National resilience, preparedness and risk:
the view from front-line experts

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Foreword

THE UK is a global leader in science, with some of the world's foremost experts, leading research establishments, and an interconnected ecosystem of scientific excellence in the public and private sectors.

Nowhere is that expertise more importantly employed than in protecting the UK, and often the wider world, against threats that have potentially disastrous consequences for our population. Whether that is the devastating impact of climate change, or the potential calamity of disease outbreaks, it is science and scientists who are on the frontline of this fight.

But this frontline has rarely looked so vulnerable. A combination of direct budget cuts, disconnection from global research talent, and uncompetitive conditions risk fatally weakening our national scientific capacity at exactly the time when it is most needed.

We have just been through a global pandemic which has exposed the UK's reliance on public science, and yet there has been little recognition that this capacity is often hanging by a thread.

This report, which draws on the experience of Prospect members across the scientific profession, is intended to demonstrate the importance of UK scientific resilience work and the challenges it currently faces from the perspective of those who see these challenges first hand.

We hope it will contribute to a serious conversation about how this capacity can be protected and enhanced in the coming years as we meet an increasingly complicated and dangerous array of threats.

Sue Ferns
Senior Deputy General Secretary

> *Prospect is proud to represent scientists and will always champion science in the workplace and in the wider national debate.*

Introduction

Prospect represents 50,000 members working across Science, Technology, Engineering and Maths (STEM) disciplines. Many play important roles in the machinery of national resilience:

- **research**
- **planning and regulation**
- **specialist advice**
- **monitoring, forecasting and warning-systems**
- **emergency response**.

The focus of this paper is the health of these essential systems and services. As experts in their fields, however, our members have also commented on the wider adoption of their knowledge, and resulting adaptation of national policy, behaviours and infrastructure, which will be the ultimate determinant of national resilience.

Unprotected public sector departments have recently been asked to prepare for budget cuts of up to 11%. This will cause particular concern for Prospect members in regulatory functions and public sector research and development, whose capacity has already been seriously undermined by the budget cuts of the 2010s.

According to a recent review of government science capability[1], total government expenditure on R&D outside protected departments roughly halved, to less than £600M, from 2009 to 2015, and has largely flatlined since. The impacts of cuts to regulators have been well reported. A 2024 press release by the Liberal Democrats[2] described the Environment Agency as "a leaky bucket", with ongoing issues of staff retention linked to earlier austerity budget cuts. RoSPA has sounded the alarm on HSE resourcing[3], with budgets down 43% and staffing down 35% since 2010.

With the experience of the pandemic still fresh in our minds, and increasing risks associated with climate change, cyber-attacks, and global political instability, further cuts to agencies such as these are simply incompatible with national resilience.
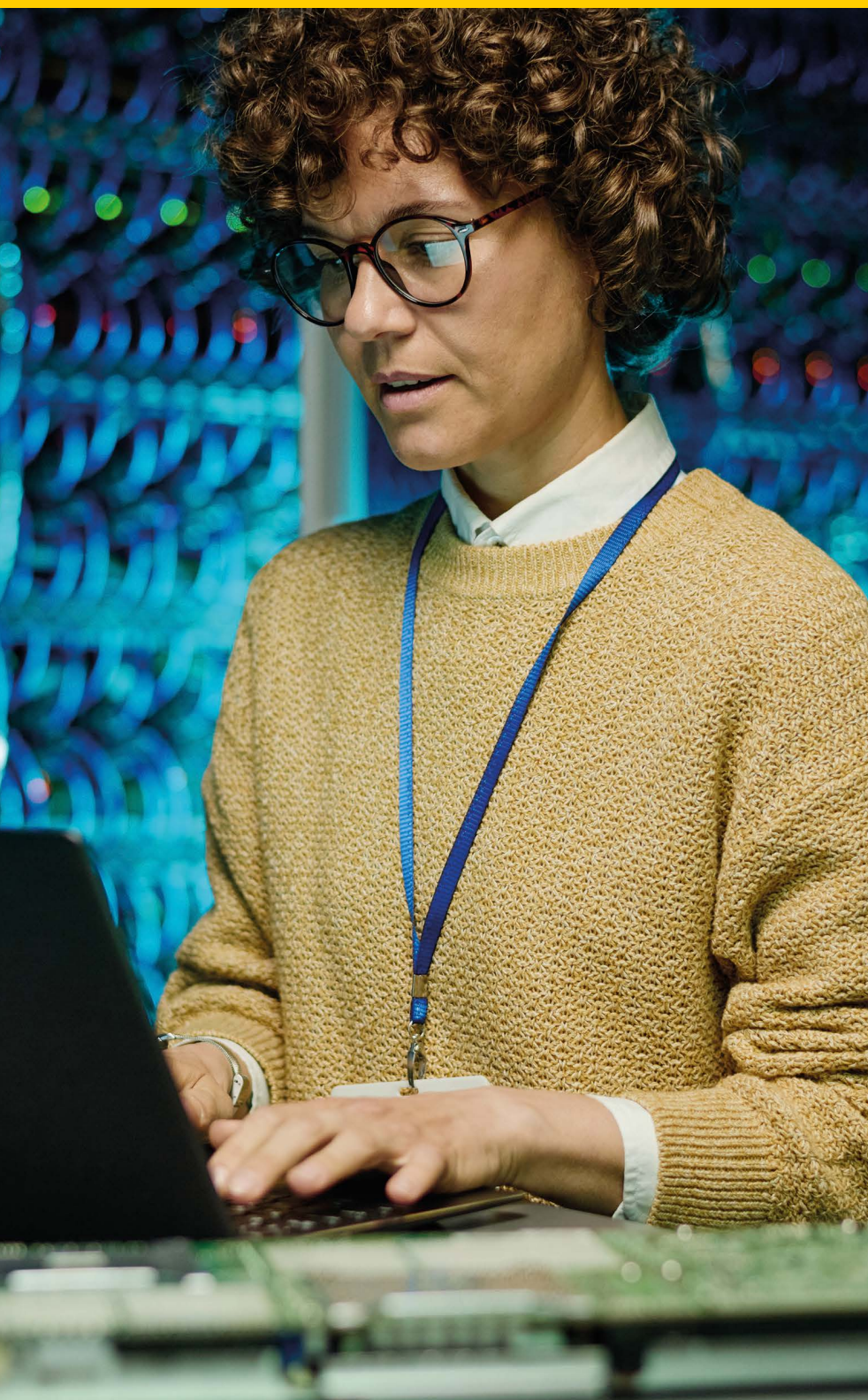
The organisational landscape of national resilience has also evolved in the wake of the austerity years. In 2010, public sector research organisations accounted for a fifth of the science and engineering research workforce, compared to about 10% in 2023[4]. This is partly due to an increase in private sector research organisations, and partly to the privatisation of research institutes such as those formerly owned by BBSRC, NERC and Defra.

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1   A Review of Government Science Capability: progress update (9 January 2024) https://www.gov.uk/government/publications/government-science-capability-review/a-review-of-government-science-capability-progress-update-9-january-2024

2   https://www.libdems.org.uk/press/release/almost_9000-staff-leave-environment-agency-following-cuts-and-low-morale

3   https://www.rospa.com/news-and-views/hse

4   Estimate from UK Business Counts – enterprises by industry and employment size band, https://www.ons.gov.uk/businessindustryandtrade/business/activitysizeandlocation/bulletins/ukbusinessactivitysizeandlocation/2022

The UK pandemic response demonstrated that private sector (including non-profit) organisations can play an active role in supporting national resilience and preparedness. It is necessary, however, that their contribution to national capacity in skills and infrastructure is recognised, and strategically developed and maintained, through public sector funding mechanisms.

We have recently heard from members in non-profit research institutes that they have been warned of 4.5% cuts in the National Capability funding streams that support large scale infrastructure, data and services to the UK research community. Outside the public sector, these organisations do not have the scale or financial buffering to run these services at a loss.

National resilience and preparedness must not pay the price. National capability funding design must be updated to reflect the plurality of specialist

organisations that deliver on it.

We acknowledge the difficult choices the government faces in its spending allocations. We assert that national capacity in risk management and preparedness is not the place to cut. Since the pandemic, the UK has experienced cyber attacks on national institutions, travel disruption due to extreme weather, an IT failure that interrupted NHS services for days, and widespread flood damage to homes and businesses. Every incident is evidence that our society, security and economic growth depend on national resilience.

Methodology

We have received input from 350 Prospect members spanning all nations of the UK, the Isle of Man and Channel Islands, working in resilience-critical operations as diverse as road transport, ecosystem health, cyber security, climate research, safety regulation, veterinary science, and defence engineering. The majority of responses were from the public sector, but with significant contributions from non-profit and private sector research institutes, which provide an important component of our national capacity – skills and infrastructure – in a number of key disciplines.

Given the diversity of our respondents, there was striking commonality across major themes, and even some very specific issues. Areas of contrast tend to suggest opportunities for cross-discipline learning.

Human resources

Great staff, but not enough of them

Overwhelming numbers of respondents identify a lack of 'boots on the ground', in public services and resilience-critical science disciplines, as a major threat to national resilience. They hold their colleagues in high regard, for their abilities, motivation, and 'public-good ethos', but there is serious concern that teams constantly running at or beyond their capacity is eroding morale, contributing to staff attrition, and severely limiting proactive, preventative risk management.

Importantly, Prospect members across all kinds of resilience-critical public services, from transport infrastructure to scientific research, are telling us that after a decades-long and ongoing drive to "do more with less", there is simply no slack in the system. Many respondents identify that such knife-edge resourcing makes organisational resilience highly sensitive to individual resilience: whole functions can

> *Reduced headcounts for ground level, safety-critical roles is increasing the risk of an accident, with little or no time for proactive safety management.*

be vulnerable to the loss of one or two staff members.

Low pay is a universal threat to STEM capacity

Pay and progression are well established as risk factors in public sector STEM capacity. With the focus on national risk and resilience, respondents highlight specialisms such as radiation protection, cyber security, and 'novel technologies', all of which are in high demand in the private sector, with salary differentials estimated at 25-50% (DE&S), or £20K/yr (UKHSA). The overall pay issue is tightly bound to a lack of pay progression, which signals to early- and mid-career

professionals, especially, that they have to 'move on to get on'.

High staff turnover erodes development and retention of knowledge

The loss of highly-qualified, in-demand STEM workers, and the challenges and delays in recruiting replacements, obviously contributes to the general strain on staff resources. It also prohibits development of the highly specialised skills essential to many public service STEM functions, such as safety inspections, environmental regulation, or research data management. Members from the research institutes describe roles requiring "several years' training on top of post-doctoral qualifications and experience". There is real concern that current rates of staff attrition are fundamentally breaking the pipeline of future expertise.

"It takes about ten years to become proficient in our disciplines… You can't turn expertise on and off depending on the latest political priority."

There is a clear need for workforce analysis, planning, and corrective investment in resilience-critical organisations and functions.

Deep expertise is especially precarious

Responses from both research and operational functions show particular concern for their deepest expertise and experience. A history of hiring freezes and a leaky skills pipeline has left many organisations with a skewed age profile, and dependent on staff who are at or nearing retirement. Some members warn that specialist safety or security functions are within five or ten years of losing their critical mass of expertise or, evocatively, "expertise is spread one person thick". Others, notably in scientific research, tell us it is already underway: "our world experts have retired."

The maintenance of deep expertise, and the pride of working with 'world experts' is vital to motivating and developing the entire specialist workforce.

Pertinently, deep expertise and experience really show their value when dealing with unusual or extreme events, both in anticipating and in responding to emergencies.

Members in research institutes and operational bodies acknowledge the dependence of their work on expertise in the critically underfunded heritage sector, such as the museum-based taxonomists who provide vital support to surveillance of ecosystems and invasive species.

Training provision is inadequate and inconsistent

There are many concerns about training for specialist functions, such as downgrading of training from high-quality interactive courses to generic e-learning, and unclear or inconsistent approaches to on-the-job development, where specialist functions lack competency frameworks. Understaffing is highlighted as an obstacle to both on-the-job learning and quality management, as it

reduces scope for shadowing and peer evaluation.

Lack of functional expertise in management undermines preparedness

Members from a wide range of organisations flag concerns about a lack of 'functional expertise' among managers of specialist functions. In some cases, this may be due to uncompetitive pay:

"We have been without a Head of Group for a year and a half, due to the pay not being high enough for the role."

In other cases, it is suggested that employers give preference to 'career managers', or organisational insiders such as military personnel, rather than promoting or seeking out specialist professionals. Specific examples include Digital, Data and Technology (DDAT), and notably cyber security functions.

It is noted that a lack of specialist experience at decision-making levels is a

weakness in anticipation and preparedness for unusual or extreme events, and can create a disconnect from the grassroots work of the team. Additionally, the perceived lack of progression opportunities may contribute to the loss of specialist skills to resilience-critical functions.

Internationalism is a vital asset to STEM capacity

Prospect members in STEM recognise international mobility, collaboration and exchange as signatures of a healthy STEM ecosystem. With respect to resilience and risk management, international collaboration is cited as a factor in some of our best successes (nuclear safety, data standards) and best opportunities (cyber security, failover for weather forecasting).

The immigration regime, and cultural attitudes to international workers and their families, remain a central concern for members. The UK's capacity in animal health, in particular, has benefited from and remains dependent on international expertise, to facilitate imports and exports while safeguarding national food security and animal welfare.

System functioning

World-class science; slow knowledge-to-action pipeline

Many responses celebrate the UK's "world class" and "internationally respected" science base:

"We are partners to governments around the world."

UK research outputs are widely praised, but our members also highlight strengths in infrastructure and services, including excellent mapping, and laboratory and testing facilities and expertise, including Science and Technology Facilities Council's beamline scientists, or Animal and Plant Health Agency's high-performance liquid chromatography (HPLC) laboratory. The Scottish Government's "Underpinning National Capacity" programme was highlighted as having helped to connect the NHS with testing facilities during the pandemic, and to locate expertise on food security after the Russian invasion of Ukraine.

Unfortunately there are serious concerns that the science-to-action pipeline is too slow, and too leaky, with commercial and short-term economic interests, political priorities, and public behaviour all resisting the adoption of our world-class science into policy, practice and infrastructure development. In short, what we do does not reflect what we know.

'Enabling-regulation' nurtures sustainable development and growth

Members working in areas such as planning, chemicals regulation, and flood management and response describe the concept of 'enabling regulation' that guides industry and political decision-making towards long-term, sustainable growth:

> *Regulation should not be a dirty word.*

One example gave environmental expertise in high-risk planning as a driver of sustainable, climate-resilient housing development. Another looked outward at the EU ban on microplastics, which has already established the EU's market in sustainable alternatives, as demand grows across the rest of the world. Enabling regulation brings the learning ahead of the crisis. The acceleration of "Green Channel Patents" through the application process was highlighted as a success in the spirit of enabling regulation.

Remote working where we can; getting people to work as we must

Many members credited the cultures, practices and technologies enabling remote working as having supported our national resilience during the pandemic, and continuing to support organisational resilience and preparedness for the next emergency. In addition to home working, remote- and asynchronous working practices enable emergency

Regulation for strategic growth

The ministerial foreword to the 2024 Lough Neagh Report[1] blames an overfocus on 'growing the economy' for the neglect of environmental safeguarding. In fact, the fallout of Lough Neagh's ecosystem crisis highlights the fallacy of a choice between our natural environment and the economy – the latter, ultimately, depends on the former.

The real mistake is to take a short-term and first-order view of economic growth.

Not all growth is equal. Growth today that limits growth tomorrow, growth that will be swept away by the next storm surge, or growth that undermines our national security or resilience are false friends. Thoughtful regulation provides the essential counterbalance to short-term market forces, steering us out of a 'Canutist' mentality.

Growth-enabling regulation brings a strategic perspective

into the growth mission. It recognises that strategic innovation and growth:

- Are resilient to changing environments and conditions
- Are compatible with the plurality of government missions
- Are commercially viable in the medium to long term
- Return a fair share to the workforces and society that power them

With respect to national risk and resilience, regulation provides an opportunity to put adaptation ahead of the crisis: planning, engineering and ecosystem management for flood resilient homes; NetZero-ready transport infrastructure and buildings regulations; redirection of innovation into sustainable products and services in anticipation of consumer behaviour; proactive management of new risks, or threats to national resilience from emerging technologies.

Attitudes to regulation have been injured by successive governments, whether in open attacks on 'red-tape' or by trivialising important issues such as data privacy and ecosystem health. Below every sneering headline about newts there is a resilience critical story about water security. The other side of privacy and intellectual property rights in AI regulation is data security and cyber risk management, which may be harder to disregard.

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1   Lough Neagh Report and Action Plan, DAERA, 2024
    https://www.daera-ni.gov.uk/publications/lough-neagh-report-and-action-plan

critical organisations to manage distributed, multi-site facilities – data centres, testing facilities and services – giving confidence of operation in any but the most extreme scenarios.

However, remote working does not diminish the need to get people to work. There are concerns that the frailty of our transport infrastructure is an intolerable vulnerability for national resilience. Many of our respondents work in laboratories, on field-sites, and not least as emergency responders to industrial and environmental incidents. The

> *There has been some research funded to examine 'multi-hazard events', where an event in one risk category may trigger an event in another. More could be done to link this area of study to the National Risk Register.*

recurrent failure of rail and road networks in extreme weather is already disruptive, and likely to become more so as climate change advances. Ironically, it may turn out to be most disruptive to some of the very workforce essential to emergency management.

Layered risks

There are complex interconnections between risk categories. Very notably, climate change is highlighted as a driver of accelerating risk to transport, industrial safety, plant and animal health, border security and more. Cyber security risks, meanwhile, are noted as a threat to crisis responses across every risk category.

Many members, from many different organisations, raise concerns about specific risks to ecosystem health that are not clearly identified in the latest edition of the national risk register. These include issues around invasive species, biodiversity, and habitat loss, which have serious implications for plant and animal health, fisheries and food security, and

> *It's easy to say 'more investment', but we need a more efficient process for sharing information across agencies.*

flood and drought resilience. We propose that this is an area that may need attention in the risk register, particularly as climate change threatens the equilibria of these natural systems in unpredictable ways.

Our members urge a better awareness of the multidomain 'connectedness' of national risk and resilience, from national to organisational level policy, strategy and operations. Planning and resourcing of risk management and mitigation in any category must reflect its full chain of impact.

Cross-agency collaboration

Inter-agency communications and collaboration are a mixed

Ecosystem health – easy to dismiss right up to the crisis

Lough Neagh, in Northern Ireland, has been subject to a catastrophic ecosystem collapse in recent years, resulting in the proliferation of toxic cyanobacteria. This ecosystem imbalance is a threat to 40% of the province's water supply, Europe's largest commercial eel fishery, and the recreational safety of bathing waters as far away as Portrush harbour on the north coast. By the time the crisis made headlines, it was visible from space.

Decades of research have warned of the fragility of this unique lake ecosystem and, particularly, its sensitivities to pollution and temperature change. Nevertheless, it has been allowed to suffer from weakened management of wastewater and agricultural run-off, and the invasive zebra mussel, just as climate change is undermining its natural ecological buffering.
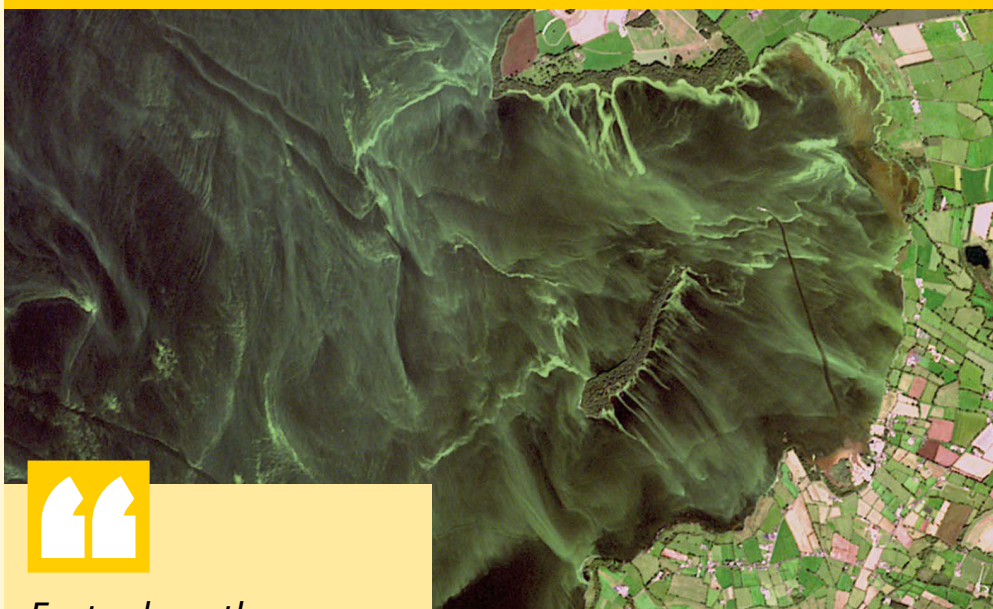
> **For too long, the balance between growing the economy and safeguarding our environment has not been right.**
>
> **ANDREW MUIR**
> *Ministerial foreword to the 2024 DAERA Lough Neagh Report*

■ *Sentinel-2 true-colour satellite image, September 2023, of eastern Lough Neagh. The bright green 'filaments' indicate intense, prolific cyanobacteria (blue-green algae) blooms.*

EUMETSAT: Lough Neagh algal bloom
https://user.eumetsat.int/resources/case-studies/loch-neagh-algal-bloom

The action plan to rehabilitate this environmentally- and economically important water body has been politically fraught, and will be expensive to implement. The crisis gives stark warnings to regulators and policy-makers throughout the UK:

- when ecosystems reach tipping points they can collapse devastatingly fast

- ecology is not a novelty side-issue, but has real consequences for industry, human health, climate resilience, and food security

- proactive risk management, and preventative regulation are in the interests not only of environmental sustainability, but also of economic sustainability.

bag. Many members tell us that their work with partner organisations is effective or improving. Collaboration on data standards between environmental agencies is credited for good outcomes in data sharing. There are reports of effective collaboration with international agencies, for example through NATO and UNESCO working groups. There are constructive networks and knowledge sharing between regulators.

We are also told of barriers to collaboration, such as 'contractual nit-picking' between environmental agencies, over the financial details and intellectual property rights associated with grant proposals. Elsewhere there is siloing, and 'stove piping' knowledge, between agencies, and even within agencies. Members from several organisations describe their sponsoring departments, or occasionally even their direct management, as lacking understanding of their purpose and operations.

> *There is still too much of a tendency to look at Net Zero in isolation from resilience to climate risks, and restoring ecosystem health, We need to move away from thinking in silos.*

Some public sector organisations work well with academia, while others tell us that the erosion of public sector STEM skills, by creating a gulf of knowledge between the sectors, inhibits the translation of theory into practical applications.

Crisis operations highlight a complex organisational landscape

Communications and collaboration are tested to extremes by the profound complexity of the organisational landscape, particularly when it comes to the speed of crisis responses. The 'horrendogram' immortalised in the **UK Covid inquiry – Module 1** *(see p13)* gave a sobering view of pandemic preparedness and response structures.

Our members report complexity, misunderstandings and waste at an everyday scale. For example, those working on transport networks describe a lack of clarity and alignment in roles and responsibilities, between the responders to incidents such as flooding or damage to infrastructure.

There are concerns about disconnects in understanding and priority between specialist functions and senior decision-makers, notably on engagement with uncertainties, and "credible worst-case scenarios". High turnover of staff in the coordinating bodies, such as GO-Science, undermines the long-term, systemic knowledge needed to stabilise networks and brief decision-makers.

Prime Minister of the UK
The Cabinet
Cabinet Office
Cabinet Secretariat
National Security Secretariat
Civil Contingencies Secretariat

New and Emerging Respiratory Virus Threats Advisory Group (NERVTAG)

COBR forward look

Readiness and Response Team

National Risks and Infrastructure

COBR

Deputy National Security Adviser for Intelligence, Security & Resilience

National Security Adviser

National Security Council

Devolved nations
Scottish Government
Northern Ireland Executive
Welsh Government

Chief Medical Officers for each devolved nation

Deputy Chief Medical Officer for health protection

Office of the Chief Medical Officer

Chief Medical Officer (England)

Government Chief Scientific Adviser

GO-Science
SAGE secretariat

National Security Risk Assessment

National Risk Register

Resilience Capability Board and Programme

Scientific Advisory Group for Emergencies (SAGE)

SPI-M-O   SPI-B

Moral and Ethical Advisory Group

Scientific Pandemic Influenza Group on Modelling

Pandemic Flu Readiness Board and Programme

Other government departments

Departmental Chief Scientific Advisers

Joint Committee on Vaccination and Immunisation

UK Vaccine Network

Ministry of Housing, Communities & Local Government

Resilience and Emergencies Division

Government Liaison Officer

Department of Health and Social Care (DHSC)
Secretary of State for Health and Social Care

Director of Emergency Preparedness and Health Protection

DHSC Chief Scientific Adviser

Operational Response Centre

Operational Response Board

National Institute for Health Research (NIHR)

Pandemic Influenza Preparedness Programme Board

NIHR Clinical Research Unit

UK Zoonoses, Animal Diseases and Infections Group

Advisory Committee on Dangerous Pathogens

BEIS   HO
DfT   MoJ
MOD   DfE
DfID   HMRC
DEFRA   FCO
DWP   DCMS

Health Protection Research Units

Resilience advisers

Scientific and Technical Advisory Committee

Strategic Coordinating Groups

Tactical Coordinating Groups

Public Health England (DHSC)

NHS England (DHSC)

NHS Improvement (DHSC)

Medicines & Healthcare products Regulatory Agency (DHSC)

Human Animal Infections and Risk Surveillance

Health and Safety Executive (DWP)

Local authorities

Local health resilience partnerships

PHE regional teams

Local Directors of Public Health

NHSE regional teams

NHS clinical commissioning groups

Local risk assessment

Community Risk Register

Via ResilienceDirect

Emergency Planning College

Local resilience forums

Local Category 1 responders

Local Category 2 responders

Local voluntary, community and social enterprise groups

Social care providers

Providers of NHS services (hospital, community, GP and ambulance services)

High-level isolation units – Specialist treatment centres for contact high consequence infectious diseases

Specialist treatment centres for airborne high consequence infectious diseases

Key (entities):
Reactive entities (stood up in response to an emergency)

Independent entities that provide scientific and technical advice and support

Entities which are internal to, or stewarded by, DHSC

Executive agencies or expert partners of DHSC

Entities involved in emergency planning or response at local level

National strategy is not always very strategic or holistic

Some members express a wish for greater scientific literacy among organisational leadership, government ministers, and in public behaviour. There is a sense that other factors often prevail over expert, systems-thinking about risk and prevention. For instance political drivers, such as regulatory alignment with the EU, may be blurred into strategic, system-functioning priorities.

There is a history of faddish interest in and funding for certain categories of risk without holistic prioritisation, and a tendency to compartmentalise inseparably-linked systems, such as ecosystem functioning and climate resilience, to fit political or administrative agendas.

There are concerns that political time-scales, and particularly the Westminster election cycle, dominate expectations of 'returns' on financial and political investments, with long-term funding to maintain workforce and infrastructure repeatedly giving way to eye-catching capital projects.

Members working across a range of sectors, including defence, energy security, food security, and chemicals regulation, raise concerns about the political visibility, and therefore the drive for security and sustainability of offshored supply chains.

Proactive preparedness

Monitoring, forecasting and warning systems are well-regarded

The UK's proactive monitoring/risk surveillance, forecasting and early warning systems are valued by members across sectors and functions, and generally highly regarded. Environmental specialists from a range of agencies pay tribute to the active surveillance of animal and plant health and invasive species.

The quality of UK weather and climate forecasting is valued across all areas of membership. Members reflect that severe weather warnings, and the public messaging around them are working effectively, although more nuanced messaging around the risk matrix or uncertainties in forecasts does not always land well, either with the public or with emergency planners and responders. Experts urge measures to build additional resilience into this essential infrastructure, including building on international collaborations and standards development

> *There is relatively little focus on managing climate risks, so increased reliance on impact management through incident response and recovery operations.*

to enable failover protocols to international partner organisations: ECMWF (European Centre for Medium-Range Weather Forecasts) and Met Eireann.

Members from both climate research and transport infrastructure emphasise the importance of sea level and storm surge monitoring, forecasting and alerts.

The UK's tide gauge network has suffered a period of degradation when it is becoming more vital than ever. Forecasting of extreme events – weather conditions and flooding – is highly sensitive to the completeness, timeliness and consistency

of observational data. Both operational warning systems and long-range forecasting to support cost-effective future-proofing of aging flood defences call for investment in sea level monitoring.

There is high praise for the UK's up-to-date mapping resources from operations, infrastructure and regulatory functions. There is a concern that drives for commercialisation have priced some products out of reach of the public sector emergency responders they were designed to serve. It is suggested that more could be done to digitalise important historical mapping resources.

Good emergency- and threat-response protocols

There are positive accounts of emergency (and emergent threat) response protocols, including public-service incident management or human, animal or plant health hazard containment, and also internal-facing contingency and business
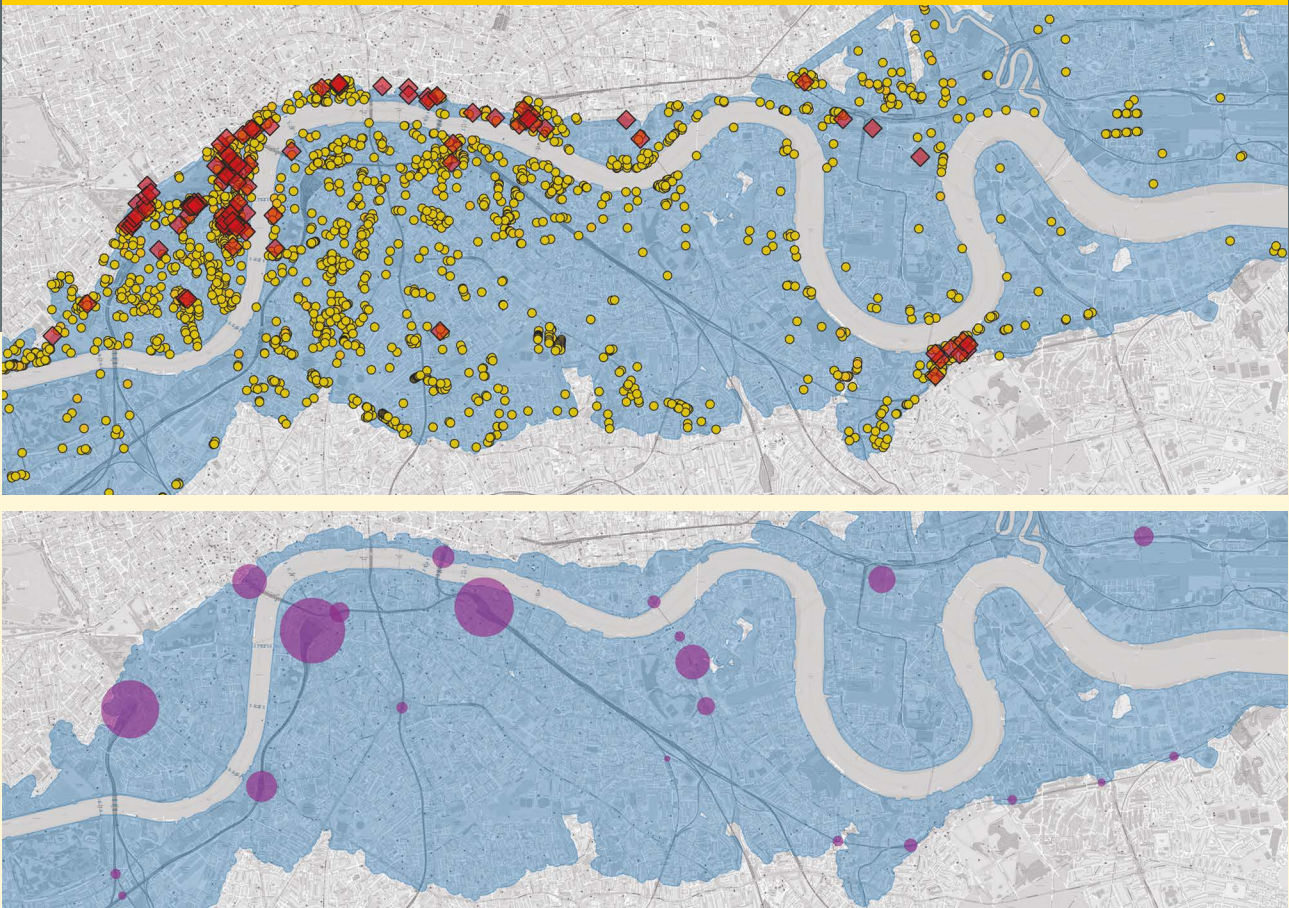
Climate change – one risk to rule them all

■ *Above, Zones at risk of flooding from the Thames. The top panel indicates Heritage at risk, with the locations of grade I (red diamonds) and grade II (yellow dots) listed monuments within the flood risk zone. The lower panel indicates Transport at risk, with the mainline railway stations (purple circles) within the Thames flood risk zone. The markers are scaled by area to annual passenger footfall. The three largest, from west to east are Victoria, Waterloo and London Bridge.*

Climate change is a driver of second-order hazards across all risk categories, including border security, disease control, and infrastructure failures.

The national assessment of flood and coastal erosion risk in England[1] gave a sobering picture of the millions of properties, including people's homes, currently at risk of flooding, and the additional risk anticipated as a result of climate change.

This is not a hypothetical hazard. In 2024, the UK experienced major flood incidents across the Midlands in January, on the south coast in April, flash flooding in May, August and September, record floods from the river Great Ouse in October, and widespread flood damage and disruption due to winter storms in November, December and into the new year.

Prospect members' work brings additional focus to flooding as a hazard to national infrastructure, including transport and energy networks, and to our

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1   National assessment of flood and coastal erosion risk in England, Environment Agency 2024
     https://www.gov.uk/government/publications/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024

cultural and natural heritage. Based on official flood risk data[2], we estimate that across England and Wales there are

- 432 grade I, and nearly 12,000 grade II or II* listed monuments
- 67 power grid substations and 72 primary substations
- 140 mainline railway stations at risk of flooding from rivers and seas, with many more at risk from surface water flooding.

In London alone, the nation's third, fourth and fifth busiest mainline stations are in the Thames flood zone. Following the logic of the Environment Agency's national assessment, these threats are only increasing as climate change advances.

The challenge of rebuilding national capability in sea level and climate observing systems, research, forecasting, alerts, and defences is not trivial. It must, however, be prioritised in proportion to the unthinkable costs and losses associated with a lack of preparedness.

2   Flood risk areas, published by the Environment Agency, June 2024 https://www.data.gov.uk/ dataset/42c31542-228d-439b-8dbe-e72135dae71c/flood-risk-areas

continuity planning and testing at resilience-critical organisations.

In fact, there is a view that some areas, such as animal health and industrial safety, are better resourced to respond to emergencies than to prevent them. These are functions that have been hit particularly hard by the years of public sector cuts, with reduced headcounts and, in the case of the health and safety inspectorate, cost-recovery mechanisms driving a reactive 'fire-fighting mentality', rather than cultures of prevention and education.

Aging defensive infrastructure and equipment

The austerity years have eroded standards in infrastructure as well as workforce capacity. Prospect members identify long-term underinvestment in basic national infrastructure, such as transport and water supply, as increasing risks. Meanwhile, underinvestment in monitoring and defensive

> *The lessons that were supposed to have been learned from the 2001 foot and mouth outbreak were ignored, and the country is now at enormous risk.*

infrastructures, such the tide gauge network, coastal flood defences, and even crisis responders' vehicle fleets have undermined our preparedness for escalating climate threats.

Inaction on existing improvement plans and known-threats

Across a range of risks, there are concerns that lessons are not being acted on fast enough or thoroughly enough to prevent the next crisis. There are improvement plans not yet actioned, and cyber-security incidents not yet even fully investigated.

Plant and animal health inspectors are concerned

that the consequences for breaches of import controls are inadequate to improve importers' behaviour. The International Atomic Energy Agency has flagged a shortfall in radiation specialist regulators and inspectors that has yet to be addressed.

Similarly, public sector veterinary resources are critically low, despite imminent threats from avian flu, bluetongue, foot and mouth disease, and African swine fever.

Several members note that, without systemic adoption of lessons into policy, culture and practice, the knowledge itself is vulnerable to loss along with the staff who hold it.

Data and technology

Leading-edge examples of advanced technology

There are success stories in the adoption or development of advanced technologies. UK weather and climate forecasting has clearly benefited from advances in supercomputing, and now AI.

The climate science community is, however, measured in its estimation of the role of AI in national resilience, identifying limiting factors in the quantity and quality of data inputs, and emphasising the undiminished importance of scientific and technical expertise.

Several other areas identify opportunities for AI adoption, including safety regulators, government veterinary services, and transport infrastructure.

It is noted that the consolidation and dependence of resilience critical research and operations on a handful of data storage and computing facilities must be proportionately guarded and buffered against system failures or cyber-attacks.

> *Uptake of standards such as ArcGIS has meant Defra and its agencies can share data and apps much better than in the past. We have talked for years about joined-up working; this is the first time it has felt like it's happening.*

Data management practices can make or break tech opportunity

Environmental agencies count the adoption of community data standards, notably geospatial data standards, as one of their successes in improving preparedness and resilience.

The practice is credited with enabling fast, fluid, data sharing between agencies both in business-as-usual and emergency operati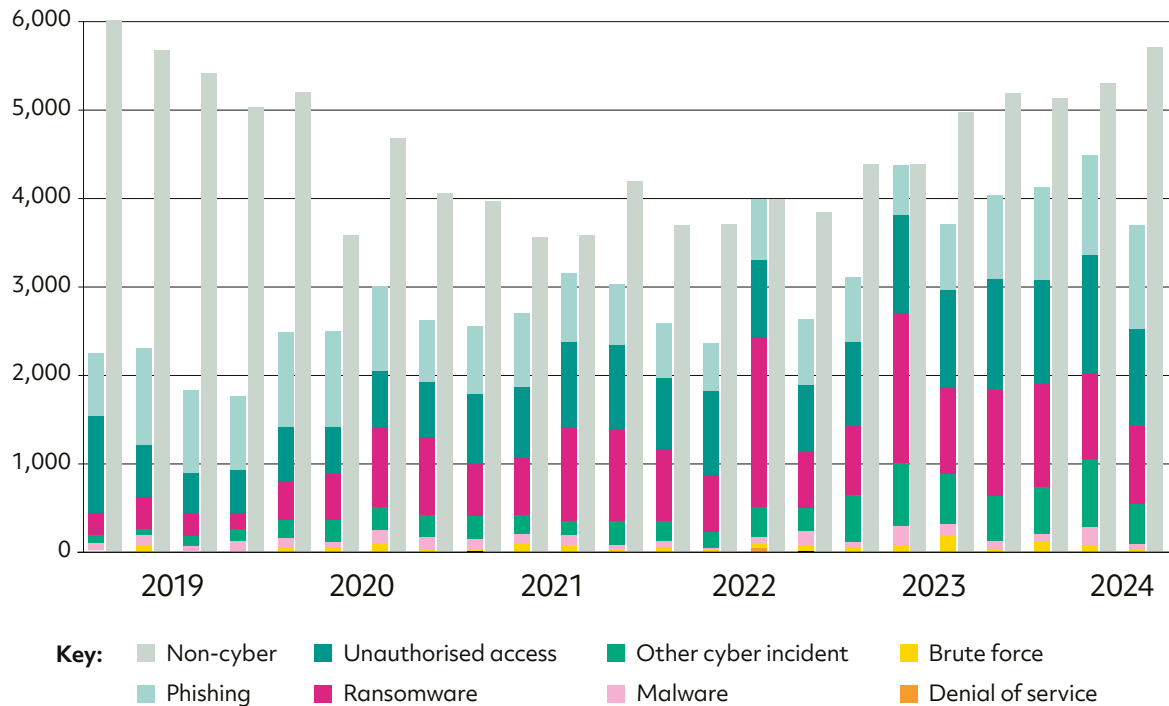ons. This is a significant achievement, requiring proactive collaboration between agencies, and commitment to ongoing data management.

Other areas of operation, including human health, animal and plant health, and chemicals regulation identify data management, cross-agency data standards adoption, and fluid, timely data sharing as priorities for improvement. The challenges of data management for interoperability and sharing grow as the user group widens and diversifies.

Huge ambitions for national planning, resilience, growth and economic transformation are pinned on the optimisation of national data assets, including those from public sector operations and monitoring systems. However, many current practices in administrative data management are not, yet, designed with downstream reuse in mind, much less emergency operations.

The erosion of the Labour Force Survey, and its long-delayed transformation is an example of the widespread

Quarterly numbers of data security incidents reported to the UK ICO, by incident category

Key:
- Non-cyber
- Phishing
- Unauthorised access
- Ransomware
- Other cyber incident
- Malware
- Brute force
- Denial of service

Cyber security – undermining resilience

Cyber security and resilience are critical determinants of risk and preparedness across all themes, with every resilience-critical operation and service dependent on digital technologies, not least for monitoring, forecasting and alerts. It is particularly important that all possible measures are taken to safeguard and back-up our warning and emergency response systems.

According to ICO data, there is an upward trend in the number of cyber-attacks being reported to the regulator. These are now becoming comparable in number with 'non cyber' data security incidents. While there is excellent information and training available from providers such as the National Cyber Security Centre and the City of London Police, it is not yet as widespread as equivalents on UK GDPR obligations.

Cyber resilience is not just about deliberate attacks. The July 2024 CrowdStrike incident led to the world's largest ever IT failure, causing havoc in operations dependent on Microsoft Windows devices:

- Well over 10,000 flights were cancelled worldwide
- The NHS was unable to use EMIS for appointment bookings and patient records, resulting in cancelled procedures, delayed referrals and patients unable to access essential medication
- Cyber risk consultants, KOVRR, estimate the cost to the UK economy between £1.7B and £2.3B, due to business interruption and resulting expenses such as litigation.

The episode was a devastating reminder of the vulnerability of our infrastructure and operations to non-malicious incidents. It has escalated concerns about the IT 'monoculture' as a source of risk to businesses and the public sector.

mismatch between expectations of public sector data and investment in the skilled work of data management, whether by dedicated surveyors and technical professionals at ONS, or in the redesign of administrative processes elsewhere in the public sector to ensure the value of the data they produce.

Cyber security is a very mixed bag

There are positive reports of cyber security awareness and practice in some areas, including good and improving technical controls, and specialist cyber security inspections at national infrastructure sites. Some organisations have well-developed resilience and business continuity drills, including cyber resilience scenarios. These measures should be cultivated throughout resilience-critical public services.

A number of areas, including some whose cyber security is otherwise good, acknowledge weaknesses in

human factors, and physical security. There is widespread concern that technology practices undermine cyber security, such as keeping on aging hardware, or failure to provide secure file-sharing facilities conformant to organisational policy.

Members from several organisations that have experienced cyber security incidents share concerns about the lack of institutional learning and action in their wake:

> *We were cyber-attacked and it is still not clear to staff how the attackers got in: inadequate systems or individual error?*

As previously noted, cyber security may be considered as the risk category that affects national resilience to all other risk categories. Its management should be resourced accordingly.

Technical debt threatens resilience from all directions

Many agencies are struggling with a long legacy of underinvestment in basic technologies. Aging PCs and unpatched software create a drag on resilience-critical operations, and are also weak links in organisations' cyber defences. There is also significant technical debt in in specialist systems: aging super computers and critical processes run on 'Heath Robinson' or archaic and unsupported software.

Members from several areas comment that their

organisations' technology and procurement policies, designed for typical office work, are a poor fit for specialist roles and environments

> *What we need is investment in aged and broken IT systems (and staff).*

For example, Teams calls do not replace traditional phones in laboratories; desktop interfaces don't fit the workflow of field workers; scientific programming may benefit from different processors than standard issue laptops; some esoteric, research-critical software may genuinely be one-of-a-kind, with no comparator quotes to appease the procurement process.

Funding

Funding regimes must reflect national objectives

There is a strong feeling, from a range of disciplines and services, that funding amounts and mechanisms have fallen out of sync with the strategic delivery of national resilience. The result is a fragmentation of purpose, with individual agencies identifying priorities in relative isolation, and chasing funding from different sources with varying degrees of success. The charity sector exerts considerable creative ingenuity to fill gaps left by the underfunding of the public sector. There are agencies trying to supplement public services on 'soft money' from research grants.

Even those working in pure research tell us that a disproportionate and increasing amount of their time is spent in fierce competition for grants rather than 'doing science'. Research institutes in the public and non-profit sector have concerns that funding policies, such as UKRI's 80% of full economic costing,

have been designed without consideration for the diversity of organisations and business models that make up the current research landscape. The shortfall in grant funding sets up a virtual lottery among the proposals that surpass quality thresholds.

Too little long-term funding

Many functions and services are suffering from

a lack of stable, long-term funding. There is a sense that funding cycles are too much driven by the tempo of Westminster elections, rather than by strategic purpose. Sustained public services, national infrastructure, and the development and maintenance of a (STEM) skilled workforce all require planning and budgeting on much longer time horizons. Some members note the loss, post-Brexit, of a stabilising effect on both funding and

policy that was a welcome side effect of participation in EU research, and EU regulatory commitments such as on biosecurity and environmental monitoring.

Commercialisation and competition can undermine the public good

A number of responses signal tensions within and between public sector agencies as a result of competition, and of drives for commercialisation and diversification of income. We have heard about 'contractual nit-picking' between public sector partners over a collaborative grant proposal, and emergency services priced out of public-sector mapping products designed to support emergency responders.

Some members in research and innovation roles feel under pressure to "compete with tech start-ups", while others are emphatic that the

> *Lack of funding is holding back the potential for innovation. Only 1 in 10 proposals, typically, gets funded under NERC, although many more meet the criteria for quality and importance. Make more funding available for climate research, given the urgency… it would support more numerous and more diverse approaches to major climate challenges.*

values and public-good duties of the public sector must preclude any suggestion of a "move fast and break things" culture. Public services, and the machinery of national resilience are what we cannot afford to break.

Innovation must make allowance for experimentation

Our members acknowledge tensions between stability and innovation in public services. They call for 'sandbox' environments, policies and training that encourage

contained experimentation without pressure to persist technologies or practice that threaten the standards or financial viability of public services. In contrast, there are examples of funding policies disincentivising important research and development, for example in the water supply industry, with financial penalties for trials that do not progress as hoped. It is clear that the UK's resilience and preparedness for the risks of a changing world call for innovation and adaptation within the public sector and its institutions.

National resilience, preparedness and risk:
the view from front-line experts