

Climate change adaptation and the subsurface in the UK: workshop summary

National Programme

Open report OR/25/093

BRITISH GEOLOGICAL SURVEY

NATIONAL PROGRAMME

OPEN REPORT OR/25/093

Keywords

Subsurface; Climate change adaptation; workshop.

Bibliographical reference

Sargeant S., Napier, H., Bricker, S. 2025. Climate change adaptation and the subsurface in the UK: workshop summary. *British Geological Survey Open Report*, OR/25/093. 23pp.

Copyright in materials derived from the British Geological Survey's work is owned by UK Research and Innovation (UKRI) and/or the authority that commissioned the work. You may not copy or adapt this publication without first obtaining permission. Contact the BGS Intellectual Property Rights Section, British Geological Survey, Keyworth, email ipr@bgs.ac.uk. You may quote extracts of a reasonable length without prior permission, provided a full acknowledgement is given of the source of the extract.

Climate change adaptation and the subsurface in the UK: workshop summary

S Sargeant, H Napier and S Bricker

Editor

J M Hannaford

BRITISH GEOLOGICAL SURVEY

The full range of our publications is available from the BGS online shop at <https://shop.bgs.ac.uk/> and our Cardiff office (Welsh publications only). The London Information Office also maintains a reference collection of BGS publications, including fossils, for consultation. We publish an annual catalogue of our maps and other publications; this catalogue is also available online.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as basic research projects. It also undertakes programmes of technical aid in geology in developing countries.

The British Geological Survey is a component body of UK Research and Innovation.

British Geological Survey offices

**Nicker Hill, Keyworth,
Nottingham NG12 5GG**

Tel 0115 936 3100

BGS Central Enquiries Desk

Tel 0115 936 3143

email enquiries@bgs.ac.uk

BGS Sales

Tel 0115 936 3241

email sales@bgs.ac.uk

**The Lyell Centre, Research Avenue South,
Edinburgh EH14 4AP**

Tel 0131 667 1000

email scotsales@bgs.ac.uk

**Natural History Museum, Cromwell Road,
London SW7 5BD**

Tel 020 7589 4090

Tel 020 7942 5344/45

email bgs_london_staff@bgs.ac.uk

**Cardiff University, Main Building, Park Place,
Cardiff CF10 3AT**

Tel 029 2167 4280

**Geological Survey of Northern Ireland, 7th Floor,
Adelaide House, 39-49 Adelaide Street, Belfast, BT2 8FD**

Tel 0289 038 8462

www2.bgs.ac.uk/gsni/

**Natural Environment Research Council, Polaris House,
North Star Avenue, Swindon SN2 1EU**

Tel 01793 411500

Fax 01793 411501

www.nerc.ac.uk

**UK Research and Innovation, Polaris House,
Swindon SN2 1FL**

Tel 01793 444000

www.ukri.org

Website: <https://www.bgs.ac.uk>

Shop online: <https://shop.bgs.ac.uk/>

Foreword

This report presents the discussions from an online workshop on 31 July 2025. The workshop was hosted by the British Geological Survey for members of the Future of the Subsurface Community of Interest. Participants represented a range of organisations, including national and local government, regulators and public bodies. Discussions focused on the role of the subsurface in climate change adaptation in the UK.

Acknowledgements

The authors are very grateful to all the workshop participants who gave their time, knowledge and thoughts so generously during the discussions.

Contents

Foreword	ii
Acknowledgements	ii
Contents	iii
Summary	iv
1 Introduction.....	1
2 Overview of the workshop	3
2.1 Summary of the discussions.....	3
2.2 Next steps	12
Appendix 1 Outcome and thematic areas in NAP3	13
References.....	15

FIGURES

Figure 1 Some of the issues arising from not considering the role of the subsurface in CCA identified at the Col spring meeting	2
Figure 2 Summary of the national adaptation plans in the UK, which all emphasise understanding and managing risks and have a resilience focus.....	3

Summary

This report presents the discussions from an online workshop on climate change adaptation (CCA) and the subsurface on 31 July 2025.

The Climate Change Committee (CCC) defines CCA as the process of preparing for and adjusting to the current and expected impacts of climate change, with the goal of reducing risks and increasing the UK's resilience. There is growing recognition that the subsurface has a crucial role in CCA and of the challenges relating to how it is used (Government Office for Science, 2024). The aim of this workshop was to draw together experts on the subsurface to consider how the subsurface is being accounted for in the current adaptation plan for the UK and England.

The workshop, hosted by the British Geological Survey, involved members of the Future of the Subsurface Community of Interest. This is a community of decision makers from Government departments, local authorities, regulators and others in the public sector involved in subsurface policy and planning. Participants represented a range of UK organisations, including:

- Department for Energy Security and Net Zero
- Department for Science, Innovation and Technology
- Environment Agency
- Gateshead Council
- Glasgow City Council
- Government Office for Science
- Greater London Authority
- Historic Environment Scotland
- Historic England
- North Sea Transition Authority
- Nuclear Waste Services
- Ordnance Survey
- Scottish Government

Workshop participants were asked to consider whether the subsurface is adequately considered in current Government CCA plans (focusing on the plans for the UK and England) and identify any perceived gaps. Recurring themes that emerged during the discussion included lack of access to data, fragmented regulatory systems and the need for greater investment and education.

Some of the main points were:

- a holistic view of the environment that takes the subsurface into account is necessary to ensure interactions and dependencies between surface and subsurface systems are recognised
- the lack of data about the subsurface and how it is currently being used is a major issue when implementing adaptation measures and there are numerous questions relating to data stewardship and ensuring it is accessible for the decision makers implementing adaption measures
- sharing subsurface-related data between sectors must be improved and barriers to effective communication (for example, the use of technical or sector-specific language) must also be tackled
- connections and interactions between different subsurface systems can have an impact on adaptation options and must be better understood
- the effects of climate change and the need to adapt are leading to numerous competing or interacting demands on the subsurface, which must be understood and managed
- there are conflicts or inconsistencies between planning or regulatory regimes that must be recognised and managed to ensure the subsurface can support adaptation in a sustainable way

- there is a need for greater investment in repairing and monitoring existing infrastructure rather than constructing new assets
- more education is needed to raise awareness of the subsurface and how it affects people's lives and the built and natural environment, particularly in towns and cities

In addition to challenges relating to data, which extend beyond CCA, participants identified several potential areas for further consideration. These included further engagement with CCA communities across the four UK nations and opportunities for collaborative work between the community of interest and key stakeholders.

In terms of next steps, suggestions included the development of a theory of change, or roadmap, outlining what is needed to ensure the subsurface is available to support CCA in the UK in the short and long term.

1 Introduction

The British Geological Survey (BGS) hosted an online workshop on climate change adaptation (CCA) and the subsurface on 31 July 2025 for members of the Future of the Subsurface Community of Interest (Col). This includes decision makers from Government departments, local authorities, regulators and others in the public sector involved in subsurface policy and planning. The Col's aims are:

- increase cross-departmental and cross-sector collaboration and knowledge exchange on subsurface issues
- improve coordination and regulation
- allow more effective management of the subsurface and the services it provides

The Col is co-chaired by BGS and the Geological Society.

The workshop was organised in response to challenges identified in the 2024 foresight report 'Future of the subsurface' (Government Office for Science, 2024) and growing recognition that the subsurface will play a crucial role in future CCA plans. Discussions focused on the role of the subsurface in CCA in the UK and participants represented a range of UK organisations, including:

- Department for Energy Security and Net Zero
- Department for Science, Innovation and Technology
- Environment Agency
- Gateshead Council
- Glasgow City Council
- Government Office for Science
- Greater London Authority
- Historic Environment Scotland
- Historic England
- North Sea Transition Authority
- Nuclear Waste Services
- Ordnance Survey
- Scottish Government

Under the Climate Change Act 2008, the UK Government is legally required to assess climate change risks, produce national adaptation programmes (for example, the National Adaptation Programme (NAP3) (England and the UK); Climate Ready Scotland; Prosperity for All: a climate conscious Wales; the Northern Ireland Climate Change Adaptation Programme) and respond to independent Climate Change Committee (CCC) assessments of progress. This workshop therefore sought to understand how the subsurface is considered in national adaptation plans.

According to the CCC, adaptation is needed now to ensure that the UK is prepared for today's extreme weather as well as the rapidly increasing severity of future risks, even if international targets to limit global warming are met (Climate Change Committee, 2025). In addition, climate adaptation and net zero targets were priority topics of interest identified by members of the Col when it was first established. Addressing this, initial discussions on this topic were held at the spring meeting of the Col on 27 March 2025. During that initial discussion, participants identified numerous problems arising from not adequately considering the subsurface in CCA (Figure 1). There was also general agreement that the level of awareness of the importance of the subsurface for CCA policy, plans and action is probably relatively low.

- Subsurface already compromised in places where we can't use it
- Not safeguarding high value uses
- Poor optimisation leading to unintended consequences
- Failure to deploy new energy technologies
- Reduced energy security and missing net zero targets
- Conflicting uses/demands locally and nationally
- Negative interactions between uses
- Potential competition between environmental and human need
- Critical National Infrastructure is compromised
- Deteriorating ducts leading to worsening leakage
- Failure to link surface and subsurface
- No legislative framework in place for action

Figure 1 Some of the issues arising from not considering the role of the subsurface in CCA identified at the Col spring meeting. BGS © UKRI 2025.

Given the criticality of these issues for UK CCA, the aim of the July workshop was to consider how the subsurface affects all current outcome areas as described in the CCC's 'Progress in adapting to climate change' report to Parliament (Climate Change Committee, 2025). This report focuses on the implementation of NAP3, the current national adaptation plan developed by the UK Government, to identify potential risks to adaptation if the subsurface is not taken in to account and consider where more action may be needed.

It was noted during the July workshop that adaptation is largely a devolved matter, therefore the national adaptation plans for Scotland, Wales and Northern Ireland respond to the needs of each nation, thus framing adaptation differently to NAP3. Consequently, additional workshops that explore the role of the subsurface for CCA in the devolved nations would be helpful to fully capture the complexity of CCA as it relates to the subsurface across the UK.

2 Overview of the workshop

There were 16 participants from a range of organisations across the UK, including national and local government, regulators and public bodies. The workshop took place online and consisted of a mix of plenary and focus group discussions over half a day. The sessions were facilitated by BGS and all contributions were captured on a MS Whiteboard. These contributions and the notes taken by the facilitators form the basis of this report. Where possible, original contributions have been included in the report narrative as they were recorded by participants on the whiteboard.

2.1 SUMMARY OF THE DISCUSSIONS

A very brief overview of the national CCA plans in the UK was used to give context to the discussions (Figure 2). Focus then moved to the CCC's 2025 report to Parliament, 'Progress in adapting to climate change' (Climate Change Committee, 2025). This is the CCC's first statutory progress report on NAP3, which sets out the UK Government's plans to prepare for the impacts of climate change. The outcome areas in that report informed the structure of the discussion sessions (see Appendix 1).

Programme	Period covered	Background	Aim	Evaluating progress
Third National Adaptation Programme – England	2023-2028 (NAP3)	UK gov actions to adapt to CC in England + reserved sectors across the UK like defence	To address risks and opportunities identified in the risk assessment for England	Climate Change Committee every 2 years
Scottish National Adaptation Plan	2024-2029 (SNAP3)	Scottish gov ministers lay out programme for CCA following each CC risk assessment	To build Scotland's resilience to CC, defines priorities for action over the next 5 years	Annual report on progress + independent review every 2 years
Prosperity for All: A Climate Conscious Wales	2020-2025	UK CC Act requires Welsh Ministers to produce reports on objectives, actions and future priorities re CC impacts	To increase knowledge, capacity and resilience as Wales respond to CC risk	Evidence gathered by WG and external partners, passed to relevant gov depts for review
Northern Ireland Climate Change Adaptation Programme	2024-2029 (NICCAP3) draft currently out for public consultation	UK CC Act requires NI gov depts to prepare a programme to respond to CC risks and opportunities for NI based on UK CC RA	To deliver vision of 'a resilient NI which will take timely and well-informed decisions to address the socio-economic and environmental impacts of CC'	Stock take reviews by DAERA and independent assessments by CCC

Figure 2 Summary of the national adaptation plans in the UK, which all emphasise understanding and managing risks and have a resilience focus. BGS © UKRI 2025.

2.1.1 Agenda

The workshop was divided into three separate sessions that included a mix of plenary and breakout discussions. Each session posed a different set of questions that were designed to build a picture of the relevance of the subsurface to current national adaptation plans and how it is currently accounted for in these plans, including any gaps, and the risks of not accounting for the subsurface adequately.

Please note that the following session summaries reflect, as far as is possible, the words and phrases shared by participants on the whiteboard during the breakout and plenary sessions. For this reason, the summaries include a list of key points that were identified from the participant contributions and short paragraphs that attempt to capture the language and sentiment of the contributions as closely as possible.

2.1.2 Session 1: what aspects of the subsurface are relevant for adaptation outcomes?

This session was structured around the outcome areas identified in the CCC report:

- land
- nature and food
- built environment and communities
- health and well-being
- infrastructure and economy

See Appendix 1 for full details.

Participants were assigned to four different breakout groups and asked to focus on one outcome area each. We aimed to ensure there was a spread of experience and sectors in each group. Each group then moved on to consider two further outcome areas during two further breakout sessions, to facilitate a breadth of input across all sectors and areas of expertise.

The groups were asked to consider the following questions.

- What aspects of the subsurface are relevant to this outcome area, or could help to deliver it?
 - Are there any subsurface-related policies or initiatives that are relevant?
- What are the potential risks to delivering this outcome if the subsurface and the challenges identified in the 2024 foresight report 'Future of the subsurface' are not adequately accounted for in CCA policies, plans and practice?
 - How would we know if they are or not?

2.1.2.1 LAND, NATURE AND FOOD

Key points:

- A holistic view of the environment that takes the subsurface into account is necessary to ensure interactions and dependencies between surface and subsurface systems are recognised
- There are conflicts or inconsistencies between planning or regulatory regimes that must be recognised and managed to ensure the subsurface can support adaptation in a sustainable way
- The effects of climate change and the need to adapt are leading to numerous competing or interacting demands on the subsurface, which must be understood and managed
- Greater investment in repairing and monitoring existing infrastructure is needed rather than constructing new assets
- Limited data about the subsurface and how it is currently being used pose significant challenges for implementing adaptation measures; there are also numerous questions relating to data stewardship and ensuring it is accessible for adaptation decision makers

Nature

There is a significant risk to the subsurface and its ability to support CCA due to the siloed approach to the environment that is currently taken.

We must increase consideration of the role nature can or should play in mitigating climate change and our ability to adapt. Nature-based solutions (NBS) will need to provide a significant contribution to net zero (40 per cent) but the focus is on commercial use of land, and energy and emissions. A focus on incentivising NBS is needed.

It is also vital to recognise the benefit of nature on mental health (currently a gap in the outcome areas) and public health should be included in any assessment of nature and water.

Underground (lost or covered) rivers are a critical aspect of the freshwater system and the health of freshwater habitats. However, nationally, they are not mapped in the same way as sewers. Different groups are responsible for these assets even though they are both underground.

Working land and seas

Land use

Risks to the subsurface and its ability to support climate change are symptomatic of the siloed and fragmented approaches to the environment that are taken. There are risks associated with the different planning systems in the four nations; each have different 'headlines' and focuses. The situation is exacerbated by the numerous other factors that influence the subsurface-adaptation context (for example, levelling up, city deals and government budgets that change targets every election cycle).

Many farming land-use changes fall outside current regulatory systems. Since farming relies on soils and groundwater systems, any changes in farming land use would affect soils and groundwater from quality and quantity perspectives.

Net zero technologies such as solar arrays have new effects on the subsurface over large land areas; for example, plant and soil properties linked to ecosystem services (Carvalho et al., 2025), often in locations where these have previously been minimal.

Some of these regional differences do, however, present localised opportunities. For example, in Scotland, coal exploitation is a matter reserved to the UK Government but planning policy and determinations are devolved to the Scottish Government. The Scottish Government's finalised policy position is one of no support for coal extraction in Scotland. In addition, the Scottish Government has finalised policy positions of no support for onshore conventional and unconventional oil and gas (including fracking). However, the post-industrial subsurface environment can now be used or repurposed, for example for geothermal energy, therefore providing adaptation opportunities.

2.1.2.2 INFRASTRUCTURE

Key points:

- Critical interactions, interdependencies and competing demands within and between sectors must be managed
- There is limited data, knowledge and understanding to manage resources and the demands placed on them optimally
- Investment is needed in maintaining existing infrastructure, data collection and monitoring

Water supply

Improving system performance and increasing supply

Subsurface water sources and their management are critical for adaptation to climate change, for example:

- meeting increased irrigation demand
- building more reservoirs to improve water security
- ensuring better drainage solutions in the event of flooding

Understanding the performance of the subsurface is necessary to support water supply — how geology impacts aquifers and how can this be optimised. Increasing supply is as much about optimising existing sources as the construction of new ones.

Understanding leakage in system performance is still a work in progress and the age of assets is relevant. There is an argument that more needs to be done on this before new reservoirs are built. In addition, monitoring is critical but there is very little investment in this compared to economic value of water.

Interdependencies and competing demands on the water supply system

There are numerous competing or interacting demands on water supply, so the interdependency of groundwater resources needs to be understood. The allocation of water to meet the needs of industry and nature must be balanced between the different uses. For

example, for groundwater, this may be drinking water vs. energy-generation use (such as geothermal or hydrogen production water supply). Investment is also needed to enable planning and monitoring to reduce the risk of a lack of water for one activity as a result of what is supplied for another.

The relative locations of potential subsurface activities are dependent on the water supply system. For example, ensuring separation between geological disposal options and aquifers places significant constraints on subsurface disposal of nuclear waste. Data stores also consume significant amounts of water when it is hot.

Climate change is expected to increase the occurrence of multi-year droughts, which will require careful management. The interplay between surface water and groundwater requires approaches that account for both; for example, using groundwater in the first year to support surface water but protecting recharge in the second year as groundwater also goes into drought. One-year droughts are generally manageable, but two-year droughts are significantly more challenging and climate scenarios tend not to represent this. In addition, conjunctive use of surface and groundwater needs to be addressed given the Water Framework Directive tends to push back against stressing groundwater to support surface water.

Energy

Climate resilient supply and vulnerability of assets to extreme weather

The subsurface can be used for active cooling of infrastructure; for example, aquifer thermal-energy storage. Energy infrastructure is being strategically placed below ground to protect it from overheating or high surface temperatures during hot days. However, there is a risk that, if energy centres are not placed with due consideration of climate change, they could be prone to flooding or other risks.

Trench length and choosing where to dig is key for the viability of heat networks. However, we do not have sound data to allow for good decision making on this in all areas and there is significant competition for space. For example, heat network pipes, which are large (second largest after water pipes), are fighting for space in a very busy underground network of utilities.

Lack of ease in obtaining data on the subsurface means that feasibility studies for heat networks are based on assumptions, leading to risks at a later stage; for example, the project may be more technically complex or expensive than planned. Additionally, sewer-source heat pumps linked to district heating are located based on the data available today and will not necessarily reflect the water and sewer flows of the future.

Not knowing where different energy assets are below the ground introduces competition and reduces efficient use of subsurface. It also impacts opportunities presented by previous use of underground space, such as the use of excess heat from mine-water remediation for district heating. This overlaps with competition for space and co-location of infrastructure, which is also relevant for other types of infrastructure including telecommunications and information and communication technology.

Transport

This sector was not well represented by the group participants. However, there were two contributions relating to the use of the subsurface that would be relevant for roads, rail and other forms of transport: resilience of ground engineering and the need for consistent standards and indicators to assess risks to transport and performance.

It was also pointed out that the overlaps between resilience (the return or continuation of a state) and adaptation (reducing vulnerability and including transformation) of infrastructure are unclear. This may mean that measures to make infrastructure resilient are different to those seeking adaptation. Equally, measures to make infrastructure resilient to one hazard can result in an increase in vulnerability to another.

Data and regulations

Currently, regulations are usually or mainly specific to a certain infrastructure asset, which raises the question of whether there is a need for subsurface regulations to enable more cohesive use of the subsurface.

The subsurface must be understood conceptually from the outset and having sufficient, trusted information about the subsurface is critical to its use. Both the subsurface and the surface are contested spaces and we do not know where all the subsurface infrastructure is, where suitable geology is and if the introduction of one type of infrastructure may have a negative impact on other options.

Although people are generally very keen to share data and knowledge, they do not always know how to and there can also be some nervousness around this. Data is therefore often shared as spreadsheets rather than geospatial mapping layers. There are then further questions around who is assessing the risks and who is mapping and stewarding the data to ensure it is up-to-date and accurate.

The role of artificial intelligence was also discussed in regard to monitoring. It has the potential to improve understanding and reduce physical monitoring but there is a question about whether this information can be trusted in a changing environment.

2.1.2.3 BUILT ENVIRONMENT AND COMMUNITIES

Key points:

- Connections and interactions between different subsurface systems can have an impact on adaptation and must be better understood
- Planning in relation to the subsurface is inconsistent and often absent
- More education is needed to raise awareness of the subsurface and how it affects people living or constructing houses in towns and cities
- There is a lack of openly accessible and reliable data about the subsurface, which affects planning and decision making for adaptation

Towns and cities

Understanding how the subsurface can help to slow down water flow and manage heavy rainfall is an important part of managing flood risk. There is currently no national database of all flood-risk assets and those that exist may only focus on a subset of these; for example, the Environment Agency database only includes their own assets and not surface-water assets.

Better understanding of groundwater and mine water is needed to support planning and implementation of sustainable urban drainage systems (SuDS), as is understanding of the limitations in relation to infiltration, which is much reduced in urban areas. However, it is important that the impacts of drought are also recognised and this is why the integrated water system should be optimised, since it links with subsidence and groundwater and affects buildings.

Understanding the presence of water and flow pathways is also needed to understand interactions with subsurface infrastructure or more widely. For example, better conceptual understanding is needed of the connectivity of abandoned coal workings and how infiltration to dry workings may remobilise contaminants and potentially cause pollution at the surface.

The regulatory landscape relating to the subsurface is complicated. Critically, planning in relation to the subsurface is inconsistent and often absent. In addition, there are four different planning systems in the UK and each takes a different view on adaptation and mitigation, which can cause difficulties when multinational companies are involved (for example, biodiversity net gain in England, which is a legal requirement for developers to consider the long-term impacts of a project on biodiversity, vs. Policy 3 of the National Planning Framework in Scotland, which focuses on biodiversity and requires all development contributes to its enhancement). Planning also tends to focus on site-level issues and adaptation, whereas the ability to deliver regional solutions and enable regional collaboration is also needed.

Buildings

In the past, buildings were constructed in a way that minimised the impact of floods: basements used to be allowed to flood, but now they are built to be extra rooms. Historic buildings are exposed to a new suite of climate change impacts they were not designed to withstand.

The subsurface has an important role to play in regulating heat of buildings. Aquifer thermal storage for heating and cooling of buildings reduces the need for electricity in winter, when subsurface temperatures are elevated.

Heat networks are a viable solution for high population density areas like cities, where heat pumps per property are not viable. However, the subsurface impact of heat networks vs. heat pumps is not well considered.

Community preparedness and response

Subsurface experts such as archaeologists and geologists are accustomed to the evolution of our environment through time and are therefore better able to appreciate how a climate-influenced future might unfold. However, most house builders will not think about the integrity of the subsurface unless they have experienced, for instance, a flood.

Generational memory (for example, about how housing was built in the past to manage the impacts of hazards like floods) alongside identity and connection to place are also important for community adaptation and, while specialist sectors like insurance are aware of climate risks, communities do not necessarily understand the risks with which they are living. More education for communities is required so they understand what is going to be needed for climate adaptation and so that issues such as people continuing to build in climate-stressed areas can be addressed.

Cultural heritage is also being affected by changes in the subsurface (for example, by groundwater) due to climate change. There is currently a lack of in situ monitoring data on changes to soil chemistry over time and the implications for long-term survival of buried archaeological artefacts.

2.1.2.4 HEALTH AND WELL-BEING

The wider health and well-being benefits of 'blue' or 'green' infrastructure are not appreciated, such as the cooling effects of SuDS (permeable paving is cooler). Potential health risks from flooding should also be considered. These include pollution, pests and disease, and mental health impacts.

2.1.2.5 ECONOMY

Key points:

- Subsurface issues must be accounted for from the outset, because failure to do so can lead to significant losses (for example, from subsidence) — many businesses are not aware of this
- Businesses should anticipate and plan for the impact of installation of adaptation measures such as heat networks
- Sharing of subsurface-related data between sectors must be improved, with barriers to effective communication, like the use of technical or sector-specific language, tackled

Business

Asset owners are not required to disclose all subsurface assets and this lack of knowledge, along with a more general lack of information about or understanding of the subsurface, may affect businesses. For example, adaptation projects such as blue or green infrastructure may fail after pre-feasibility checks, because of lack of knowledge of the assets that are present at that location.

Subsidence, which is one of the biggest financial risks, is often overlooked. The London Climate Resilience Review highlights that climate change, particularly extreme weather, is significantly increasing the risk of subsidence in London. London boroughs therefore include subsidence in their 'risk wheel' (London Risk Register and the Borough Risk Registers). Many businesses are

not aware of this or assessing their claim risk when implementing climate actions. That said, the insurance sector is aware of the issue because it affects their business; we should learn from their experience. Ground risk effects on productivity, for example when there is disruption to transport networks, must also be properly accounted for.

Businesses should anticipate and plan for the costs and disruption that will arise from the installation of new heat networks. It is important to be aware of the potential for supply chain risks of resource and skills for adaptation measures in the water and energy industry, such as installing SuDS at scale.

It is also important to recognise the risk of protest or rejection by the public of the use of the subsurface (for mitigation or adaptation) by businesses or other institutions, due to perceived unfairness and unequal distribution of impacts and benefits.

It is worth noting the potential for subsurface resources to be used as an 'offset' for businesses to 'greenwash' or justify other polluting activities. It could be viewed as a 'silver bullet' to avoid other adaptation or mitigation measures.

Finance

There is a lack of skills and understanding of the subsurface in the finance and economic sector that must be addressed, especially when losses due to subsidence are significant. Subsurface issues are not accounted for in the value proposition or cost-benefit analysis of different climate adaptation options as there is a lower level of understanding of the subsurface system. For example, funders of heat networks such as the National Wealth Fund and the Scottish National Investment Bank would not necessarily have an understanding of the subsurface or any risks in this area.

Heat network routing is optimised to reduce pipe length and cost. This may mean that future re-routing of pipes, to account for adaptation needs, could be cost prohibitive. Financial instruments that allow for adaptation, such as schemes that consider subsurface technologies that can be used for both heating and cooling, are required; for example, aquifer thermal energy storage.

Data and information

The sharing of data and information should be improved. Useful but potentially proprietary risk information held by the insurance sector is not shared but could be very useful. Barriers to effective communication between experts in the subsurface and the insurance sector (for example, using different languages, data and approaches) should also be addressed.

2.1.3 Session 2: what needs to be done better to understand any risks?

In this session, the participants worked in two groups and discussed these questions.

- What do you think needs to be done to better understand any risks to sustainable adaptation that relate to the subsurface or how they could be managed?
- What do you think is most important and/or urgent?

These are the main themes that emerged in the discussion.

2.1.3.1 FUNDING AND INVESTMENT

The group thought there should be incentives for using and exploring the subsurface for climate adaptation. Government grants and incentives should be aligned to climate adaptation and made effective to avoid the risk of them appearing as gimmicks.

Institutions such as councils, systems and budgets, etc. have not evolved to respond to the current issues and issues may have moved on whilst systems have not evolved. Businesses tend to be more agile.

UKRI is funding research into CCA but the missing partners are local authorities, who are not funded by UKRI. This forces a break in the collaboration and co-production process between research institutes and local authorities.

Where funding is available, it is easier to get capital rather than funding for maintenance. The scale of the maintenance needed is underestimated and, ideally, the number of short-term investments should be limited. For example, highway gullies and connections form a significant part of surface-water assets but there is no funding to maintain them.

Additionally, no investment is being made in 'sustainable places' based on potential climate impacts, for example avoiding development in climate-stressed areas.

2.1.3.2 DATA

Data was a recurring theme in the discussion and the group recognised that significantly more work is needed to understand the current situation and what may be standing in the way of progress.

There are a huge number of unknowns regarding what is already in the subsurface and what it is being used for. We do not monitor, keep records of or maintain what is there and investment in gathering new data or information is limited. Opportunities to gather data about the subsurface are also being missed, for example capturing data contained in planning applications and feasibility studies. Without this information, it is not possible to get a full picture so that actions can be prioritised adequately — for instance, the national register of surface-water assets does not include below-ground assets. Furthermore, data is also necessary for 'political dialogue' relating to the subsurface, which is not possible without it.

Finding or accessing data relating to the subsurface that is held by different agencies or governments is a big challenge and the systems to manage it can be lacking. For example, local authorities have different levels of data that can be locked away and the guardians of the data may not have the expertise to ask the right questions of the data. There were suggestions that a central repository and greater stewardship was needed.

2.1.3.3 COMMUNICATION, AWARENESS AND EDUCATION

Communities should be engaged from the start so they can be involved and part of the decision-making process. Taking this approach would also help get people interested in the subsurface, see the bigger picture and understand the impact of the decisions being made. For example, homeowners could gain the understanding that paving over gardens impedes where water can go.

There is a need for clarity of information. This is especially important when communicating flood risks or translating surface-water warnings into action, both of which can be difficult. It can be hard to get people on board if it is something that is not within living memory, locally relevant or the messaging is not right.

It is crucial to find a way to communicate technical information and uncertainty around climate impacts to support action. In addition, more awareness of subsurface impacts on heat network projects is needed through engagement with developers, financiers, local authorities, etc.

2.1.3.4 TAKING A SYSTEMS APPROACH

Disconnections, siloed approaches and only taking a narrow view of the subsurface and how it relates to CCA must be addressed. A broader systems view would assist in understanding unintended consequences and place-based complexities, as well as help to identify opportunities such as the potential for excess heat from data science and industrial processes to be stored in the subsurface for later use. Silos and the segmentation of risk ownership could potentially be addressed through cross-cutting missions.

Communication on co-location issues should be improved to support a strategic approach that looks at co-location optimisation of both shallow and deep subsurface use. A more strategic approach to using the subsurface is also required: it currently happens on a 'first-come first-served' basis, but this may not be the best use of the subsurface for adaptation in the future. Currently, there are instances where economics is overriding sensible decisions, for example not investing in the less climate-stressed north of the UK.

The multiple demands on the subsurface and the community and financial benefits they bring need to be weighed up. There needs to be a level playing field when it comes to comparing and prioritising subsurface use. For example, carbon capture, utilisation and storage might be prioritised because it generates revenue, whereas deep disposal of nuclear waste is a cost to the taxpayer but aims to solve an environmental challenge. There needs to be an objective way to evaluate subsurface planning.

Finally, we need 20 to 50-year plans for adaptation and use of the subsurface. Political timescales are insufficient to tackle the challenge we face.

2.1.4 Session 3: the way forward

The workshop concluded with a plenary discussion to consider these questions:

- What does success look like?
- What needs to happen next?
- Who needs to be involved?

Due to time constraints, participants were not able to discuss these questions fully. However, some themes did emerge, which are recorded in this section. Future discussions will cover these questions in greater depth.

Not fully accounting for or considering the subsurface could mean the difference between adaptation projects succeeding or failing, or between choosing the right or wrong option.

Participants spoke of the need to move away from ‘end-of-pipe’ reasoning regarding how people fit into the implementation of mitigation and adaptation approaches, and that the social element must be considered first. There was one suggestion that we get back to thinking about ‘place’ since this is something people connect to and fight for: it is part of their culture, heritage and future and not just a neutral ‘space’. This must be recognised because the subsurface is going to play a major role in adaptation as time goes on. We can expect heat network pipes in all major towns and cities in the future and this will change the makeup of subsurface utilities as we know them.

There were a few ideas about next steps:

- we must recognise there are both ‘data’ issues (for example, not knowing what is in the subsurface) and ‘data maturity’ issues (the extent to which data can be used to achieve results):
 - data maturity issues include (HM Government, 2023):
 - having the right data skills and knowledge
 - having the right systems in place to manage and analyse data
 - having appropriate systems and processes to manage data
 - being able to record, catalogue and preserve data
 - incorporating ethics in the management and use of data
 - both data and data maturity issues must be addressed; other initiatives such as the Marine Environmental Data and Information Network (MEDIN) provide valuable demonstrations and such a model could potentially provide a blueprint that would form the starting point for developing a similar resource for the subsurface
- we need to get better at documenting the valuable tacit knowledge that sits within a few individuals
- we must engage with stakeholders including communities right from the start and avoid ‘communicating to them’ at the end of the process
- With the increase in unconventional hydrocarbons (shale gas), communities became more interested in subsurface technologies but controversy around fracking has meant people became more wary about use of the subsurface and we must be aware of that

2.2 NEXT STEPS

Workshop discussions indicated broad recognition of the subsurface as an important resource for CCA, alongside acknowledgement of a number of challenges that affect how it is currently understood and used. These challenges span sectors, responsibilities and geographical scales, reflecting the cross-UK context in which subsurface planning and management take place.

Together with a fragmented regulatory landscape and limitations in available data, the complexity of the subsurface, including its multiple uses, interactions and dependencies, was highlighted as influencing adaptation outcomes. Participants identified further dialogue between the CoI and climate adaptation communities across the four nations as a potential next step to explore these issues in more detail. Such engagement could support the articulation of a shared theory of change or roadmap setting out the conditions under which the subsurface could more effectively contribute to sustainable CCA in the UK.

Data collection, governance and sharing arrangements were recurring themes, described as both enabling factors and constraints. MEDIN was referenced as an example of an established approach from which transferable lessons could be explored. Increasing consistency in awareness of the subsurface and its contribution to adaptation objectives across England, Northern Ireland, Scotland and Wales was also identified as an area for further consideration.

Appendix 1 Outcome and thematic areas in NAP3

Outcome and thematic areas in NAP3. Adapted from Climate Change Committee (2025) under the [Open Government Licence v3.0](#), © Climate Change Committee copyright 2025.

Outcome area	Thematic area	Outcome
Land, nature and food	Nature	Terrestrial habitats are in good ecological health Freshwater habitats are in good ecological health Marine and coastal habitats are in good ecological health
	Working land and seas	Climate-resilient agricultural production Climate-resilient commercial forestry sector
	Food security	Disruption to food and feed-import supply chains due to climate change is minimised Vulnerability to food price shocks is reduced
Infrastructure	Water supply	Reduced demand Improved system performance Interdependencies are identified and managed
	Energy	Reduced vulnerability of energy assets to extreme weather Climate-resilient supply Interdependencies are identified and managed Vulnerability of assets is reduced
	Telecommunications and ICT	System-level resilience Interdependencies are identified and managed
	Transport	Asset and system-level reliability of: • rail network • road network • local roads • airport operations • port operations Interdependencies are identified and managed

Outcome area	Thematic area	Outcome
Built environment and communities	Towns and cities	Places are resilient to river and coastal flooding Places are resilient to surface water and flooding Sustainable coastal management is in place Urban heat risks are managed Planning system prioritises climate resilience
	Buildings	Buildings: - do not overheat - are prepared for flooding - are resilient to other climate risks
	Community preparedness and response	Communities are prepared for climate shocks Communities can prepare for climate shocks Local cultural heritage is preserved
Health and well-being	Health	Population health is protected from the impacts of climate change and potential benefits are utilised Quality and accessible healthcare is delivered during extreme weather
Economy	Business	Public and private adaptation measures are implemented to minimise risks to business sites Businesses have access to capital and insurance, including adaptation Productivity losses due to physical climate risks are minimised Supply chain risks are identified and managed Risks and actions are disclosed and managed by businesses
	Finance	All financial institutions incorporate physical risks into financial decision making UK financial services are a global leader in adaptation No viable adaptation project fails for lack of finance Risks and actions are disclosed and managed by financial institutions

References

Carvalho, F, Montag, H, Bentley, L, Šarlej, R, Broyd, R C, Blaydes, H, Cattin, M, Burke, M, Wallwork, A, and Ramanayaka, S. 2025. [Plant and soil responses to ground-mounted solar panels in temperate agricultural systems](#). *Environmental Research Letters*, Vol. 20, 2. DOI: <http://doi.org/10.1088/1748-9326/ada45b>.

Climate Change Committee. 2025. [Progress in adapting to climate change: 2025 report to Parliament](#) [online]. Available: <https://www.theccc.org.uk/wp-content/uploads/2025/04/Progress-in-adapting-to-climate-change-2025.pdf> [accessed 22 August 2025]

Government Office for Science. 2024. [Future of the subsurface](#) [online]. Available: https://assets.publishing.service.gov.uk/media/66fd3c52e84ae1fd8592ecb1/Foresight_Future_of_the_Subsurface_report.pdf

HM Government. 2023. [Data maturity assessment for Government](#) [online]. Available: https://assets.publishing.service.gov.uk/media/64184bccd3bf7f79d9675dbd/Data_Maturity_Assessment_for_Government_-_FINAL_PDF.pdf [accessed 17 September 2025]