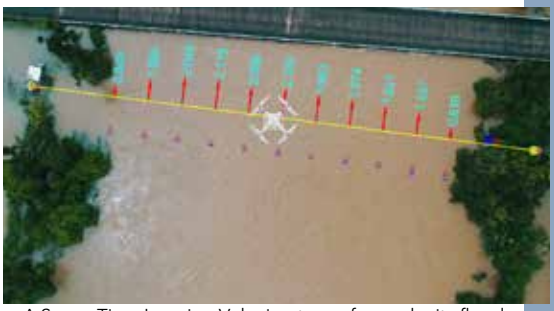
‘Future Hydrology in a Changing Environment’ – a lunchtime webinar series

Unfortunately, the 2020 pandemic has affected us all and in particular how we approach work. The same applies to the programme of BHS meetings which were scheduled for the year, all of which are now postponed until it is safe to do so. However, science still goes on and now, more than ever, hydrologists are reflecting on what the future brings for our profession.

Consequently, we have now organised a series of lunchtime webinars under the theme of a changing environment and the future role of hydrology. Webinars will be held on Zoom with a maximum capacity of 500 and anyone wishing to join will need to register via the Institution of Civil engineers ice.org.uk/events

The first webinar on **26th August (1-2pm) by Nick Everard** is on **Hydrometry for a Climate Emergency**. Nick is currently a Technical Advisor for Hydro-Acoustics with the Environment Agency and has over 30 years’ experience leading in river discharge measurement methods with the Agency. By the time of the webinar, Nick will have taken up a new role with the UK Centre for Ecology and Hydrology.

As Nick explains: “Accurate measurements of river discharge have always been a vital component of hydrology, but now, in face of growing populations and a rapidly changing climate, the need is stronger than ever. Happily, the opportunities for innovation and collaboration to meet these challenges are also greater than ever. This presentation will provide an update on many of the prospects outlined at last year’s BHS ‘Celebrating Hydrometry’ meeting, and will discuss new opportunities to meet the complex challenges of measuring river flow, and in particular the extremes.”



A Space Time Imaging Velocimetry surface velocity flood discharge measurement processed from drone footage captured in Queensland Australia.

The second webinar on **30th September (1-2pm) by Lucy Barke**r is on **Historic Droughts: Using the past to inform the future.** Since 2014, Lucy has been a Drought Monitoring Scientist (Research Associate) in the Hydrological Status and Outlooks Group at UKCEH.

As Lucy explains: “Climate change projections indicate that extreme events will increase in their frequency and severity in the future. An improved understanding of the drought events of the past can inform

current and future management. . With this talk we will demonstrate how reconstructed river flows have enabled consistent, national scale characterisation of historic hydrological droughts; how improved historical rainfall data can be used alongside climate projections to inform water resources management planning; and how access to current and historic data can support ongoing drought monitoring activities."
This webinar will be followed imediately by the **BHS Annual General Meeting.**

The next webinar will take place on **28th October (1-2pm) by Dr. Christopher White** on **Future of Hydrological Forecasting**. Chris is the Director of Postgraduate Research and part of the Water, Environment, Sustainability and Public Health (WESP) research centre in the Department of Civil and Environmental Engineering. He specialises in the understanding, modelling and prediction of extreme weather events on both the extended-range 'subseasonal-to-seasonal (S2S)' and climate timescales.

As Chris explains: "Hydrological forecasting is one of the most effective water resource management and flood and drought disaster risk mitigation measures. Hydrological forecasts rely heavily on data and models, which have seen continuous development and improvement over recent years. However, inherent uncertainties will always remain, meaning that decisions are (and will continue to be) made in the face of uncertainty. This presentation will demonstrate (recent) progress in hydrological forecasting across various predictive timescales, ranging from real-time to seasonal to climatic, and explore the future potential of hydrological forecasting."

Our final webinar on **25th November (2-3pm) by Professor Hayley Fowle**r is on **Anthropogenic intensification of short-duration rainfall extremes.** Hayley is a hydroclimatologist with over 15 years' experience in analysing the impacts of climate change and variability on hydrological systems. She is currently Professor of Climate Change Impacts in the Water Resource Systems Engineering Group at the University of Newcastle.

As Hayley explains: "There has been a recent surge in studies which aim to understand short-duration rainfall extremes, due to their impacts on flash floods, landslides and debris flows and the potential for these to worsen with global warming. This has been led over the past six years in a concerted international effort by the INTENSE crosscut of the GEWEX (Global Energy and Water Exchanges) Hydroclimatology Panel. This seminar will present a summary of the findings of INTENSE and considers the gaps that remain in understanding the potential impact of climate change on short-duration rainfall extremes."

Michael Cranston
BHS Honorary Secretary



Some Thoughts on the Incipient Drought

As is common with Hydrologists, after a period of flooding, we automatically assume that a drought is going to follow. We have had a long spell of sunny, sometimes hot weather in early summer, but now that lock-down is ending, we are back to cool, somewhat damp weather, even in the south-east, which of course drives the media hype, despite of wholesale moves of BBC staff to Manchester The question is are we heading for a drought, and 'Old Jim' has been asked to gaze into his crystal ball and share his wisdom of years.

My initial answer has to be "No", but as a scientist I have to say that it is too early to say. Why do I say that? Firstly, it is only back in February, we were awash form river and groundwater flooding, and aquifers and reservoirs were full. Secondly. the really big historical droughts have extended over 18 to 24 months. I once carried out an analysis of East Anglian drought from 1910–2010 from the sequence of monthly rainfall, and this revealed 4 major droughts: 1920–22; 1933–34; 1975–76, and 1992–94. The 1933–34 drought had served for a long time to provide design criteria for water supply companies in the south-east, i.e. predominantly on chalk-based catchments. Groundwater behaviour is somewhat different in major sandstone catchments of the west Midlands.

To see where we are now, we should look at the data – not the sort of thing the average media person does who wants a new doom-and-gloom story now that Covid-19 seems to be on the retreat. Take a look at the monthly Hydrological Summary, just 2 mouse-clicks away on the National River Flow Archive (NRFA) website. It gives a very good overview with maps, graphs and text of river, groundwater and rainfall conditions, plus reservoir levels, and some historical con-text.

At the end of June, from the information given in Hydrological Summary, the situation still has some potential for a serious drought. Reservoir stocks are lower than this time last year, but it must be noted that last summer's recession was cut short by an early start (September) to the recharge season. However, given the general lack of rainfall from March, this is hardly surprising. The rainfall totals for June appear to have redressed this situation somewhat, with much of upland UK being considerably wetter than average. Soil Moisture Deficit (SMD) is still very high (100 mm

or greater) in most of eastern and south-east England. Locally in south Suffolk, any recent rainfall events have produced negligible flow response However, river flows are generally in the normal range across wide areas of the country, having shown some recovery since lowest flows in May. Groundwater levels are generally normal for the time of year, and will not be expected to show general recovery until the Autumn.

There is a need to distinguish between types of drought. In meteorological terms, an 'absolute drought' is defined as 14 days without rainfall: obviously we experienced that over wide areas of the UK in April–May. Then there is drought relevant to the growing season of particular crops.The agricultural reports in the *East Anglian Daily Times* in early July noted that grain crops, particularly barley, had narrowly escaped disaster, thanks to the timely rainfall in mid-June. As it is, yields will be low, but conditions look more promising for wheat. Given also that in autumn and winter the land was too wet for sowing, it is a salutary reminder that a few generations ago, such a combination of flood and drought, coupled with widespread disease and the collapse of markets, would have resulted in famine and prolonged economic depression.

How this potential drought develops all depends on what happens between now and the beginning of October, that is when evapotranspiration has declined and precipitation starts to produce a surplus, which after replenishing the summer accumulation of SMD, will allow excess run-off and recharge to take place. It is not easy however to get a handle on current ET and SMD, as these data are not regularly published by UK Met Office. By contrast Met Eireann provides maps and at of both variables, updated weekly in the Agricultural Data graphs on their website.

So my response to the question of whether or not a drought will happen is very much "let's wait and see". Always remember that anything can happen, and even if it does, nature in the shape of the hydrological cycle, eventually get's back to normal.

James Dent



Reminder!
A notice about this survey was sent round to BHS members recently but in case you've lost/forgotten/didn't get it, it is aimed at all those who receive or produce drought (or dry weather) communications and thus to comprehensively review the current methods of drought risk communication in the UK.
Please access the survey via https://ceh-online-surveys.onlinesurveys.ac.uk/radar-survey-drc

Visualising the length of dry spells

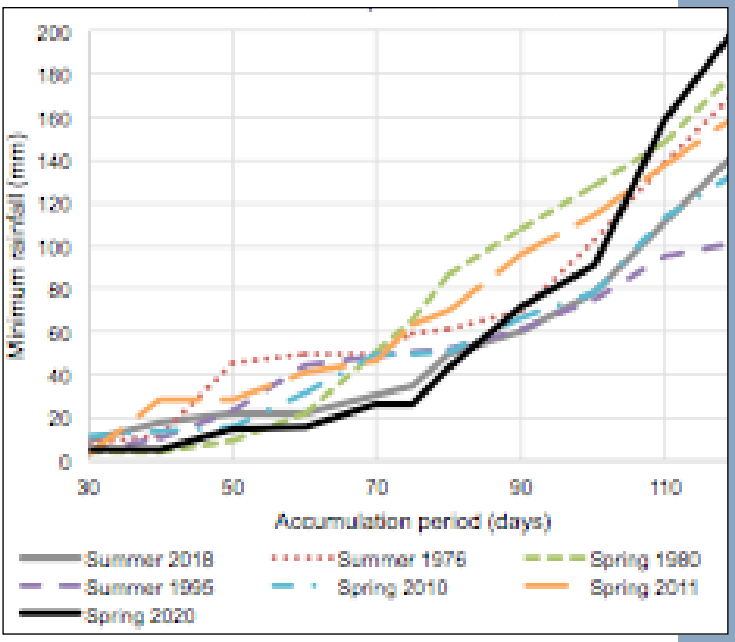
At the start of June I was comparing empty water butts, fissured flowerbeds and browning lawns with our neighbour. His comment on the weather was "this is unprecendented". I replied "No", with 2018 in mind, but then realised that I didn't know for sure. So I got hold of the records from the local Met Office rain gauge which has been operating since 1972. It's at Bank Newton on the Leeds-Liverpool canal where (pre-Covid) I have been part of a rota to take the weather readings. I wanted to find a way of comparing the length and severity of different dry spells.

The graph plots the minimum rainfall over a sliding accumulation window, against the length of that window, with different lines showing a variety of the driest periods over the record. I am sure this isn't original, but I don't think I have seen this sort of plot before so I thought some other members might be interested.

It turns out Keith next door was right: over a period of 60–80 days, Spring 2020 was the driest on record. Summer 2018 was driest over a longer period, 90 days. The 1995 Yorkshire drought comes into its own for longer durations, where water resources start to be seriously impacted. Of course seasonality is another dimension of interest. Spring droughts mean serious amounts of watering work for vegetable gardeners like me.

I'd be interested to know if any members have come across analysis of trends in the persistence of wet or dry weather. Is climate change leading to longer periods of unusually wet or dry conditions, I wonder?

Duncan Faulkner



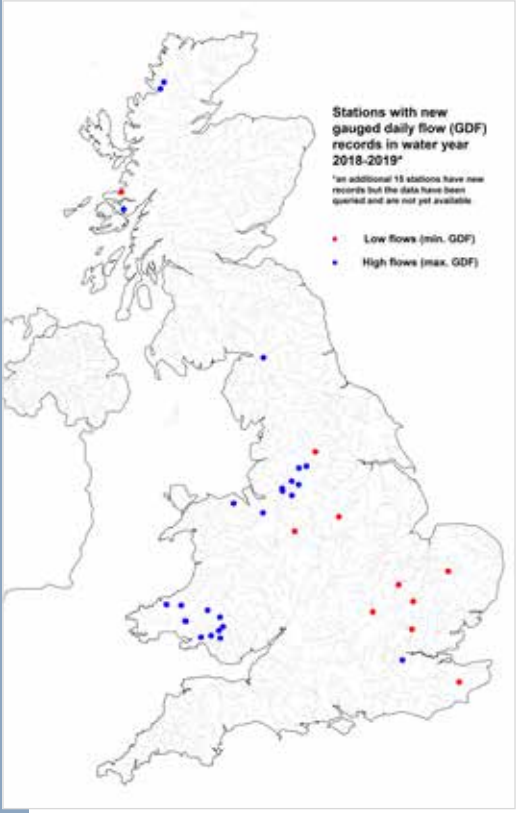


Daily flow data for water year 2018/2019 available

to download from the NRFA website for most stations in the UK.

This annual update contains new record flows for a number of stations, shown on the map below - new record low flows (minimum daily flows) are shown in red and new record high flows (maximum daily flows) are shown in blue.

Some stations are still undergoing the quality control process and data for stations in Hydrometric Areas 17-20 have not yet been submitted to the NRFA. Where more recent river flow data are required, users may be able to source these by contacting the relevant Measuring Authority, or by looking at the live data tab where available on station pages.



Measuring Authorities provide daily flow data to the NRFA through an annual submission programme. Data for each water year are normally submitted to the NRFA the following spring, after which they undergo detailed quality control before being added to the national archive. Peak flow (AMAX and POT) data for water year 2018/2019 will be released later in the year.

The NRFA is maintained by the UK Centre for Ecology & Hydrology and we are grateful for our long-standing partnerships with the UK Measuring Authorities – the Environment Agency in England, Scottish Environment Protection Agency, Natural Resources Wales and for Northern Ireland, the Department for Infrastructure – Rivers.

Steve Turner
NRFA

New BHS YouTube Channel launched!



BHS Pennines: Overview of the winter 2019-2020 floods in Yorkshire (Richard Maxted, EA)

BHS has launched a new YouTube channel. This will allow us to share recordings of meetings for those unable to attend in person (or virtually at the time!) and other video content produced by the society.

Recording of meetings has proved challenging in the past. However, the COVID-19 lockdown and the move to using tools such as Zoom for meetings have given us the opportunity to test these technologies. The recording and sharing of BHS meetings now allows us to share our activities more widely, not only in the UK but around the world.

The first recording available is of the BHS Pennines Section webinar given by Richard Maxted on the 22nd July 2020 on the winter floods in Yorkshire, hosted by Victoria Coates and Rob Burton.

Further videos will be added to the channel such as the BHS Pennines NRFA update on the 12th August and the BHS national webinar series 'Hydrology Under a Changing Environment' happening over the coming months.

Lucy Barker
BHS communications sub-group

CHECK OUT THE BHS CHANNEL HERE

https://www.youtube.com/channel/UCQ3xxpdbW_AhS4Ht6btLbbDQ

The Future of Hydrological Science – We need YOU

Some of you may remember that last year there was an invitation via the BHS Mailing List to join a working group on the Future of Hydrology. While there were far more applications than it was possible to accept to keep the group manageable, we did manage to put together a collection of people that spanned academia, industry and the Agency, and a range of ages and experience. The initiative was also later accepted as an official BHS Working Group.

An update appeared in a previous edition of Circulation when the report on the initial meeting of the group appeared on the BHS Web Pages. This was accompanied by an invitation to the membership to comment on that report (there was one comment posted, and it did not come from Russia!). There has been some progress since then. In January, those members of the working group particularly interested in observational needs met in Birmingham. A report of that meeting can also now be found on the BHS Web Pages at ***http://www.hydrology.org.uk/bhs-working-group-future.php***. The overall conclusions were to respond to the challenges posed to hydrological science by demonstrating the value of new types of observations that may not exist yet, through a model experiment. We would hope that this might help provide a case for a bigger programme of UK hydrological science at a time of unprecedented change.

The Birmingham meeting on observational needs also led to an opinion piece that was accepted for publication in Hydrological Processes. This was made open access by the NERC HydroJULES project and can be read at ***https://onlinelibrary.wiley.com/doi/full/10.1002/hyp.13622.***

Another outcome was the start of a table of current observational capabilities (types of measurement, space and time scales, precision and uncertainties, etc.). This is the first way in which you can help the Working Group based in expanding the range of expertise represented. The table can be downloaded on the Working Group page of the BHS web site (see link in left-hand column). The header for the table provides instructions as to how to suggest changes to existing entries or information for new entries.

We really do need your help on this.

Finally, the Working Group has produced a draft "white paper" on observational needs for the future. This is a second way in which the BHS Membership can help in this exercise. The paper can also be found on the Working Group web site and you are welcome to post comments on that page. The devil is in the detail here, particularly in the suggestions about the types of novel observations required, and how models might be used to assess which might have the greatest value in being pursued in future (with an obvious question being, but *which* model?). If you can take the time to take a look at the suggestions and make some comments on the BHS page or by email to me, the Working Group would value your input. We hope that some small groups can be created to push some of the most promising ideas

forward, particularly those that will require longer term planning and funding.

There has also been some progress on thinking about the future theory and modelling needs, in relation to the range of hydrological behaviours in the UK and the context of potential future change. The outcomes of this will be reported later.

Keith Beven
Chair, BHS Working Group on the Future of Hydrology.
k.beven@lancaster.ac.uk

FDRI Scoping Study: an invitation for you to get involved

The FDRI Scoping Study is a 15-month NERC-funded project, running from May 2020 to July 2021, to establish the requirements for a new national Floods and Droughts Research Infrastructure.

It seeks to identify the data, monitoring and infrastructure requirements to enable the improved process understanding necessary to better predict and mitigate floods and droughts in the UK. The Infrastructure will contribute ultimately to increasing the nation's resilience to such extreme events.

The Scoping Study team is led by the UK Centre for Ecology & Hydrology and comprises researchers from the University of Bristol, Imperial College London and the British Geological Survey (BGS). The study will be consultative, collecting views via surveys, webinars and virtual workshops from a broad range of stakeholders, including the academic community, businesses, landowners, government and regulatory agencies. It will undertake a thorough review of past and ongoing flood and drought monitoring programmes, both in the UK and internationally, and will consider a range of technical options to ensure the infrastructure's long-term sustainability. The study will build on the NERC-funded community workshops that took place in 2019 and which identified strong stakeholder interest in engaging with a dedicated scoping phase project.

During the Scoping Study there will be two additional virtual community workshops and further extensive stakeholder engagement, which will be key to the study's success. BHS membership has been identified as a major stakeholder community to engage with. We would very much welcome your involvement so that we can get a clear understanding of the diversity of opinions and priorities across the community. In order to do this, and in compliance with UK GDPR requirements, we need you to 'opt in' to the process by emailing FDRI@ceh.ac.uk.

Please also forward this invitation to anyone else in your organisation who you feel would be interested in contributing.

Marcia Spencer
UKCEH

Natural Flood Management in the South East

BHS SE Section evening meeting, 6 February 2020

In what proved to be the last meeting of the 2019/20 South East programme, an interested and enthusiastic audience gathered to hear about the latest ongoing research into the effect of naturally focused flood risk management interventions. Talks focused on two separate study areas on minor tributaries of the River Thames: the Littlestock Brook in west Oxfordshire that joins the Evenlode, and the Pipp Brook which flows into the River Mole near Dorking in Surrey, plus a brief presentation on the Q-NFM work in Cumbrian catchments.

Descriptions of the different approaches in the three locations complemented each other and highlighted common issues. The need to work in cooperation and forge partnerships was integral to each of the cases presented. Measuring the impact of the interventions as part of research studies is important for all these pioneering projects, as opportunities are sought to apply natural flood management measures more widely. The schemes are also gathering evidence of the theory and practice of delivering benefits beyond reduction in flood risk, improving water quality and improving wildlife habitats, farming and recreation opportunities.

Joanne Old and **David McKnight** of the Environment Agency presented 'Slowing the flow in the Littlestock Brook, Evenlode Catchment:partnership working to deliver multiple benefits (2016-2021)'. The talk described work based on the River Evenlode, a headwater tributary in the Thames Basin. This is a lowland, clay catchment with high runoff rates that result in flooding in several small rural towns and villages. The river has also been failing to meet its Water Framework Directive status requirements, for water quality and fish habitat. The project, one of 60 DEFRA NFM pilot schemes, is assessing the effectiveness of using natural river processes, land management and soft engineering approaches to reduce the risk of flooding and improve water quality and biodiversity.

Work to create 40,000m^3 of flood storage is being undertaken on the Evenlode's Littlestock Brook tributary upstream of the village of Milton-Under-Wychwood. Several field corner bunds, with woody dams installed in the watercourse to divert high river flows into them, are maximising the floodplain storage. Decul-verting, interception ponds and 13 hectares of woodland planting are also slowing and storing overland flow and associated sediment and nutrient run-off. [See https://www.youtube.com/watch?v=27rdsS9eNl8|

Implementation is through the Evenlode Catchment Partnership (ECP, hosted by Wild Oxfordshire) with local community based groups and landowners working along-side the Environment Agency, West Oxfordshire District Council, Thames Water and others. Local people and organisations have contributed support, funding and time and effort in planning, building and monitoring the effect of the measures. The Parish Council have also contributed to twelve woody dams to reduce channel erosion immediately upstream of Milton-under-Wychwood, and negotiated a 500m riparian strip whichthe



community have planted with trees, willow spiling bank protection and created a new riverside footpath.

NFM requires multiple land management changes across a landscape, so working with Catchment Partnerships (CaBA), landowners and local communities is essential. Intensive monitoring is ongoing, with the EA working together with Atkins and UKCEH and includes a network of measurements of rainfall, water levels, flows, soil moisture, water quality and turbidity. This network, maintained by UKCEH PhD students James Bishop and John Robotham, has yielded some excellent data over the 2019/20 winter to show the effectiveness of the different measures. Time series data are being used to show the responses as the storage areas fill and discharge, allowing further work to assess the effect on peak flows at receptor sites. The data set is also useful in the development of hydraulic modelling by HR Wallingford, allowing the effect of the interventions to be tested across a range of simulated events. The model will be used to investigate the behaviour of the interventions and their effect on flood water levels downstream. Model results so far show that the interventions have a positive effect, reducing flood water levels and delaying the onset of flooding at properties for a range of flood events.

The intention is to use the model to inform the location, size and construction of interventions in remaining phases of the work, and to help quantify the flood benefits

As the work is completed, findings will be added to Version 2 of the Working With Natural Processes (WWnP) evidence base (see www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk) informing the science as well as delivering multiple benefits for local people and wildlife. The work is also being used to inform changes to prioritising funding for flood risk management schemes, which it is hoped will help see natural flood management play an important future role alongside other measures.

Geoff Foulkes and **Ben Tonkin**, also from the Environment Agency, presented 'NFM Dorking – Working in Partnership'. This project is located in the Pipp Brook catchment, a tributary of the River Mole near Dorking. The catchment characteristics are ideal for testing a range of NFM techniques and assessing their effectiveness. In the winter of 2013/14 the Pipp Brook experienced the worst flooding for over 50 years, flooding 26 properties. A report completed in

2015 had concluded that a traditional engineered scheme would be difficult to fund and that consideration should be given to alternative options using NFM.

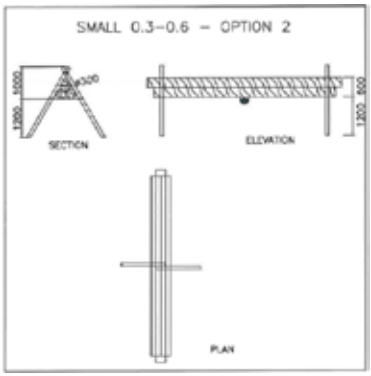
The scheme is funded through DEFRA's NFM research programme, with implementation of most of the identified measures during 2019. As with the Evenlode, monitoring and ongoing research form a key aspect of the scheme. The key partnership has been the Environment Agency working with the Forestry Commission/Forestry England who own the land and manage it as a forest. Partnerships have also been forged with Universities which will enable research into the effect of the scheme over coming years.

On this already forested site, the focus was on designing and implementing interventions using trees and materials that could be felled in the immediate vicinity, within a few tens of metres of the stream. The work incorporated clearance of invasive plant species to promote restoration of some 15 ha of wet woodland habitats.

As well as providing the land and the materials for the interventions on site, Forestry England's role included providing expertise to work with Environment Agency project and Area staff in guiding the design, learning from other successful schemes they had been involved with including the one in Pickering.

A series of woody dam sites were chosen and the team worked with Environment Agency framework contractors Team Van Oord to develop a series of standard designs to impede flow on stream channels and retain water on the floodplain.





Challenges included the ecological sensitivity of the area, restrictions to vehicle access, and the need to ensure no non bio-degradable materials would be left on site. The designs included log stakes used as piles to hold the dams and in places hemp rope was used for fixing. In the more remote, more sensitive sites where using heavy machinery wasn't possible, holes for the piles were dug using hand-held tools, with the timber winched into place. The interventions were com-pleted in the autumn of 2019 and evidence of the storages being filled has begun to be gathered.

As with the Evenlode scheme, monitoring is being put in place. This includes rainfall, water levels, flows and soil moisture with event information gathered using fixed point photography. The change in effectiveness and the structures' development and deterioration over time will also be studied.

The scheme's work has influenced the NFM design guide, and will also add to the evidence base.

The last talk of the evening saw **Nick Chappell** of Lancaster University gave an overview of work within the NERC Q-NFM programme (funded by UKRI-NERC) to quantify reductions in flood peaks at scales ranging from individual features to large catchments in Cumbria.
As with the other projects, implementation of Q-NFM has been based around forming a partnership of organisations working together. Organisations involved include government bodies, farmers, industry and numerous environmental action bodies. Nick described interventions at 15 micro-basin sites, mostly distributed across the larger catchments of the Rivers Kent, Derwent and Eden in Cumbria. Relationships needed to be forged with landowners and organisations involved to enable work at each of the sites.

Key interventions being tested across the sites include implementing one or more from among: differing types of woody dams; tree(scrub) planting; peatland restoration; commercial forest management; sward lifting; channel realignment; and 'hydrohedges'. Monitoring has been installed to show effects at the individual and groups of interventions on hydrographs at the micro-basin scale. Nick showed pictures of flow measurement flumes installed on steep channels, which highlighted one of the differences from the lowland streams shown earlier from the South East.

The contribution of groundwater flows that vary with solid geology of the micro-basins was described as a key factor in the study of the



NFM measures on runoff response. Nick finished his talk with thoughts on the place of NFM interventions alongside more conventional engineered flood risk management interventions. He suggested that numerous interventions on hillslopes, streams and floodplains could be scaled up to give retention volumes comparable to larger storage schemes. This could be achieved through measures including distributed micro-storage; increased wet-canopy evaporation losses by tree planting; and enhanced infiltration where overland flow is an issue.

The discussions that followed highlighted the interest and enthusiasm for further investigation and implementation of NFM measures as the science is able to influence and guide practice to help maximise the multiple benefits. There was general agreement that great opportunities are in prospect with the increasing knowledge base and awareness of the benefits combined with the new agricultural payment scheme and changes to flood management appraisal guidance.

Joe Pearce
Environment Agency



HELP SUPPORT THE SOCIETY'S JOURNAL…

2020 is the 50th anniversary of Hydrology Research, having been founded as Nordic Hydrology in 1970. In 2008 onwards BHS entered into a partnership with the Nordic Hydrology Federation (NHF) and it became Hydrology Research. Subsequently, both the Italian and German Hydrological Societies adopted it as their official journal.

There are three things that you can do to help:

(i) Publish an article in the journal

Until recently we were a subscription-based journal, but since the start of the year we have been fully open access. This means that BHS Members now have free access to the full archive of *Hydrology Research* including special issues arising from several of our Symposia. Of course, in common with all other open access journals, authors now need to pay an article processing charge (APC) once a paper has been accepted (£1400). However, we are pleased to say that BHS members currently have some options to avoid these costs:

- **APCs for BHS Members have been waived for 2020. To take advantage of this offer BHS Members just need to use the BHS waiver code - HR2020BGS – when submitting a manuscript.**
- **This will change to a 25% discount from 2021.**
- **A number of UK universities have signed up to a 2-year pilot publish and read deal – this means that corresponding authors from these institutions will not have to pay APCs. These are: Cranfield University, Imperial College London, Lancaster University, University College London, University of Bristol, University of Edinburgh, University of Exeter, University of Leeds, University of Reading.**

(ii) Explore the archive and sign up to receive notification of the latest issue

Hydrology Research is published six times a year (excluding Special Issues). Sign up to receive notification of Table of Content alerts . You can also

explore the full archive of papers and join us in celebrating the success of BHS symposia. For example, three papers by BHS members. – and all part of BHS Special Issues - have made it on to the 'Top 20 most downloaded Hydrology Research papers':

- **Harrigan et al. (2018) Designation and trend analysis of the updated UK Benchmark Network of river flow stations: The UKBN2 dataset**
- **Beven (2019) How to make advances in hydrological modelling**
- **Wilby (2019) A global hydrology research agenda fit for the 2030s (see here)**

(iii) Offer to become an Associate Editor, Editorial Board Member or Reviewer

We are always on the lookout for colleagues who can help out with reviews, and periodically we review the Editorial Board.

We are also very keen to identify a further BHS appointed Associate Editor in any area of hydrology (see advert on pg X). If you would like to discuss any of these opportunities, or feel you can help the journal in any way please contact the BHS Editor-In-Chief

Nevil Quinn (nevil.quinn@uwe.ac.uk)

Implementing the Flood Hydrology Road Map

The Environment Agency's National Flood Hydrolog Programme has preliminarily been awarded £6.6M funding in the next 6-year FCRM programme (from April 2021) to put towards improvements in flood hydrology.

We are currently working with others to outline a future vision for flood hydrology and a programme to deliver that vision: the Flood Hydrology Road Map. This project started a few years ago and is ongoing. It will be finalised later this year and produce a programme of work. This future funding will be used to deliver the first steps of that road map over the next 6 years.

The road map will cover a range of activities aligned in sub-programmes. We expect to deliver much of this work in collaboration with suppliers who can provide hydrological and project management expertise and will be considering various routes to market including the MMF framework.

Anita Asadullah
National Flood Hydrology team

Hydrology and race: What is the problem and what can we do about it?

Does the hydrology community in the UK represent modern Britain? Sixteen percent of the British population is classified as from a Black, Asian and Minority Ethnic (BAME) background[1]. We have no figures for hydrology yet, but we can infer from employers in environmental sciences (NERC 5% in 2016[2], EA 4% in 2020[3] and BAS 3% in 2019[4]) that BAME employment in hydrology is likely to come in around 5% or lower. This suggests we are preferentially attracting some parts of society into hydrology or accidentally putting off others.

Why does it matter? It's bad for the future of our science and any efforts to make it a modern and thriving discipline. It also means we are missing out on attracting the best minds into hydrology from across society. Beyond that, studies have shown that diversity is good for organisations and business, so we're also missing out there[5]. Finally, it matters fundamentally because it means that we have inadvertently created a scientific community that discriminates.

A study by NUS, IEMA and The Equality Trust[6] showed that the lack of diversity in environmental science actively discourages students from BAME communities to go into it. No-one likes to feel like an outsider. Humans are profoundly social creatures and we take our cues on what is appropriate and safe for us from what we see around us. It is extremely important therefore to make an effort to encourage and welcome that diversity of race.

That same NUS study[7] showed that students from BAME backgrounds, once presented with information, were actually more interested environmental careers than white students. So we cannot dismiss this lack of ethnic diversity in environmental sciences as a lack of interest from BAME communities.

It's not a level playing field

So what is stopping us recruiting more hydrologists or students from minority ethnic backgrounds?

My Bengali dad was always telling me that I had to do better than everyone else at school, because I was a woman and I was Asian, and no-one would give me a job. I rolled my teenage eyes at him for being so out of touch and frankly ridiculous. I was getting straight A's and felt everyone would want to employ me. I have not struggled to get a job, graduating during an economic boom, but this is not about me. Numerous studies have since shown that my dad might have had a point (sorry, Dad!) even after 20 years of 'progress'. One study showed that a CV submitted under the name Adam Henton received three times more interview offers than the same CV submitted under the name Mohamed Allam. You can read about it here[8]. A UKRI study has also shown that BAME scientists are almost half as likely as white peers to be awarded research grants in environmental science[9]. An Oxford study has shown there has been no progress in job discrimination for some ethnic groups over the last 50 years[10] .These are all big numbers and will be affecting both current and potential hydrologists.

Why is discrimination still a problem when we know it to be wrong?

I recently had a baby and

practised 'hypno-birthing' on the run up to the birth as it is proven to have the best outcomes for mother and baby. It works on the premise that if you hear something often enough, you believe it (in this case that you will have a safe and quick birth). What has this got to do with racism or hydrology? Well, I think that it means all hydrologists are racist.....*Stay with me*...

I think it means everyone in society is racist to a greater or lesser degree. It means that if our news, media and entertainment industry feeds us overwhelmingly negative threatening stories about black people or Muslims or the Chinese or anyone, we come to associate these people with these ideas. Racism. In addition, most of the heroes in our stories are white men. This all means that we come to subconsciously value ethnic minorities less than white people. In some, this may manifest itself as abuse of minorities (I would call this racial hatred); some may openly make sweeping generalisations about people of certain races or be dismissive (this is racism and encourages others to be racist); whilst others' racism will be more of a subconscious bias. It's all damaging in different ways. As scientists, we know all of it to be illogical and we know those stories to be inaccurate representations of race, but human brains look for patterns and ways to generalise. We have to be especially aware of these unconscious assumptions we make in our professional lives and make sure we are exposing ourselves to other ideas and stories from minority ethnic communities to counteract prevailing narratives.

One influential narrative is that of our history and we must consider how this influences our present-day attitudes. If we want to feel proud for defeating Hitler in Europe, we must also recognise the exploitation, famines and massacres perpetrated in the name of the British Empire and the racial inequalities these caused.

This 'hypno-racism' we all have is ingrained and can be subtle which means we may not be aware we are doing it and you cannot always be 100% sure that you're on the receiving end of it. This makes the whole thing harder to call out and change, so it carries on in silence. I know I rarely tell people about my experiences for fear of not being believed or having to defend myself. I'm obviously not the only one.

The map of the UK differs depending on the colour of your skin

Rural areas may signal pleasant and relaxing times for some, but the countryside and small towns can be hostile environments if you're not white. This clearly impacts hydrology, as much hydrological study starts in such rural areas. While carrying out Masters fieldwork at the Pontbren study in mid-Wales, our mixed ethnicity group was stopped by three police vehicles because someone had reported us as armed robbers! You can imagine the impression of hydrology fieldwork that this left on a group of students.

It goes beyond such extreme examples in remote places: when I leave the house each day I naturally consider where I am going and what discrimination I might face there, especially when travelling alone. It is just a fact of life and feels quite normal for me. This can however mean there is a certain tension around visiting regional offices and field sites for work. All of this and I am only a bit brown. The racism I face is minor compared to that which others experience, so I imagine that I am not the only one who considers it daily.

What is it about environmental engineering?
Is there something particular about engineering and environmental sciences that makes it particularly difficult to modernise the culture? One hundred years after the Women's Engineering Society was founded, still only 12% of the UK's engineering workforce are women , far behind other sectors. Why so slow? Is this discipline somehow more unwilling to change than others? Is it more risk averse?

If we still have not addressed the obvious gender disparities (and women make up 50% of the population), how long is it going to take us to deal with disparities along racial lines? Is it inevitable that it will be decades? Can't we just act now?

What can we do?
How can we make hydrology an open welcoming representative place, attracting the best minds to work on our problems? Greater diversity would bring in new ideas. It could lead to progress in ungauged basins!
To encourage racial diversity, perhaps we could look at the following:

- We could implement a reverse mentoring scheme similar to that at the Environment Agency. This would match experienced hydrologists with young people from different ethnic backgrounds to help those in positions of authority understand how to open hydrology to a wider audience, whilst providing encouragement to hydrologists from minorities. BHS is planning something along these lines.

- We can be aware of how others may be experiencing situations differently from ourselves and plan work to be comfortable for everyone. We can also encourage our organisations to write and implement action plans to do this. There is an example from Oxford University in the resources list.

- We can call out racism when we hear it. It sounds simple but it can be hard to do, no one likes to feel outside of the group. It is an important way of changing cultural norms. You can be very powerful as an individual.

- Perhaps, most importantly, we can all widen our intellectual diets and expose ourselves to other stories from minority communities to try to counteract the subconscious stereotypes we all hold, whether through books, films or TV.

This article was about race, but race is not the only diversity issue we need to address. Other topics need to be taken separately to make sure each is discussed in a sensible and meaningful way. I'm not an expert on any of this and I would like to hear what you think. Change can be hard, but there is a lot to gain for hydrology in addressing this.

Anita Asadullah

The views expressed here are my own and do not necessarily reflect those of the British Hydrological Society. With thanks to Lucy Barker for conversations on the topic and the list of resources.

Note:
The BHS Diversity SubGroup will be explaining in the next issue what it has been doing in the past year on diversity for Society activities.
Editor

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Resource List

This is a short list of resources that Lucy Barker and I have found useful. There is a lot more out there. Please do send us suggestions or comments about other things we could add and we can perhaps keep an updated list on the BHS website.

IN THE WORKPLACE

- The Business in the Community Let's Talk About Race Toolkit
- Recommendations for improving racial equality, diversity, and inclusion in the De-partment of Earth Sciences, University of Oxford

WEBSITES AND ARTICLES

- On Whiteness in the Earth Sciences
- This blog post from the European Geophysical Union Black in geosciences includes pointers to other resources you can read.
- What is wrong with saying 'https://guidetoallyship.com/' in response to 'Black Lives Matter'
- On being an ally https://guidetoallyship.com/
- How white fragility reinforces racism with lots great resources signposted
- BBC articles on race and Black Lives Matter

TELEVISION

- Netflix has a BLM (Black Lives Matter) playlist including documentaries and also Spike

Lee films. You can also watch the brilliant film '13th' on YouTube here.
- Documentaries on the BBC iPlayer by David Olusoga on the Windrush scandal, the house of a slave trader in Bristol and being black and British.

BOOKS

- Why I'm no longer talking to White People about Race, by Reni Eddo Lodge, this book sold out almost everywhere in June, it is a discussion about the structural racism and white privilege pervasive in Britain today.
- Inglorious Empire, by Shashi Tharoor lays out how the British Empire plundered India and left the country broken.
- This list recommends these and other books on race in Britain: Race in Britain: the best books to help understand

PODCASTS/AUDIOBOOKS

- We Need to Talk About the British Empire podcast, by Afu Hirsch, on Audible
- This Anti-racism listening list on Audible includes essays, memoirs and fiction

BHS Hydro Profiles Questionnaire



*Thank you to **Katharine Smart** for completing a Questionnaire!*

How did you become interested in hydrology?

I've always loved water – it's fascinating and full of juxtapositions. Abundant and scarce. Powerful and gentle. Turbulent and calm. My interest in hydrology specifically came about during my undergraduate course of Environmental Sciences at the University of Southampton, when I took a third-year civil engineering module in Hydrology and loved the technical nature and real-world application of the topics being taught. So much so that I went on to study a MSc in Hydrology and Water Resources Management at Imperial College London.

What is your current job?

I work as a Principal Water Resources Consultant for Ricardo Energy & Environment, where I am involved in various water resources and drought projects. Prior to this (up until November 2019) I was in Anglian Water's Water Resources Management Team, working on the Drought Plan, Water Resources Management Plan, sustainable abstraction and reservoir management amongst others!

What is your dream job?

Something that's varied, challenging, and meaningful – which is why I enjoy working in the field of water resources. It's fulfilling to think your work directly contributes to ensuring society has a resilient water supply for the future whilst protecting the environment. I think I'd always need to do something that has a connection to the natural world.2

What, or who, has helped you get to this point in your career?

I will have to nominate that civil engineering university lecturer at Southampton who opened the doors of hydrology for me. I have also been lucky to work with some excellent and very kind hydrologists in my career so far who have always been happy to share their expert knowledge with me.

Do you have any advice for your younger self?

You don't have to do all of the things all of the time. This isn't something that comes easily to me even now, but I've got better at it!

Do you have a favourite river? Why is it your favourite?

The River Stour and its estuary in Dorset. A lot of my family live near Christchurch and I have many happy memories spending time around Christchurch Harbour and Hengistbury Head. Plus, it gave me my second ever otter sighting (in Blandford Forum; the first being on the River Cam in Cambridge!)

What keeps you busy apart from hydrology?

Let's assume this is a pre- or post- Covid-19 world! Generally being outdoors – cycling, walking, camping, touch rugby, gardening. I also sit on the CIWEM East Anglian Branch Committee and Water Resources Panel. I used to volunteer with WaterAid which was really rewarding.

Which BHS meeting did you enjoy most?

I think the Peter Wolf early-career symposiums are excellent, and a great gateway into the world of professional hydrology. I did a presentation at the 2013 one at Imperial College, and thought it was a great opportunity to practice presentation skills, as well as network with peers and learn about all the hydrological work being undertaken.

What do you like about being a member of BHS?

Having a community of like-minded people and finding out about research and projects through the Circulation magazine and conferences.

Describe BHS in three words:

Informative, scientific, friendly

Letter to the Editor

Dear Celia,

We are both professional hydrologists and meteorologists and long-time members of BHS. We were saddened by recent 'Tweet' pronouncements made by the Chief Executive of the Environment Agency, Sir James Bevan, that suggests to us that he is ill suited to his job. On the 22 June he stated that in spite of the torrential rainfall, there were no flood warnings issued in the UK, as if it was a great achievement, akin to reaching a sales target. Perhaps the lack of floods is because we have had a very dry spell in southern England: at Charldon Hill Research Station in East Somerset, where the soil moisture deficit has been measured for the past 26 years, the deficit was 56mm, thereby allowing considerable take up of rainfall by the soil.

In another recent statement, Sir James, who has no background in water resources management, suggested that England was no longer a damp country. This statement was highlighted in the 'Barometer' column of 'The Spectator' of 26 June. It gave figures for average rainfall for England during the past three 30 year standard time periods: 828mm for the period 1961-1991; 839mm for 1971-2000; and 855mm for 1981-2010. Corresponding figures for the UK as a whole show the same pattern. So, the opposite to Sir James' assertion is true! One of the great features of the variability of our climate across the British Isles, is that in parts of Scotland you can experience over 3,000mm of rain a year, while, for the sake of Sir James, he may prefer as little as 500mm a year that is received in parts of East Anglia.

These statements are unfortunately typical of recent years, showing a decline in the accuracy of content for the sake of giving a "message". These messages are delivered to the Public who are expected to believe what they are told without question. Has fiction taken over from fact or is it that people like Sir James needs to go on a science refresher course before making another Tweet? We suggest he reads "Hydrology in Practice" (Elizabeth Shaw) and "Climate and Weather" (John Kington) for a solid grounding. It pains us to see the fine organisations that we once knew, that is the Water Authorities which were then succeeded by the National Rivers Authority, which we admired now been turned into a bureaucratic machine whose opinion of itself far exceeds its abilities. the fine scientific organisation we once knew and admired, It appears to have been reduced to an organisations to dispense 'sound-bites' that fit media led fashion, rather than reporting good science. This is unfortunately not an isolated example of a general trend: during the past few months much data regarding public health have been misused and misrepresented. Once the current virus mania has settled down, the true cost of the experimental lockdown will become apparent. The Public have a right to relevant and objective facts, and those in critical positions should have the responsibility to behave accordingly.

Yours sincerely

James Dent, Brent Eleigh, Suffolk
Colin Clark, Charldon Hill Research Station, Bruton Somerset

UK Hydrological Bulletin: May – July 2020

Even given the inherent variability of the UK climate the rainfall patterns experienced in 2020 thus far have been exceptional. The second wettest January-February (in the Met Office series from 1862) was succeeded by the second driest April-May for the country as a whole. Correspondingly, the water resources – and agricultural – outlook has fluctuated markedly reflecting regional contrasts in both rainfall patterns and catchment geology. Covid-19 caused some hydrometric data acquisition challenges (particularly with regard to groundwater levels) and, with much of the population at home, domestic water demand increased substantially in some areas. The exceptionally low May rainfall, coupled with notably high temperatures and associated evaporative demands, caused a steep decline in reservoir stocks and a notable contraction in the stream network. Above average rainfall in June and July across much of the UK generated a notable upturn in river flows with significant summer flooding in some areas. The drought threat was considerably moderated but not eliminated, remaining significant in many southern areas and parts of Wales. .

May was a record-breaking month with exceptionally sunny and dry conditions, most of the southern half of Britain recording less than 20% of average rainfall, and terminating the 2nd. driest spring (after 1893) for England & Wales. Correspondingly, end-of-month soil moisture deficits were the highest on record for the UK – see Fig 1. Agricultural stress was therefore considerable (see page 9), aggravated in some areas by the impact of prolonged floodplain inundations during the late winter. Whilst a number of groundwater flood warnings remained operational

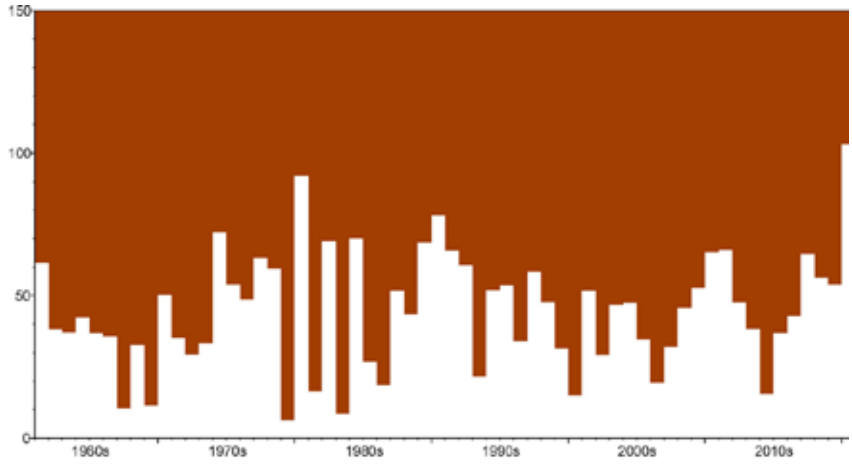


Fig. 1 End-of-May soil moisture deficits for the UK (data source: Met Office

(e.g. in the Berkshire Downs), and some notable rainfall accumulations were recorded in northern Scotland (Achnagart registering 141.6 mm in 48 hrs during the fourth week), runoff from England & Wales (Northern Ireland also) declined throughout almost the entire month, closely matching the minimum on record for the month-end. New minimum May runoff totals were registered for many index rivers from the Ythan in north-east Scotland to the Taw in Devon and month-end flows fell below minima for the time a year across much of the country. The meagre runoff was reflected in monthly declines of 20% or more in the stocks of a number of major northern reservoirs including the Teesdale and Derwent Valley groups. The water resources stress was aggravated by increases in garden watering, crop irrigation and domestic water consumption. Fortunately, the very wet winter of 2019/20 ensured that groundwater levels generally remained healthy, with levels in the Permo-Triassic outcrops of the Midlands and Lake District still exceptionally high. In the southern Chalk, above average levels ensured that flows for many groundwater-fed streams and rivers remained well within the normal range.

Weather patterns throughout June were particularly unsettled. Rainfall was around 150% of average for the UK as a whole – with the South-West reporting more than twice the monthly average – adding to a cluster of wet Junes; for England & Wales four of the last five have been being well above average. Early in the month exceptional water demand combined with low reservoir stocks at Blackdown reservoir required the distribution of bottled water in and around Haslemere (Surrey). Parched soils initially constrained river flow recoveries and any substantial reservoir replenishment.

However, the frequent passage of active low-pressure systems did produce exceptional storm rainfall totals in many areas. On the 11th, Mumbles (on the Gower peninsular) recorded 68 mm in 24 hours triggering a Flood Alert whilst, in Cornwall, Cardinham also recorded >60mm in 24 hrs. A week later Havering (Essex) reported an overnight total of 69 mm and surface flooding incidents were common across southern England. In northern Britain, an exceptionally wet final week

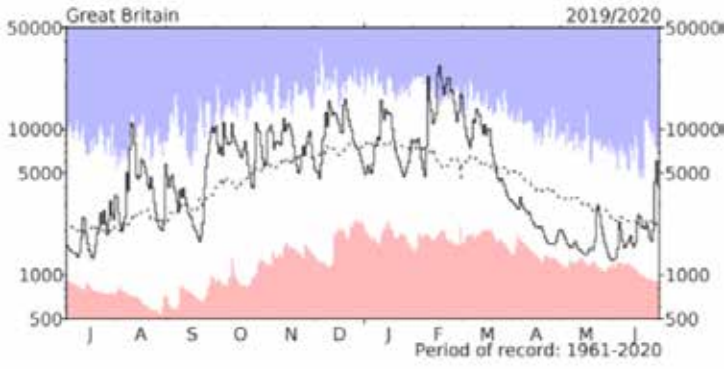


Fig. 2. Daily outflows (m^3s^{-1}) from Greater Britain – the blue and pink envelopes show the highest and lowest daily flows in a in a series from 1961; the dotted trace is the long-term mean

culminated in a 221.8 mm 24-hr rainfall total for Honister (Lake District). Correspondingly, river flows increased steeply; the Forth and Mourne being among many rivers exceeding previous late-June maxima.

Outflows from the UK as a whole were close to the highest on record for the time of year (Fig. 2). However, the Severn and Wye were among several major rivers registering only around half of the average June runoff, with exceptionally low month-end flows. Declines in reservoir stocks were generally much less notable than during the spring but remained around 20% below the month-end average in many large impoundments across Wales and north-west England, and approached 10% below average for England & Wales as a whole (Fig. 3).

Groundwater levels continued their seasonal decline but remained mostly within the normal month-end range, although still high in some slow-responding Permo-Triassic boreholes in Wales and the Midlands.

July was another generally unsettled month with rainfall about 15% above average for the UK. However, accumulated deficiencies continued to grow in some regions – most notably in south-east England where the May-July rainfall total was only just over 60% of the average. A sequence of active frontal systems crossed northern Britain in the first week and flood alerts were extensive in Scotland on the 3rd and widespread in north-west England and in Wales on the 4th (when a 24-hr rainfall total of 97mm was recorded at Capel Curig, Caernarfonshire). Further high spates were reported in south Wales on the 8th and thence across much of northern Britain. In contrast, summer recessions were re-established in many southern catchments. With soil moisture deficits still above average in many areas, aquifer recharge was very modest but substantial storm runoff allowed reservoir stocks to recover considerably across northern Britain - and, very unusually, overall stocks for England & Wales increased through July. However, well below average stocks still characterised much of southern England and Wales. This serves to emphasise that, whilst the late spring and early summer have seen a clear moderation in drought severity across most of the UK, the amount and spatial distribution of rainfall through the autumn will be critical in determining the scale of the ongoing risk to water resources in some regions.

Terry Marsh
11/08/20

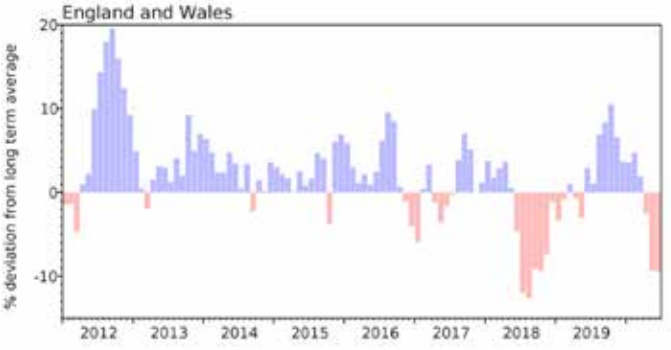


Fig. 3 Percentage departures from the long term average end-of-month reservoir stocks for England & Wales

