

Navigating Water-Related Risks in the UK: Climate, Infrastructure, and Resource Management for Resilience

ADDRESSING THE IMPACTS OF CLIMATE CHANGE,
INFRASTRUCTURE CHALLENGES, AND WATER RESOURCE
MANAGEMENT IN THE UK

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Navigating Water-Related Risks in the UK. Climate, Infrastructure, and Resource Management for Resilience

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Dr. Freeman led the research, analysis, and drafting of this paper. Her work focuses on climate and nature related risks, water resources, and the intersection of environmental and financial governance.

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Abstract

Water is central to the UK's environmental and economic resilience, yet it faces increasing pressures from climate change, aging infrastructure, and complex resource management challenges. This working paper explores the interconnected risks posed to water systems, from the degradation of natural water environments to the growing impact of urbanization, pollution, and climate-driven extremes like flooding and drought. It delves into issues such as the loss of wetlands, over-abstraction of water sources, and the rise of combined sewer overflows, all of which are exacerbating the vulnerabilities of the UK's water resources. By analysing current trends and emerging challenges, the paper advocates for more integrated approaches—combining better infrastructure planning, collaborative water management, and stronger flood risk mitigation. These insights aim to inform policymakers, financial institutions, and stakeholders in shaping the UK's water resilience strategy as part of broader climate adaptation efforts.

Surface and ground water related risks.

“Water, water everywhere, nor any drop to drink” (The Rime of the Ancient Mariner, a poem by Samuel Taylor Coleridge, 1798)

The exacerbation of challenges pertaining to water supplies and the aquatic environment arises from pollution, urbanization of larger towns and cities, population growth, and the compounding effects of climate change. Climate change contributes to the intensification of these pressures, manifesting in prolonged and more frequent drought events, leading to increased disruptions in water supply systems. Simultaneously, the prevalence of wetter winters and heightened frequency of heavy storms culminate in elevated instances of flooding and the subsequent runoff of contaminants from both agricultural and urban landscapes.

Emerging contaminants, such as microplastics and various chemicals, have garnered heightened attention due to their discernible impact on the aquatic ecosystem. These contaminants stem from routine human activities, ranging from vehicular emissions to laundry practices and the disposal of substances into sanitation systems (DEFRA, 2023).

The United Kingdom has undergone substantial alterations to its water environment across centuries. These modifications have encompassed actions such as river channelization, the construction of rigid concrete embankments, and the erection of small dams. Many of these

alterations have conferred indispensable advantages to both the economy and society but resulted in the significant changes in the natural environment.

For example, approximately 90% of the original wetland area in the United Kingdom has been lost over time. Within this 10% that remains, there is considerable variation in the extent to which different types of wetlands have been altered from their natural state (CaBA, n.d.).

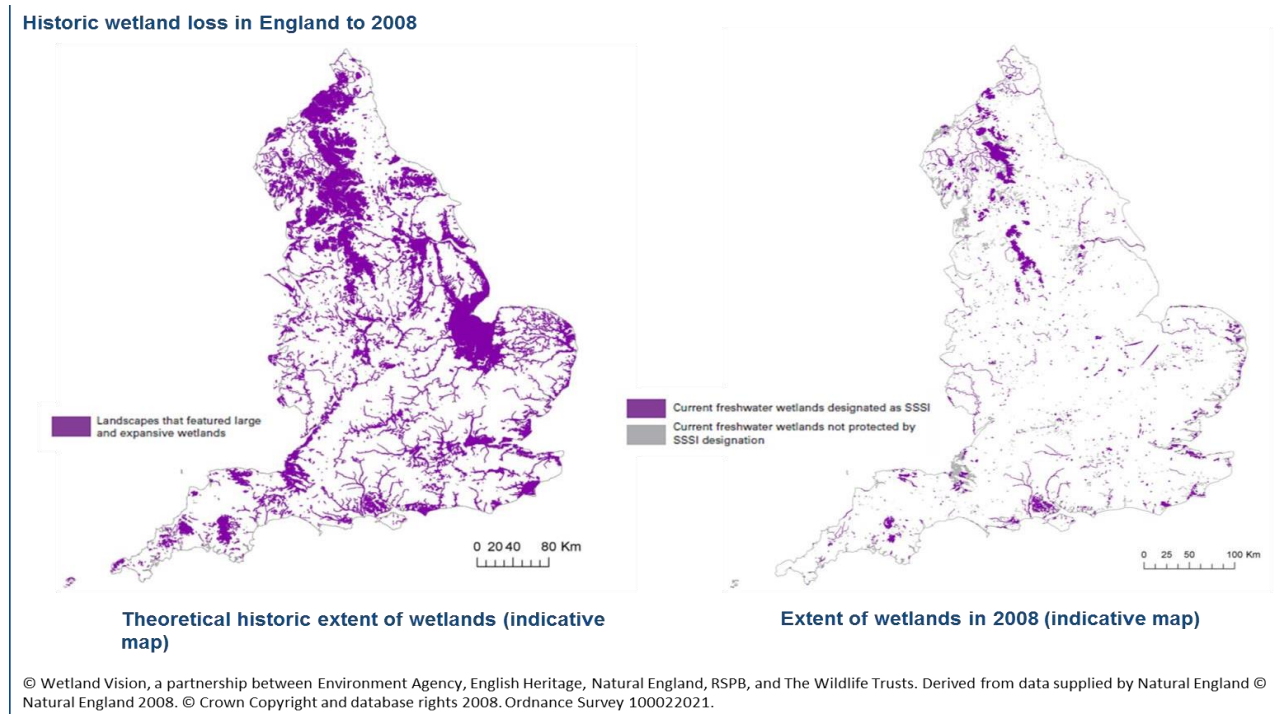


Figure 1 Maps produced by the Wetland Vision Project, showing Historic extent of wetlands (left), Current extent of wetlands (middle) –distinction is made between wetlands protected by Sites of Special Scientific Interest (SSSI) designation (purple) and other current wetlands (grey). Reproduced from 'A 50-Year Vision For Wetlands', (Hume, 2008).

Hume, C., 2008. *Wetland Vision Technical Document: Overview and reporting of project philosophy and technical approach.*

For instance, the fenland basin in eastern England underwent a significant transformation as tidal marshes and floodplain fens were reclaimed for agriculture, resulting in the destruction of nearly all of the original wetlands, leaving less than 0.1% intact. Similarly, between the 1930s and 1980s, almost two-thirds of the coastal and floodplain grazing marsh in the Thames Estuary were converted to other land uses out of the original 44,000 hectares. Both upland and lowland bogs have been extensively drained, altering their hydrology. The remaining peat soils have lost their structural integrity and can no longer support typical wetland species. Arable agriculture remains a significant pressure on wetland habitats, with about 40% of UK wetlands currently under agricultural use, producing the majority of the country's food.

Reviewed in Stratford, C. & Acreman, Mike. (2016). *Rehabilitation of degraded wetlands: UK experience.*

Water supply and over abstraction

The UK relies on a comprehensive water supply system to meet the demands of its population and industries. Approximately two-thirds of the UK's water supply for public use comes from surface water sources, such as reservoirs and rivers.

Groundwater can account for up to one-third of the water supply, but this varies across the UK. The proportion of groundwater and surface water in the water supply can vary significantly depending on regional geographical and climatic conditions, it accounts for about 11% in Northern Ireland and 3% in Scotland. Desalination plants and treated wastewater contribute a

smaller but growing percentage. <https://www.gov.uk/government/publications/state-of-the-environment>.

Environment Agency (2018) *The state of the environment: water resources*. (June), 22. <https://www.gov.uk/government/publications/state-of-the-environment>.

Domestic use accounts for around 55% of total water consumption, encompassing activities like drinking, sanitation, cooking, cleaning, and gardening. ("*Water consumption per person*", <https://www.statista.com/statistics/1211708/liters-per-day-per-person-water-usage-united-kingdom-uk/>).

Consumer Council for Water. (2022). *Average household water usage per person per day in England and Wales from 2016 to 2022 (in liters per day)*. Statista. Statista Inc.. Accessed: January 04, 2024. <https://www.statista.com/statistics/1211708/liters-per-day-per-person-water-usage-united-kingdom-uk/>

Manufacturing, agriculture, and power generation collectively consume approximately 25% of water. In the past 20 years the abstractions were rising due to demand for electricity generation. <https://www.gov.uk/government/statistical-data-sets/env15-water-abstraction-tables>

Department for Environment, Food & Rural Affairs (DEFRA), 2022. ENV15: Water abstraction tables. [online] Available at: <https://www.gov.uk/government/statistical-data-sets/env15-water-abstraction-tables> [Accessed 4 January 2024]

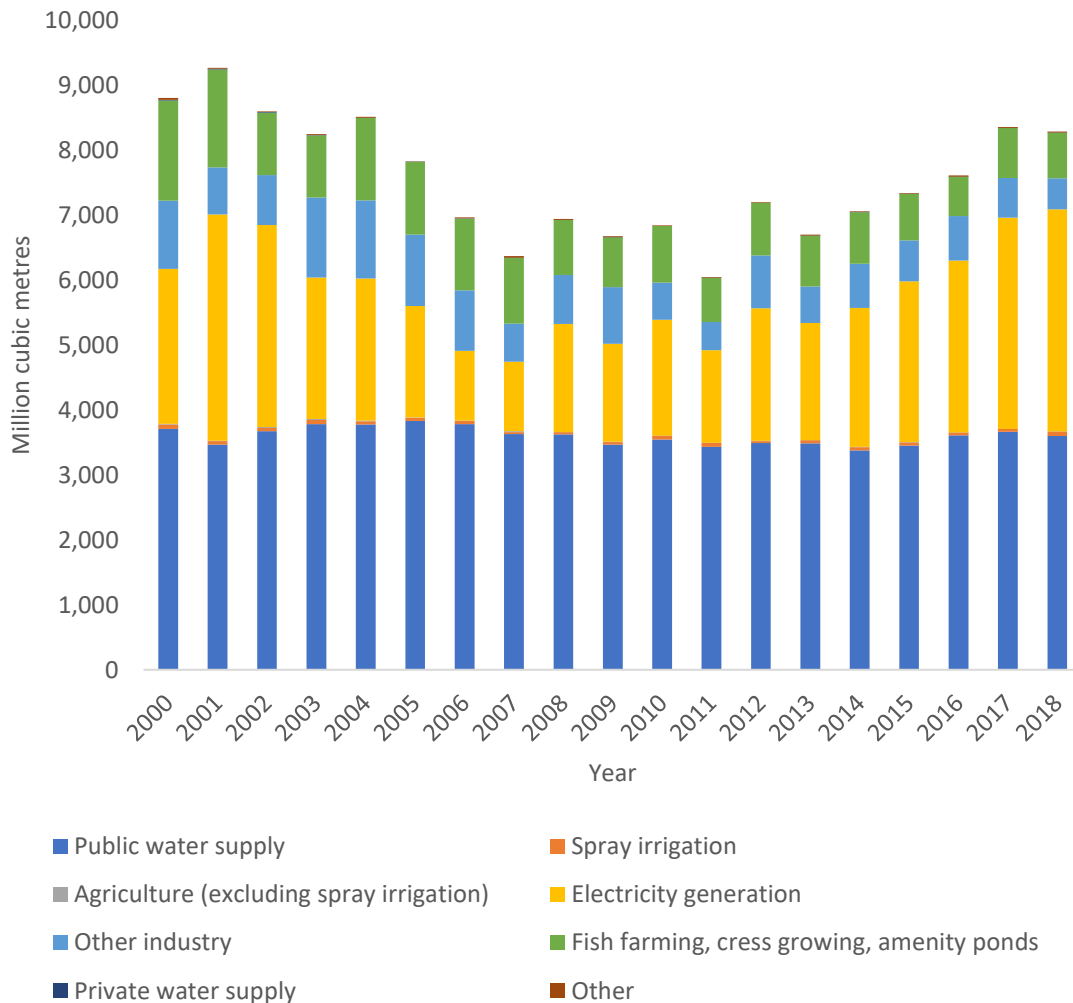


Figure 2 Estimated abstractions from non-tidal surface waters by purpose, England (million cubic metres). Source: Authors (data source: DEFRA, 2022).

In England, around 20% of electricity production relies on freshwater-cooled power stations. Coastal and estuarial power generation primarily uses seawater cooling. Short-term forecasts

suggest a slight increase in demand by 2030, but a potential decrease by the 2050s, ranging from a 13 MI/d increase to a 370 MI/d decrease. A significant portion of freshwater-cooled electricity generation occurs in over-abstracted areas, raising concerns about the resilience and future water security of these supplies. Despite accounting for about 45% of licensed water abstraction, primarily for hydropower, this sector contributes only 0.5% to England's electricity.

High water demand results in over abstraction of water in rivers. A third of river catchments in England are currently at risk due to high abstraction levels.

This situation is largely attributed to the existing licensing rules that allow water companies to extract more water than is sustainable, threatening local ecosystems. The impact of over abstraction becomes particularly acute during periods of low rainfall, when water usage in gardens increases. While ecosystems can sometimes recover from one-off events, repeated or prolonged drought conditions can lead to the permanent loss of ecosystems (WWF, 2009). https://assets.wwf.org.uk/downloads/riverside_tales.pdf WWF (2009) Riverside tales. *Change.*

In England and Wales, the Environment Agency has issued approximately 20,000 abstraction licenses, predominantly held by water utilities and agricultural enterprises. Current estimates indicate that over 1,100 megalitres per day are abstracted from boreholes, surpassing the ecological capacity. Similarly, over 1,300 megalitres are drawn from rivers, with each megalitre equating to the daily water consumption of approximately 7,000 individuals. Several challenges exacerbate this situation. Firstly, an excess of abstraction licenses has been granted, leading to imbalances where rights to extract water exceed the available supply in certain catchment areas. Additionally, the Environment Agency relies on self-reporting by companies and individuals for monitoring water usage, including any violations (DEFRA, n.d.) <https://www.gov.uk/business/environmental-management-water-abstract-take-water>.

Department for Environment, Food & Rural Affairs (DEFRA), n.d. Manage water abstraction or impoundment. [online] Available at: <https://www.gov.uk/business/environmental-management-water-abstract-take-water> [Accessed 4 January 2024].

The Environment Agency maintains that abstraction licenses come with stipulated conditions aimed at safeguarding the environment and the rights of other water abstractors. However, there are legal exemptions that permit farms, as well as other businesses or households, to extract up to 20,000 litres per day, equivalent to the capacity of a tanker-lorry, with limited or no comprehensive checks to ensure adherence to these regulations. Furthermore, while licensed abstractions are expected to cease when water flows drop below a certain minimum level, there are no restrictions on unlicensed withdrawals. This contributed to algal blooms, contaminated sediment, and a notable decline in salmon and other aquatic life in the River Wye. This alarming scenario creates a toxic environment where insufficient water during low flows exacerbates pollution levels, posing a severe threat to river ecosystems <https://www.ft.com/content/19caeb90-b5c9-46b2-9118-8d69d4c48d53> .

Financial Times, 2023. [online] Available at: <https://www.ft.com/content/19caeb90-b5c9-46b2-9118-8d69d4c48d53> [Accessed 4 January 2024].

The Environment Agency evaluated current and future water use and climate change to determine water stress for each water company area, as required by the 1999 Regulations (as amended). Water resources are under pressure even in areas not classified as seriously water stressed. The results show where water resources are or will be overused, affecting the environment or water supplies now or later. They do not reflect the performance or risk of individual water companies. The Secretary of State identified the following areas as seriously water stressed for metering purposes based on the updated analysis. The numbers in brackets match the numbers on the map in Figure 1: Cambridge Water (4); Portsmouth Water (7); South Staffordshire Water (10); Severn Trent Water – excluding Chester zone (12); Veolia Water (15); Wessex Water (17); South West Water – Bournemouth (19); South West Water – Isles of Scilly (20); Affinity Water (1); Anglian Water – East Anglia (2); Essex and Suffolk Water (5); SES Water (8); South East Water (9); Southern Water (11); Thames Water (14)

Figure 1 shows a map of the results. It shows areas coloured red are those that are seriously water stressed and those in yellow are not seriously water stressed.

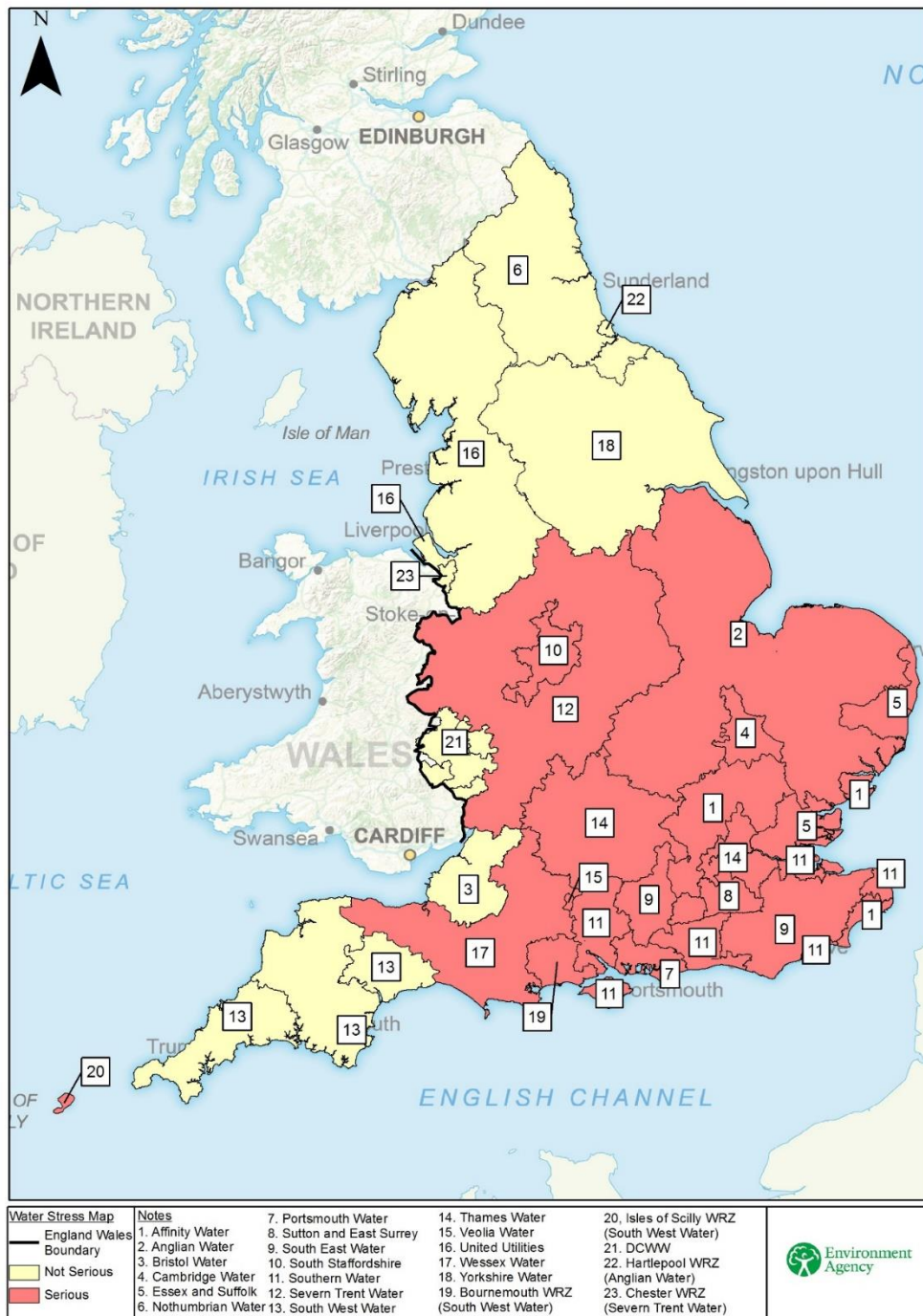


Figure 3 Water stress for each water company in England. Source: (Environment Agency, 2021)

Environment Agency. (2021). Water stressed areas – final classification 2021. [Online] Available at: <https://www.gov.uk/government/publications/water-stressed-areas-2021-classification> [Accessed 3 January 2024].

Climate change

The United Kingdom, traditionally perceived as a region with abundant rainfall, is increasingly confronted with challenges such as water supply shortages and drought. This situation, which may seem paradoxical at first glance, is the result of several interconnected factors, including, but not limited to, climate change, population growth, and aging infrastructure.

Climate change has significantly altered the hydrological landscape in the UK. The country is experiencing more extreme weather patterns, including heavier rainfall and prolonged dry

spells. (<https://www.metoffice.gov.uk/research/climate/understanding-climate/uk-and-global-extreme-events-drought>).

Met Office, 2012. UK and Global extreme events – Drought [online] Available at: <UR<https://www.metoffice.gov.uk/research/climate/understanding-climate/uk-and-global-extreme-events-drought>> [Accessed 4 January 2024].

BBC News, 2011. Cambridgeshire's sugar beet and potato farmers struggle to harvest their crops. [online] Available at: <https://www.bbc.co.uk/news/uk-england-cambridgeshire-15449979> [Accessed 4 January 2024].

BBC News, 2011. [online] Available at: <https://www.bbc.co.uk/news/uk-england-14390607> [Accessed 4 January 2024].

BBC News, 2011. Drought forces rail line closure after causing track movement. [online] Available at: <https://www.bbc.co.uk/news/uk-england-suffolk-15790022> [Accessed 4 January 2024].

Anticipated changes in precipitation and evapotranspiration due to climate change are likely to alter water flow patterns, affecting water quality and availability. This could lead to a decrease in river flows during summer with higher frequencies and magnitudes of flash floods, and increase in runoff during winter months. Arnell, N.W., Kay, A.L., Freeman, A., Rudd, A.C. & Lowe, J.A. (2021) *Changing climate risk in the UK: A multi-sectoral analysis using policy-relevant indicators*. *Climate Risk Management*. 31 (December 2020), 100265. doi:10.1016/j.crm.2020.100265.

Increased average temperatures lead to higher evaporation rates, drying out soil and reducing surface water availability. Heatwaves can further exacerbate this, putting immense pressure on freshwater resources. Less precipitation impacts replenishment of groundwater reserves disrupting seasonal water distribution.

Higher summer temperatures may reduce water quality in rivers and lakes, exacerbated by reduced flows and more frequent algal blooms. Conversely, winter might see higher flows, posing additional challenges. Watts, G., Battarbee, R.W., Bloomfield, J.P., Crossman, J., Daccache, A., et al. (2015) *Climate change and water in the UK – past changes and future prospects*. *Progress in Physical Geography*. 39 (1), 6–28. doi:10.1177/0309133314542957.

Drought impact examples

Drought 2010-2012

The 2010-2012 droughts in the UK posed substantial environmental challenges. Reduced river flows and disrupted ecosystem processes and negatively impacted fish populations (Centre for Ecology & Hydrology, n.d.). Lower water levels resulted in increased concentrations of harmful elements. During this period, wildfires occurred in Scotland, Wales, and southern England (Met Office, 2012).

Agricultural lands suffered from intensified soil erosion due to dry conditions (Met Office, 2012). Plant and animal species experienced habitat loss and reduced water availability, impacting their populations (Centre for Ecology & Hydrology, n.d.). In 2011, up to 85% of the UK's cereal crops, including winter wheat and barley, were affected by the drought (Centre for Ecology & Hydrology, n.d.). Cambridgeshire's sugar beet and potato farmers struggle to harvest their crops <https://www.bbc.co.uk/news/uk-england-cambridgeshire-15449979>

Wheat farmers found their harvest was down by up to 60%. <https://www.bbc.co.uk/news/uk-england-14390607>

During the management of water shortages, 7 Public Water Supply (PWS) companies had to impose Temporary Use Bans (TUBs) for 3-4 months, impacting 20 million customers. Additionally, 5 companies sought drought permits/orders for reservoir refilling. These events led to significant financial implications: PWS companies faced total costs around £19 million, with Anglian Water and Southern Water each spending over £5 million. Revenue losses in the second quarter of 2012 for various firms, including PWS companies, amounted to about £165 million, with profits dropping by £96 million. Notably, £72 million of this loss was linked to

irrigated potatoes. A figure illustrates the sector-wise distribution of this "first-round" turnover reduction (Reviewed by Water UK, 2015).

Water UK (2015) Water resources long term planning framework (2015-2065).

The droughts ended with sudden extreme rainfall and flooding, exacerbating challenges for growers. Early-season irrigation was necessary due to dry weather beginning in mid-March 2010, impacting cereal growth (*Rey, Holman, & Knox, 2020*). Livestock management became difficult due to water scarcity and dry pastures, increasing costs for irrigation and feeding (*Met Office, 2012*).

The construction sector reported a decline in output, partially due to the dry weather conditions (Construction Products Association, 2012). Drought also forces rail line closure after causing track movement. <https://www.bbc.co.uk/news/uk-england-suffolk-15790022>

A study by Vivid Economics conducted after the 2012 drought suggested that, had the drought persisted and rainfall stayed at 80% of the long-term average into 2013, the energy industry's turnover costs could have reached around £1.2 billion.

<https://assets.publishing.service.gov.uk/media/5a804f89ed915d74e622db6a/ea-analysis-water-sector.pdf>

In other sectors water usage represents about 5.5% of the actual water abstraction. Key industries with high water dependence include food and drink, mining and quarrying, chemicals and paper, and manufacturing. Generally, water abstraction in these areas is thought to closely correlate with the country's economic performance, although the Environment Agency has not conducted detailed analysis to confirm this.

Drought 2018-2019

During 2018 drought, Between May and August, 10 major fish kill incidents occurred in central, southern, and eastern England, including the Teme on the Welsh borders. These incidents were directly attributed to the dry weather. Numerous wildfires, including the Saddleworth Moor fire in Greater Manchester, took place during this period. The Saddleworth Moor fire lasted for 24 days (*Turner, S. (2021). The 2018/2019 drought in the UK: a hydrological appraisal*).

United Utilities, the water company serving northwest England, announced a temporary use ban (TUB or 'hosepipe ban') scheduled to start on August 5. However, it was not activated due to wetter conditions in August.

Drought impacts were measured in southern and eastern Scotland, slightly later in the year compared to England. These impacts included dry riverbeds, isolated pooling of water, and evidence of dead, diseased, or distressed animals.

Natural Resources Wales (NRW) responded to dry weather-related incidents, such as fish kills, algal blooms, pollution, and wildfires across Wales. Dry riverbeds had detrimental effects on fish migration and spawning. On a positive note, the dry weather uncovered the locations of Roman fortifications across Wales.

In Northern Ireland, a Temporary Use Ban (TUB) was introduced at the end of June, along with water efficiency campaigns. This was in response to infrastructural challenges caused by high consumer demand during the heatwave, rather than major resource shortages.

The agriculture sector was severely affected. Crops, grass, feed, and livestock were the most impacted areas of farming. Reduced crop yields, shortages of grass and feed, and increased prices were among the negative impacts. In Scotland, the brewing and distilling sectors faced impacts on the quality and yield of malt barley, leading to increased raw material costs. Some sections of canals in northern England were closed in late July and early August due to low water levels, impacting transportation (*Turner, S. (2021). The 2018/2019 drought in the UK: a hydrological appraisal*).

In England and Wales, the likelihood of emergency water restrictions due to drought is estimated at 1% annually. Recent droughts have been more severe than historical benchmarks used for water industry planning. The National Infrastructure Commission (2018) estimated that a severe drought, occurring with a 1% annual probability by 2050, could affect water

supply to 40% of households in England. An even more severe drought, with a 0.5% annual probability, could impact 60% of households. Economic losses from such droughts are significant, with potential Gross Value Added (GVA) losses of £1.4 billion per day under highest water use restrictions (Jenkins, K., Dobson, B., Decker, C. & Hall, J.W. (2021) *An Integrated Framework for Risk-Based Analysis of Economic Impacts of Drought and Water Scarcity in England and Wales*. *Water Resources Research*. 57 (8). doi:10.1029/2020WR027715).

AECOM's analysis predicts that a severe drought lasting three years in the 2050s could cost up to £80 billion, though this figure is a high-level estimate of the potential costs. The impact of such a drought would be widespread, significantly disrupting businesses, public health, and social stability. The analysis highlights that the River Thames catchment, particularly due to London's demand, would bear a substantial portion of these costs, with the South East facing the highest risk of severe water supply restrictions.

<https://assets.publishing.service.gov.uk/media/5a804f89ed915d74e622db6a/ea-analysis-water-sector.pdf>.

The direct Expected Annual Loss (EAL) to water users, averaged over an ensemble equivalent to 2800 years of synthetic daily weather, was estimated to be £11.7 million in the 2011 base-year according to the study by Jenkins et al. 2021. The total economic losses, including indirect economic losses, amounted to £30.2 million in 2011. The most severe event simulated resulted in a total loss of £1.4 billion in 2011, equivalent to 0.11% of GVA.

- Centre for Ecology & Hydrology. (n.d.). *Drought to Flood - 2010 to 2012* [Online] Available at: <https://www.ceh.ac.uk/our-science/projects/drought-flood-2010-2012> [Accessed 3 January 2024].
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- Met Office. (2012). *England and Wales Drought 2010 to 2012*. [Online] Available at: <https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2012/england-and-wales-drought-2010-to-2012---met-office.pdf> [Accessed 3 January 2024].
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- Atkins. (2018). *Analysis of the cost of emergency response options during a drought*. Available at: <https://nic.org.uk/app/uploads/atkins-2018-analysis-of-the-cost-of-drought.pdf>
- Turner, S., Barker, L.J., Hannaford, J., Muchan, K., Parry, S. and Sefton, C. (2021), *The 2018/2019 drought in the UK: a hydrological appraisal*. *Weather*, 76: 248-253. <https://doi.org/10.1002/wea.4003>
- Water UK (2015). *Water resources long term planning framework (2015-2065)*. (Report): Water UK.

Flood risks

Floods 2013-2014

Some areas faced prolonged water shortages and disruptions: <https://www.ofwat.gov.uk/regulated-companies/resilience-in-the-round/climate-change/>.

Raw sewage contaminated water supplies, leading to health concerns

<https://www.oxfam.org.uk/oxfam-in-action/oxfam-blog/climate-change-and-flooding/>

There is very little evidence that developers, planners and financiers are taking into account climate change when deciding how and where to build. The insurance industry is very well informed of the current and future levels of flood risk.

<https://www.lse.ac.uk/granthaminstitute/news/flood-risk-is-rising-and-so-must-our-resilience-to-it/>

Simulation studies conducted on behalf of the Commission have revealed that an investment of approximately £12 billion over a 30-year period in efficient drainage infrastructure measures has the potential to decrease the count of properties vulnerable to surface water flooding in 2055 by roughly 60 percent. Currently, there are approximately 325,000 properties in England situated in regions with a greater than 60 percent likelihood of facing surface water flooding within the next three decades, categorized as 'high' risk. Additionally, there are 500,000 properties in areas with a similar risk probability within the next century, without accounting for climate change or new development effects. It is noteworthy that over 85 percent of these high-risk properties are situated in urban areas. It is important to note that flood risk management responsibilities are decentralized to the governments of Scotland, Wales, and Northern Ireland. Floods in Britain significantly impact water supplies, and climate change is exacerbating these effects.

<https://nic.org.uk/app/uploads/NIC-Reducing-the-Risk-of-Surface-Water-Flooding-Final-28-Nov-2022.pdf>

Public and industry awareness

A public survey suggested that British public is largely unaware of the risks that climate change and population growth have on water supplies (<https://www.cambridge-water.co.uk/news/the-great-british-rain-paradox>).

In 2022, the UK faced unprecedented high temperatures, leading to dried-up soils and reduced river flows. A survey sent to 2,500 private water abstractors demonstrated that around 40% experienced the impact of this drought, but only 6% of those affected sought assistance from their local water company, and merely 9% have ever relied on a water company's supply. Despite the challenges faced in 2022, only half of those affected have developed drought contingency plans. A third of the respondents reported that their business operations are limited by their current water abstraction capacity. A significant reduction of 25% in their abstraction license would severely affect three-quarters of these businesses. A vast majority, 94%, anticipate an increase in their water usage by 2050.

<https://www.watermagazine.co.uk/2022/09/30/british-water-warns-uk-water-sector-must-work-more-collaboratively-and-transparently-or-risk-more-supply-chain-companies-abandoning-the-industry/>

<https://www.gov.uk/government/news/action-on-preparing-for-drought-must-remain-experts-warn>

Currently, water-related risks in the UK are typically assessed independently, either pertaining to an excess or deficiency of water resources. However, it is evident that there exist synergistic advantages in addressing these risks collectively in specific geographic regions. For instance, strategies centred around natural flood management, such as the restoration of peatlands, possess the capacity to serve a dual purpose: not only mitigating flood risks but also facilitating the retention of rainwater in elevated terrains, consequently aiding in the replenishment of aquifers.

Moreover, within urban areas, Sustainable Drainage Systems (SuDS) play a pivotal role by decelerating the flow of rainwater and capturing it for infiltration into the soil. This contrasts

with the conventional scenario where rainwater contributes to rising river levels or overflows into sewage systems, ultimately being discharged into the sea.

In light of these considerations, it is imperative for water utilities to forge closer collaborations with flood risk authorities. This collaborative effort should seek opportunities to holistically manage water resources at the catchment scale, recognizing water as an increasingly valuable and diminishing asset in the context of the UK's resource landscape.

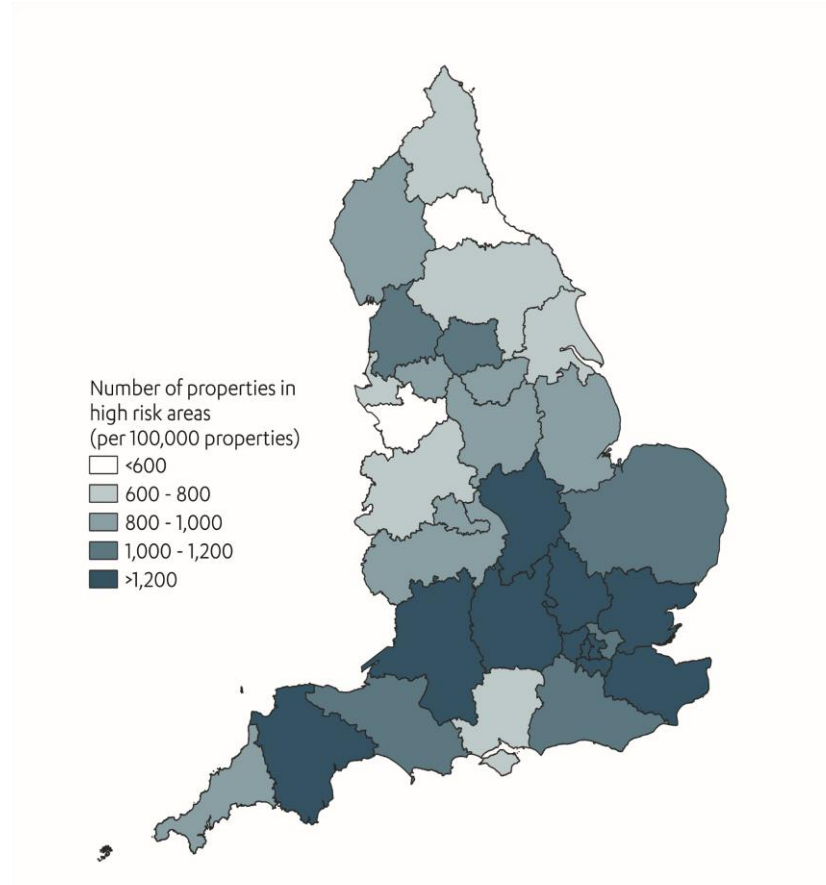


Figure 4 Number of properties in high flood risk areas in England. Source: Commission calculations based on Sayers et al. (NIC, 2022)

Infrastructure needs improvement

Population growth is a major factor affecting water resources. England's population is expected to reach 58.5 million by 2026, with much of this growth occurring in water-stressed areas. Without measures to decrease water demand and increase supply, most regions could face supply shortages by the 2050s, especially under scenarios of high greenhouse gas emissions and significant population increase. Even with lower population growth and milder climate change, substantial deficits are anticipated by the 2050s, particularly in the south-east.

Aging infrastructure leads to significant losses, estimated at around 20% of the public water supply, equivalent to 3 billion litres a day. This is down from a high of over 4.5 billion litres a day in the early 1990s but higher now than it was 20 years ago (Ofwat, 2022).

Consider the cost of treating and distributing water, even a conservative estimate of £0.1 pence per litre (accounting for treatment, loss, and distribution costs) would amount to a daily loss of approximately £292.3 million. Annually, this could be in the region of £106.7 billion

Research by HR Wallingford for the Adaptation Sub-Committee's 2017 Climate Change Risk Assessment considered scenarios including climate change and population growth. Without further actions, significant water deficits are projected, particularly in the northwest of England, Yorkshire and Humber, London, and the southeast, as well as parts of south Wales and central Scotland. By 2050, the shortfall in England, Scotland, and Wales could range from

800 million to 3 billion liters per day, expanding to 1.4 to 5 billion liters by 2080 (Committee on Climate Change, 2017). A more recent report indicates an expected nationwide shortfall of around 4 billion liters per day by 2050. This challenge is already affecting areas like Sussex, Cambridgeshire, Suffolk, and Norfolk, where water scarcity restricts growth (Department for Environment, Food & Rural Affairs, 2023).

Committee on Climate Change (2017) Pressure: Preparing for UK Water Shortages. Available at: <https://www.theccc.org.uk/2017/09/12/pressure-preparing-uk-water-shortages/> Accessed: [Accessed 4 January 2024].

With water companies proposing to spend £96 billion between 2025 and 2030, an 88% increase on the previous five years, this indicates the scale of investment required to address current and future challenges. It amounts to an annual investment of around £19.2 billion and builds on over £200 billion that has been invested by companies over the last three decades.

These plans will:

- Fund the development of up to ten new reservoirs and major new national water transfer schemes;
- Upgrade England's ageing pipes to reduce leakage by 28% with similar reductions in Wales;
- Remove a million tonnes of phosphorus from English rivers, while eliminating an average of 140,000 sewage spills each year and funding the construction of 28 wetlands to improve water quality and biodiversity.

Issues like sewage overflow into rivers and seas are becoming prevalent, with 301,091 occurrences reported in 2022. This is partly due to the existing infrastructure design and pressures from climate change and population growth.

They pose significant environmental and health hazards. Latest study (Giakoumis & Voulvoulis, 2023) indicated that the recent increase in sewage overflows was due to wastewater treatment works (WWTWs) lacking the capacity to handle increased flows resulting from population growth and industrial activities. The UK sewer system, combining wastewater from various sources with stormwater runoff, uses over 14,000 Combined Sewer Overflows (CSOs) to discharge excess sewage into natural watercourses. These overflows can lead to environmental deterioration and human health risks, such as enteroviruses causing gut infections and antibiotic resistance, negatively impacting tourism, leisure activities, and seafood consumption due to accumulated toxins and microplastics. The chronic under-capacity of wastewater systems is a fundamental cause behind the increased frequency and duration of CSO spills, highlighting the urgent need for infrastructure investment.



Figure 5 Sites in England and Wales where overspills occurred more than twice between 2016-2023 Map data ©[2023] Google. Source: Authors, data@theriverstrust.org

In England, the length of combined sewers is over 62,000 miles, which is equivalent to circling the Earth more than twice. To enhance this infrastructure, substantial investments are necessary, but these should not lead to excessively high costs for consumers. The total cost to stop all discharges might reach £600 billion, potentially raising yearly water bills to about £820 by 2049. The Storm Overflows Discharge Reduction Plan represents an unprecedented initiative to address pollution from storm overflow spills. This plan mandates water companies to undertake the most extensive infrastructure project ever seen in the sector, with a capital investment of £56 billion over a 25-year period, aimed specifically at reducing storm overflows (DEFRA, 2023).

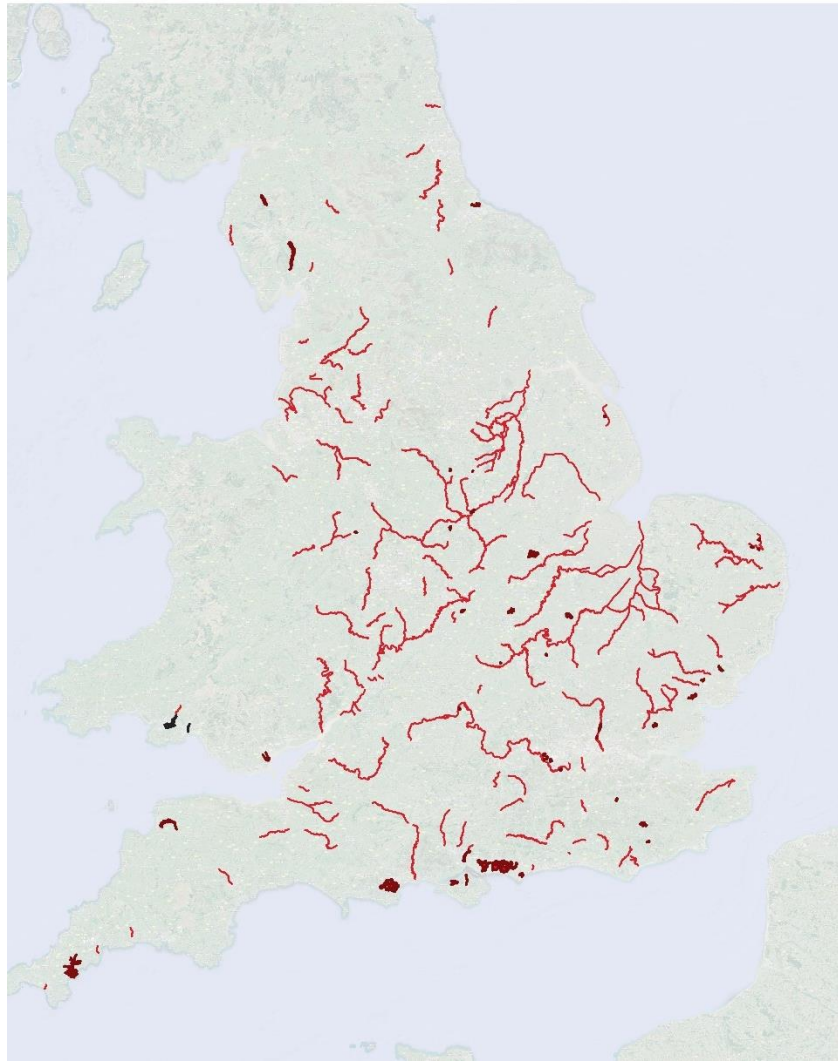


Figure 6 Eutrophic water bodies in England and Wales. Source: Authors. Data

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Conclusion

The water-related risks facing the United Kingdom are complex and increasingly urgent, driven by the confluence of climate change, growing population pressures, aging infrastructure, and unsustainable water management practices. The assumption of the UK as a water-rich nation is rapidly shifting, with more frequent droughts, severe flooding, and rising demand placing unprecedented stress on both natural ecosystems and critical infrastructure.

This paper highlights the necessity of adopting a comprehensive and forward-looking approach to managing water resources. Integrating climate resilience into policy and infrastructure investment will be key. The restoration of natural systems, such as wetlands, and the implementation of sustainable drainage solutions in urban settings present promising avenues for mitigating the dual threats of flooding and drought. However, these challenges cannot be addressed in isolation. Meaningful progress will depend on coordinated efforts between water utilities, government bodies, and the financial sector, all working together to secure the necessary funding and implement long-term adaptive measures.

Looking ahead, it is vital that the UK moves from reactive crisis management to proactive, strategic planning. By aligning investments in water infrastructure and ecosystem restoration with long-term climate adaptation goals, the country can better safeguard its water resources and enhance its resilience to the escalating impacts of a changing climate.

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