

National Heatwave Warning Framework





Review status

Date	Version	Reviewer	Description
3/02/2023	0.13	Hazard Services Forum	For Committee to review and approve
21/07/2023	0.13	ANZEMC	For Committee to review and approve

Release history

Date	Version	Status	Approval
13/11/2023	1.0	Published	Hazard Service Forum and ANZEMC



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Acknowledgements

The Bureau of Meteorology would like to thank everyone who contributed to the development of the Heatwave Warning Framework.

Australian Capital Territory

- Chris Kelly
- David Foot
- David Horner
- Scott Hanckel

Commonwealth

- Adam Lambert
- Leighton Morvell
- Rhonda Owen
- Sally Mclean
- Steve Dwyer

New South Wales

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1. Background

1.1. Purpose

The purpose of the National Heatwave Warning Framework (the Framework) is to provide the foundation for a consistent approach to heat health and heatwave warnings across Australian state and territories.

The primary intent of the Framework is to reduce the health impact of heatwaves, noting that heatwaves also adversely impact sectors such as water, energy, infrastructure, agriculture and transport.

Improving knowledge of heat hazards can assist people and organisations to prepare for, and cope with, the effects of extreme heat and the impacts of a changing climate. The capacity of people and organisations to act is enhanced by nationally consistent and aligned guidance that clarifies methods, approaches, roles and responsibilities.

Making this achievable requires collaboration and cooperation across multiple stakeholders, focused on a unified approach to effective climate and disaster risk reduction.

1.2. Scope

The Framework aims to align the approaches to heatwave warnings taken by the Commonwealth, state and territory governments. Although local governments or non-government associations contribute to heatwave response, the Framework scope does not currently include their roles.

Approaches to the management of heatwaves varies across Australia.

States and territories have different portfolio responsibilities, and each jurisdiction uses its own metrics, warnings thresholds, nomenclature and response processes. In recognition of these different approaches, this Framework provides a consistent basis for all jurisdictions to work towards.

This Framework is about heatwave as a hazard however it sits within a broader context of international and domestic risk reduction strategies (see Appendix A).

1.3. Approach

The Framework is based on a total warning system (TWS) (AIDR 2018). The TWS describes the lifecycle of action before, during and after an emergency, as well as ongoing actions. It involves understanding the nature of a hazard and effectively communicating that information to facilitate protective action and timely response (Mileti and Sorenson 1990; Sorenson 2000).

The TWS provides a structure for capturing the steps that should be taken by health agencies, emergency services and the Bureau of Meteorology (the Bureau) to move towards a nationally consistent, end to end warning service for heatwaves. The Framework also aligns with the Australian Warning System (AWS) which provides an agreed 3-level warning framework for Australian governments.



2. Heatwave in Australia

Heatwaves are Australia's most costly natural disaster in terms of loss of life, accounting for around half of Australian natural disaster fatalities (Handmer et al. 2016). While the deaths attributed to most hazard types have remained relatively stable over time, there is a strong recent increase in heatwave fatalities. Climate projections indicate that "increasing heatwave severity and frequency are virtually certain" (Handmer et al. 2016 p. 3). Heat health impacts range from mild conditions, such as rashes and cramps, through to exacerbation of existing conditions and potentially fatal conditions, such as heat stroke (NCE 2018).

There is a growing awareness among disaster response practitioners of compounding disaster risks and the interconnected causes and cascading effects of disasters (PEAN 2021). Recent research (PEAN 2021) highlights that the impact of heatwaves can be both mitigated and exacerbated by social, economic and physical circumstances, including health risk factors, income level, household composition and neighbourhood vegetation cover. In addition to health risks, heatwaves can significantly impact critical infrastructure including transport and electricity supply which in turn create risks to community safety (NCE 2018). Costs of heatwave principally relate to the loss of life (Handmer et al., 2016), demands on emergency and health services, and loss of production through both health effects, including longer-term disability, and direct impacts on industries (NCE 2018).

Secondary impacts from heatwaves can also limit the range of protective actions available to mitigate harm of the original hazard. Electricity supply failure can lead to disruption to air conditioning systems, potable water supply, wastewater treatment systems, telecommunications and traffic signals. Natural Capital Economics (NCE) (2018) considers that vulnerability in the electricity and water supply sectors has a high capacity to increase the vulnerability of other sectors, including health. Although beyond the scope of this Framework, heatwaves create broader economic disruptions to many industries, with agriculture being the worst affected (NCE 2018).

2.1. Future projections

Australia's national climate projections indicate that over coming decades Australia will experience further increases in temperatures, with more extremely hot days. Heatwaves are becoming more frequent, hotter, of longer duration and occurring earlier in the peak season (BOM and CSIRO 2020).

The Bureau notes that Australia's climate has warmed by around 1.44 degrees Celsius since 1910, leading to an increase in the frequency of extreme events. Rarely experienced hot days now happen multiple times per year (see Figure 1) (BOM and CSIRO 2020).



Number of days each year where the Australian area-averaged daily mean temperature is extreme

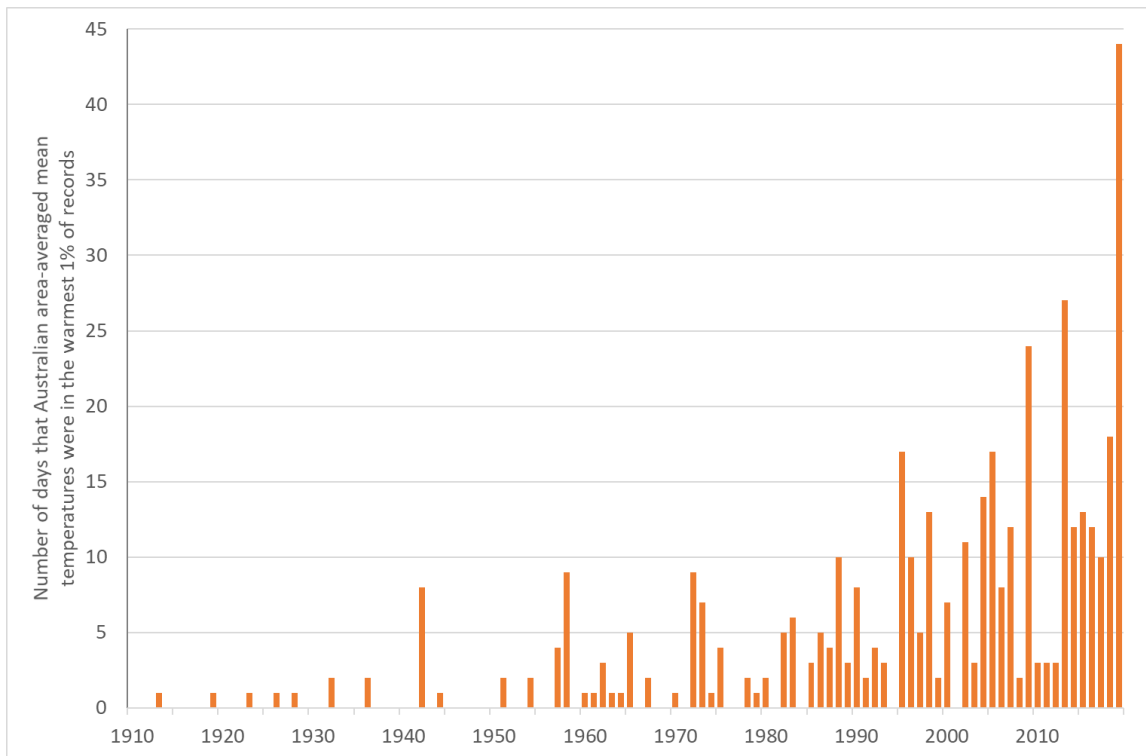


Figure 1: Number of days each year where the Australian area-averaged daily mean temperature is extreme. Extreme days are those above the 99th percentile of each month from the years 1910–2019 (BOM and CSIRO, 2020, p4).

The effects of heatwaves can be exacerbated by changes in demographic and social factors, including population growth, and the effects of urbanisation in retaining heat in built up areas (PEAN 2021). This in turn exerts more pressure on health systems and infrastructure.

2.2. Who is at greatest risk?

The factors determining a person's vulnerability to heatwaves include age, pre-existing physical and mental health conditions, occupation and socioeconomic status. Other relevant factors include the nature of the urban environment, which can amplify heat exposure, dwelling type, social connectedness, access to health services and access to web and phone services (PEAN 2021).

Anyone can be affected by heatwaves; however, health risks are greatest in the elderly and young, those with underlying chronic diseases, people in low-income households and people that are socially isolated (Coates et al. 2014). Appendix B details population groups likely to be susceptible to heat-related illness. Individuals belonging to more than one at-risk group may be at higher risk of heat illness.

2.3. Public understanding of impact

Recent research about community understanding of warnings found that public recognition of formal systems for heatwave warnings was almost non-existent. Participants spoke of receiving



information regarding days of above average temperatures through news outlets, including advice on simple actions to be taken (Metrix 2019).

However, "almost all participants felt extreme heat warnings are only applicable for vulnerable groups" (Metrix 2019 p35). As described by Nairn and Fawcett (2013), the "Australian community understands that heatwaves are a common summertime experience and rarely anticipates significant human health risk".

Individuals and communities are better able to respond to extreme weather when the impacts of forecast weather are communicated and understood. Although there is good public understanding of what the weather will be, there is a less understanding of what that weather will do and, consequently, what action is needed (WMO 2015, Kaltenberger et al. 2020). An impact-based warning approach remedies this disconnect between the quality and accuracy of forecasts and warnings, and the understanding of their meaning by relevant authorities and the public (WMO 2015). Best practice warnings provide information about what the hazard will do and the kind of protective action people should take.

In Australia, Commonwealth and state and territory governments are working towards impact-based forecasts and warnings across many hazards. In many cases, partnerships and institutional arrangements between relevant agencies are already in place to support this work.

Consistent with the guidance of the World Meteorological Organisation (WMO), the Bureau is reviewing its warning services to ensure they deliver on the organisation's strategic objectives to understand and meet customer needs and to amplify its outreach to the public sector, industry, and the community (BOM 2017).

As part of the Bureau's 3-year program to strengthen its public services, the organisation has committed to contributing to zero lives lost due to natural hazards and contributing \$2 billion in added social and economic value to the Australian community (BOM 2019). Under the program, the Bureau completed a trial during the 2021–22 severe weather season which involved issuing warnings for severe and extreme heatwaves to partner agencies. In October 2022 these heatwave warnings went live as part of the Bureau's public weather warning service.

The program also includes the development of a new weather alerting platform, alongside an upgraded website and mobile app.

Under the Bureau's Research and Development Plan 2020–2030, the Bureau aims "to create customised impact-based forecasts and warnings when and where it counts" to provide more localised, timely and clear information to Australians (BOM 2020 p.10).

Recently, the Australia Government announced the formation of the Australian Climate Service (ACS), a collaborative service provided by the Bureau, Geoscience Australia, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Bureau of Statistics (ACS 2021). One ACS deliverable is to develop and implement a National Hazard Impact and Risk Service (NHIRS) with multi-hazard capability. As the development of this project matures, it will inform the broader approach to warnings.



3. Delivering Heatwave Warnings

Through the National Heatwave Working Group, a parallel approach to delivering warnings has been developed. While this is the agreed approach, the parties will continue to work together to review and strengthen the Framework as approaches to heatwaves develop over time. This will form part of the Framework review process.

Under this approach, the Bureau issues heatwave warnings on its public channels. The warnings include a description of the expected weather, its likely impact and some simple agreed protective action statements. Alongside this, responsible state and territory agencies issue a heatwave warning on their public channels detailing specific protection actions, advice and available supports, including nuanced and targeted messaging aligned with the AWS.

To support jurisdictional agencies in their planning and response to heatwaves, the Bureau publishes an agency-only 7-day forecast product, the Heatwave Decision Support Product. The interaction between the Bureau and state and territory warnings and other Bureau products is shown below.

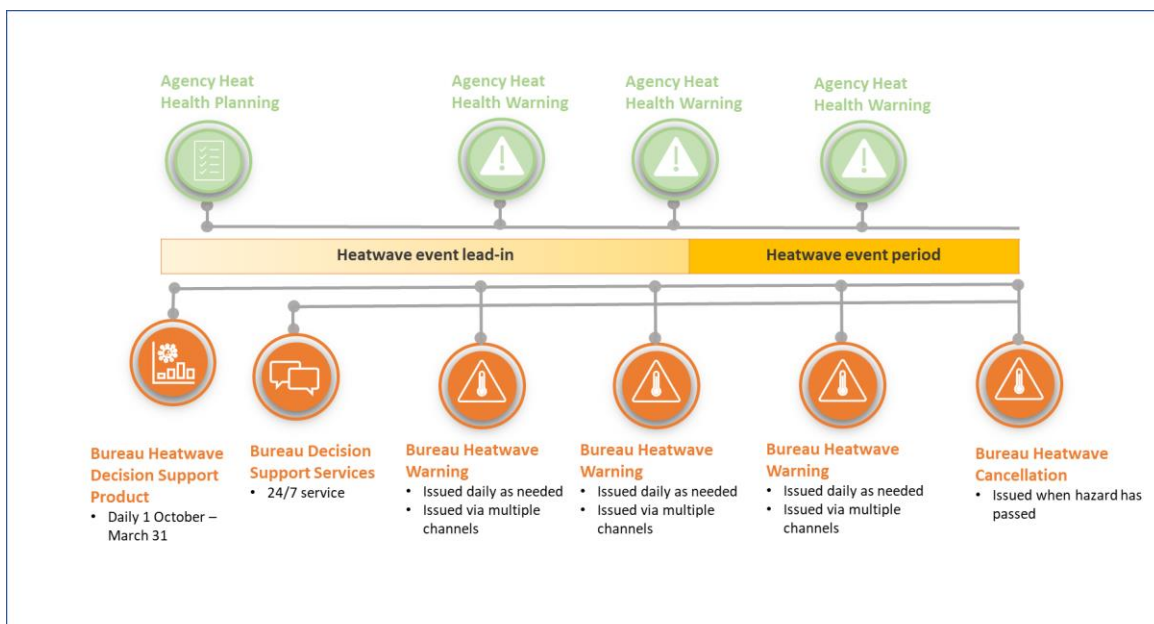


Figure 2: Interaction between the Bureau of Meteorology and State and Territory Warnings

3.1. Standards and Definitions

3.1.1. Framework review

This Framework will be reviewed by agencies every 5 years to ensure it reflects current best practice. The Bureau and Emergency Management Australia will design and lead the evaluation process and seek input from relevant government and non-government agencies. Additional updates to the Framework may be made in response to significant advancements in forecasting science, forecasting, or warning practice, or health and emergency response practices. The forecasting and warning of 'spike days', single days of extreme heat, has been identified as one area for future focus.



3.1.2. Defining heatwaves

For a heatwave definition to be applied nationally it needs to meet the following criteria:

- can be easily measured and repeated
- can be applied consistently across Australia
- can be applied to past analysis and future projections
- can be useful as an indicator of impact
- can support emergency management and health frameworks.

The Bureau defines a heatwave as:

Three days or more of high maximum and minimum temperatures, that are unusual for that location.

Minimum temperatures are included in the definition because, when nighttime temperatures remain high, health risks increase as the temperature drop may not be sufficient for people who have been exposed to extreme heat all day to recover (Healthline 2016).

The Bureau issues heatwave warnings at weather district level, including Excess Heat Factor (EHF) severity levels and general safety advice. The Bureau warning has a threshold of 10% of the weather district being affected, in alignment with Bureau warnings for fire weather and severe thunderstorms. Bureau weather districts can encompass a range of local communities and conditions; accordingly, the Heatwave Decision Support Products provide more granular information, including town level forecasts.

The Bureau's heatwave warning can be issued with several days lead time, allowing state and territory governments time to issue heatwave warnings aligned with the AWS, which may include more targeted or nuanced messaging to vulnerable communities and stakeholders.

3.1.3. Excess Heat Factor

The Bureau has developed, tested and made operational a measure of heatwave severity, the Excess Heat Factor (EHF) (Nairn and Fawcett 2013). The EHF provides a robust exposure index that scales well against human health impacts in Australia for both city and regional communities (Langlois et al. 2013, Scalley et al. 2015).

The EHF uses 2 excess heat anomalies, based on the long-term climate record and short-term comparison. Using the EHF, heatwaves are calculated using the forecast maximum and minimum temperatures over the next three days. This information is compared to actual temperatures over the previous 30 days, and the long-term climate record for what should be considered hot at the location at that time (Nairn and Fawcett 2013).

The EHF calculation also considers people's ability to adapt to and recover from heat. For example, the same high temperature will be felt differently by residents in Perth compared to those in Hobart, who may not be used to the higher range of temperatures experienced in Perth (Nairn and Fawcett 2013).

Similarly, if there has been a period of relatively cool weather in a location, then a sharp and sustained increase in temperature will be defined as a heatwave. This means that in any one location, temperatures meeting the criteria for a heatwave at the end of summer will generally be hotter than the temperatures that meet it at the beginning of summer (Nairn and Fawcett 2013).



The way EHF is calculated considers the exposure of the population to a heat hazard relative to normal and longer-term conditions for day and night-time temperatures. It has been shown to correlate well with the measurable health impacts of heatwaves (Langlois et al. 2013, Scalley et al. 2015, Williams et al. 2018).

The Framework adopts the EHF as the measure of heatwaves nationally for forecasting and Bureau warning purposes. However, because the Framework places responsibility for AWS aligned warnings with state and territory agencies, there remains scope in the Framework for agencies to warn communities about extreme heat, even when the EHF thresholds are not met, should they determine a community need. Alternatively, agencies may choose not to issue an accompanying warning where the EHF is met, and a Bureau warning is issued, if they believe this will not support local community preparedness.

Further detail on the EHF is at Appendix C.

3.1.4. Common Alerting Protocol

The Common Alerting Protocol and the Australian profile of it (CAP-AU-STD) is a standardised data exchange format for the encoding of messages for emergencies and hazards, and related warnings, alerts, and associated cancellations. It allows consistent and easy to understand emergency messages to be broadcast across a variety of communication systems and can be used to alert and inform emergency response agencies, media and the general public (AIDR 2018). Message construction and communication under the framework should conform with CAP-AU-STD to allow consistent messaging re-publishing.

3.1.5. Total Warning System

The Total Warning System (TWS) is described in the [Public Information and Warnings Handbook](#) (AIDR 2021). The Handbook presents nationally agreed principles for warning policy and practice and explores the essential elements and discipline of effective public information and warning delivery. The Framework adopts the principles of the TWS and details their application on page 16.21). The Handbook presents nationally agreed principles for warning policy and practice and explores the essential elements and discipline of effective public information and warning delivery. The Framework adopts the principles of the TWS and details their application on page 16.

3.1.6. Australian Warning System

The AWS is a new national approach to information and warnings for the following hazards: bushfire, flood, storm, tropical cyclone and extreme heat (AIDR 2021). Over time, the implementation of the AWS may be expanded to other associated, for example storm tide, storm tide) or distinct hazards, for example tsunami. e.g., tsunami).

The AWS has been developed based on community research and input from Australia's emergency services and hazard management agencies (AIDR 2021). The goal of the AWS is to deliver a more consistent approach to community impact, no matter where you are in the country. It uses a nationally consistent set of hazard icons to show incidents on websites and apps, supported by calls to action at 3 consistent warning levels.



The 3 warning levels in the AWS are:

- **Advice:** An incident has started. There is no immediate danger. Stay up to date in case the situation changes.
- **Watch and Act:** There is a heightened level of threat. Conditions are changing and you need to start taking action now to protect you and your family.
- **Emergency Warning:** An Emergency Warning is the highest level of warning. You may be in danger and need to take action immediately. Any delay now puts your life at risk.

Each warning level has a range of action statements to give the community clearer advice about what to do. Action Statements can be used flexibly across all 3 warning levels and contextualised for each hazard within each state or territory. Additional warning information can be supplied below the AWS warning.

Given the AWS relates to community impact warnings, the Framework adopts the AWS as far as practicable. The Framework outlines the application of AWS to heatwaves on page 14. The National Heatwave Working Group (NHWG) has agreed a set of heatwave specific action statements to be carried on Bureau warnings. The jurisdictions will carry the responsibility of applying the AWS to heatwave warnings by providing nuanced action and health advice and messaging as required by local conditions and communities.

3.2. Roles and Responsibilities

Through the NHWG, there is support for a nationally consistent heatwave warning message to be produced in each jurisdiction to raise the public awareness of heatwave as a significant health hazard and to encourage protective actions by individuals and the community.

3.2.1. Commonwealth

The Bureau is the Commonwealth Government agency responsible for the provision of weather forecasting and climate data across Australia.

The Meteorology Act 1955 (C'th) describes the functions of the Bureau to include promoting the use of meteorological information, forecasting weather and the issuing of warnings of gales, storms and other weather conditions likely to endanger life or property.

The Bureau currently provides a Heatwave Service which generally operates between the start of October and the end of March each year and a Heatwave Decision Support Product for health and emergency service agencies. The Heatwave Service provides information about heatwave severity, including a national 7-day Heatwave Forecast and is publicly available. The Decision Support Product is a geographically detailed 7-day forecast product to support agency planning. From 1 December 2021, the Bureau ran a one-season trial of a Heatwave Warning, delivered directly to agencies only.

Under this Framework, the Bureau will provide meteorological information, data and forecasts in a uniform manner, using the EHF as the metric for defining heatwaves.



3.2.2. States and territories

Under Australian constitutional arrangements, state and territory governments have primary responsibility for the protection of life, property and the environment, and to make relevant decisions affecting these areas of responsibility (AIDR 2019).

Most states and territories develop and maintain heatwave plans with associated communication strategies and arrangements. Plans rely on strong cooperative, coordinated and consultative relationships among state and territory government departments and agencies, local governments and other specialist organisations or key stakeholders.

Ideally, state and territory plans should include:


- The strategic priorities for the preparation, response and recovery from heatwaves within their boundaries, including heatwave management and coordination arrangements.
- The roles and responsibilities of agencies and organisations impacting the management of heatwave events – potential agencies that may have a role in responding to or mitigating the impacts of heatwaves are at Appendix D.
- Triggers and alerts for actions for agencies and stakeholders, with associated communication strategies and arrangements.

Under this Framework, states and territories have discretion to issue warnings or information in line with their relevant heat health or heat management plans or arrangements.



4. Australian Warning System: Heatwave Application

Early advice of a severe or extreme heatwave expected to occur later in the week

EHF trigger level	Lead time	Impact	Bureau warning action statements	AWS alignment	Jurisdictional agency response
N/A	Prior to event onset	Increased morbidity and mortality for vulnerable groups, such as those over 65, pregnant women, babies, and young children, and those with relevant illnesses or injuries.	<ul style="list-style-type: none"> A heatwave is forecast for your area. Extreme heat can cause illness. Monitor the weather on the Bureau of Meteorology website or app, and warnings and advice through your state or territory emergency or health service. Plan – have a place to keep cool. 	Advice  ¹	Consider issuing additional heatwave warning and/or advice consistent with heat health planning.

Recommended response agency action statements/topic areas


- Plan shelter and cool water for pets and other animals.
- Support vulnerable persons to prepare for the heatwave, including elderly neighbours and relatives.
- Prepare to stay cool while you sleep – nights can still be hot.
- Plan your activities to avoid the heat.
- Charge mobile phones and devices in case power supplies are affected.

Table 1: AWS Heatwave Application - Early advice of a severe or extreme heatwave expected to occur later in the week

¹ Lead time for heatwave exceeds that of the advice level, however it remains the closest alignment and jurisdictions should select the appropriate lead time for the community action required.



Severe heatwave is imminent or occurring now

EHF trigger level	Lead time	Impact	Bureau warning action statements	AWS alignment	Jurisdictional agency response
>1<3	Imminent or occurring (<1 day)	Increased morbidity and mortality for vulnerable groups, such as those over 65, pregnant women, babies, and young children and those with relevant illnesses or injuries.	<ul style="list-style-type: none"> Severe heatwaves can be dangerous for many people, especially older people, babies, children, pregnant and breastfeeding women, people with medical conditions and people who are unwell. Seek a place to keep cool, such as your home, a library, community centre or shopping centre. Close your windows and draw blinds, curtains, or awnings early in the day to keep the heat out of your home. If available, use fans or air-conditioners to keep cool. 	Watch and Act 	Consider issuing severe heatwave watch and act warning, consistent with heat health planning.


Recommended response agency action statements/topic areas

- Schedule activities in the coolest part of the day and avoid exercising in the heat.
- If you must go out, wear a hat and sunscreen and take a bottle of water with you.
- Drink water frequently unless your doctor normally limits your fluids.
- Never leave a person or pet in a car.
- Check in regularly with vulnerable persons, including elderly neighbours and relatives.
- Provide shelter and cool water for pets and other animals.
- Seek help if you feel unwell from your GP, pharmacist, or Nurse-On-Call. In a life-threatening situation call triple zero (000).

Table 2: AWS Heatwave Application - Severe heatwave is imminent or occurring now



Extreme heatwave is imminent or occurring now

EHF trigger level	Lead time	Impact	Bureau warning action statements	AWS alignment	Jurisdictional agency response
≥ 3	Imminent or occurring (<1 day)	<ul style="list-style-type: none"> Even healthy people who do not take precautions to keep cool are at risk. Normally reliable infrastructure, such as power and transport, are at risk of impact at this level. 	<ul style="list-style-type: none"> Extreme heatwaves can be dangerous for everyone. Seek a place to keep cool, for example: at home, a library, community centre or shopping centre. Close your windows and draw blinds, curtains, or awnings early in the day to keep the heat out of your home. If available, use fans or air-conditioners to keep cool. 	Emergency Warning 	Consider issuing extreme heatwave emergency warning, consistent with heat health planning.

Recommended response agency action statements/topic areas

- Schedule activities in the coolest part of the day and avoid exercising in the heat.
- If you must go out, wear a hat and sunscreen and take a bottle of water with you.
- Drink water frequently unless your doctor normally limits your fluids.
- Never leave a person or pet in a car.
- Check in regularly with vulnerable persons, including elderly neighbours and relatives.
- Provide shelter and cool water for pets and other animals.
- Seek help if you feel unwell from your GP, pharmacist or Nurse-On-Call. In a life-threatening situation, call triple zero (000).

Table 3: AWS Heatwave Application - Extreme heatwave is imminent or occurring now



De-escalation of heatwave warning

EHF trigger level	Lead time	Impact	Bureau warning action statements	AWS alignment	Jurisdictional agency response
N/A	1-3 days following the end of the heatwave	Heatwaves effects on health, the community, infrastructure and services can continue for some days after temperatures have fallen	<ul style="list-style-type: none">• Hot weather can still occur even when a heatwave has ended.• It may take some days to recover from a heatwave.• You should continue to take care of yourself and others, including animals.	N/A	Consider issuing health advice consistent with heat health planning.

Recommended response agency action statements/topic areas

- Prolonged heat can still be dangerous.
- Seek help if you feel unwell from your GP, pharmacist or Nurse-On-Call. In a life-threatening situation call triple zero (000).
- Continue to check in regularly with vulnerable persons, including elderly neighbours and relatives.

Table 4: AWS Heatwave Application – de-escalation of heatwave warning



5. Total Warning System: Heatwave Application

Timing	Element	Description	Responsibility	Action
Always	Situational awareness	Continuous attention to and connection with the past, current and emerging situation	Bureau	Provide weather observations, heatwave warnings, 7-day heatwave forecast and seasonal outlooks available to agencies responsible for heatwaves and the community.
			State or territory	Continue existing practices to maintain situational awareness through existing Commonwealth or jurisdictional mechanisms. Monitor the Bureau's heatwave situational awareness and forecast and warning products and issuing of warnings as needed without duplicating effort.
Before	Building community resilience to heatwaves	Pre-emergency community engagement and education about their heatwave risk, shared responsibilities and protective action	Bureau	Provide information: <ul style="list-style-type: none"> • Pre-season emergency service briefings. • Public awareness raising campaigns. • Targeted information for public sector, business, and industry.
			State or territory	Pre-season planning: <ul style="list-style-type: none"> • Assess heatwave risk and identify vulnerable groups drawing on available data. • Develop strategies to mitigate risk, potentially including participatory planning with communities and industry. • Pre-season public and industry preparedness and awareness campaigns including:



Timing	Element	Description	Responsibility	Action
				<ul style="list-style-type: none"> – Inform the community of their heatwave risk. – Provide heatwave advice to the community including vulnerable groups. – Facilitate message sharing by third parties (for example: the Department of Health National Incident Room, aged care providers, relevant health networks). – Provide targeted information for relevant sectors, such as the water, power and telecommunication sectors.
	Organisational readiness to warn	Organisational capability, systems and arrangements in place to warn effectively	Bureau	<ul style="list-style-type: none"> • Ensure that roles and responsibilities, as defined in this Heatwave Warning Framework are acknowledged amongst TWS partners. • Ensure that necessary systems and capabilities are operationally ready and tested. • Warning lead times should allow for immediate and short-term community responses.
			State or territory	<ul style="list-style-type: none"> • Ensure that roles and responsibilities, as defined in this Heatwave Warning Framework, are acknowledged amongst TWS partners. • Ensure that necessary systems and capabilities are operationally ready and tested. • Warning triggers and thresholds for issuing warnings should reflect the needs of key stakeholders, including industry, and be identified in state and territory planning.



Timing	Element	Description	Responsibility	Action
During	Monitoring and prediction	Detecting conditions that can lead to heat related illness and predicting the likelihood, timing, level and nature of impact	Bureau	<ul style="list-style-type: none"> Weather conditions monitored for the likelihood of heatwave (as defined by the EHF) using the national weather observation network and available suite of numerical weather prediction models and tools. Heatwave warning criteria (EHF severity thresholds and warning lead times) available nationally.
	Interpretation	Understanding the impact as predicted and deciding whether and how to warn	State or territory	<ul style="list-style-type: none"> Systems and processes in place to understand impacts of heatwaves at differing severity levels. Warning decisions, whether and how to warn, predetermined based on warning severity thresholds and lead times.
	Message construction	Devising the content of a message to inform and warn people of their risk, including recommended or required action	Bureau	Bureau heatwave warning using EHF severity and generalised safety messages as agreed in this Framework. The Bureau is responsible for status and forecast text.
			State or territory	States and territories issue heatwave warning with AWS aligned severity level and tailored safety advice.
	Communication	Disseminating timely, targeted and tailored warnings through multiple channels to all who may be affected.	Bureau	<ul style="list-style-type: none"> Warning lead times should allow for immediate and short-term mitigation actions. Bureau to share with states and territories the forecast certainty related to lead times required by partners and the community. Heatwave warnings disseminated via: <ul style="list-style-type: none"> RSS feed in accordance with CAP-Au practices (see Appendix E).



Timing	Element	Description	Responsibility	Action
				<ul style="list-style-type: none"> Bureau distribution networks, include the Bureau's website and apps and other agreed channels to targeted audiences, for example health and emergency service agencies and the media.
			State or territory	Heatwave warnings disseminated via state and territory distribution networks using multiple channels to relevant audiences, for example hospitals, aged care facilities and the media.
	Community response – messages are received, interpreted and acted upon	Seeking assurance communities have received, understood and are acting upon warnings	State or territory	<p>Community prepared and ready to respond to warnings. Where possible, real time incident monitoring data/information available to provide assurances that communities have received, understood and are acting upon warnings. Agencies should be able to provide assurance that services within their remit are acting in accordance with advice.</p> <p>Shared incident monitoring information may be used to target and tailor further messaging to under responding communities. To the extent possible and the degree allowed under relevant legislation, incident monitoring data and information may be available to involved agencies, including monitoring community activities, syndromic surveillance of health impacts, monitoring communications channels.</p>
After			Bureau	Post event verification that:



Timing	Element	Description	Responsibility	Action
	Continuous review and improvement			<ul style="list-style-type: none"> monitoring and prediction (forecasting) capability satisfies the requirements of the heatwave TWS (warning criteria/service levels) communication, dissemination and publishing of warning and situational awareness products satisfies the requirements of the heatwave TWS, warning criteria/service levels. <p>Post event learnings shared amongst TWS partners.</p>
			State or territory	<p>Post event verification that:</p> <ul style="list-style-type: none"> EHF thresholds or equivalent used in state or territory correspond to intended and meaningful impacts. warning lead time provides sufficient time to allow individuals to take some protective action in response to heatwave events. message construction and community readiness sufficiently tailored and targeted to elicit desired community response. <p>Post event learnings shared amongst TWS partners.</p>
			Bureau and State or territory	<p>Post event review and debrief including evaluation of all activities across the total warning system to continuously improve the delivery and effectiveness of warning service.</p>
	Feeding results into policy process to improve the		Bureau and State or territory	<p>Identified service and process improvements should be widely disseminated to allow other agencies and jurisdictions to learn from the experience of others.</p>



Timing	Element	Description	Responsibility	Action
	national warning service			

Table 5: Total Warning System: Heatwave Application



Appendix A – Authorising Environment for a National Heatwave Warning Framework

Australia adopted the Sendai Framework at the Third United Nations World Conference on Disaster Risk Reduction in Sendai, Japan, on 18 March 2015. The Sendai Framework aims to achieve substantial reduction of disaster risk and losses in lives, livelihoods and health, as well as losses in the economic, physical, social cultural and environmental assets of persons, business, communities and the nation.

The National Disaster Risk Reduction Framework (NDRRF) was endorsed by the Ministerial Council for Police and Emergency Management on 28 June 2019. The NDRRF, which is informed by the Sendai Framework, sets out the foundational work to proactively reduce disaster risk now and into the future. It guides national, whole of society efforts to reduce disaster risk to minimise the loss and suffering caused by disasters.

The National Strategy for Disaster Resilience (NSDR) was adopted by the Council of Australian Governments in February 2011. The NSDR provides the basis to governments to shift from an emphasis on response and recovery from natural disasters to a greater focus on prevention, mitigation and preparedness. The NSDR acknowledges that all levels of government have a role in driving systemic change for greater resilience to disasters in Australia.

The Australia-New Zealand Emergency Management Committee (ANZEMC) works to influence and advocate for national policies and capabilities that reduce disaster risk, minimise the potential for harm and uphold public trust and confidence in emergency management matters. The ANZEMC supported the development of a national framework for consistent heatwave information and warnings.

The ANZEMC initiated a National Review of Warnings and Information (2014) which called for greater consistency in the development of warnings frameworks across jurisdictions and all hazards, with frameworks flexible enough to accommodate the nuances in warning for the various hazards experienced in Australia. Further, with the call for agencies to formally consider using the Total Warning System in future warning frameworks, the Review draws an explicit connection between community preparedness and how it influences effective response to warnings (EMV 2014).

On 31 October 2019, the Commissioners and Chief Officers Strategic Committee supported the development of the AWS, a national three level multi-hazard warning framework. This was based on the findings from a comprehensive social research project that provided the evidence base for the development of the AWS to communicate risk and subsequently increase community safety and promote desired protective behaviours.

The National Health Emergency Management Standing Committee (NHEMS)² of the Australian Health Protection Principal Committee (AHPPC) identified a need for a nationally consistent health sector heatwave policy.

² NHEMS includes as its core membership health commanders in each state and territory with responsibility for management of the health sector response to emergencies, including natural disasters.



Appendix B – Population groups that may be susceptible to heat-related illness

While heatwaves can affect anybody (BOM, 2022), the following population groups may be more likely to be susceptible to heat-related illness:

- people aged over 65 years
- people who have an existing medical condition
- pregnant women, breastfeeding mothers, babies and young children
- people who work in hot environments or are physically active outdoors
- those taking some medications that affect the body's ability to cope with heat
- people who are socially isolated
- people living alone.



Appendix C – Excess Heat Factor

The EHF is calculated based on average daily temperatures over 3 consecutive days. This is measured in relation to the local long-term climate, by comparing the three days to a climatological threshold for that location, and to the local recent past, by comparing the three days to observed temperatures over the previous thirty days at that particular location.

The raw EHF values are scaled to severity quantities, called EHFsev. These quantities are based on reproducible and objective statistics founded on the Pareto principle which holds that most impact is felt in conditions that are outside the normal range.

A heatwave day is defined as any day for which EHFsev is positive, greater than zero. It is the first day of a 3-day period with unusually high temperatures. A heatwave event is defined as one or more consecutive heatwave days.

Heatwaves are further classified into 3 levels (low-intensity, severe, extreme – see Table 2), based on EHF values exceeding EHFsev thresholds within an event.

Low-Intensity Heatwave

- Lower positive EHFsev values ($\text{EHFsev} > 0$ and $\text{EHFsev} < 1$) –such as., greater than zero but less than one.
- Most common.
- Most people can cope.

Severe Heatwave

- Higher EHFsev values ($\text{EHFsev} \geq 1$ and $\text{EHFsev} < 3$) – such as, between one and 3.
- Less frequent.
- Can impact vulnerable people.

Extreme Heatwave

- Highest EHFsev values ($\text{EHFsev} \geq 3$) –such as, greater than 3.
- Rarest.
- Capable of causing widespread health issues.
- Can impact infrastructure such as power and transport.

The different levels of heatwave, such as low intensity, severe and extreme, with an increasing risk profile, enable the generation of tiered arrangements to manage heatwaves with defined activation triggers and escalating response levels.



Appendix D – Agencies relevant to Heatwave

The following agencies may have a role to play in mitigating and/or responding to, and recovering from, the impact of heatwaves:

- Health Departments including hospitals, mental health services and aged care services.
- Public Housing agencies.
- Human and Welfare Services agencies.
- Planning agencies.
- Transport agencies.
- Infrastructure agencies.
- Primary Industry agencies, including agriculture, animal welfare, construction and heavy industry representatives.
- Local Governments and Local Government Associations.
- Utility and essential service providers including water, power and telecommunication organisations.
- Education providers including childcare, schools and higher education organisations.
- Environmental agencies.
- Emergency Services, including fire agencies, emergency response agencies, police and ambulance services.
- Organisational health and safety agencies.
- Tourist organisations and peak bodies.



Appendix E – Common Alerting Protocol

The Common Alerting Protocol - Australia Profile (CAP-AU) (OASIS 2010) provides the Australian community with a common standard for the dissemination of all-hazard alert and warning messages during any emergency including event code terms commonly understood by the Australian community.

The Common Alerting Protocol standard establishes the basic structure and data elements for a CAP warning message; however, it leaves considerable room for inconsistencies in how and when the various data elements are employed. The CAP provides flexibility in how most of the CAP data elements are completed. Accordingly, the successful development of a CAP message warning system will necessarily involve the close collaboration of CAP producers and CAP consumers/re-publishers to conform to emerging usage standards, the Google profile and to enable the RSS feed.

Close collaboration is required

- Between the Bureau and state and territories to determine appropriate element values for the different stages of a heatwave event. In addition, the element values must be aligned to the EHF warning thresholds and the AWS. Draft element values aligned with the EHF warning thresholds and the AWS are presented in Table 6.
- To coordinate/manage concurrent warnings (e.g., Bureau heatwave warnings and heat health alerts) for the same impact affected area, event and event type. This can cause issues for publishers in presenting overlapping areas spatially and for CAP consumers especially if the messaging is inconsistent.
- To ensure warnings are as accurately targeted to the impact affected areas as possible, in accordance with the accuracy and resolution of available exposure and impact information, to avoid over alerting. Spatial scales are defined for the different warnings/alerts in **Error! Reference source not found..**

Alignment of CAP element values to AWS and EHF warning thresholds (OASIS 2013)

EHF	AWS	CAP element code value(s)				
Warning threshold	Warning level	Severity	Certainty	Instructions	Response type	Urgency
0-1	Advice	Moderate	Possible	<ul style="list-style-type: none"> • Prepare Now • Stay Informed • Monitor Conditions 	<ul style="list-style-type: none"> • Prepare • Monitor 	Future
0-1	Advice	Moderate	Likely	<ul style="list-style-type: none"> • Prepare Now • Stay Informed • Monitor Conditions 	<ul style="list-style-type: none"> • Prepare • Monitor 	Expected
0-1	Advice	Moderate	Observed	<ul style="list-style-type: none"> • Prepare Now • Stay Informed • Monitor Conditions 	<ul style="list-style-type: none"> • Prepare • Monitor 	Immediate



EHF	AWS	CAP element code value(s)				
>1<3	Advice	Severe	Possible	<ul style="list-style-type: none"> • Prepare Now • Stay Informed • Monitor Conditions 	<ul style="list-style-type: none"> • Prepare • Monitor 	Future
>3	Advice	Extreme	Possible	<ul style="list-style-type: none"> • Prepare Now • Stay Informed • Monitor Conditions 	<ul style="list-style-type: none"> • Prepare • Monitor 	Future
>1<3	Watch and Act	Severe	Likely	Action statement 1 Action statement 2 Action statement 3	Avoid	Expected
>1<3	Watch and Act	Severe	Observed	Action statement 1 Action statement 2 Action statement 3	Avoid	Immediate
>3	Emergency Warning	Extreme	Likely	Action statement 1 Action statement 2 Action statement 3	Shelter	Expected
>3	Emergency Warning	Extreme	Observed	Action statement 1 Action statement 2 Action statement 3	Shelter	Immediate
		Minor			All Clear	Past

Table 6: Alignment of CAP element values to AWS and EHF warning thresholds (OASIS 2013)



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