

# Chief Scientist's Annual Review 2022

Chief Scientist's Group report

March 2023



We are the Environment Agency. We protect and improve the environment.

We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea-level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We can't do this alone. We work as part of the Defra group (Department for Environment, Food and Rural Affairs) with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

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Cover photo by Martyna Bober on Unsplash – View of Bristol Harbourside and Brandon Hill from the top of Cabot Tower. Environment Agency science underpins our work to describe the state of rivers, the huge societal value they provide and the actions being taken to protect them

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# Foreword

Welcome to the Environment Agency's second Chief Scientist's Annual Review.

2022 was a year of considerable change on many fronts. In that context, it is inspiring to reflect on the important work of so many scientists who have helped us all understand, protect and improve the environment during 2022. I have inherited with deep gratitude a fantastic portfolio of work from my predecessors Dr Doug Wilson and Dr Jo Nettleton, whom I succeed as Chief Scientist. This review focuses on that portfolio within the Environment Agency and celebrates the many other groups across the country, and indeed across the world, that our scientists have worked with over this last year.

Science underpins much of what we do in the Environment Agency. It enables us to deliver effectively and evaluate that delivery. Science also enables us to look ahead at how we might address our longer-term ambitions set out in the Environment Agency's five-year action plan (EA2025), and the government's Environmental Improvement Plan.

The review contains case studies highlighting the role of the Chief Scientist's Group and of science and evaluation across the Environment Agency's remit. Each is placed within the context of EA2025 to demonstrate how science supports our work, how we use data analysis and evaluation to improve decision making, and where we are looking to the future. The review doesn't attempt to cover everything we do, but we have included a list of published work and peer reviewed papers produced in 2022 at the end to capture some of our other science work.

Science in the Environment Agency is also very much about our people. The review therefore gives a flavour of the work we are doing to attract and develop the current and next generation of scientists from all backgrounds and disciplines. This includes our PhD programme, working closely with UK Research Councils to shape and deliver research fellowships, and growing our summer work placements for year 12 students and academic interns. I am hugely proud of this group of talented individuals and teams across the Environment Agency, and I hope you enjoy this review of some of their work.



**Dr Robert Bradburne FRSB**

Chief Scientist and Director of the Chief Scientist's Group, Environment Agency

# Introduction

## The work we do

The Environment Agency has set out in its strategic plan (EA2025) how it will protect and enhance the environment as a whole and contribute to sustainable development. Through this work, we will contribute to the United Nations Sustainable Development Goals and help protect the nation's security in the face of emergencies. Our focus is on achieving three major goals:

- a nation resilient to climate change
- healthy air, land and water
- green growth and a sustainable future

Achieving these goals will require us to work and think differently. We will have to unlock ideas, innovation and ingenuity in all areas of our business. This means we will need a strong science function within the Environment Agency, drawing from science and innovation across a wide range of disciplines.

There are scientists working to meet this need in diverse roles throughout the Environment Agency. The Chief Scientist's Group's purpose is to put strong science and rigorous analysis at the heart of the Environment Agency's work to create a better place for people and wildlife and support sustainable development. Over 150 scientists work within this group on research, innovation, evaluation, data analysis and reporting, and horizon scanning. Within our Flood and Coastal Risk Management directorate, their Research team provide evidence and scientific leadership to support the flood risk management community through delivering the Flood and Coastal Erosion Risk Management Research and Development Programme (in partnership with Natural Resources Wales, the Welsh Government and Defra). The Flood and Coastal Risk Management directorate

is also home to the Social Science team who head up the Social Science Profession and provide cross-functional social science support across the Environment Agency.

These national teams work with operational colleagues and scientists in local teams in a variety of ways. They may provide incident management support across technical issues, rely on the delivery of monitoring data or sample analyses, or be engaged in joint projects. Already over 1,000 people – more than 10% of the Environment Agency's staff – have joined the Science Profession, which is recognition of the important role that science plays in the work we do.

The Chief Scientist's Group leads for the Environment Agency on statutory reporting on environmental standards. We undertake assessments of the environment and the Environment Agency's understanding and uptake of natural capital approaches that are fundamental to the government's Natural Capital Ecosystem Assessment Programme. We have strong links with the Defra Chief Scientific Adviser and other science groups across Defra bodies and government, as well as with the devolved administrations in Wales, Scotland and Northern Ireland.

Environment Agency scientists also work directly for other parts of government through joint programmes with Defra, the Food Standards Agency and the Department of Health and Social Care, and through providing direct services to others, such as to the Health and Safety Executive on chemical toxicity. As a Public Sector Research Establishment, we also have access to UK Research and Innovation funding to work with universities and research establishments across the UK and internationally.

## Our people

Our talented and experienced people are some of the Environment Agency's main assets. Between them, our scientists cover disciplines as diverse as physics, chemistry, biology, hydrology and ecology with specialisms in air quality, water quality, waste and recycling, climate change, groundwater, geomorphology, fisheries science, flood science, social science, ecosystems, data science, ecotoxicology and science communication.

Supporting these scientists, the Chief Scientist is also the Head of Profession for Science for the Environment Agency. This involves:

- running our own development network to build our talent, holding regular science webinars with internal and external speakers, and developing specialist training and support for working scientists
- gelling our science communities by bringing together groups with specialist scientific interests, running a mentoring scheme and supporting those pursuing membership of professional groups
- providing support and frameworks to enable all our scientists to apply the highest professional standards to the work they do and have this professionalism recognised by those they work with
- growing and encouraging future talent through co-supervising 15 PhD students, running a very successful annual conference for them, and offering three-to-six-month placements to give them experience of working in a scientific environment beyond academia
- Offering apprenticeships and supporting the Nuffield Placement scheme for sixth formers from disadvantaged backgrounds

## Structure of the Annual Review

This Annual Review showcases the diverse work of scientists across the Environment Agency in 2022. It is impossible to capture everything we have achieved, so the series of case studies represent some highlights.

This science delivers broadly to the Environment Agency and often beyond. The case studies support multiple aspects of EA2025, and we have shown how our science links closely to all aspects of delivery. The review ends with a brief look to future challenges. This will be picked up more fully as we develop a strategy for science and analysis, which will be published later in 2023.



## The Chief Scientist's Group year in numbers



**70**

staff have incident roles, supporting the Environment Agency's response to flood and environment incidents



**1000**

members of the Science Profession



**125**

PhD network members from participating universities and staff across the Environment Agency



Over **4270**

unique views of Chief Scientist's Group research reports published in 2022



**38**

scientific seminars delivered to Environment Agency staff



Over **£3.5m**

research project spend

# Case studies

## Bringing together the next generation of environmental scientists

**Our PhD network is supporting emerging scientists by providing valuable research, engagement and development opportunities.**

The Chief Scientist's Group leads the Environment Agency's academic engagement with universities. We host interns, PhD students, research fellows and other academic placements as part of the EA2025 People Plan to inspire and develop the next generation of scientists.

We run a network of Environment Agency funded or co-supervised PhD students to share research and access the latest developments in environmental science. The network has over 100 members, including current and previous students. This year, network members have started attending Environment Agency webinars, allowing students to present their research and gain vital experience of communicating their science with impact.

The students are working on a wide range of priority research areas for the Environment Agency. Examples include:

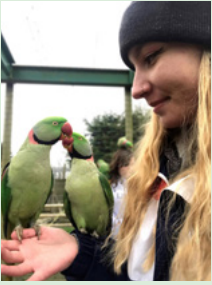
- environmental antibiotic resistance in UK landscapes
- detection thresholds and behaviour of fish eDNA in lakes
- smarter analysis of satellite data for air quality regulators
- understanding exposure of wildlife to persistent chemicals
- understanding present and future rainfall extremes

Students are also contributing to various journal articles, with research from 2022 published in Ecological Indicators and the International Journal of Sediment Research.

To engage our PhD students effectively, we run an online networking group, produce a quarterly newsletter showcasing student and Environment Agency research, and host an annual PhD Knowledge Exchange event. The latter brings together students and Environment Agency supervisors to network, provide updates on their research and be inspired by leading science professionals from within the Environment Agency and beyond.

This year we are providing additional opportunities for PhD students to showcase their research and build on their relationships with Environment Agency staff. An alumni network is in development to maintain connections with students when they finish their PhD. Supporting our PhD students during and after their studies is vitally important for the Chief Scientist's Group to help develop the next generation of environmental scientists.



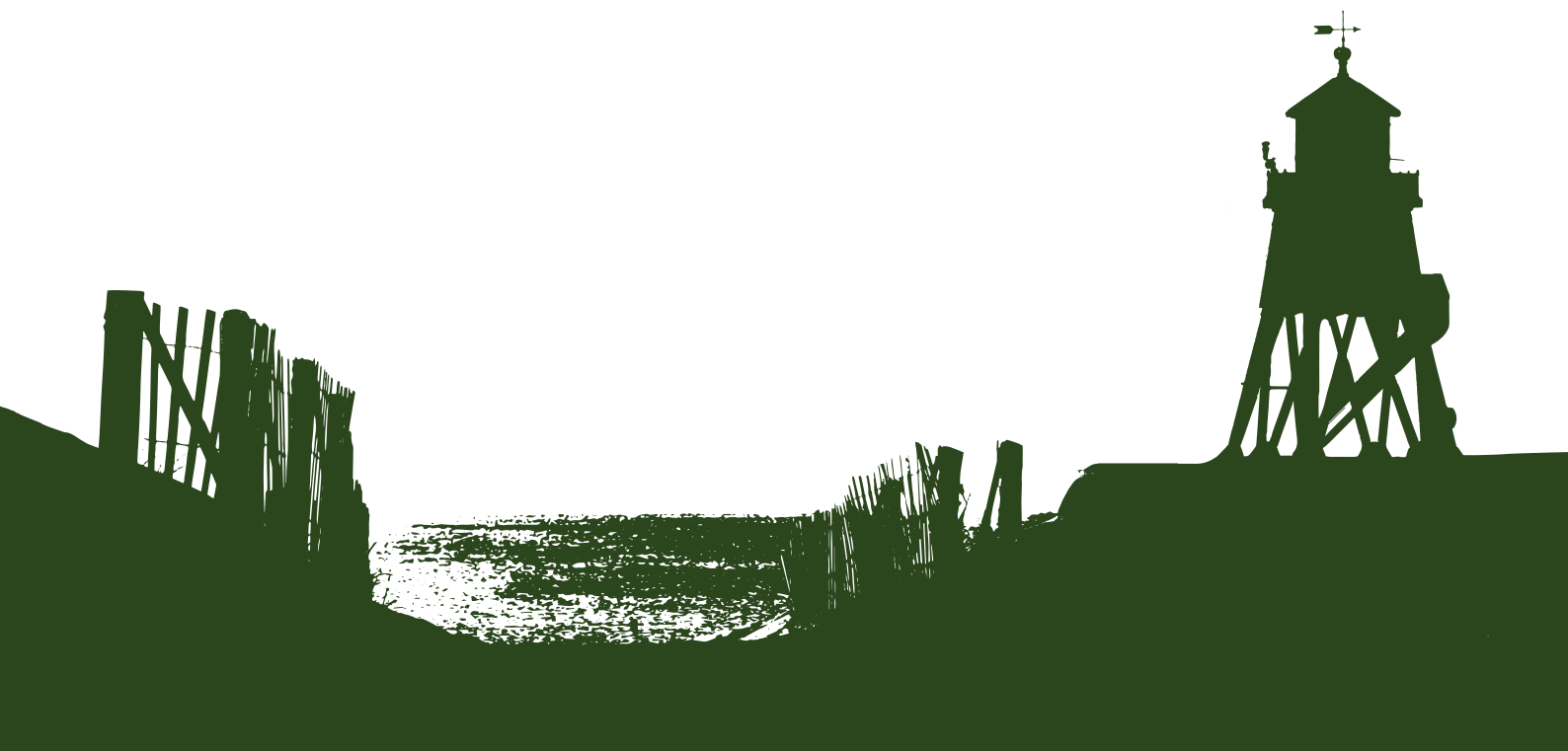


I joined the Environment Agency for a six-month work placement in 2021 after graduating from university. I'm now an apprentice, which allows me to gain additional skills and qualifications while working.

My role ensures I can use my passion for people and the environment to inspire the next generation of scientists. I support academic outreach, publishing and engagement. This includes managing the PhD network, enabling PhD students affiliated with the Environment Agency to share their research and learn from one another. I continue to expand the network and revise how we work to provide the most effective support for students, helping connect the next generation of environmental scientists.

**Chloe Etchells | Support Officer, Research Hub**

Contact: [Chloe Etchells](#)



## Championing scientists in the Environment Agency

**We are creating connections and improving the skills of our scientists through the Science Profession to strengthen the quality of science in the Environment Agency.**

The Science Profession is a community of science and evidence professionals in the Environment Agency that helps members develop through knowledge sharing, expanding networks and creating opportunities for personal growth. Over 10% of Environment Agency employees are members, demonstrating the widespread importance of science across the organisation.

In 2022 we continued the science seminar series, with leading researchers from within and beyond the Environment Agency. We also launched the Science Profession mentoring network to help members fulfil their professional goals.

The seminars have grown from strength to strength. Topics ranging from climate denial to chemicals of emerging concern have inspired and provoked discussion among audiences, which totalled 3,000 over the year (almost tripling from 2021). The seminars have included world-renowned academics, such as Professor Stephan Lewandowsky and Professor Elizabeth Clare.

The Science Profession has enabled colleagues to connect with others within and beyond their scientific discipline. Members have created two sub-group specialist communities for specific areas of science, which harness the collective power of Environment Agency scientists to share knowledge and resolve challenges:

“The Science Profession has created the opportunity to communicate with fellow scientists, enabling me to make space for my broader learning and development of connected areas of science to my role.” – Science Profession member

During 2023 we want to use the profession to strengthen the quality of science in the Environment Agency through embedding the Head of Profession for Science role across the organisation, creating a science champion’s network and reviewing our role in professional accreditation for scientists.

Strong science and evidence are fundamental to achieving EA2025. As the Science Profession expands its offer, it will continue to support Environment Agency scientists and the important work they do to protect and enhance the environment.

Contact: [Susan Tate](#)



I joined the Chief Scientist’s Group in 2019 as an apprentice personal assistant shortly after graduating with my degree in international relations and politics. Two years later, I moved to my current position, facilitating and growing the Environment Agency’s Science Profession and supporting our Chief Scientist.

Making connections, joining the dots and bringing people together is one of the best parts of my role. I love meeting people who are passionate about their work and sharing their enthusiasm across the organisation. Co-ordinating the Science Profession allows me to see the bigger picture and work with all corners of the Environment Agency. It’s especially rewarding when I see how Chief Scientist’s Group and wider Environment Agency science directly impacts people, health and the environment.

**Susan Tate | Support Officer, Chief Scientist’s Co-ordination team**

### The Science Profession 2022 in numbers



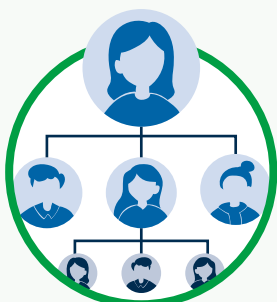
**1000  
members**

Scientists across the Environment Agency are connected by the Science Profession and given access to new knowledge



**2 specialist  
communities**

Specialist communities harness the collective power of our scientists to resolve challenges and share knowledge



**80  
mentors**

Science mentors support the continuous professional development within our scientific community



**27  
seminars**

Science seminars facilitate the sharing of knowledge inside the Environment Agency, and bring in learning from leading academics

## Managing the release of radiation

**The Chief Scientist’s Group has updated a tool that assesses the risk of radioactive waste disposal on the environment, which will provide better information to support our decisions.**

Effective regulation of radioactive waste disposal is vital. Getting the science right is fundamental. Environment Agency scientists are responsible for understanding the radiation dose when allowing disposal of radioactive material to the environment.

In 2022, the Chief Scientist’s Group published the updated Initial Radiological Assessment Tool 2. The tool calculates radiological doses for many radionuclides (the radioactive forms of elements) to assess the risk of disposing radioactive waste in air, coastal waters, rivers and sewers.

The updates used scientific evidence from the latest and most reliable sources, such as the International Atomic Energy Agency. They include:

- adding some radionuclides, particularly those used in nuclear medicine
- changes to the descriptions of how radiation might reach a person
- incorporating a model which helps assess radiation doses for wildlife

The growing potential of the nuclear industry, including nuclear power, medicine and research, mean that the need for tools like the Initial Radiological Assessment Tool 2 to assess radiation doses from releases to the environment is increasing. The tool is already being used by Environment Agency radiological substances regulation staff when assessing permit applications and will enable nuclear regulators to make decisions based on up-to-date information.

Links:

[Initial radiological assessment methodology 2](#)

Contact:

[Louise Paul | research@environment-agency.gov.uk](mailto:research@environment-agency.gov.uk)

## A bullseye for environmental targets

### Environment Agency scientists provided evidence to help government set an ambitious new water target for agriculture.

The Environment Agency has provided evidence and technical advice to Defra to set environmental targets for water as part of the 2021 Environment Act, with the Chief Scientist's Group providing the largest input to developing an agricultural target. Not only do these targets underpin the government's Environmental Improvement Plan, but they are also critical building blocks for delivering the Environment Agency's Water Strategy.

One of the targets is to reduce nitrogen, phosphorus and sediment pollution from agriculture to the water environment by at least 40% by 2038, against a 2018 baseline. To measure progress, modelling will be used to quantify pollutant loads lost from agricultural land, with field verification of model predictions based on water quality monitoring. The Agriculture, Risk and Evaluation team within the Chief Scientist's Group developed this combined approach to evaluate the success of the Catchment Sensitive Farming Scheme.

In their modelling and analysis, the Chief Scientist's Group showed that the 40% reduction target is ambitious, but feasible using a range of policy options. The policy pathway includes increased regulatory compliance and high uptake of incentives and advice for farmers. It also includes land use change, which is targeted for water quality as well as net zero and biodiversity targets. Finally, the pathway must look ahead to account for emerging technological developments in the farming sector.

Achieving these ambitious targets will require government policies to drive change in agricultural practices to reduce agricultural pollution. The targets will encourage innovation by polluting sectors and deliver a step change towards overall water quality ambitions. The impact is significant, with Environment Agency evidence being fundamental to how government sets, measures and reports on targets for water and agriculture.



Sediment running into a stream from an agricultural field drain.

#### Links:

[Delivering on the Environment Act: new targets announced and ambitious plans for nature recovery](#)  
[New legally binding environment targets set out](#)

#### Contact:

[Vicky Beaumont-Brown](#) | [Rachael Dils](#)

## Protecting the future of antifungal treatments

**Chief Scientist's Group researchers are part of a major research effort to understand the role of the environment in antimicrobial resistance.**

Antimicrobials are used to control infections, such as those caused by bacteria and fungi in humans, animals and plants. However, microorganisms treated with antibiotics and other antimicrobials can develop resistance to the point that antimicrobials are less effective or no longer work. Overuse and misuse has led to the continued rise of antimicrobial resistance. Resistant microorganisms enter the natural environment through air, land and water. Once there, the extent to which resistance occurs or spreads between these microorganisms in the environment is largely unknown.

Chief Scientist's Group researchers are leading aspects of a multi-million-pound, cross-government Pathogen Surveillance in Agriculture, Food and Environment Programme to address this knowledge gap. This study has made a major contribution to understanding the development of resistance in fungi. There are relatively few medicines available to treat fungal infections. Global human mortality rates for serious resistant fungal infections now exceed those of diseases like breast cancer and are comparable to those for tuberculosis and HIV. The Antimicrobial Resistance Research team published a review of the development of resistance following exposure to antifungals and effective ways to study it. They are now exploring some of the most promising approaches, including those adapted from bacteria as well as specific ones for fungi.

Antifungals are used widely as medicines, personal care products and agriculture. As a result, there are lots of ways that antifungals can end up in the natural environment.

One such way is through biosolids from wastewater treatment. In the UK, biosolids are applied to crops to provide nutrients and improve soil structure. The Antimicrobial Resistance Research team carried out one of the most comprehensive surveys of antifungals in biosolids using samples from the UK Water Industry Research Chemicals Investigation Programme. Initial results suggest a widespread presence of antifungals and we will be doing work to assess whether this contributes to the development of fungal resistance in the environment.



Antifungal treatments are widely used to protect crops against fungal infections. This could be contributing to the development and transfer of antifungal resistance in different fungal pathogens.

Links:

[Antimicrobial resistance surveillance pilot site selection and database extension](#) | [Sampling strategy and assessment options for environmental antimicrobial resistance in airborne microorganisms](#) | [Scoping review into environmental selection for antifungal resistance and testing methodology](#) | [Antifungal exposure and resistance development: defining minimal selective antifungal concentrations and testing methodologies](#)

Contact:

[Helen Wilkinson](#) | [Ian Martin](#)



I've worked for the Environment Agency for 23 years, starting with the remediation of contaminated land, where we developed the widely used assessment approaches to protect people who live and work on previously used land. In the Chief Scientist's Group, my current work includes understanding and managing the risks from emerging threats, such as the presence of antibiotic or antifungal residues in waste-derived materials applied to agricultural land (and their environmental role in antimicrobial resistance) and emissions from emerging technologies such as carbon capture and storage that are needed to achieve net zero by 2050. There's real job satisfaction from my role as the science we do informs effective regulation to protect public health and the wider environment.

**Ian Martin | Senior Specialist, Air, Land and Water team**



## Staying ALERT against farm pollution

Through innovative imaging technologies, the Environment Agency is improving how farmers can reduce their environmental impact.

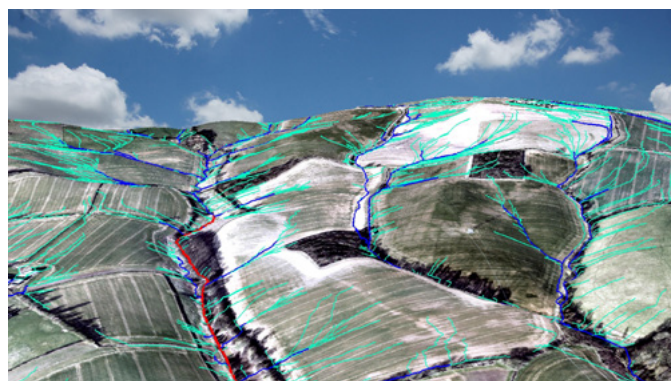
The Chief Scientist’s Group and the Environment Agency’s National Monitoring Survey team are working together to target opportunities to mitigate pollution and evaluate the efficacy of the Catchment Sensitive Farming (CSF) partnership.

Since 2006, CSF has worked with around **24,000 farms** and helped farmers take more than **80,000 positive actions** to reduce pollution.

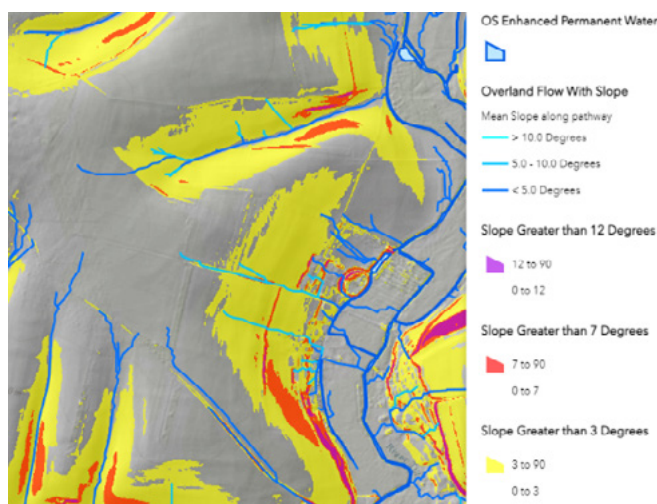
The teams are using Earth observation and other geospatial technologies to do this. Earth observation data can provide near real-time imaging, giving an overview of the Earth’s surface across the entire country. It can also visualise the Earth’s surface during different times of year, enabling CSF to highlight season-specific risks. Through these technologies, CSF can help identify which mitigation measures are most likely to curb pollution and where, revolutionising how the partnership provides evidence to stakeholders.

CSF is delivering this analysis through ALERT (Agricultural Land Environmental Risk Tool), an internet mapping platform that visualises complex combinations of national-coverage and field-scale spatial data layers. The layers in ALERT include flow pathways, satellite imagery, crop data and slope information. The partnership is also developing tools that use satellite imagery and the Environment Agency’s LIDAR (light detection and ranging) data. By tracing the uptake of CSF mitigation measures, the data helps identify how these measures benefit water quality.

During this year alone, there was an **8-fold** increase in the number of visits to ALERT.



Conceptual model of overland flow pathways (above). Screenshot of the ALERT tool (below).



Earth observation data has become an integral part of CSF, with 2022 being the first year that the programme has funded full-time resource into developing these cutting-edge, remote-sensing technologies. Tools like ALERT signal a step change in how CSF targets opportunities and evaluates their impact, ensuring the partnership can best support farmers in addressing agricultural pollution.

Links:

[Catchment Sensitive Farming: advice for farmers and land managers](#) | [Catchment Sensitive Farming evaluation report](#)

Contact:

**Crispin Hambidge** (National Monitoring Survey team, Operations directorate) | **Antony Williamson**



## Limiting the REACH of forever chemicals

### Environment Agency scientists have assessed regulatory risk management options for perfluoroalkyl and polyfluoroalkyl substances (PFAS) in Great Britain.

Due to their chemical bond strength, PFAS molecules – often called ‘forever chemicals’ – are slow to degrade and remain in the environment for many decades. With thousands of PFAS identified across hundreds of global products and recently being detected in human blood samples, there has been growing concern about widespread environmental contamination and human health risks from PFAS exposure.

#### Where are PFAS found?

PFAS have a wide range of professional, industrial and consumer uses, including:

- cleaning agents, paints, polishes and waxes
- pharmaceuticals, medical devices and products
- construction materials, including polymers
- surface coatings for textiles, food contact materials and packaging

Until recently, there has not been a comprehensive overview of risk management options for PFAS use in Great Britain. Following the EU exit, Great Britain now has the opportunity to decide on steps to more closely manage the risks arising from these chemicals.

In partnership with the Health and Safety Executive and at Defra’s request, the Chief Scientist’s Group launched the first-ever regulatory management options analysis (RMOA) for PFAS used in Great Britain. The Chemicals Assessment Unit at the Environment Agency led an assessment of the existing evidence for PFAS use on the environment. Following a call for evidence, we considered current uses, exposure and hazards.

The PFAS RMOA uses an innovative grouping approach, providing a new scientific basis to regulate chemicals as a collective rather than on an individual substance level. It identifies key evidence gaps, uncertainties and recommendations of several potential regulatory options for Defra to consider. It also provides evidence to inform the development of the Chemicals Strategy, which is a commitment in the 25-Year Environment Plan.

This work marks the biggest, most complex REACH RMOA produced in the UK, and one of the first produced under the new UK REACH regime. Working together, the Environment Agency and the Health and Safety Executive submitted the draft RMOA in 2022 for independent scientific review, with final publication expected in early 2023. Once published, government will make decisions on the need for further regulatory action.

Links:

[UK REACH – PFAS RMOA: call for evidence](#)

Contact:

[Richard Dean](#)



I've worked for the Environment Agency for over 22 years, nearly all of which has involved chemicals. In the Chief Scientist's Group, our team assesses the environmental hazards and risks of industrial chemicals. These can be anything from the flame retardant preventing your sofa catching fire to the active ingredient of your sunscreen.

This work can involve national regulations and international agreements. We're currently assessing a chemical through the United Nations Stockholm Convention. If our UK proposal is agreed, under international law there will be stringent controls placed on the manufacture and use of the substance. There's real job satisfaction from my role as the science that our team does has a direct effect on managing chemicals emitted to the environment.

**Ian Doyle | Principal Scientist, Chemicals Assessment Unit**



## Reporting on the state of the environment

**Our regular reports give a snapshot of the present and a glimpse into the past and future of England’s environment. Two new outlooks bring together evidence to enable thriving ecosystems and healthy coastlines.**

Since the 1990s, our scientists have reported on the state of the English environment. Our two latest reports – ‘Working with Nature’ and ‘State of the Environment: The Coastal and Marine Environment’ – provide up-to-date and authoritative evidence on environmental pressures, status and trends.

The Working with Nature report found that a **quarter of mammals** in England and nearly a fifth of UK plants are threatened with extinction.

Launched in July 2022 by Sir James Bevan, the ‘Working with Nature’ report carries a clear message: we should be working with nature and not against it to protect and enhance biodiversity and ecosystem services. Complex natural ecosystems provide clean water, climate regulation and food, which are essential for life on Earth. The potential loss of ecosystems poses an existential risk to England’s wildlife and human prosperity and wellbeing.

‘Working with Nature’ found that significant land use changes are needed for wildlife recovery and for humans to mitigate and adapt to the effects of climate change. The report demonstrates many ways to restore biodiversity, from rewilding to protecting coastal wetlands. It also shows that ‘nature-based solutions’ have added benefits such as removing excess carbon from the atmosphere, providing clean water and creating flood defences.

It is estimated that UK coastal and marine environments – including sediment, seagrass, and saltmarsh habitats – store **136 million tonnes of ‘blue’ carbon**.

Published in January 2023, the ‘State of the Environment: The Coastal and Marine Environment’ report summarises the status of English coasts and estuaries. Our coastlines provide many essential services, but face threats from climate change and human activities. The report found that a step change is urgently needed for the protection, recovery and restoration of England’s estuarine, coastal and marine environment.



Environment Agency scientists regularly report on data and information that summarises the state of soil, air quality, water resources and water quality in England.

Our Chair, Alan Lovell, launched the report in a keynote speech at the Coastal Futures conference. He called for co-ordinated action to better manage our coastline and address the factors degrading our environment. The report suggests that collaboration between private, public and non-governmental sectors can bring about positive changes at larger scales. It also highlights examples that successfully demonstrate this system-wide approach, from launching a national marine park in Plymouth to co-developing solutions to restore nature through Defra's marine pioneer.

Links:

[Working with Nature](#) | [State of the Environment: The Coastal and Marine Environment](#)

Contact:

[Simon Bingham](#) | [Rachel Gibson](#)



Growing up in Devon with Dartmoor on my doorstep, I've always been passionate about protecting the environment, the landscape and its biodiversity. I enjoy multi-disciplinary science, so the variety and complexity of environmental science never fails to inspire me.

I've been in the Environment Agency for almost 20 years and now work in the Integrated Assessment and Evaluation team. We provide evidence on the state of the environment, the performance and impact of regulated businesses, the effectiveness of our activities and interventions, horizon scanning and futures thinking. My team is brilliantly supportive, enthusiastic and up for the challenge of such highly varied work. It's rewarding to know that we're making complex science accessible to all.

**Susan Casper | Manager, Integrated Assessment and Evaluation team**



## Community engagement for a changing climate

### The Environment Agency is showing how authorities and communities can work together to address future challenges.

For coastal and inland communities alike, climate change is putting buildings and livelihoods at risk. In many places we are already seeing the effects, with homes being lost to coastal erosion and lives disrupted by flooding. Because of this, it is important to develop a common understanding of how to manage the increasing risks. But a big challenge lies in how to make the best decisions for communities based on uncertain climate predictions.

Part of the solution could lie in how the Environment Agency works with others. While the organisation already works closely with communities on present-day flood preparation, response and recovery, there has been less focus on how communities could and should respond in the face of a future changing climate.

The Flood and Coastal Risk Management Research team explored how authorities can work with coastal communities to reduce such risks. We sought to build knowledge, methods and skills to co-create solutions with communities that work for them. This way of working was fundamental to the project. Without it, there was a risk that plans would not account for local knowledge, resulting in inappropriate solutions for certain areas.

We worked with two communities, in London and Norfolk, in the pilot to respectively address future risks of surface water flooding, coastal erosion and storm surges. Various engagement tools were created and trialled to help assess how prepared people were to engage on complex issues like climate adaptation, increase understanding of flood risk and bring stakeholders together to imagine possible future scenarios.

The project has driven new evidence-based engagement practices within authorities, in turn producing more collaborative community conversations about long-term change. It has also enabled decision makers to have a greater understanding of what is needed for this kind of engagement. More broadly, it has contributed to England's Flood and Coastal Erosion Management Strategy with its central themes of adaptation and community-based decision making. The newly developed engagement tools have been adopted elsewhere.



The impacts of coastal erosion in Hemsby, Norfolk. Seven houses were lost during a storm surge in 2013.

#### Links:

[Working together to adapt to a changing climate – flood and coast](#)

#### Contact:

**Kate Kipling** (Flood Research team, part of the Economics, Appraisal and Research team in the Flood and Coastal Risk Management directorate)

## Informing investment to improve England's waters

**Environment Agency scientists are developing new datasets and expanding our understanding of how protecting England's rivers can be valuable for many reasons.**

The Chief Scientist's Group and the Economics team within the Flood and Coastal Risk Management directorate have provided new insights to reflect decisions underpinning the River Basin Management Plans (RBMPs) – supporting the national economic assessment of the plans and helping to create a novel dataset of England's water bodies. This demonstrated that the benefits of RBMP implementation exceed the associated costs of investing in improving England's waters – while helping to focus efforts into the places that most need it.

As a result of investment to reach RBMP objectives, the value of the water bodies as natural capital assets could **increase by 50%** and **£30 billion** over the next 100 years.

For the national economic assessment, we helped provide an additional perspective on the RBMPs using natural capital and ecosystem services metrics. We also used the Natural Capital Register and Account Tool to calculate natural capital values for freshwater quality across England and a range of indicators across the North West river basin district. The project mapped out the increase in asset values over 100 years, showing the benefits gained from RBMP investment.

The new dataset includes **2.3 million data points** covering all of England and parts of Wales and Scotland where there are catchments across borders.

As part of our rolling programme of statutory reporting, the Chief Scientist's Group with teams across the Environment Agency collated a robust evidence base to drive investment into work that will improve deteriorating water environments.

The dataset is unique in its precision, scale, and resolution. For each stream, river, lake, coast, estuary and groundwater, we compiled data on the condition of the water environment, the cause of impact, and the RBMP plans and objectives for that water body. We made this information publicly available at different scales across specific points along a waterway. This enables stakeholders to interact with the evidence, zooming in to see the condition of their local river or to see how the condition, causes and objectives vary across the country.

Links:

[Investment requirements for England's river basin management plans](#) | [Enabling a natural capital approach](#) | [Catchment data explorer](#)

Contact:

**Ruth Jones** | **Owen Lewis** | **Viviana Levy** (Economics team, part of the Economics, Appraisal and Research team in the Flood and Coastal Risk Management directorate)

## Final RBMP data: Changes since draft plan

Since the end of the draft RBMP, we have been preparing the data for the final RBMP



### Over 100 water body changes

29 new water bodies, 35 designation changes plus other updates and edits. Better resolution mapping



### 100k Cycle 3 classifications

Created a Cycle 3 dataset. Made corrections and created classifications for new water bodies



### Over 100k objectives

Prepared a dataset then supported staff to update the final objectives



### 88k site classifications

Loaded site classification data delayed by the pandemic



### Protected areas automation

Protected areas automation: Overhauled the data flow, now up to date and more accurate



### 40k Cycle 3 RNAGs

Compiled a Cycle 3 baseline of RNAGs based on Cycle 2 data

## In the flow to predict future floods

**In an expansive new study, Environment Agency scientists have developed an interactive tool and provided guidance to predict future flood risk.**

Previous Environment Agency research developed a new approach to estimate the impacts of climate change on flood flows. Working with the UK Centre for Ecology and Hydrology (UKCEH), we applied this approach to 154 catchments across Great Britain and found that some were more sensitive to changes in rainfall than others. We categorised the catchments by their sensitivity to climate change, so we could then predict how a larger river basin may respond to climate change.

However, the various steps in the analysis created uncertainty. This year, researchers in the Chief Scientist's Group and the Flood and Coastal Risk Management directorate worked with UKCEH to expand this project and reduce the uncertainty. The new study directly combines the information on catchment sensitivity with a national-scale model that represents all catchments. To achieve consistency across Great Britain, we collaborated with Natural Resources Wales and the Scottish Environmental Protection Agency.

The grid-based hydrological model generates river flow information for every square kilometre of Great Britain's river network. It also uses the latest UK Climate Projections, which improves understanding of the possible impacts of climate change on flooding. The study modelled three future dates and different scenarios of greenhouse gas emissions, which were compared to historic flood peaks and the change in flood peaks over time. The model's large number of runs allowed us to calculate the likelihood of certain changes in flood peaks happening in the future.

The new model includes **3,000 groups** of climate projections and was run over **56.7 million times**.

Researchers and planners alike can now view the results through an interactive web tool, providing a convenient way of exploring the wealth of information at different locations across Great Britain. The Environment Agency has used these change values to create catchment average changes. It has included these updates in operational guidance for its staff and has supported English flood risk management authorities and developers who undertake flood risk assessments.

This project provides the UK's most up-to-date understanding of how river flooding is expected to alter due to climate change. This information will enable the Environment Agency and others to better manage future risk from flooding.



Environment Agency scientists are working to understand the changing risk from flooding, such as that shown here at the Ouse Bridge in York.



Links:

[Climate change impacts on peak river flows: combining national-scale hydrological modelling and probabilistic projections](#) | [Climate change impacts tool](#)

Contact:

**Stuart Allen** | **Sally Brown** (Flood Research team, part of the Economics, Appraisal and Research team in the Flood and Coastal Risk Management directorate)



I'm an enthusiastic and inquisitive environmental scientist. I feel lucky to have worked on many different research topics in my 20 years at the Environment Agency, including flood and coastal risk management, DNA-based methods for ecological monitoring and anti-microbial resistance. I'm now leading work to explore how we can increase the impact and accessibility of scientific data and knowledge to support climate change adaptation.

Our team of passionate scientists has lots of exciting research projects kicking off this year. We want to be imaginative and experiment with developing these collaboratively with colleagues across the Environment Agency and with partners and wider stakeholders. It's been highly energising and rewarding to bring experts together from across government, academia and industry and build energy and commitment to collaborate.

**Vicki Rhodes** | **Principal Scientist, Climate Change and Resource Efficiency Research team**



## Going global to understand extreme events

**Researchers from the Environment Agency contributed to the development of a global socio-hydrological dataset of extreme flood and drought events as part of an international collaboration.**

The Research team in the Chief Scientist's Group was approached by the Environment Agency's Hertfordshire and North London Area team, who wanted to understand how changes in water resource management had affected the impact of drought in the Ver chalk catchment in Northeast London. Chief Scientist's Group summer intern Hannah Matthew-Richards used code created by researchers at Birmingham University to analyse historic groundwater level data in the serious droughts of 2003 to 2006 and 2010 to 2012. These events affected water users across a large area in Southeast England, as well as businesses, food production, tourism and the environment. Environment Agency records, published papers and news articles were reviewed to compile detailed data on the socio-economic and hydroclimatic characteristics of each event.

The 2010 to 2012 drought was shorter than the 2003 to 2006 drought but more intense. Changes in drought management reduced the socio-economic impact of the 2010 to 2012 drought. Improved seasonal forecasts gave better predictions of the affected area, public awareness campaigns started earlier and water use restrictions were communicated widely on national television before implementation. Earlier dialogue with water users provided early warning and allowed some to identify alternative sources of water. These actions demonstrate adaptation, with the implementation of lessons learned from the earlier event.

The collaboration involved **92 researchers** from over **70 organisations**.

The analysis from the Ver chalk catchment study was also used as part of an international study led by the International Association of Hydrological Sciences. The international study compiled a large dataset of paired events that could be analysed to understand the effectiveness of risk management in extreme hydrological events. Published in the journal *Nature*, the paper uses 45 paired studies of both floods and droughts to analyse the socio-hydrological characteristics of each event. The study suggests that by enacting three success factors – effective governance of risk and emergency management, high investment in structural and non-structural measures, and improved early warning and real-time control systems – countries can minimise the impacts of extreme events.



Misbourne pool drying up during a period of drought.

Links:

[The challenge of unprecedented floods and droughts in risk management](#)

Contact:

[Natalie Kieboom](#)

## New water temperature projections in chalk streams

**Our researchers have collaborated with the University of Birmingham to start finding out how climate change will impact rivers and the life they host.**

Certain plants and animals that live in rivers are very sensitive to changes in their environment, meaning even slight increases in water temperature could have a big impact. The Environment Agency needs to understand how these plants and animals might be affected, so appropriate climate change adaptation can be put in place before it is too late.

Chalk streams are a unique kind of river. They are of national importance because their waters are particularly clear, clean and host an abundance of aquatic life. Globally, about 200 chalk streams exist and the majority are in England. This made them the ideal candidate to pilot a model which could estimate the impact of temperature changes on river ecology over the next 60 years.

The new projections suggest that average temperatures of chalk streams for the hottest months could rise by just over half a degree Celsius per decade. Those around London would see the largest changes.

Temperature changes on this scale would limit the survival of eggs from fish like salmon and trout. These fish, which are particularly important for rural livelihoods, are dependent on water temperatures of around 12°C during their winter mating period. The projections suggest that over 80% of chalk streams could exceed this temperature by 2080. Many other species would be similarly affected over the coming years.

This pilot project was a helpful starting point to understand how certain rivers will respond to climate change and will help inform the Environment Agency's approach to chalk streams. Ongoing work will expand the approach beyond chalk streams to estimate the impact of rising river temperatures generally across England.



Pond water-crowfoot (*Ranunculus peltatus*) growing in a chalk stream.

Links:

[Chalk streams of the future: the effects of climate change on biodiversity in England's iconic river ecosystems](#)

Contact:

[Judy England](#) | [Matt Charlton](#)



## Taking out the trash: using research to tackle waste crime

### We are developing new insights to stop waste crime in its tracks.

The Environment Agency's National Waste Crime Survey estimates that 18% of all waste produced is illegally handled. These crimes, ranging from illegally exporting waste electrical goods to dumping hazardous waste in makeshift landfills, add up to a potential 36 million tonnes of waste a year.

Waste crime costs the UK economy at least **£1 billion a year**.

Our Evaluation team has a programme of work looking at the impact of waste crime on people and the environment, and how effective Environment Agency interventions are at preventing it. This year, we investigated current preventative measures, the links between waste crime and deprivation, the changes in our projected deterrent effect, and the overall value for money of the Environment Agency's waste enforcement operation.

For every **£1 invested** in waste crime enforcement, there are **£5.52 in benefits** for society through reduced tax evasion, reduced social and environmental harm, and increased profit for legitimate businesses.

Our analysis showed that deprived urban communities are most likely to suffer from higher rates of waste crime and its impacts. We also applied deterrence theory (the interaction between severity of punishment, likelihood of apprehension and the speed of justice) to develop the UK's first-ever 'deterrence index'.

Our analysis highlights the importance and cost effectiveness of the Environment Agency's fight against waste crime, shedding light on possible drivers and solutions. The deterrence index will help the Environment Agency shape strategic approaches to do more of the things that work, and less of those that don't. The Evaluation team is continuing to work with the Environment Agency's Enforcement and Waste teams to integrate this analysis into the metrics they use to monitor waste crime. Together, we are helping to reduce harm and drive tax money toward legitimate sources – stopping waste crime in its tracks.



Environment Agency staff members surveying illegally dumped waste.

Contact:  
**Matthew Hess**

## The River Surveillance Network: representing rivers on a national scale

**From detecting rare species to pointing out pollutants, new national-scale river data is part of a wider transformation on how Environment Agency scientists can support reporting and decision making.**

The River Surveillance Network (RSN) marks our first unbiased, robust, statistically designed monitoring network representative of river environments in England. When combined with relevant information, the new dataset will enable the RSN to provide broad-scale information on the condition of rivers in England, enable inferences to unmonitored sites and deliver robust data to influence policy at a national level.

The entire RSN monitoring network has over **1,600 unique sites**, with the Environment Agency monitoring **500 sites per year** through its sampling.

The Chief Scientist's Group lead on the design of the RSN. The network design is a first for England and has proven to be particularly influential for designing other monitoring networks for the terrestrial Natural Capital Ecosystem Assessment Programme.

This new programme, which includes water, is part of a wider Defra-lead Natural Capital Ecosystem Assessment Programme covering terrestrial, marine, freshwater and soil natural capital. The programme aims to build a world-class assessment capability which enables transformational environmental policy and helps inform investment to improve the environment, benefit people's health, and support a sustainable economy.

The RSN embodies this wider aim by including sites which are different from locations conventionally monitored by the Environment Agency, including temporary watercourses and some streams. This has resulted in species being found which were historically under-recorded. As a result, the RSN is already getting a glimpse into the distribution of some rare species across England, including certain stoneflies (such as *Nemoura lacustris*) and mayflies (such as *Paraleptophlebia waeneri*).

Links:

[Natural Capital and Ecosystem Assessment Programme](#)

Contact:

[Jennifer Taylor](#)



## Dreams are where the future is made

**We have worked with regulators to instil a new way of thinking – establishing a future vision for the nuclear industry and highlighting the actions needed to achieve it.**

The Horizon Scanning and Futures team have been advocating the Three Horizons approach as a simple but effective model for envisioning what could be, and how to get there. This new approach identifies which current ways of working may no longer be right, how emerging societal or technological trends can influence the future, and what creative, collective actions are needed for a better future.

The team used the Three Horizons approach with the Environment Agency’s Nuclear Regulation Decommissioning and Clean Up Programme to look at dealing with the legacy of radioactive waste from nuclear powerplants and facilities, establish a future vision for the industry and describe the actions they could take today to make this happen. We trained over 60 participants with a ‘futures’ mindset to develop ways to virtually collect diverse opinions on the future and use data to inform the vision for its delivery.

Applying the Three Horizons approach in this way and at this scale was a first in the Environment Agency. Not only did it allow the programme staff to reflect on the gap between ‘business as usual’ and their future vision, but also helped them see the power of futures to build a collaborative new approach to delivering the vision. As a result, the Nuclear Regulation Decommissioning and Clean Up Programme is going through significant change and is leading with this way of working in the sector. Tracy Braithwaite, project lead for the programme, said:

“It has changed the way the team thinks about why we are delivering what we are delivering, and we will use the output of the workshops to shape our team for the next five years [...] We wouldn’t have had the depth of experience or the output we now have if not for the Futures team.”

Contact:  
**Jason Dinsdale**



I’ve worked in the Horizon Scanning and Futures team for nearly a year. My role is endlessly interesting because I get to work across the Environment Agency to help shape thinking around long-term risks, opportunities and uncertainty in order to promote more resilient decision making. The Futures team use a range of systematic tools and offer workshops and input for anyone interested.

My background is a bit eclectic but encompassed by the theme of ecological and cultural curiosity. I hold a BSc, MSc and PhD in the field of environmental science. I’ve previously been lucky enough to work as a field assistant in the Antarctic, as a consultant ecologist in the UK and as an adventure travel guide in more than 20 countries.

**Jenny James | Evidence Advisor, Horizon Scanning and Futures team**

## Zeroing in on future scientific challenges

**Through our future challenges, we are exploring how England can achieve a clean energy future in a way that maintains a healthy environment and thriving communities.**

Since 2019, the Chief Scientist's Group has produced a list of future challenges – areas where there is opportunity for the Environment Agency to show scientific leadership on complex, longer-term issues with potential to impact the environment. While the challenges vary in terms of their science, size, and purpose, they are all explorative in nature and focus on thought leadership. They anticipate the possible implications of emerging issues, spot where transformational science can solve complex problems and ensure that the latest evidence continues to underpin the Environment Agency's strategic environmental leadership.

One of these challenges focuses on the Environment Agency's contribution to the UK achieving net zero emissions by 2050. The scale and pace of the required transformation is huge, and will affect all aspects of the economy and people's daily lives. It will also have major implications for nature and natural resources, although the picture of how these will happen isn't yet clear.

Our three-year net zero future challenge programme explores:

- methane management techniques for landfill sites
- the impact of heat pumps on river ecosystems
- biochar as a greenhouse gas removal technique

The Chief Scientist's Group is exploring how the net zero transition may impact nature and natural systems, while also reviewing the potential to reduce greenhouse gas emissions in the sectors it regulates. The results will inform permitting for low carbon technologies and activities. This information is also vital to accurately advise government on whether environmental risks and constraints could affect their policy goals.

The project bridges the natural and social sciences to understand the cumulative and system risks of net zero for air, land and water and the impacts for local communities, focusing on areas where the Environment Agency can facilitate a sustainable transition. This forward-looking agenda requires the Chief Scientist's Group to work in new ways and develop new skills. By building academic, government and local partnerships, the challenge is bringing together a range of perspectives to ensure that the latest science steers critical clean energy decisions.

Links:

[Achieving net zero: keeping people and nature in mind](#)

Contact:

[\*\*Molly Anderson\*\*](#)



## Chief Scientist's future challenges 2022-23



### Climate change

- Decision-making under uncertainty
- Stress testing



### Health

- Biological risks to health in the environment
- Environment and human health



### Water

- Urban rivers
- Evidence for future water strategy
- Vision for DNA
- Evaluation programme for WLB



### Net zero

- Environmental impacts of net zero



### Cross-cutting

- Changing public expectations of the environment
- Setting targets in a world with shifting baselines



### Circular economy

- Circular economy



### Chemicals

- Pharmaceuticals in the environment

The Strategic Evidence Unit maintains the Chief Scientist's list of future challenges to signal the areas where science and evidence can inform how we understand and tackle the future. To progress these topics, the Strategic Evidence Unit works with staff across the Environment Agency to develop new scientific insights.

# Forward look

2023 promises to be an exciting year for the Chief Scientist's Group. Under our new Chief Scientist, Dr Robert Bradburne, we intend to strengthen the role of excellent science in understanding, predicting and managing the environment. Our planned highlights are listed below.

## 1. Strengthening the Science Profession

We want to double the membership of the profession to 2,000 people, or about 20% of the Environment Agency workforce. This will enable us to develop the role of Head of Profession for Science – for example in improving science assurance across the Environment Agency.

We will also strengthen the offer to our members. We will hold at least 20 science seminars and support members to achieve professional accreditation. We will hold an online PhD conference for all our sponsored PhD students and their supervisors and will host up to seven summer academic interns covering topics including water temperature, natural capital and science communication.

## 2. Keeping everyone informed about their environment

We will publish a number of annual statutory reports, with examples including urban waste water treatment compliance, shellfish and bathing waters. We will continue to publish new state of the environment reports and other assessments of our changing environment.

## 3. Innovating the way we understand our environment

The Natural Capital Ecosystem Assessment Programme will be expanding its small streams monitoring and bringing online new

surveillance monitoring programmes covering water temperature, groundwater ecology and wetlands, estuaries, and coasts. It will also invest in the new data analysis and metrics needed to build our understanding of the value of the natural capital that we protect, manage, enhance or own.

## 4. Supporting efficient and effective operation of the Environment Agency

We will evaluate the effectiveness of interventions in a number of areas, starting with water industry regulation to provide insight for continued improvement of the way we work. In our scientific role as part of the UK Chemicals Agency, we will conclude environmental risk assessments on lead in ammunition and perfluoroalkyl and polyfluoroalkyl substances.

## 5. Conducting novel science for now and the future

We will publish the results of our HM Treasury-funded project looking at how to monitor antimicrobial resistance in the environment. We will also publish a synthesis of existing research on UK droughts and identify the big research questions that would improve our understanding and management of drought.

We will horizon scan and analyse emerging issues to enable the Environment Agency to anticipate risks and opportunities for the environment and our business.

We will also set out our future needs and plans in the first Environment Agency Science Evidence and Analysis Strategy, as part of our intention to grow co-operation with experts in all areas of scientific interest who work in different institutions across the UK and abroad.

# Publications and peer reviewed papers

## 2022 research publications from the Chief Scientist's Group and Flood and Coastal Risk Management Research teams

### Chemical assessment

[Evaluation of the potential approaches to risk assessment of unintentional chemical mixtures for future UK REACH assessments](#) identifies a recommended approach to addressing the risks to both the environment and human health from unintentional mixtures of chemicals.

[Applicability of OECD Test Guideline 201 validity criteria to algae in the genus Skeletonema](#) examines whether the validity criteria specified by a widely used standard method for algal growth inhibition studies are relevant for Skeletonema species.

[Persistent, bioaccumulative and toxic \(PBT\) properties of long chain chlorinated paraffins \(LCCPs\)](#) updates a previous Environment Agency PBT evaluation on LCCPs.

[Guidance on interpreting biota tissue concentrations for bioaccumulation assessment](#) investigates the relationship between the total body burden of a chemical in whole organisms and tissue-specific concentrations.

### Water

[The extent and zonation of saltmarsh in England 2016 to 2019](#) examines the overall picture of change in saltmarsh extent in England over a decade: between 2006 to 2009 and 2016 to 2019.

### Biodiversity

[Working with Nature](#) discusses the importance of nature in providing ecosystem services and presents recent and historical trends in biodiversity.

### Antimicrobial resistance

[Antimicrobial resistance surveillance pilot site selection and database extension](#) develops selection criteria to identify suitable river catchments for piloting a surveillance programme for environmental antimicrobial resistance.

[Scoping review into environmental selection for antifungal resistance and testing methodology](#) reviews the current understanding of the selection mechanism for antifungal resistance in fungal species following exposure to antifungals.

[Sampling strategy and assessment options for environmental antimicrobial resistance in airborne microorganisms](#) reviews the available sampling options for antimicrobial resistant microorganisms, including their antimicrobial resistance genes, from the atmosphere.

### Regulated industry

[Initial Radiological Assessment Tool 2](#) is an updated methodology and spreadsheet system used by the Environment Agency to assess radiation doses to people and wildlife.

### Onshore oil and gas

[Potential environmental impacts from techniques to enhance rock permeability](#) reviews ways in which oil and gas or geothermal reservoirs in England could be engineered to enhance rock permeability and productivity.

[Quantification of whole-site methane emissions and associated uncertainties](#) investigates methods for quantifying the amount of methane emitted from onshore oil and gas sites in England.

[Specific environmental risks from repurposing oil and gas wells](#) examines the environmental risks from using onshore oil and gas wells for other purposes.

[Study of ambient air quality at Preston New Road](#) examines the results of an ambient air quality monitoring campaign at a shale gas site.

## Climate change

[Water temperature projections in chalk streams](#) develops water temperature projections to 2080 for English chalk streams.

## State of the environment

[State of the Environment: The Coastal and Marine Environment](#) provides an evidence-based overview of the pressures, state and trends in England's coastal, marine and estuary environments.

## Flood and coastal risk management

[Flood hydrology roadmap](#) develops a hydrology roadmap for the UK to highlight priority work in this topic area.

[Groynes in coastal engineering](#) details a consistent approach to the design and management of both rock and timber groynes.

[Updating the Chartered Institute of Water and Environmental Management \(CIWEM\) integrated modelling guide](#) provides practitioners who need to undertake integrated risk assessments with updated guidance and current best practice.

[Measuring resilience to flooding and coastal change](#) looks at ways to measure changes in resilience to flooding and coastal change over time.

[Culvert, screens and outfall manual](#) produces a guide for the design, operation and management of culverts, trash screens and outfalls.

[Spillway design, examination and failure mechanisms](#) produces guidance on designing and examining spillways and the mechanisms that could lead to spillway failure.

[Working together to adapt to a changing climate – flood and coast](#) explores how authorities work with communities on future planning and decision making to help reduce flood and coastal erosion risk.

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