Department for Transport

Met Office

Issued September 2025

Transport hazard summary series

Coastal flooding and erosion

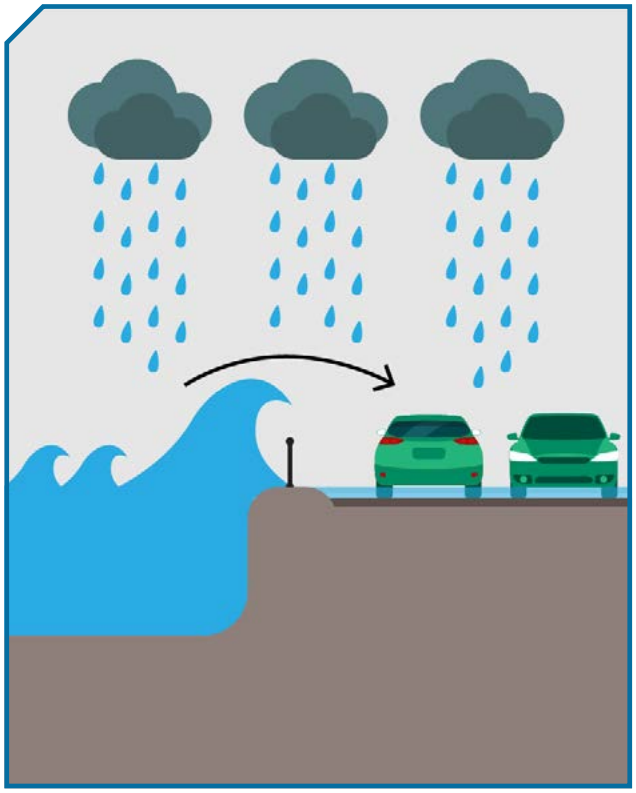
Coastal flooding and erosion is posing a growing risk to the transport network near UK coasts. There is the potential for 1 metre or more of sea level rise before the end of this century, making more roads, railways and ports exposed to being inundated with sea water more often. Without sufficient defences, some low-lying coastal routes are at risk of becoming unsustainable. Higher tides, larger waves and accelerating coastal erosion are increasing the risk of damage to coastal transport infrastructure. The transport sector will need to adapt to maintain safe and reliable transport routes.

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 the future. This summary will introduce what is meant by coastal flooding and erosion and how it can impact transport, and offers further information to help decision makers manage and adapt to these risks.

Mean sea levels around the UK have risen by approximately 12 to 16cm since 1900.*

* MCCIP, 'Marine Climate Change Impact Report Card', 2020, available at: **https://www.mccip.org.uk/sites/default/files/2021-07/mccip-report-card-2020_webversion.pdf**

What is coastal flooding?



Coastal flooding is when sea water floods normally dry land. This can happen through several mechanisms described below, which in severe cases can act together to overwhelm natural or built coastal defences.

Flooding can have different causes that can happen at the same time but are distinct. There are separate **transport hazard summaries** focusing on river flooding, groundwater flooding and surface water flooding.

Figure 1:
Large waves, storm surges and high tides can causing coastal flooding.

Coastal flooding mechanisms

Very high tides (known as 'spring tides')*
These can flood low lying coastlines and tidal estuaries. Peak high tides occur approximately every 14 days, with twice yearly maximums.

Large waves breaking over coastal structures (known as overtopping)
These can flood coasts exposed to the prevailing wind and wave direction during high winds and storms. Impacts may be increased when waves are directed towards sections of coast that are usually sheltered.

Storm surges†
A surge of water associated with a storm due to low atmospheric pressure and strong winds, temporarily increasing the sea level. When this surge hits the coast, water is pushed on shore leading to flooding, especially in shallow water areas like the southern North Sea coast.

* Met Office, 'Tides', available at: **https://weather.metoffice.gov.uk/learn-about/weather/oceans/tides**
† Met Office, 'Storm surges', available at: **https://weather.metoffice.gov.uk/learn-about/weather/types-of-weather/storms/storm-surge**

What is coastal erosion?

Waves, tides and rising sea levels remove sand or rock from beaches and cliffs, causing the shoreline to retreat, particularly where there are geological weaknesses and cracks in cliffs.

- It is most impactful on coasts made of soft sand, clay, shale or chalk.*
- Significant erosion events often occur when high tides coincide with storms.
- To check coastal erosion risk in your area, see the Environment Agency's national coastal erosion risk maps.†
- Sea defences or natural features can protect against coastal flooding and erosion, but can be costly to build or maintain. It is not possible to protect all parts of the coastline.

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

† GOV.UK, National coastal erosion risk maps, available at: **https://www.gov.uk/check-coastal-erosion-management-in-your-area**

How are coastal flooding and erosion events changing due to climate change?

Increasing greenhouse gas emissions are changing the global climate and causing global sea levels to rise. This is due to expansion of the ocean as it warms and the addition of water from loss of land-based ice such as glaciers and ice sheets. As global sea levels rise, so do those around the UK.*

Sea levels are not just rising, they are rising more quickly

- UK tide measurements show that sea level rise has accelerated, from about 1.5mm per year in the early 20th century to around 2.4mm per year more recently.† This adds up over time and overall average sea levels around the UK have risen by about 12 to 16cm since 1900.‡
- The amount differs regionally. There is greater sea level rise in the south of the UK and less of a rise in the north, due to geological changes since the last ice age.§
- Higher sea levels are increasing the risk of coastal erosion and coastal flooding because they lead to higher overall water levels when combined with tides and storm surges.§

Rainfall patterns are also changing

Heavier winter rainfall that saturates coastal soils can contribute to increased cliff instability and erosion, especially softer shale cliffs such as those at Lyme Regis.¶

More information on changing rainfall patterns can be found in the transport hazard summaries on surface water flooding and river flooding. Emissions scenarios and global warming levels are explained in 'The changing climate' transport hazard summary.

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* Met Office, 'Effects of Climate Change', available at: **https://weather.metoffice.gov.uk/climate-change/effects-of-climate-change**

† Kendon, M., McCarthy, M., Jevrejeva, S. and others, 'State of the UK Climate 2022' 2023, available at: **https://rmets.onlinelibrary.wiley.com/doi/10.1002/joc.8167**

‡ MCCIP, 'Marine Climate Change Impact Report Card', 2020, available at: **https://www.mccip.org.uk/sites/default/files/2021-07/mccip-report-card-2020_webversion.pdf**

§ Palmer, M., Howard, T., Tinker, J. and others, 'UK Climate Projections Science Report: UKCP18 Marine report', 2018, available at: **https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Marine-report.pdf**

¶ UK Climate Risk, 'UK Climate Risk Independent Assessment (CCRA3)', 2021, available at: **Technical-Report-The-Third-Climate-Change-Risk-Assessment.pdf**

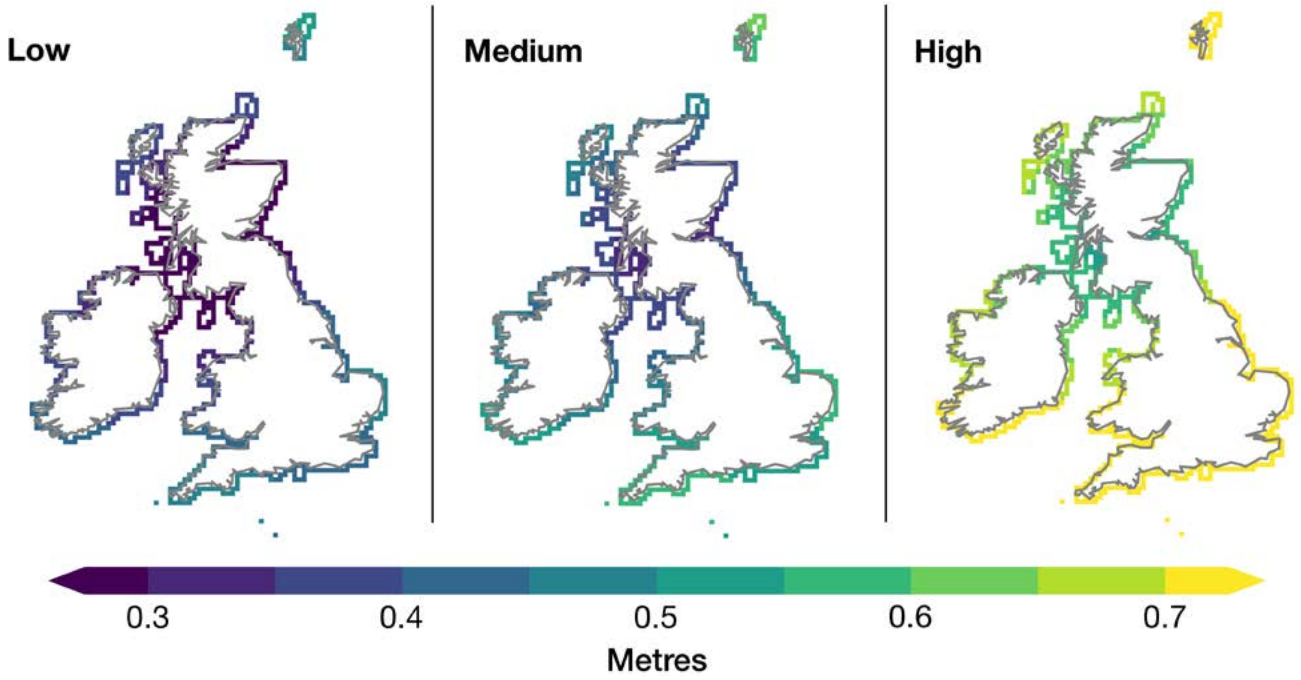
Global sea levels are projected to rise even further in the future due to climate change*

Up to the middle of the 21st century (2040 to 2060) changes to UK sea levels are similar for different emissions scenarios. Sea levels around the UK could be around 10 to 50cm (in the south) and 5 to 40cm (in the north) higher than the average sea level of 1981 to 2000.*

Peak water levels associated with high tides and storm surges will continue to become higher. This is likely to increase the frequency of coastal flooding and the number of areas that are impacted. Higher sea levels are also likely to cause increased coastal erosion.† The Environment Agency produces flood risk maps that show which coastal areas are at risk of flooding in the current climate and in future up to 2069. See 'further reading' on page 11 for a link.

Increased coastal flooding and erosion mean that some coastal communities and infrastructure may not be viable to sustain in parts of south and east England and the west coast of Wales.‡

Figure 2: UKCP18 marine climate projections of how sea levels will rise around the UK by 2100 when compared to 1981 to 2000 for different greenhouse gas emissions scenarios.*



Note that the maps do not show any anticipated change in shape of the coast. The amount of sea level rise varies around the UK coast but could be as much as 1 metre by 2100.

There is a slim possibility that the melting of Antarctic sea ice accelerates considerably, resulting in sea level rises of 2m by 2100. This is considered a worst-case scenario.§

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* Palmer, M., Howard, T., Tinker, J. and others, 'UK Climate Projections Science Report: UKCP18 Marine report', 2018, available at: **https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Marine-report.pdf**

† MCCIP, 'Storms and Waves Update 2025', 2025, available at: **https://www.mccip.org.uk/storms-and-waves**

‡ UK Climate Risk, 'Flooding and coastal change briefing', 2021, available at: **https://www.ukclimaterisk.org/wp-content/uploads/2021/06/CCRA3-Briefing-Flooding-and-Coastal-Change.pdf**

§ Hanlon, H., Palmer,M., Betts, R. and others, Met Office, 'Effect of Potential Climate Tipping Points on UK Impacts', 2021, available at: **https://www.ukclimaterisk.org/wp-content/uploads/2021/06/Effect-of-Potential-Climate-Tipping-Points-on-UK-Impacts.pdf**

Case studies

A series of severe storms during winter 2013 to 2014 led to widespread coastal flooding and erosion across the UK. In December 2013, a major North Sea storm surge combined with exceptionally high tides resulting in some of the highest sea levels recorded in 60 years on England's east coast, causing extensive flooding in areas like Norfolk, Humberside and Essex. Soon after, in early 2014, repeated Atlantic storms battered western and southern coasts with large waves, causing significant coastal damage.*

Flooding closed key roads, including parts of the A12 in Suffolk and Essex, and temporarily cut off Walney Island in Cumbria due to flooded causeways. Many seaside streets were covered in debris, causing lengthy cleanup and repair operations lasting weeks to months.

Storm waves at Dawlish in Devon demolished 80 metres of sea wall and track, closing the main rail link to and from Cornwall for nearly two months and disrupting over 7,500 services, while flooding and landslides also blocked lines in parts of Wales and northwest England.

Sumburgh Airport in Shetland closed for three days due to wave-driven debris and unsafe conditions on the runway. Across the UK, strong winds and local flooding led to widespread flight cancellations and delays, with airport access roads such as those near Liverpool John Lennon Airport affected.

The North Sea surge inundated the Immingham-Grimsby port complex, cutting power and halting freight, with impacts lasting several days. Ports such as Dover were forced to shut at high tide, leaving passengers, lorries and vital cargo stranded.

* Masselink, G., Castelle,B., Scott, T. and others, Geophysical Research Letters, 'Extreme wave activity during 2013/2014 winter and morphological impacts along the Atlantic coast of Europe', pages 2135 to 2143, volume 43, issue 5, 2016, available at: **https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015GL067492**

Direct transport impacts due to coastal flooding and erosion

Human health and safety

- Powerful floodwaters, wave-thrown debris and collapsing coastal structures can lead to injuries or fatalities for pedestrians and people in vehicles.
- Flooded roads can trap passengers and drivers, cutting residents off from essential services.
- Frequent flooding events or continuous coastal erosion can make travelling stressful for passengers and work difficult for transport staff near the coast.
- Coastal rescue crews need to use coastal roads to access their lifeboat station, so damage to roads would impact call-out on higher risk days.

Vehicle and service operations

- Coastal floods can force the closure of roads, rail lines and ports causing long detours, delays and cancellations.
- Saltwater flooding can damage vehicles and trains, often beyond repair, due to its corrosive nature.
- Storm conditions often occur at the same time as coastal flooding, with strong winds and reduced visibility making handling of aircraft, vehicles and vessels dangerous.

Infrastructure

- Wave impacts and floodwaters cause severe structural damage, undermining roads, railway tracks, airport runways and port facilities.
- Storm surges pose a particular risk of disruption to ports and shipping, especially those on the east coast where the risk of water being pushed onshore during a surge event is greatest.*
- Continuous coastal erosion removes land supporting roads and railways, resulting in costly repairs or permanent closures.
- Flooding can overwhelm sea walls and drainage systems, inundating transport infrastructure such as tunnels and underground stations.
- Ongoing exposure to saltwater and storms increases the corrosion of transport infrastructure, raising maintenance costs significantly.
- In response to flooding and erosion, transport infrastructure may have to be raised, moved inland or even abandoned if the cost of defending it becomes unaffordable.

Interdependencies: Flooding at coastal fuel storage sites and ports disrupts fuel supplies, severely limiting inland transport capabilities.

* Climate Change Committee, 'UK CCRA Evidence Report: Chapter 4, Infrastructure', 2016, available at: **https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Chapter-4-Infrastructure.pdf**

Hazards associated with coastal flooding and erosion

Groundwater flooding

High groundwater levels can contribute to the instability of coastal cliffs and increase the risk of coastal erosion.

Landslides and earthwork failures

Landslides can occur along coastlines as a form of coastal change, often triggered or influenced by erosion of the coastline.

River flooding

Tidal and storm surges can travel up estuaries and combine with high river levels to threaten areas beyond typical flood zones. When tidal-surge barriers such as the Thames Barrier are closed, river outflow to the sea slows, water backs up upstream, and flood risk rises.

Storms

Winter storms are the main driver of coastal flooding and erosion due to the storm surges and large waves they produce. Damage and disruption from strong winds and heavy rain can compound the impacts.

Subsidence, soil degradation and sinkholes

Repeated coastal flooding and wave erosion can wash away supporting soils, triggering subsidence and sinkholes that undermine roads and rail lines.

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

Risk mitigation and adaptation

To reduce coastal flooding and erosion risks to transport networks, co-ordinated action between transport providers, local authorities, government agencies and other infrastructure owners is essential. Examples include:

- building and upgrading coastal defences with consideration that flood defences can sometimes redirect floodwaters, causing problems in nearby areas
- retrofitting key transport facilities like ports and terminals with improved flood protection, drainage systems and backup power to keep them operating during floods and storms
- flexible, long-term flood risk management plans such as the Thames Estuary 2100 Plan which sets out different ways to adapt to sea-level rise*
- using flood forecasting and climate projections to identify and prioritise vulnerable transport infrastructure and plan for closures or diversions

Questions for decision makers

- Which coastal roads, railways, stations, airports or ports and their access routes in your area are currently exposed or likely to become exposed to the risk in the future?
- With increased coastal flooding and long-term changes to the coastline projected, what actions are needed to ensure that there are safe and reliable transport options in areas affected? Do you have links with relevant organisations for managing these risks to transport?
- Do you have plans in place to communicate transport disruption and safety messages to the public and are plans in place to evacuate stranded travellers and ensure the safety of vulnerable people?
- What personnel and equipment will you need to respond to flood incidents and are responsibilities well defined during a large-scale flooding event?

* Department for Environment, Food and Rural Affairs, 'Thames Estuary 2100', 2023, available at: **https://www.gov.uk/government/collections/thames-estuary-2100-te2100**

Further reading

Check coastal erosion risk for an area in England – GOV.UK

Environment Agency check your flood risk map – GOV.UK: The risk from coastal flooding can extend surprisingly far inland, and this map can be used to check the risk in your area

Environment Agency flood risk information for planning in England maps – GOV.UK

GeoCoast Premium – British Geological Survey: Data providing information on coastal inundation, erosion and climate change impacts

Impacts of Climate Change on Transport and Infrastructure relevant to the coastal and marine environment around the UK and Ireland – MCCIP Science Review 2023

Marine Climate Change Impacts Partnership – mccip.org.uk

National assessment of flood and coastal erosion risk in England 2024 – GOV.UK

Storm surge – metoffice.gov.uk

Tides – metoffice.gov.uk

Climate information and risk assessment

See ‘The changing climate’ and ‘Transport hazards, risks and resilience’ transport hazard summaries 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.