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2023

# Bureau of Meteorology

## House of Representatives Standing Committee on Regional Development, Infrastructure and Transport

**Inquiry into the implications of severe weather events on the national road network**

February 2023


*Rural road closed west of Jerilderie in November 2022 (Credit: Blair Trewin).*

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# Contents

# 1. About the Bureau of Meteorology

The Bureau is Australia's national weather, climate, and water agency, providing a wide range of products and services to support informed decision-making by governments, emergency services, industry, and the community.

The Bureau operates under the authority of the *Meteorology Act 1955* and the *Water Act 2007*, which together provide the legal basis for its activities. The Bureau is an Executive Agency under the *Public Service Act 1999* (Cth), and a non-corporate Commonwealth entity under the *Public Governance, Performance and Accountability Act 2013* (Cth).

The Bureau supports transport agencies by providing weather, climate and hydrological data that inform the design, construction, and maintenance of transport infrastructure. It informs the operation and use of infrastructure by providing observations, forecasts, outlooks, and warnings, as well as advice supporting their use. The Bureau also seeks to improve the resilience of land transport by working directly with transport agencies and local governments in flood advisory committees and local emergency management committees in each State and Territory.

The Bureau delivers products and services to the land transport sector via its general public offering (e.g. Bureau website and app), and directly via two devoted programs: the Aviation, Land and Maritime Transport Program and the Australian Climate Service. The Australian Climate Service is responsible for connecting and leveraging the Australian Government's extensive climate and natural hazard data, information, and advice into a single national view. The Australian Climate Service comprises world-leading expertise from the Bureau of Meteorology, Geoscience Australia, CSIRO, and Australian Bureau of Statistics. The Bureau is the coordinating partner for the service, and brings expertise across hazards, forecasts, and warnings.

The Bureau welcomes the opportunity to make a submission to the Committee.

# 2. Response to the Terms of Reference

## 2.1. Road engineering and construction standards required to enhance the resilience of future road construction

*Data used in construction standards*

Weather and climate parameters are an important consideration in engineering and design standards for road construction.

These standards draw on information, including design rainfalls[1], that integrate data such as rainfall intensity, frequency, and duration so that they can be used to inform the design of engineered structures, such as road, bridge, and rail infrastructure.

Australia's Design Rainfall Data System is hosted by the Bureau of Meteorology. The design rainfall data, based entirely on historical rainfall records, was last updated in 2016.

There is an opportunity to review standards, and information used in implementing them, to ensure that they better account for Australia's increasingly variable and changing climate.

Specifically, existing design rainfall data do not consider future climate scenarios that are likely to apply during the lifespan of most significant infrastructure. Further, as climate extremes intensify, the importance of design rainfall data in designing resilient infrastructure will increase. For both these reasons, incorporating climate projections in future design rainfall updates is likely to enhance the resilience of future road construction.

Similarly, there is merit in updating hydrological modelling that is based on design rainfall data, such as peak flood levels. This will allow infrastructure to be designed to suit conditions likely to be experienced in the future.

The Australian Climate Service is developing nationally consistent climate and hazard projections for the future that would be well suited to development of future designs and standards.

*Impacts of Australia's changing and variable climate on infrastructure resilience*

Using rainfall as an example: there has been an increase in the intensity of heavy rainfall events in Australia. The intensity of short-duration (hourly) extreme rainfall events has increased by around 10 per cent or more in some regions over recent decades. These have placed increased stress loading on transport infrastructure, such as scouring damage to foundations and road formation. Design specifications used for transport infrastructure do not take this change into account.

Changes in extreme rainfall events are particularly evident in northern Australia. In addition to a general increase in average wet season rainfall, daily rainfall totals associated with thunderstorms have tended to increase since the 1970s (Fig. 1). In the northern region, the use of foamed bitumen stabilisation techniques may be required to improve road resilience into the future.

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[1] Design rainfall is a commonly used term for intensity-frequency-duration (IFD), design rainfall intensities (mm/h) or design rainfall depths (mm) corresponding to selected Annual Exceedance Probabilities (AEPs). The design rainfall is based on the statistical analysis of historical rainfall. (https://arr.ga.gov.au)

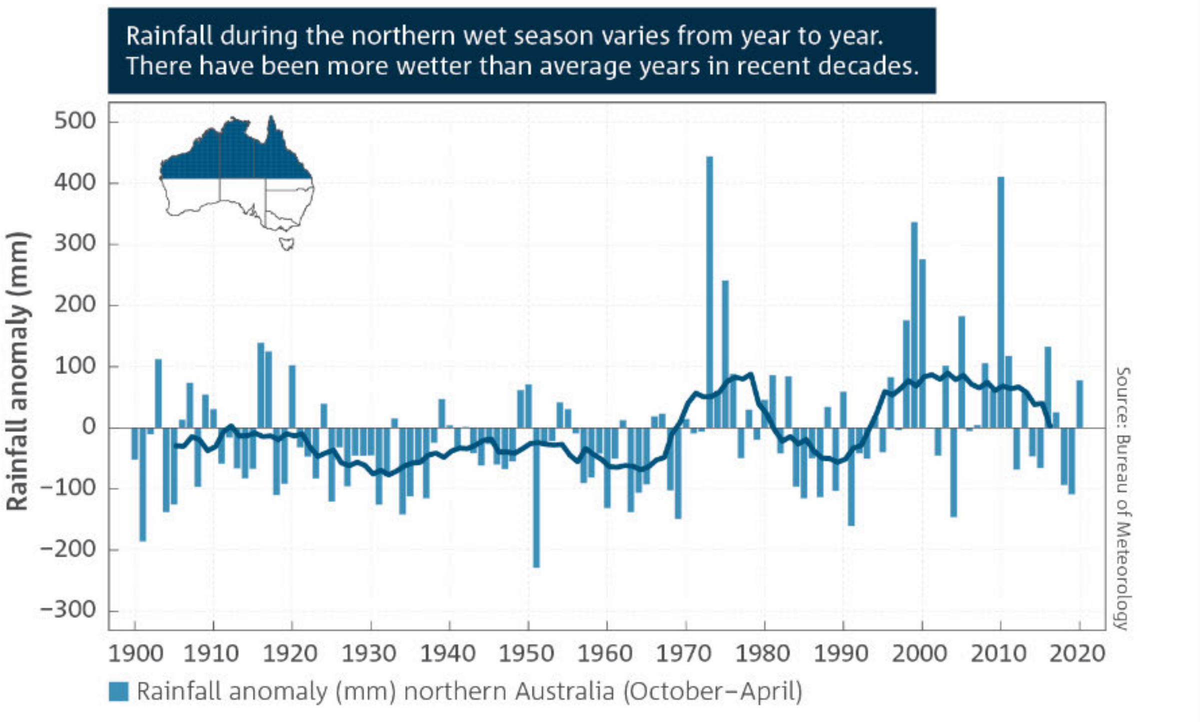


Figure 1. Rainfall anomaly (amount of rainfall above or below the long-term average) for northern Australia, 1900-2021. Bars show rainfall anomaly; line shows 11-year running average of rainfall anomaly.

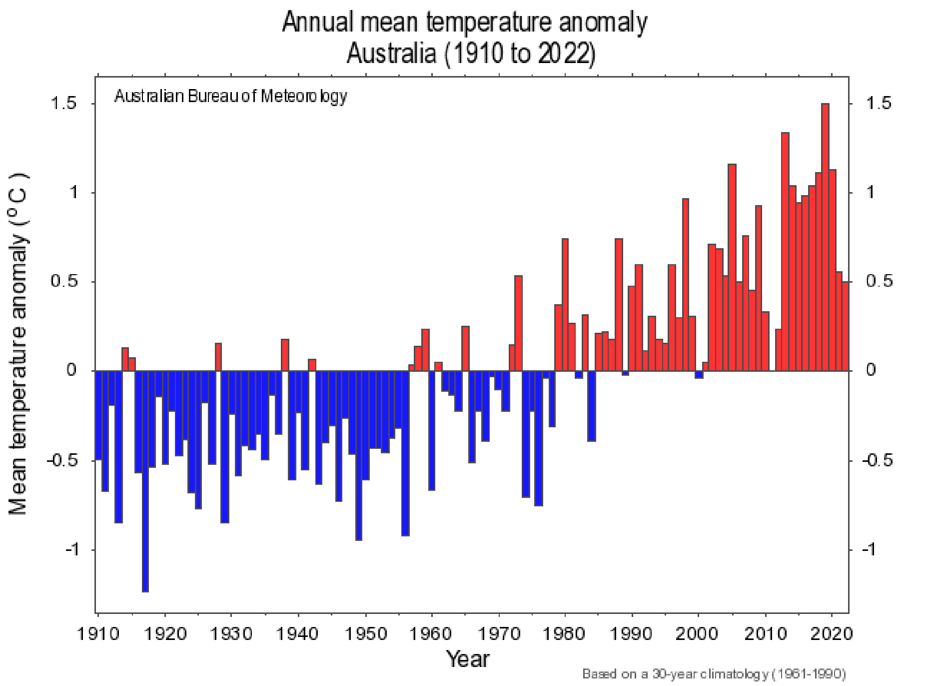


Figure 2. Annual mean temperature anomaly in Australia, 1910-2022. Blue bars show annual temperature average below the long-term mean annual temperature; red bars show annual temperature average above the long-term mean annual temperature.

Further information on Australia's variable and changing climate is available via the *State of the Climate Report 2022* (http://www.bom.gov.au/state-of-the-climate/), jointly produced by the Bureau of Meteorology and CSIRO.

## 2.2. Identification of climate-resilient corridors suitable for future road construction projects

Tools exist, and are being continually improved, to enable climate-sensitive and climate-resilient corridors to be identified.

The Australian Climate Service is working with CSIRO to model the impacts of blockages of key transport networks on Australian supply chains. CSIRO's TraNSIT tool has, for many years, identified roads that are heavily utilised by the freight sector. Further, the TraNSIT tool has identified how traffic types and volumes change according to freight supply and demand, and regulations that affect road use. TraNSIT has, for almost a decade, been used by government to identify cost-effective transport infrastructure investments.

More recently, the Australian Climate Service has been using TraNSIT to analyse real-time impacts on supply chains of road closures caused by weather and related events, such as flooding. This successful real-time use of TraNSIT could be extended by the Australian Climate Service to examination of projected impacts of weather in key locations. By this means, the Australian Climate Service could support the prioritisation of construction corridors, projects and methods that increase the network's resilience to extreme weather events.

Activity of this type would support recommendation 9.1 from the Royal Commission on National Natural Disaster Arrangements: that all levels of government, industry, and the private sector review supply chain risks and consider options to ensure essential supplies during natural disasters.

## 2.3. Opportunities to enhance road resilience through the use of waterproof products in road construction

The most common types of road construction methods used in Australia are (i) cement or cementitious blends, (ii) asphalt pavements, and (iii) spray bituminous treatments. These road construction methods are highly dependent on fine weather conditions, within a defined temperature range.

As detailed in Figure 1, above, both the average annual rainfall, and the likelihood of extremely high rainfall events, are tending to increase in northern Australia. In the rest of the country there is an increased likelihood of heavy rainfall events, even in parts of Australia where average rainfall is expected to decrease. These phenomena are consistent with the historical and projected impacts of global warming.

Also consistent with global warming is the continually increasing day and night temperatures observed across Australia in all months, accompanied by an increase in the number of extreme heat days occurring each year.

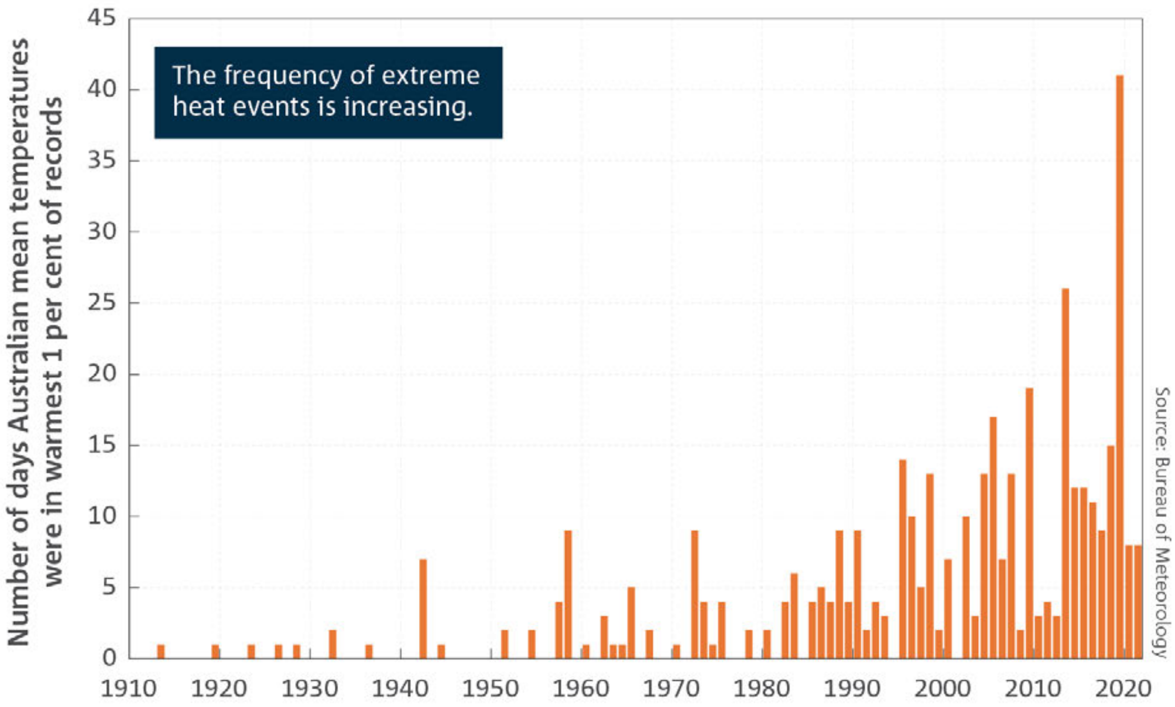


Figure 3. Number of days each year where the Australian area-averaged daily mean temperature for each month is extreme (extremely warm days). Extremely warm days are defined as those where daily mean temperatures are the warmest 1 per cent of days for each month, calculated for the period from 1910–2021.

The trend towards extreme heat, in particular, has a major impact on roads, which soften, deform and more rapidly deteriorate under load and generally age more rapidly as temperatures rise.

In addition to their impacts on operation and maintenance of transport networks, rainfall and temperature directly impact road construction. The tendency towards greater likelihood of extremes of rainfall and temperature naturally narrows the window in which conditions are optimal for road construction. Further, this increases the downside risk of proceeding with construction outside environmental optima.

This is particularly the case for the use of some waterproof road construction products, such as foamed bitumen stabilisation technique. Such innovative products require technical precision in application and are compacted at low ambient temperatures. The application, compaction and curing time periods are sensitive to temperature, humidity, and wind. Each of these weather phenomena are becoming more variable and extreme.

## 2.4. The Commonwealth's role in resilience planning

The transport network is exposed to all hazards and is particularly vulnerable to extreme heat and floods, with impacts on supply chains and consequences for all sectors of Australia. The Australian

Climate Service is bringing together relevant hazard, socio-economic, environmental, and built domain data, and intelligence to provide footprint-based information on the potential impact on communities of current and future climates. This will provide decision-makers with an evidence base to assess key vulnerabilities and make informed decisions to strengthen the network.

The Bureau, in conjunction with the Australian Climate Service, provides risk-based scenarios for exercising and planning activities to emergency services and other agencies. These scenarios provide narratives that focus on the integrated risk across multiple systems, including transport systems, during extreme weather and climate events. An enhanced understanding of systemic risks, including concurrent risks to communities, such as critical supplies and access, will support decision-makers in all sectors to plan for a more resilient Australia.

## 2.5. Any related issues

The Bureau works in partnership with transport agencies to deliver information that supports planning, preparedness, and decision support activities.

*Flood early warning system*

Installation of rainfall and river height observation equipment in the upper catchment of the Adelaide River and Victoria Rivers in the Northern Territory has provided early warning advice on the accessibility of the Arnhem and Buntine Highways. This service could be enhanced to provide automated alerts.

Automated alerts that use a combination of rainfall intensity, river height thresholds and forecast rainfall amounts have been trialled in NSW to support flash-flooding warnings, and a similar approach could be used for any number of key transport locations. For each location, key thresholds would need to be developed, and rainfall or river level observation equipment may be required.

*Real-time flood inundation capabilities*

Throughout 2022, the Australian Climate Service has progressed the development of a proof-of-concept real-time flood forecasting and inundation forecasting tool. Several different approaches to generate real-time flood inundation maps are being evaluated, along with the capability to produce a real-time gridded hydrological model that has the potential to provide greater coverage across Australia. Outputs from both modelling approaches have been made available to NEMA as a web mapping service for ingestion into NEMA's systems. Satellite technology has also been sourced to provide flood footprints during and after events.