Department for Transport

Met Office

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Transport hazard summary series

Drought

Drought is a significant natural hazard in the UK that can lead to damage to transport infrastructure and safety risks due to the ground becoming cracked and uneven at transport sites. Water shortages can cause a diverse range of impacts on transport operations.

The Department for Transport, Met Office and partners have created this series of **transport hazard summaries** to explain natural hazards and other hazards that are not the result of malicious acts, their impacts and how they may change in future.

This summary will introduce droughts and point to further information to help decision makers manage and adapt to the risks posed to transport from drought-related hazards.

The UK is projected to experience drier summers, with average summer rainfall in the south of England potentially decreasing by up to 45% by 2070.*

* Met Office Hadley Centre, 'UK Climate Projections: Headline Findings', 2022, available at: **www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18_headline_findings_v4_aug22.pdf**

What is a drought?

Drought is a prolonged period of below-average rainfall leading to water shortage in an environment or system. This means that rain can still occur while a drought is ongoing. There is no universally accepted definition for drought due to its multifaceted impacts and regional variations. The National Drought Group in England, chaired by the Environment Agency, describe three classifications for drought:*

Environmental

Low river, groundwater and soil moisture levels

Agricultural

Insufficient soil moisture to support farming practices

Water supply

Water shortages impacting water supply

Timeline of a drought

Droughts develop gradually and can take months or even years to reach peak intensity with impacts persisting long after rainfall returns. This slow onset can delay recognition of the risks to transport. Understanding these timescales can help to anticipate and plan for the possibility of drought.

- Short, intense droughts of up to 9 months typically occur in summer, following below average rainfall during winter and spring, and are more common across North West and South West England due to their geology.†
- Prolonged droughts (18+ months) over multiple drier-than-average seasons are more common across South East England as depleting groundwater can impact water supplies.

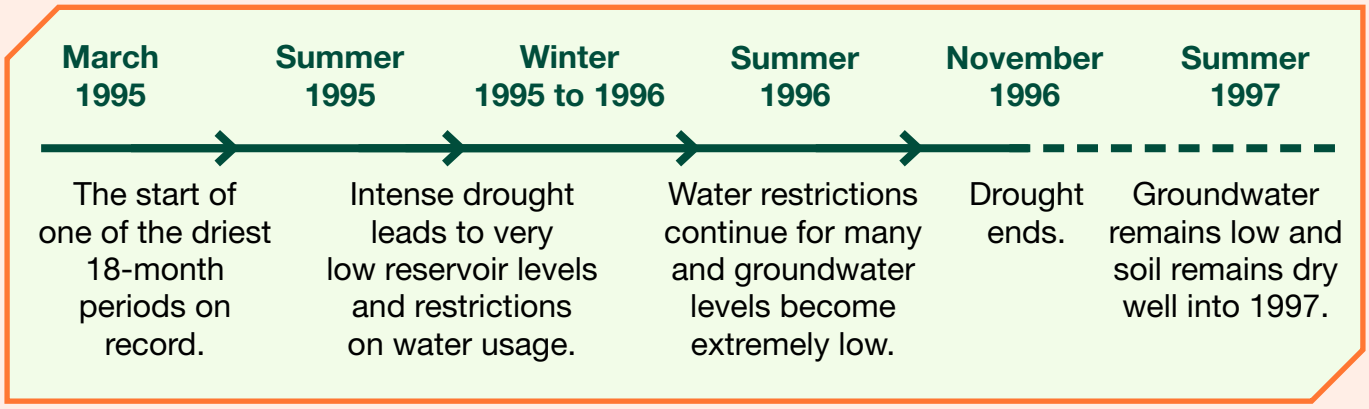
* Environment Agency, 'Drought response: our framework for England', 2017, available at: **https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/625006/LIT_10104.pdf**

† Hanlon, H.M., Bernie, D., Carigi, G. and others, Climatic Change, 'Future changes to high impact weather in the UK', volume 166, article number 50, 2021, available at: **https://link.springer.com/article/10.1007/s10584-021-03100-5**

Case studies

The 1995 to 1996 drought was marked by the extremely hot, dry summer of 1995 and a prolonged period of below average rainfall, even through the autumn and winter months.* Water usage restrictions affected transport, such as reduced visibility in the Mersey Tunnel due to limitations on cleaning the lighting and walls.

Figure 1: Timeline of the 1995 to 1996 drought*



There have been a number of notable droughts since 1996. While measures to protect water supply have been improved, water use limits were widely put in place during 2022 to 2023 when the summer of 2022 saw record breaking 40°C temperatures.†

Drought developed across much of England and Wales from 2010 to 2012 due to a lack of rainfall, rather than being associated with a significant period of hot weather. Drying of the ground caused it to become uneven, leading to significant deterioration of rail track, particularly across Southern England. Heavy rain and flooding followed the drought, however, groundwater levels took a long time to recover. Water use limits remained in place even for some regions that were flooded.†,‡

* UK Centre for Ecology and Hydrology, 'The Tanker Drought – 1995 to 1996', available at: **www.ceh.ac.uk/our-science/projects/tanker-drought-1995-1998**

† Environment Agency, 'Drought response: our framework for England', 2017, available at: **https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/625006/LIT_10104.pdf**

‡ UK Centre for Ecology and Hydrology, 'From Drought to Flood – 2010 to 2012', available at: **www.ceh.ac.uk/our-science/projects/drought-flood-2010-2012**

Drought and climate change

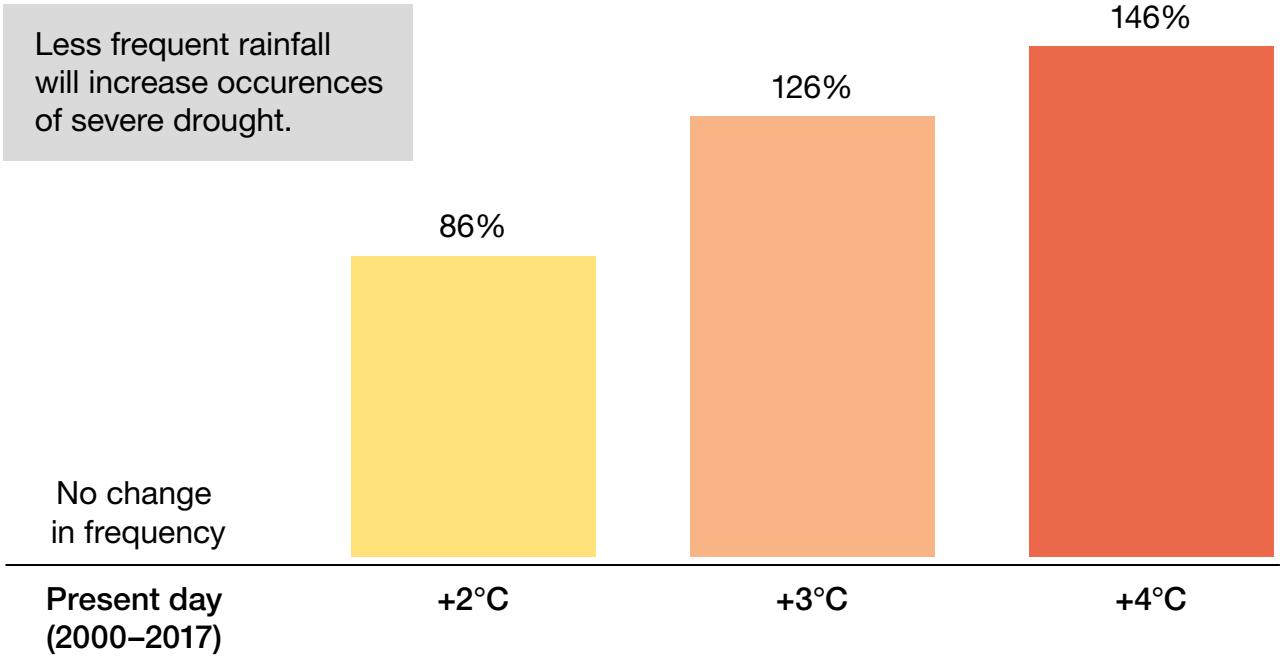
Figure 2 shows that droughts of similar or worse severity to that of 2010 to 2012 in terms of the lack of rainfall are projected to become significantly more frequent. Emissions scenarios, climate projections and global warming levels are explained in 'The changing climate' transport hazard summary.

Droughts currently occur on average every 5 to 10 years. This interval could almost halve by the 2040s in England and Wales.*,†

While winters are expected to get wetter on average, the distribution of this rainfall through the year may not prevent drought conditions from developing.*

The severity of droughts is expected to worsen for all lengths of drought, whether they last 3 months or 36 months.*

Figure 2: The projected frequency of droughts at different global warming levels where a drought is as bad, or worse than, the 2010 to 2012 drought in terms of rainfall deficit*



- Between now and the middle of the century, continued climate change is largely inevitable.
- Global warming of 2°C is reached by most emissions scenarios by the middle of the century.
- In the second half of the century, a wide range of global warming levels remain possible.
- 4°C of global warming is reached only by the higher emissions scenarios, and not until later in the century.‡ Emissions scenarios are explained in 'The changing climate' transport hazard summary.

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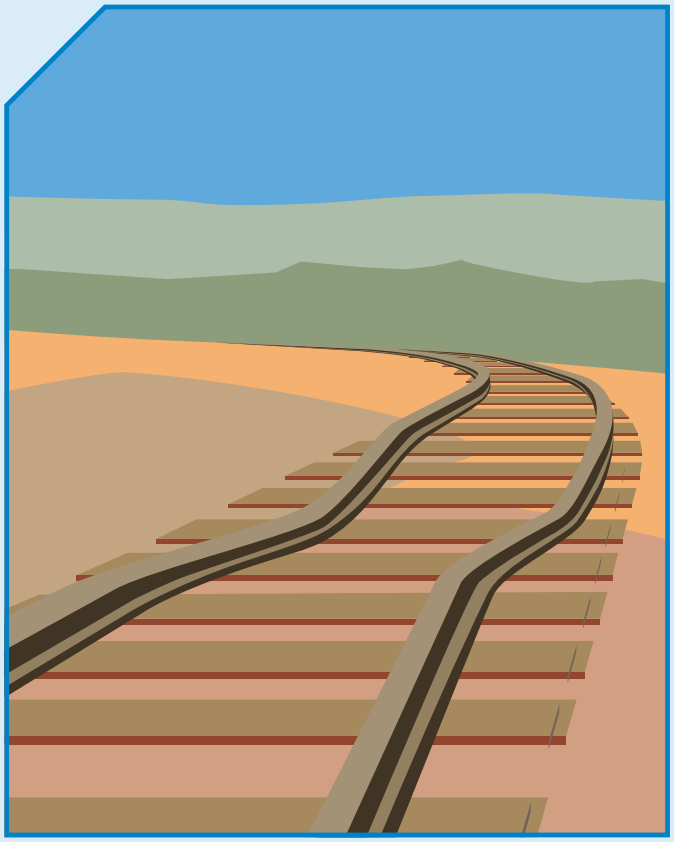
* Hanlon, H.M., Bernie, D., Carigi, G. and others, Climatic Change, `Future changes to high impact weather in the UK', volume 166, article number 50, 2021, available at: **https://link.springer.com/article/10.1007/s10584-021-03100-5**

† Met Office, 'How to Assess your Climate Risk', 2024, available at: **https://climatedataportal.metoffice.gov.uk/pages/lacs-assess-your-risk**

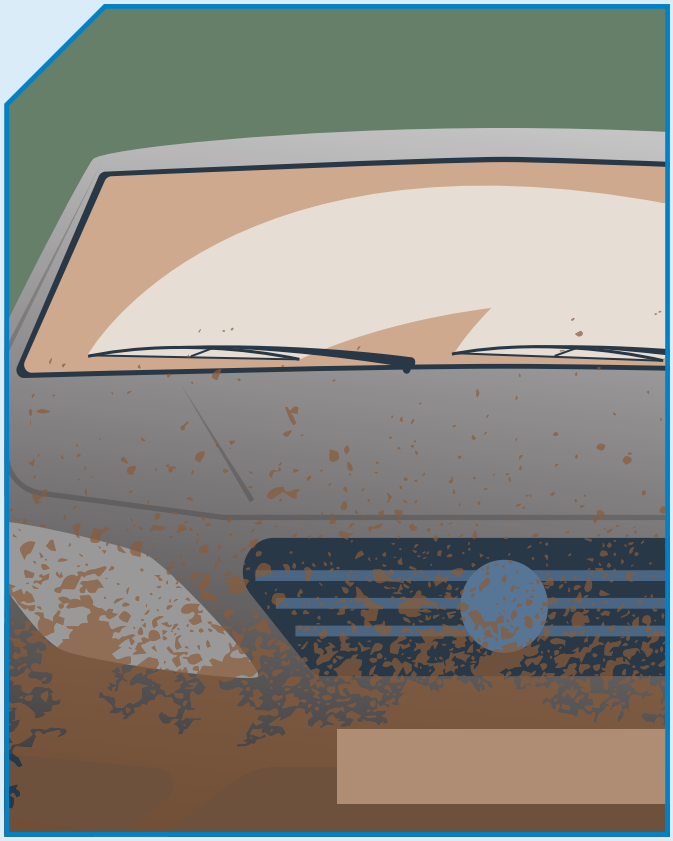
‡ Climate Change Committee, 'Proposed methodology for the Fourth Climate Change Risk Assessment – Independent Assessment', 2024, available at: **www.theccc.org.uk/publication/proposed-methodology-for-the-ccra4-advice/?chapter=3-proposed-methodological-approach-for-ccra4-ia**

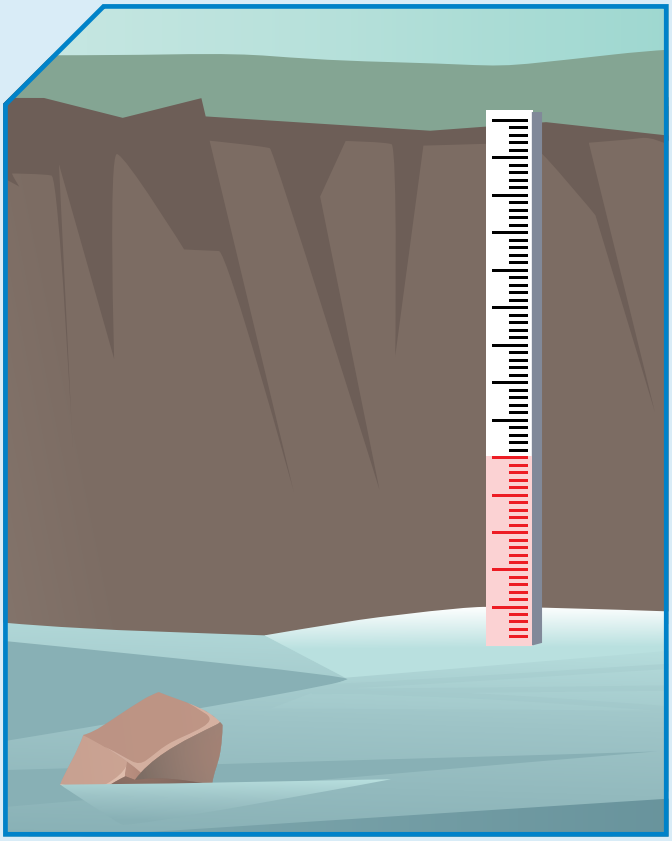
Transport impacts due to drought



Infrastructure damage and disruption

- Dry soil, particularly clay, can shrink and become cracked or uneven. This can damage or crack roads and runways and cause rails to become misaligned, potentially leading to accidents or derailments.
- Drying of soil in earthworks can lead to faster degradation making them more susceptible to fail during subsequent rain.
- If soil becomes unstable due to drying, falling trees are more likely in subsequent heavy rain or strong winds and could block roads and railways.
- A lack of clean water for concrete production or manufacturing can delay production and development of new transport assets and infrastructure.
- Dry soil and debris can clog drainage systems, heightening the risk of surface water flooding and its impacts.
- Pollutants on road surfaces can build up in prolonged dry conditions, becoming concentrated when they are eventually washed into watercourses.





Maintenance, health and safety

- Reduced water to clean buses, cars, trains and aircraft can lead to reduced visibility. Reduced cleaning of signage and lighting can pose safety risks, while dirt on solar panels could reduce energy production.*
- In severe droughts, water available for fire suppression could be limited. Low pressure in a mains water supply can lead to the failure of sprinkler systems at stations, ports and other transport hubs.
- Cooling systems in transport hubs and London Underground tunnels, using water sources such as rivers and aquifers, could be disrupted if levels are low.†
- Hygiene and facilities in transport hubs and vehicles could be impacted.

Interdependencies: Drought can impact energy production in the UK as many power stations use freshwater cooling systems. Power outages have a wide ranging impact on the transport sector.

* Global Highways, 'Essential tunnel maintenance', 2012, available at: **www.globalhighways.com/wh10/feature/essential-tunnel-maintenance**

† Stephen, P., Rail Magazine, 'Cooling the Tube', 2016, available at: **www.railmagazine.com/infrastructure/stations/cooling-the-tube**

Hazards associated with drought

Extreme heat

Drought makes the ground dry, putting less moisture in the air. This can lead to higher temperatures which in turn leads to more evaporation.

Landslides and earthwork failures

Frequent cycles of drying, due to hotter, dryer weather and wetting, can cause soil degradation on slopes making them prone to fail.*

Poor air quality

Harmful dust and particles can remain in the air during dry spells when they are not 'washed out' by rainfall.

Subsidence and soil degradation

A lack of soil moisture can lead to shrinkage and de-stabilisation of the ground, especially after repeated severe drying and wetting cycles.

Surface water flooding

Dry, hardened ground can reduce water absorption, which could increase run-off and pooling causing flooding where intense rain falls onto dry surfaces.†

Wildfire

Dry ground and vegetation can readily ignite and wildfires can spread rapidly.

Further information on these hazards can be found in our series of transport hazard summaries: **www.gov.uk/government/collections/transport-hazard-summaries**

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* Stirling, R. A., Toll, D. G., Glendinning, S., Helm, P. R., Yildiz, A., Hughes, P. N., Asquith, J. D., Geotechnique, 'Weather-driven deterioration processes affecting the performance of embankment slopes', volume 71, issue 11, pages 957 to 969, 2021, available at: **www.icevirtuallibrary.com/doi/10.1680/jgeot.19.SiP.038**

† Gimbel, K. F, Puhlmann, H. and Weiler, M. 'Does drought alter hydrological functions in forest soils?', 2015, available at: **https://hess.copernicus.org/articles/20/1301/2016/**

Risk mitigation and adaptation

With droughts expected to become more frequent and severe, ways to adapt and mitigate the risk to transport are needed. Examples include:

- low water cleaning approaches for infrastructure such as vacuum and brush machinery to clean tunnels and signs
- rainwater storage systems for vehicle cleaning using run-off from roofs
- water saving measures at transport hubs such as wastewater toilet flushing
- continual monitoring for leaks in water supply systems and timely repair of any leaks found
- seawater or stored rainwater use for fire suppression
- monitoring soil moisture and earthwork stability and planting resilient vegetation to slow moisture loss
- cooling systems which recycle or do not use water

Questions for decision makers

- How might drought impact your area of transport?
- Which of your transport assets or processes are most vulnerable to prolonged dry conditions or water scarcity?
- Can your maintenance and cleaning practices be adapted to maintain safety in times of reduced water availability?
- Can you routinely conserve or store water to allow the continued operation of transport services, stations, ports and airports and reduce pressure on water supplies?
- Can you routinely monitor the effect that degradation of surfaces has on infrastructure?
- Can you adapt your ‘business as usual’ plans to mitigate droughts that could occur every 2 to 5 years?

Further reading

Drought permits and drought orders – Department for Environment, Food and Rural Affairs and Environment Agency – information on the restrictions that can be placed on water usage in case of drought.

Drought response: our framework for England – Environment Agency

UK and Global extreme events – Drought – Met Office factsheet giving more information about drought and climate projections

Water Management at Airports – International Civil Aviation Organisation – guidance on airport water management

Water situation reports for England – GOV.UK – Environment Agency monthly reports giving the current status of water levels in England

Climate information and risk assessment

See ‘The changing climate’ and ‘Transport hazards, risks and resilience’ transport hazard summary for more information on identifying and planning for risks to transport and where to find climate data, including more detail on projected changes on a regional level.