The Bureau of Meteorology

Heatwave Service Level Specification

Season 2023 – 2024



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Revision history

Date	Version	Author	Description
24/06/2022	0.1		Initial Draft
29/08/2022	0.2		Updated to respond to feedback from Bureau teams
27/03/2023	0.3		Updated to include example products from the 2022-2023 season
21/06/2023	0.4		Converted to new Bureau template
8/09/2023	0.5		Added 2 new tables to visualise the heatwave validity periods.
23/10/2023	0.6		Incorporating internal feedback

Review status

Date	Version	Reviewer	Description
2/2/2024	1.0		Endorsed for release

Release history

Date	Version	Status	Approval
9/12/2024	1.0	Approved	GM EPS

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1. Introduction

1.1. Purpose

The purpose of the Service Level Specification (SLS) is to document the heatwave services provided by the Bureau of Meteorology (the Bureau).

The Total Warning System[1] recognises that a fully effective warning service is multi-faceted in nature. Therefore, its development and operation requires input from several agencies, each with specialised roles to play. It is vital that the agencies involved work collaboratively through all stages of developing and operating the system. The services described here are the Bureau's contribution to the Total Warning System for heatwave services.



Figure 1. Total Warning System

As detailed in the National Heatwave Warning Framework the Bureau's role in the heatwave warning system is focussed on: (i) monitoring and prediction; (ii) message construction; and, (iii) communicating threats associated with weather conditions that influence heatwave impacts. The Bureau's role is to provide this service to Government, industry, and the community.

The Bureau also contributes to activities designed to strengthen organisational readiness and build community resilience. The Bureau achieves this through participating in the planning and coordination of activities with health and emergency services agencies.

[1] https://knowledge.aidr.org.au/media/5972/warnings-handbook.pdf, pg. 10

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1.2. Scope

The scope of the SLS is the Bureau's publicly available heatwave services and additional heatwave services provided to support health and emergency management agencies.

The SLS details what the Bureau does and when it does it, to provide heatwave services. How the Bureau produces heatwave services is addressed in internal Bureau documents.

1.3. Authority

The *Meteorology Act*, 1955 (Cth) provides the Bureau a number of functions including to take observations, forecast the weather and issue warnings for weather conditions likely to endanger life or property, including heatwaves. The Intergovernmental Agreement on the Provision of Bureau of Meteorology Hazard Services to the States and Territories (IGA) confirms the roles and responsibilities of the Bureau and State and Territory governments and local governments. The Bureau has responsibility for the provision of forecasting and warning services for heatwaves. The responsibility for heatwave preparation, response and providing more detailed warnings of heatwave impacts lies with State and Territory governments and local governments.

The Bureau of Meteorology Heatwave Service Level Specification is issued by the General Manager Environmental Prediction Services under the authority of the Director of Meteorology.

1.4. Distribution

This document will be distributed to members of the National Heatwave Advisory Group including members from the agencies listed in Table 1.

Jurisdiction	Agency Name
National	National Health and Emergency Management Standing Committee (NHEMS)
National	National Emergency Management Agency (NEMA)
National	Department of Health
WA	Department of Fire and Emergency Services (DFES)
WA	Department of Health
QLD	Fire and Emergency Services (QFES)
QLD	Department of Health
NT	Police, Fire and Emergency Services (PFES)
NT	Department of Health
NSW	Resilience NSW

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Jurisdiction	Agency Name
NSW	Department of Health
ACT	Emergency Services Authority (ACT ESA)
ACT	Department of Health
ACT	Ambulance Service
SA	State Emergency Service (SES)
SA	Department of Health
TAS	Department of Health
VIC	Emergency Management Victoria (EMV)
VIC	Department of Health

Table 1. Heatwave SLS distribution list by jurisdiction

2. National Heatwave Services

The Bureau's heatwave services provide the Australian community and health and emergency services agencies with essential heatwave forecasts and warnings that are timely and accurate.

The heatwave service is designed to inform the community and response organisations of weather conditions that will lead to heatwave conditions. An important secondary role is to assist local media and state or territory health and emergency services with public education programs, and to advise on meteorological aspects of heatwave disaster preparedness and planning.

2.1. Partnerships

Partnerships underpin the delivery of effective heatwave services to the Australian community. The Bureau has formed partnerships with health and emergency management organisations, other government authorities and media across the country to ensure that products are fit-for-purpose and are broadly distributed in a timely manner.

The partnerships with State and Territory Governments and local government are formalised through the National Heatwave Warning Framework and the IGA which clarifies and confirms responsibilities across the total warning system. As described in the framework, partner health and emergency services agencies at the state and territory level issue heatwave messaging aligned with the Australian Warning System.

Importantly, the Bureau, States and Territories agree to work together to mutually develop and maintain national standards for warnings of heatwaves. This is coordinated through the National Heatwave Advisory Group.

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2.2. Heatwave Season

The heatwave season starts in early October and continues until the end of March. The season can be extended if periods of significant heat are expected to occur earlier in the year or continue past the end of March. Routine heatwave products are issued daily during the heatwave season, but heatwave warnings are issued as required throughout the year.

2.3. Area of Responsibility

The Bureau's heatwave services cover all Australian states, mainland territories and nearby offshore islands.

2.4. Dissemination of products

Publicly available Bureau heatwave products are transmitted via the Bureau's website and app. Products for health and emergency services agencies are transmitted by email, registered user web services and file transfer protocol (ftp).

2.5. Briefing Services

The Bureau will provide briefings to Health and Emergency Management partners to assist planning, response, and coordination. The format, timing and frequency of briefings will be agreed through arrangements with each agency.

2.6. Outposted Meteorologists

The Bureau has arrangements with several emergency services agencies to provide services through an outposted meteorologist to support operational awareness and communication. In each instance, the services provided will be agreed between the Bureau and the relevant agency and are provided on a cost recovery basis.

2.7. Communication and adoption activities

In addition to issuing products through standard communication channels (e.g., website, app), the Bureau undertakes a range of complementary communication and adoption activities in partnership with emergency management agencies. These activities are aimed to increase the uptake and effectiveness of the forecasts and warnings and ensure consistent weather safety messages are provided to the community.

This includes community, industry and government preparedness briefings, social media campaigns, targeted community engagement activities and the Bureau's Heatwave Knowledge Centre web pages. During the season this extends to joint press conferences and media interviews, as well as continuing social media public safety campaigns and community and industry briefings.

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2.8. Service Continuity

The Bureau maintains service continuity through its Business Continuity Plan. Most pertinent to heatwave services is the built-in redundancy of being able to transfer operations between offices as required.

To maintain service continuity, the Bureau uses a large and diverse range of observational and forecast data in the delivery of its heatwave services. This provides redundancy if any data source is unavailable during operations and ensures all products and services are based on the best available information at all times.

3. Quality Assurance and Performance

3.1. Hazard Services Forum

The IGA established the Hazards Services Forum (HSF) in 2018. The HSF facilitates consultation with State and Territory operational emergency service agencies to guide current and future strategic development of the Bureau of Meteorology's hazard services.

The forum enables the states and territories to request and prioritise changes to the Standard Services and to refer services that could be considered Supplementary Services to the Bureau for consideration. The HSF also assist with the process of consulting on modifications to Services Schedules.

3.2. National Heatwave Advisory Group

The National Heatwave Advisory Group (NHAG) will oversee the implementation, evaluation and review of the National Heatwave Warning Framework (the Framework), and the Bureau of Meteorology's (the Bureau's) heatwave service.

As an advisory group, the NHAG will consolidate and share heatwave related information and provide feedback and recommendations on the Bureau's heatwave service. Feedback and recommendations will be formally reported to the Hazards Services Forum (HSF) as the strategic body to discuss national resource prioritisation for the provision of the Bureau's hazards services to the states and territories.

3.3. Performance Statistics and Reporting

Bureau Heatwave products are verified against available observations and compiled into routine reports

In circumstances where heatwaves are deemed to have had a significant impact on community safety and/or livelihoods, the Bureau may prepare an event report. The purpose of the report is to provide an overview of the meteorological aspects surrounding the event, as well as forecast and warning performance. This forms part of the Bureau's post event review process.

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3.4. Post Event Review

The Bureau conducts an internal post event reviews after heatwave events that have had a significant community or operational impact.

The insights and recommendations gained from these post event reviews are used to improve processes, systems and services delivered by the Bureau.

Depending on the impact from a heatwave event, this process may include a debrief with external partners. Upon request, the Bureau also contributes to post incident reviews conducted by health and emergency services agencies and government.

3.5. Meteorologist Training

The Bureau delivers a heatwave training program for meteorologists. This program ensures that staff involved in analysing and forecasting heatwaves have the training and demonstrated ability to provide a high standard of heatwave services to the Australian community.

4. National Heatwave Product Schedule

Heatwave services provided by the Bureau utilise gridded forecast data covering the entire Australian domain. The service utilises the Excess Heat Factor (EHF) to provide a measure of heatwave severity.

Detailed information on how the Excess Heat Factor is calculated is included in Appendix 1: Excess Heat Factor Calculation. For a complete listing of Public Weather Districts used for Heatwave Warnings, see Appendix 2: Public Weather District Maps.

Unless otherwise noted, all issue times in this document are quoted as local time for the relevant jurisdiction and time of year.

4.1. Routine Services

4.1.1. Geospatial Data Products

4.1.1.1. Purpose

Geospatial data products provide gridded heatwave data. The highest spatial resolution data is available in the NetCDF grids. These are at a 5km resolution across Australia and available for download via FTP. There are 4 different data products available:

1. Excess Heat Factor (EHF)
2. Excess Heat Factor – Severity (EHFsev)
3. Heat Stress Acclimatisation (EHI accl)
4. Significant Excess Heat (EHI sig)

A sample of these is available at ftp://ftp.bom.gov.au/anon/sample/catalogue/Heatwave/

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The user guide is available at http://reg.bom.gov.au/catalogue/heatwave.pdf (which also describes the smoothing of heatwave areas for the WMS product).

The heatwave WMS layer is a smoothed version of the data in the NetCDF grids. Due to the smoothing algorithm, some small areas of heatwave get smoothed out and don't appear on this product. Page 10 of the user guide describes the Heatwave WMS layer http://reg.bom.gov.au/catalogue/GIS2Web.pdf

Metadata information for the GIS layer is available at http://www.bom.gov.au/metadata/catalogue/19115/ANZCW0503900601?template=full

4.1.1.2. Issue times and validity

The heatwave geospatial data products are issued at around 14:15 AEST/AEDT daily during heatwave season. The information is valid for 7 three-day periods.

4.1.1.3. Accessing geospatial data products

Agencies will need to set up separate FTP and GIS2Web accounts to access all geospatial products. The Real Time Data Services team manages all account set up and administration: webreg@bom.gov.au

4.1.2. Web-based Heatwave Map Product

4.1.2.1. Purpose

National Heatwave Assessment and Forecast maps show a broadscale picture of where the significant heatwaves are expected to occur across Australia over the coming seven days.

The national maps of heatwave areas are accompanied by a text description of the heatwave areas shown on the map, for accessibility purposes.

4.1.2.2. Issue times and validity

The Web-based Heatwave Map Products are issued at around 15:30 AEDT daily during heatwave season. The information is valid for 7 three-day periods.

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Day – 2	Day – 1 (yesterday)	Day +0 (today)	Day +1 (tomorrow)	Day +2	Day +3	Day +4	Day +5	Day +6
Heatwave Assessment Map 1								
	Heatwave Assessment Map 2							
		Heatwave Forecast Map 1						
			Heatwave Forecast Map 2					
				Heatwave Forecast Map 3				
					Heatwave Forecast Map 4			
						Heatwave Forecast Map 5		

Table 2. Visualisation of the validity of the 7 heatwave maps that are issued each day.

4.1.2.3. Accessing the web-based heatwave map product

The Heatwave Assessment and Forecast maps are available at the following web link http://www.bom.gov.au/australia/heatwave/. The areas of extreme, severe and low-intensity heatwaves on these maps have been smoothed for display purposes.

4.1.3. Heatwave Decision Support Product

4.1.3.1. Purpose

The Heatwave Decision Support Product (HDSP) is provided to Health and Emergency Service agencies, and includes aggregated information to the weather district and town level based on the EHFsev gridded heatwave data. It covers 7 three-day periods with the date listed in the tables being the first of the three days

The District severity summary forecast section shows the heatwave severity category for each district based on the highest severity affecting at least 10% of that district.

The District severity detailed forecast section shows the % area covered by each severity category. This allows users to understand how widespread the heatwave is in the area of interest.

The Town Excess Heat Factor (EHF) detailed forecast section shows the numerical EHFsev values at each location. This provides information about the severity of the heatwave.

The HDSP should be used in conjunction with the geospatial data products and maps to understand where the heatwave risk is within the weather district.

Note that because of the smoothing with the web-based national maps, it is possible that the HDSP will show significant heatwaves in a weather district that do not appear on the national map. The information in the HDSP is correct as it is based on the higher-resolution NetCDF grids.

4.1.3.2. Issue times and validity

The HDSP is issued at around 14:45 AEDT daily. The information is valid for 7 three-day periods.

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4.1.3.3. Accessing the Heatwave Decision Support Product

The HDSP is available on the registered user webpage:
https://reg.bom.gov.au/reguser/by_prod/HWDecisionSupport/#/

Health and Emergency Services agencies responsible for heatwave response have been provided the username and password details to access this page.

The HDSP is also available in xlsx and csv formats via the FTP platform.

Agencies require an account to access FTP. The Real Time Data Services team manages all account set up and administration, and can be contacted at webreg@bom.gov.au

4.2. Non-Routine Services

4.2.1. Heatwave Warning

4.2.1.1. Purpose

The Heatwave Warning is issued when Severe or Extreme heatwaves are expected to affect at least 10% of a weather district. A Severe heatwave is defined as 10% or greater of a weather district meeting the EHFsev threshold: EHFsev >= 1 and EHFsev < 3. An Extreme heatwave is defined as 10% or greater of a weather district meeting the EHFsev threshold: EHFsev >=3.

A warning can be issued up to one day in advance of the heatwave starting, to allow time for agencies and the public to take protective actions.

Agreed action statements will appear in the warning, depending on warning severity and timing. There is also a link to further information from the relevant state/territory authority.

The warning will include a description of the expected maximum and minimum temperatures, the timing of when the heatwave will peak and/or ease and affected towns and communities within the warning area.

4.2.1.2. Issue times and validity

Heatwave Warnings are issued by around 15:00 local time, but slightly earlier in Western Australia (14:00 local time). Warnings are updated daily during heatwave events and then cancelled at the end of the event.

The warning covers 4 overlapping three-day periods, extending out to 3 days in the future. A severe or extreme rating on one or more of those 4 periods will trigger a warning.

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Day – 2	Day – 1 (yesterday)	Day +0 (today)	Day +1 (tomorrow)	Day +2	Day +3	Day +4	Day +5	Day +6
Heatwave Assessment Map 1								
	Heatwave Assessment Map 2							
		Heatwave Forecast Map 1						
			Heatwave Forecast Map 2					
				Heatwave Forecast Map 3				
					Heatwave Forecast Map 4			
						Heatwave Forecast Map 5		
Heatwave Warning Map 1								
	Heatwave Warning Map 2							
		Heatwave Warning Map 3						
			Heatwave Warning Map 4					

Table 3. Visualisation of the validity of the 4 maps included in the heatwave warning.

4.2.1.3. Accessing Heatwave Warnings

Heatwave warnings will appear on the web alongside other Bureau warnings at http://www.bom.gov.au/australia/warnings/index.shtml and on the Bureau's mobile app. Subscribers to the App can choose to receive push notifications when a heatwave warning is issued for their weather district.

A voice version of the heatwave warning will be available on the Bureau's telephone weather service.

Partner agencies will receive heatwave warnings via email.

Heatwave Warnings will also be included in the All Warnings Bundle for registered subscribers.

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5. Appendix 1: Excess Heat Factor Calculation

5.1. Excess Heat Factor

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

Details of the EHF Calculation as described by Nairn and Fawcett (2013) are shown below.

Significant excess heat (EHI_{sig}) is the three-day mean temperature anomaly relative to the 95th percentile climatology value at each location. The daily mean temperature (T) is calculated as the average of the maximum and minimum temperatures recorded across the 24-hour period (9am to 9am local time) for each grid cell where the maximum temperature usually precedes the minimum temperature. Units are °C.

The significant excess heat index at a given grid cell for a particular date is calculated as

$$EHI_{SIG} = \frac{T_i + T_{i+1} + T_{i+2}}{3} - T_{95}$$

where i is the day in the three-day heatwave period and i = 1 is the first day in the sequence. T_{95} is the 95th percentile of daily mean temperature Ti for a grid cell for the climate reference period 1971-2000 across all days of the year.

Heat Stress (Acclimatisation) (EHI_{accl}) for a given grid cell on a particular date is the three-day mean temperature anomaly relative to the previous 30-day mean temperature value. This is calculated as:

$$EHI_{accl} = \frac{T_i + T_{i+1} + T_{i+2}}{3} - \frac{T_i + T_{i-1} + \cdots + T_{i-30}}{30}$$

where i = 1 is the first day in the 3 day heatwave period.

Excess heat factor (EHF) is the combined effect of EHI_{sig} and EHI_{accl} and is calculated as:

$$EHF = EHI_{sig} \times \max(1, EHI_{accl})$$

Heatwave conditions exist when EHF is positive.

Excess Heat Factor – Severity (EHF_{sev})

The EHF threshold for a severe heatwave varies by location and is taken to be the 85th percentile (EHF_{85}) at each grid cell for all positive EHF values during the reference period 1958-2016.

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To categorise heatwave severity, EHF is compared to the 85th percentile value at that grid cell. The EHF_{sev} is calculated as:

$$EHF_{sev} = \frac{EHF}{EHF_{85}}$$

Heatwaves are classified into three severity levels (low-intensity, severe, extreme), based on EHF values exceeding EHFsev thresholds within an event.

Low-Intensity Heatwave

EHFsev > 0 and EHFsev < 1 – i.e., greater than zero but less than one
Most common
Most people can cope

Severe Heatwave

EHFsev >= 1 and EHFsev < 3 – i.e., between one and three
Less frequent
Can impact vulnerable people

Extreme Heatwave

EHFsev >= 3 – i.e., three or greater
Rarest
Capable of causing widespread health issues
Can impact infrastructure such as power and transport

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6. Appendix 2: Public Weather District Maps

6.1. Western Australia Public Weather Districts



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Figure 2. Map showing WA public weather districts.

6.2. Northern Territory Public Weather Districts



Figure 3. Map showing NT public weather districts.

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6.3. Queensland Public Weather Districts



Figure 4. Map showing QLD public weather districts.

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6.4. New South Wales and Australian Capital Territory Public Weather Districts

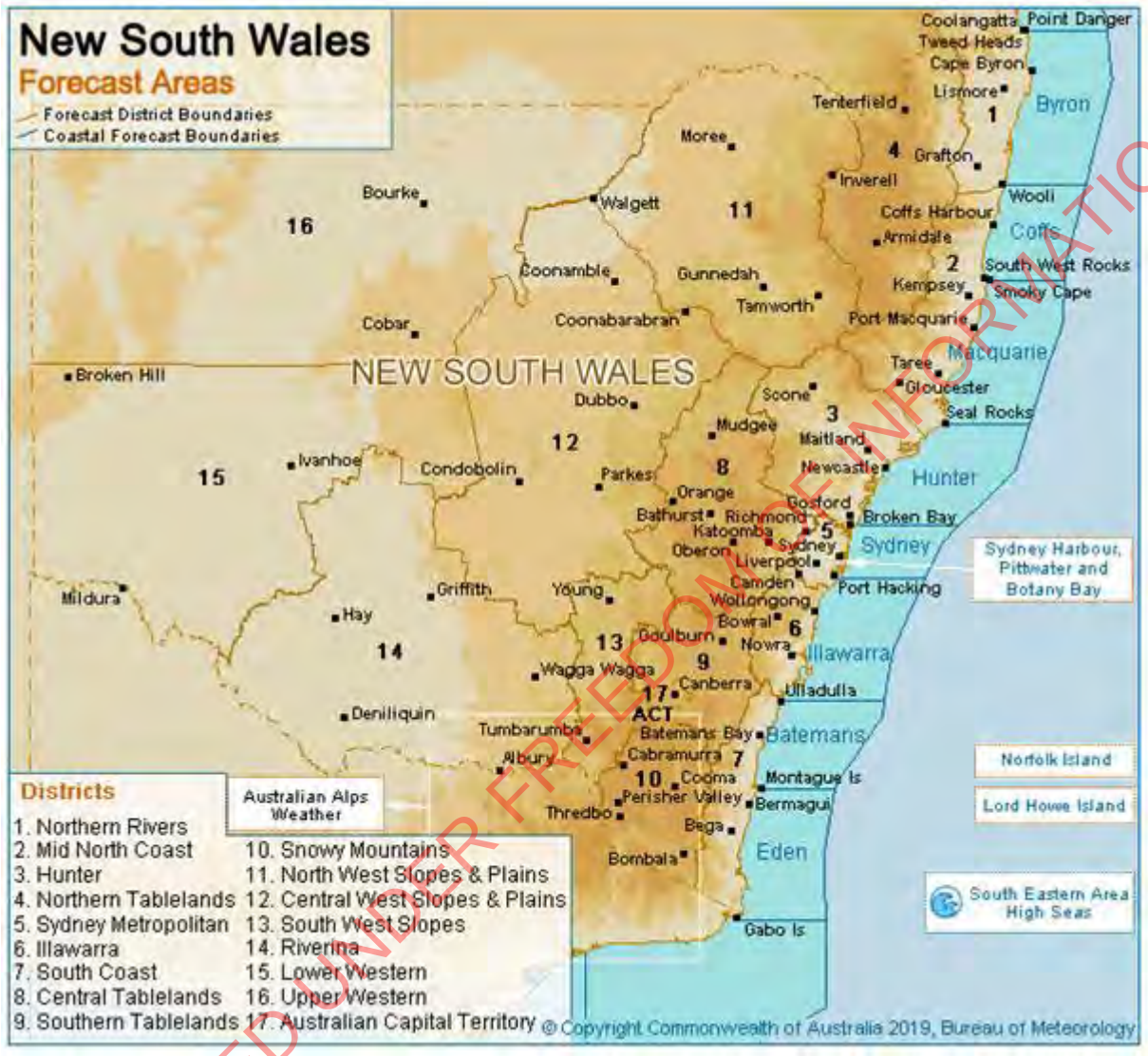


Figure 5. Map showing NSW and ACT public weather districts.

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6.5. Victoria Public Weather Districts



Figure 6. Map showing VIC public weather districts.

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6.6. Tasmania Public Weather Districts

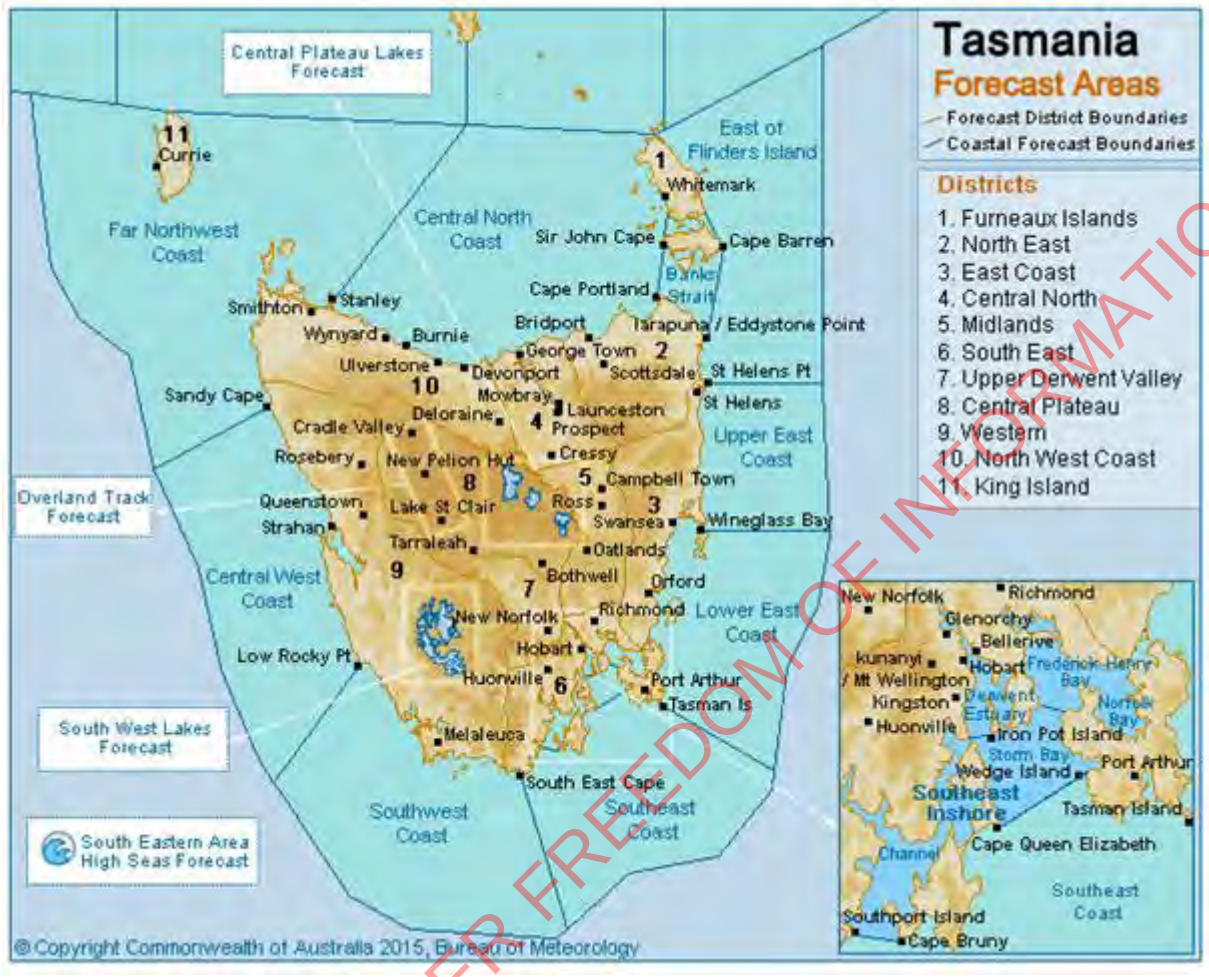


Figure 7. Map showing TAS public weather districts.

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6.7. South Australia Public Weather Districts



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Figure 8. Map showing SA public weather districts.

7. Appendix 3: Product Samples

7.1. Web-based Heatwave Map Product

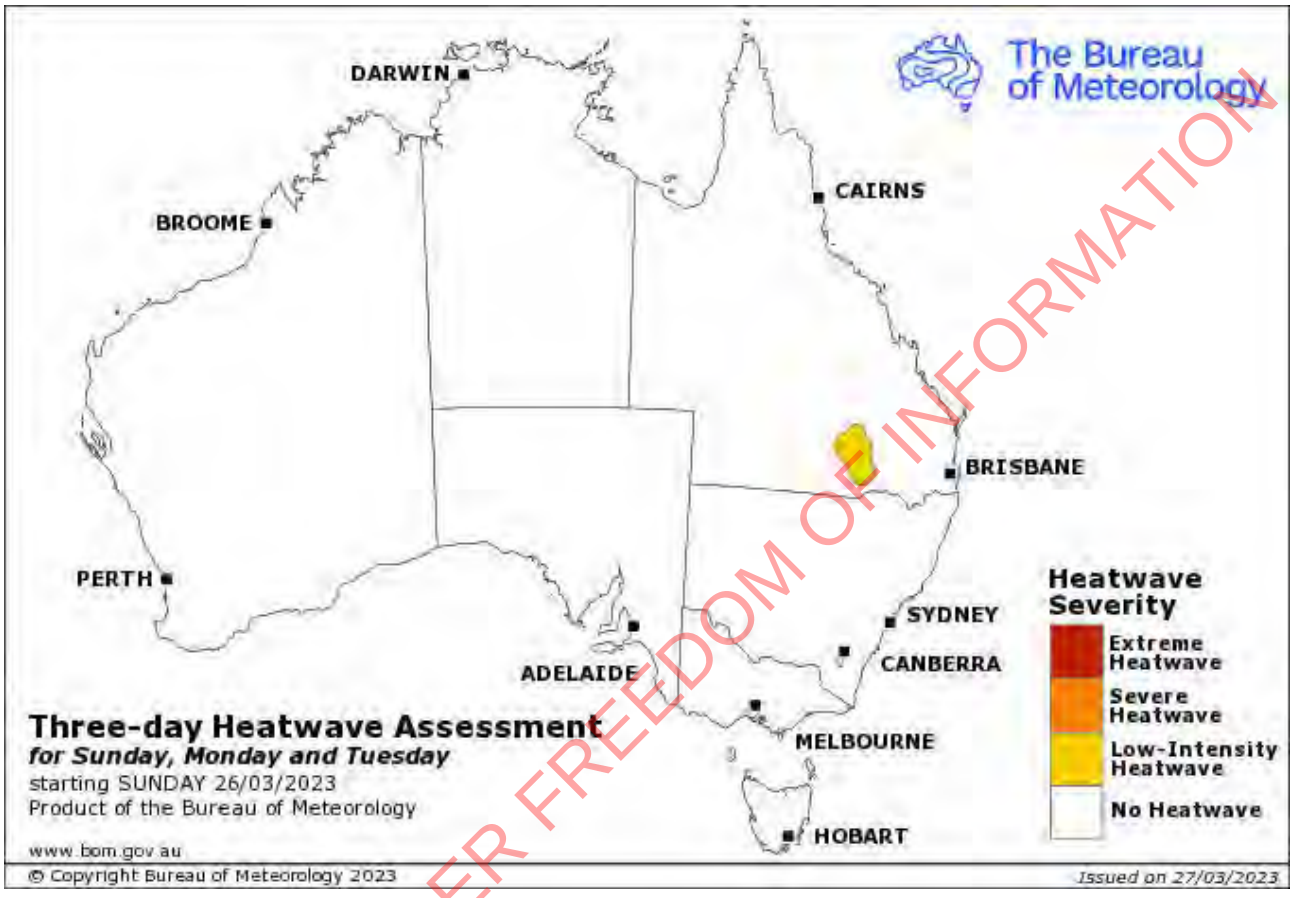


Figure 9. Heatwave Assessment Map

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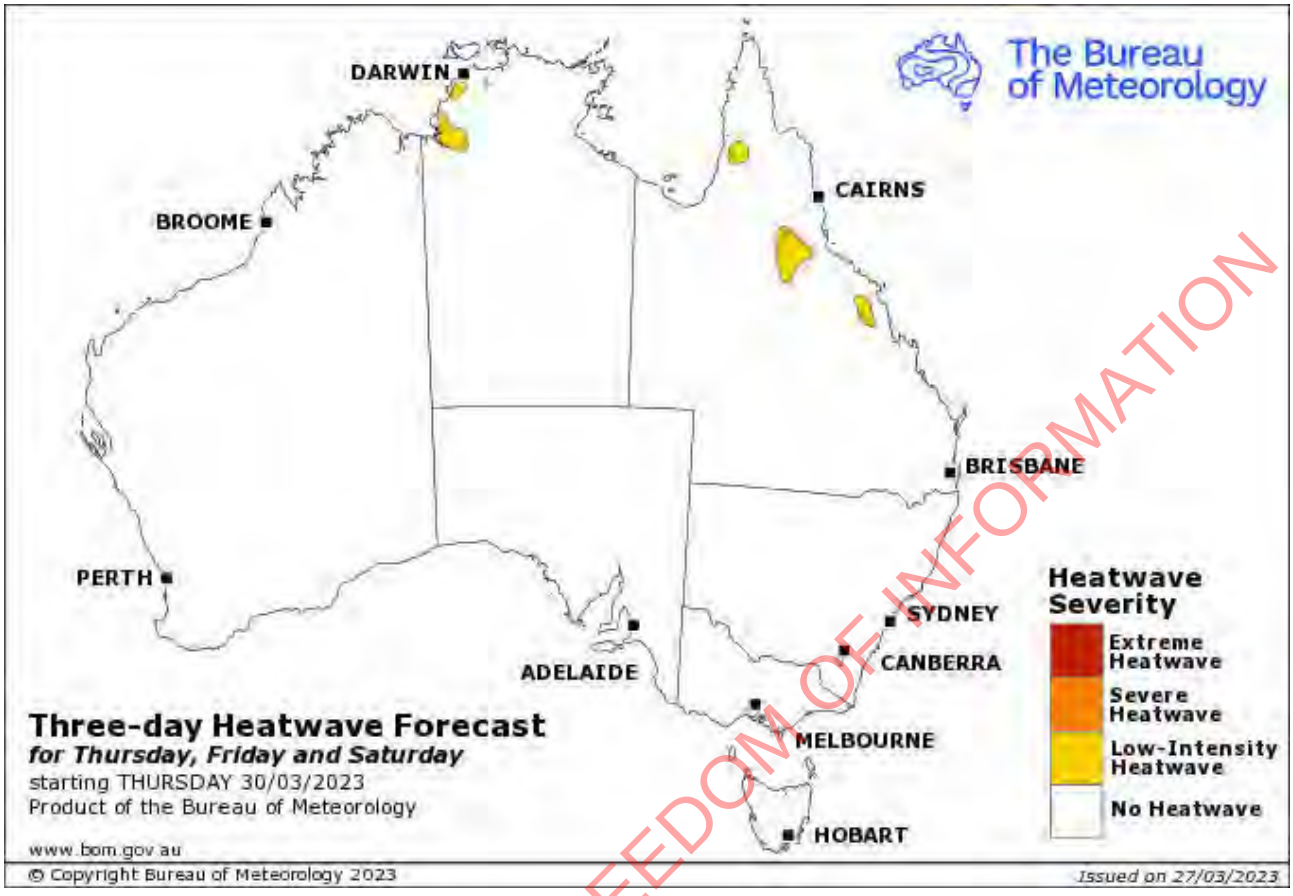


Figure 10. Heatwave Forecast Map

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7.2. Heatwave Decision Support Product



District severity summary forecast

District

Show all

District	Sat 7 Jan	Sun 8 Jan	Mon 9 Jan	Tue 10 Jan	Wed 11 Jan	Thu 12 Jan	Fri 13 Jan
Central	No heatwave	No heatwave	No heatwave	Low	Low	Low	Low
East Gippsland	No heatwave	No heatwave	Low	Low	Low	Severe	Low
Mallee	No heatwave	Low	Low	Low	Low	Low	Low
North Central	No heatwave	No heatwave	Low	Low	Low	Severe	Low
North East	No heatwave	Low	Low	Low	Severe	Severe	Severe
Northern Country	No heatwave	Low	Low	Low	Severe	Severe	Severe
South West	No heatwave	No heatwave	No heatwave	No heatwave	Low	Low	Low
West and South Gippsland	No heatwave	No heatwave	No heatwave	Low	Low	Severe	Low
Wimmera	No heatwave	No heatwave	No heatwave	Low	Low	Low	Low

Last updated
1 hour ago, 2:38 pm AEDT

Figure 11. District summary component of the HDSP showing heatwave severity categories. Example from product issued for Victoria on 9 January 2023.

The categories shown in the first four columns of the District Summary section are used to determine whether a heatwave warning is required for each weather district. The highest heatwave category in the 4 three-day periods is assigned for warning purposes.

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Northern Country

Severity breakdown (%)

Severity	Sat 7 Jan	Sun 8 Jan	Mon 9 Jan	Tue 10 Jan	Wed 11 Jan	Thu 12 Jan	Fri 13 Jan
Low	0	10	81	100	75	52	84
Severe	0	0	0	0	25	48	16
Extreme	0	0	0	0	0	0	0

Figure 12. Detailed district section of the HDSP showing the percentage of the weather district in each heatwave severity category. Example from product issued for Victoria on 9 January 2023.

Northern Country

Town Excess Heat Factor

Low Severe Extreme

Town	Sat 7 Jan	Sun 8 Jan	Mon 9 Jan	Tue 10 Jan	Wed 11 Jan	Thu 12 Jan	Fri 13 Jan
Bendigo	-0.1	0.0	0.2	0.5	1.1	1.3	0.7
Cobram	-0.3	-0.2	0.0	0.2	0.5	0.7	0.7
Echuca	-0.2	-0.1	0.1	0.2	0.7	1.0	0.6
Kyabram	-0.2	-0.1	0.2	0.4	0.9	1.2	0.7
Redesdale	-0.1	-0.1	0.0	0.2	0.8	0.9	0.3
Shepparton	-0.2	0.0	0.4	0.7	1.4	1.7	1.3
Tatura	-0.2	-0.1	0.2	0.5	1.2	1.5	1.1
Yarrawonga	-0.3	-0.1	0.3	0.5	0.9	1.1	1.0

Figure 13. Town forecasts component of the HDSP showing numerical EHFsev values. Example from product issued for Victoria on 9 January 2023.

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7.3. Heatwave Warning

Heatwave Warning For South Australia

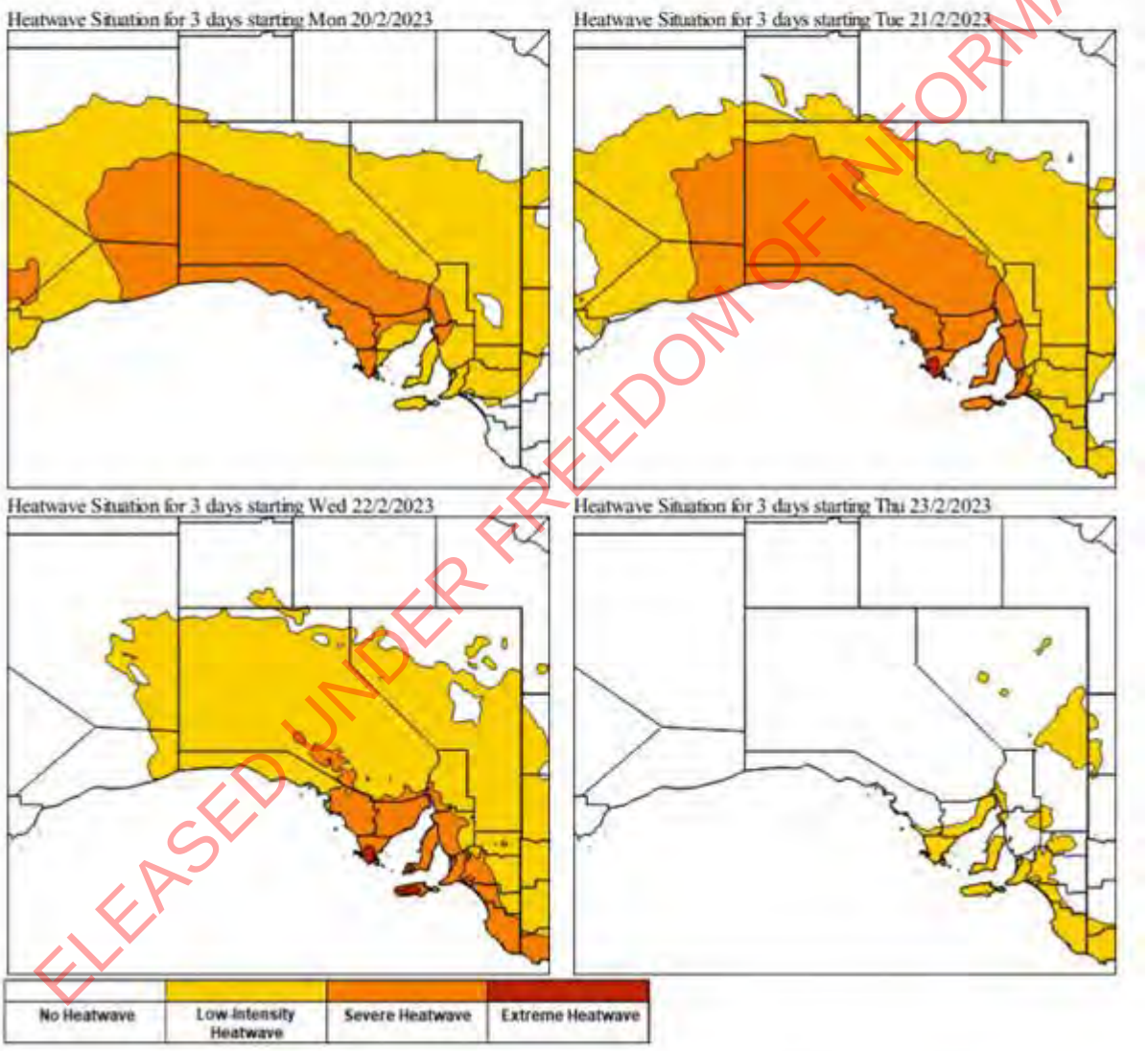
Issued at 02:59pm CDT on Wednesday 22 February 2023

Valid for Wednesday 22 February 2023 to Friday 24 February 2023

Extreme Heatwave Warning for: Kangaroo Island and Lower Eyre Peninsula Districts

Severe Heatwave Warning for: Adelaide Metropolitan, Yorke Peninsula, Upper South East, Lower South East, Murraylands, Mid North, Flinders, West Coast, Eastern Eyre Peninsula, North West Pastoral and Mount Lofty Ranges Districts

Cancelled Heatwave Warning for: Riverland District



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Safety Advice

- Extreme heatwaves can be dangerous for everyone.
- 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.

For information on staying safe during a heatwave go to the South Australia SES web page.

Weather Situation

Maximum temperatures in the low to mid forties with minimum temperatures in the mid to high twenties moving from the west through southern parts of the State.

Severe to extreme heatwave conditions extending eastwards over the coming days, then easing following the passage of a cold front during Friday.

Locations likely to be impacted include Adelaide Metropolitan Area, Ceduna, Clare, Maitland, Mount Gambier, Mount Barker, Murray Bridge, Naracoorte, Port Lincoln and Port Pirie.

The next heatwave warning will be issued by 3:00pm CDT on Thursday 23 February 2023

Figure 14. Heatwave Warning including the heading, image and text components. Example from product issued for South Australia on 22 February 2023.

8. Appendix 4: List of Product Identifiers

Product Identifier	Description	Coverage
IDY11001	Heatwave Grid – Excess Heat Factor (EHF)	National
IDY11002	Heatwave Grid – Excess Heat Factor – Severity (EHFsev)	National
IDY11003	Heatwave Grid – Heat Stress (Acclimatisation) (EHI accl)	National
IDY11004	Heatwave Grid – Significant Excess Heat (EHI sig)	National
IDBY1100	Heatwave Grids - Bundle	National
IDY10008	Australian Heatwave Warning Summary (BNOC)	National
IDW10015	Heatwave Decision Support Product (WA)	WA
IDD10015	Heatwave Decision Support Product (NT)	NT
IDQ10015	Heatwave Decision Support Product (QLD)	QLD
IDN10115	Heatwave Decision Support Product (NSW & ACT)	NSW & ACT
IDV10015	Heatwave Decision Support Product (VIC)	VIC
IDT10015	Heatwave Decision Support Product (TAS)	TAS
IDS10015	Heatwave Decision Support Product (SA)	SA
IDW21013	Heatwave Warning (WA)	WA

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Product Identifier	Description	Coverage
IDD21013	Heatwave Warning (NT)	NT
IDQ21013	Heatwave Warning (QLD)	QLD
IDN21013	Heatwave Warning (NSW)	NSW
IDN21014	Heatwave Warning (ACT)	ACT
IDV21013	Heatwave Warning (VIC)	VIC
IDT21013	Heatwave Warning (TAS)	TAS
IDS21013	Heatwave Warning (SA)	SA

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9.3. List of acronyms

ACT	Australian Capital Territory
ADFD	Australian Digital Forecast Database
AFAC	Australasian Fire and Emergency Service Authorities Council
BMTC	Bureau of Meteorology Training Centre
EHF	Excess Heat Factor
FTP	File Transfer Protocol
GIS	Graphical Information System
HDSP	Heatwave Decision Support Product
HMA	Hazard Management Agency

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HSF	Hazard Services Forum
ID	Identification (numbers or codes)
NEMA	National Emergency Management Agency
NetCDF	Network Common Data Form
NHAG	National Heatwave Advisory Group
NSW	New South Wales
NT	Northern Territory
NWP	Numerical Weather Prediction
PERM	Post Event Review Management
QLD	Queensland
SA	South Australia
SES	State Emergency Service
SLS	Service Level Specification
SOP	Standard Operating Procedures
TAS	Tasmania
VIC	Victoria
WA	Western Australia

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Thunderstorm and Severe Weather Service Level Specification

Community Services Group

Season 2023-2024

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Revision history

Date	Version	Author	Description
10/08/2023	0.1		Initial draft template
14/10/2023	0.2		Final internal draft
	0.3		Draft sent for internal consultation
9/11/2023	0.4		External consultation

Review status

Date	Version	Reviewer	Description
Oct 2023	1.0		Endorsed for further release



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Published by The Bureau of Meteorology

Cover image: Adelaide River, Northern Territory, Christopher Kent, 12 December 2019.

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List of acronyms used in this Service Level Specification

ACT	Australian Capital Territory
ADFD	Australian Digital Forecast Database
AEP	Annual Exceedance Probability
BMTC	Bureau of Meteorology Training Centre
NEMA	National Emergency Management Agency
EWA	Emergency Weather Alert
HAT	Highest Astronomical Tide
HMA	Hazard Management Agency
HSF	Hazard Services Forum
ID	Identification (numbers or codes)
IGA	The Intergovernmental Agreement on the Provision of Bureau of Meteorology Hazard Services to the States and Territories
LAT	Lowest Astronomical Tide
NSW	New South Wales
NT	Northern Territory
NWP	Numerical Weather Prediction
PERM	Post Event Review Management
PSG	Predictive Services Group
QLD	Queensland
QPF	Quantitative Precipitation Forecast
SA	South Australia
SES	State Emergency Service
SEWS	Standard Emergency Warning Signal
SLS	Service Level Specification
SOP	Standard Operating Procedures
SWH	Significant Wave Height
TAS	Tasmania

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VIC	Victoria
VDS	Very Dangerous Storm
WA	Western Australia

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1. Introduction

1.1. Purpose

The purpose of the Service Level Specification (SLS) is to document the thunderstorm and severe weather services provided by the Bureau of Meteorology (the Bureau).

The Total Warning System[1] recognises that a fully effective warning service is multi-faceted in nature and its development and operation involves input from several agencies each with specialised roles to play. It is vital that the agencies involved work in close cooperation through all stages of developing and operating the system. The services described here are the Bureau's contribution to the Total Warning System for thunderstorms and severe weather.

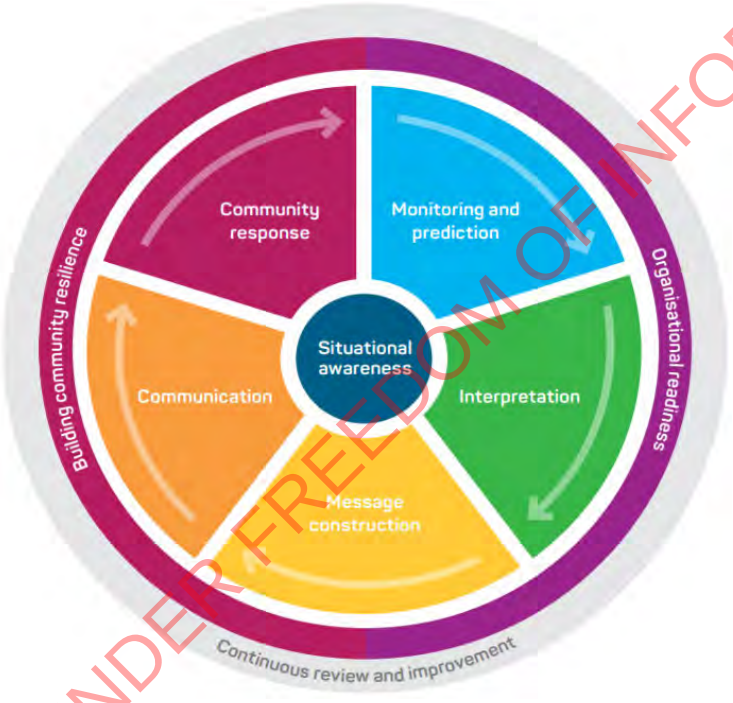


Figure 1: Total Warning System

[1] https://knowledge.aidr.org.au/media/5972/warnings-handbook.pdf pg. 10

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The Bureau's role in the thunderstorm and severe weather warning system is focussed on monitoring and prediction, message construction and communicating threats and impacts associated with these hazards to Government, industry, and the community.

The Bureau also contributes to activities designed to strengthen organisational readiness and build community resilience and participates in the planning and coordination of activities with disaster mitigation agencies.

1.2. Scope

The scope of the SLS is the Bureau's publicly available thunderstorm and severe weather services and additional services provided to support emergency management.

The SLS details **what** the Bureau does and **when** it does it, to provide thunderstorm and severe weather services. **How** the Bureau produces these services is addressed in internal Bureau documentation.

1.3. Authority

The Meteorology Act, 1955 provides the Bureau a number of functions including but not limited to the taking and recording of observations, forecasting the weather, and issuing of warnings for weather conditions likely to endanger life or property. The Intergovernmental Agreement on the Provision of Bureau of Meteorology Hazard Services to the States and Territories (IGA) confirms the roles and responsibilities of the Bureau and State and Territory governments and local governments.

The Bureau has historical and statutory responsibility for the issue of warnings of gales, storms, and other weather conditions likely to endanger life or property (Meteorology Act 1955 - Sect 6). This includes the provision of forecast and warning services for severe thunderstorms and severe weather. The responsibility for preparation for and response to thunderstorm and severe weather impacts lies with state and territory governments and local governments.

The Bureau of Meteorology Thunderstorm and Severe Weather SLS is issued by the General Manager Environmental Prediction Services under the authority of the Director of Meteorology.

1.4. Distribution

This document will be distributed to the agencies listed in Table 1.

Jurisdiction	Agency Name
National	National Emergency Management Agency (NEMA)
National	Australasian Fire and Emergency Services Authorities Council (AFAC)

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QLD	Queensland Fire and Emergency Services (QFES)
QLD	Queensland Police Services (QPS)
QLD	Queensland Inspector General Emergency Management
NSW	New South Wales State Emergency Service (NSW SES)
ACT	Australian Capital Territory Emergency Services Authority (ACT ESA)
ACT	Australian Capital Territory Parks and Conservation (ACT PCS)
VIC	Emergency Management Victoria (EMV)
VIC	Victoria State Emergency Service (Vic SES)
VIC	Victoria Department of Environment, Land, Water and Planning (DELWP)
VIC	Victoria Police (VicPOL)
TAS	Tasmania State Emergency Service (Tas SES)
TAS	Tasmanian Parks and Wildlife Service
SA	South Australian State Emergency Service (SA SES)
SA	South Australian Country Fire Service (SA CFS)
SA	South Australia Department for Environment and Water (DEW)
SA	South Australia Police (SAPOL)
WA	Western Australia Department of Fire and Emergency Services (DFES)
NT	Northern Territory Police, Fire and Emergency Services (PFES)
Norfolk Is	Emergency Management Norfolk Island

Table 1: Bureau of Meteorology Thunderstorm and Severe Weather SLS distribution list by jurisdiction

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2. National Thunderstorm and Severe Weather Services

The Bureau's thunderstorm and severe weather services provide the Australian community and emergency management with essential thunderstorm and severe weather forecasts and warnings that are timely and accurate.

Thunderstorm and severe weather services are designed to inform the community and emergency management organisations of the occurrence of, or potential for, severe thunderstorms or other severe weather conditions.

An important secondary role is to assist media and state or territory emergency services with community engagement programs, and to advise on meteorological aspects of severe thunderstorm and severe weather-related disaster preparedness and planning.

2.1. Partnerships

The Bureau has formed partnerships with emergency management organisations, other government authorities and media across the country to ensure that forecasts and warnings are fit-for-purpose and are broadly distributed in a timely manner.

Partnerships underpin the delivery of effective thunderstorm and severe weather services to the Australian community. The partnerships with Commonwealth, State and Territory Governments and local government are formalised through the IGA, which clarifies and confirms responsibilities across the Total Warning System. Specifically, the Bureau and States and Territories agree to work together to mutually develop and maintain national standards for warnings of severe thunderstorms and severe weather.

2.2. 1Definitions

2.2.1. Thunderstorm

A thunderstorm is a localised atmospheric disturbance that produces lightning and thunder. There are various types of thunderstorms, and each type has a distinct structure and set of characteristics, affecting thunderstorm motion, intensity, and longevity as well as the type of weather phenomena that they produce. Thunderstorms may evolve through various thunderstorm types during their life cycle.

2.2.2. Severe Thunderstorm

The Bureau of Meteorology defines a severe thunderstorm as a thunderstorm which produces one or more of the following phenomena:

- Damaging wind gusts
- Large hailstones
- Heavy rainfall which may lead to flash flooding
- Tornadoes

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A severe thunderstorm is categorised as a very dangerous storm (VDS) if it produces one or more of the following high-end severe phenomena:

- Destructive wind gusts
- Giant hailstones
- Intense rainfall which may lead to dangerous and life-threatening flash flooding
- Tornadoes

These weather phenomena are defined as in Table 2:

Phenomenon	Definition
Damaging Wind Gusts	Wind gusts ≥ 90 km/h (49 knots)
Destructive Wind Gusts	Wind gusts ≥ 125 km/h (68 knots)
Large Hailstones	Hailstones ≥ 2 cm in diameter * Large accumulations of small hail may be included in the text of an existing warning for Large Hail in NSW when conditions are favourable.
Giant Hailstones	Hailstones ≥ 5 cm in diameter
Heavy Rainfall	Rainfall over a period between 30 minutes and 6 hours which exceeds the 10% AEP[2] depth
Intense Rainfall	Rainfall over a period between 30 minutes and 6 hours which exceeds the 2% AEP depth ***Exception - NSW*** As above or if lower than 2% AEP depth, ≥ 70 mm in 1 hour or less ≥ 150 mm in 3 hours or less
Tornado	Any tornado occurrence

Table 2: Phenomena definitions associated with severe thunderstorms

[2] The Annual Exceedance Probability (AEP) is the probability that a rainfall amount over a given period will be exceeded in any one year. The Design Rainfall Data System (2016) provides the national datasets for 10% and 2% AEP used in Bureau services.

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2.2.3. Severe Weather

The Bureau of Meteorology defines severe weather as hazardous or dangerous weather that is not the direct consequence of thunderstorms, tropical cyclones or bushfires that consists of one or more of the following phenomena:

- Damaging and/or destructive winds
- Heavy rainfall which may lead to flash flooding and/or intense rainfall which may lead to dangerous and life-threatening flash flooding
- Damaging surf
- Abnormally high tides
- Blizzards

These weather phenomena are defined in Table 3 and Table 4.

Land Phenomenon	Definition
Damaging Winds	Wind gusts ≥ 90 km/h (49 knots) or mean wind speeds (averaged over 10 minutes) ≥ 63 km/h (34 knots) ***Exception - Tasmania*** Wind gusts ≥ 100 km/h (54 knots) for westerly winds or mean wind speeds (averaged over 10 minutes) ≥ 63 km/h (34 knots) Wind gusts ≥ 80 km/h (43 knots) for easterly winds or mean wind speeds (averaged over 10 minutes) ≥ 63 km/h (34 knots) ***Exception - NSW*** For elevations ≥ 1900 metres: Wind gusts ≥ 125 km/h (68 knots) or mean wind speeds (averaged over 10 minutes) ≥ 80 km/h (43 knots).
Destructive Winds	Wind gusts ≥ 125 km/h (68 knots) or mean wind speeds (averaged over 10 minutes) ≥ 89 km/h (48 knots) ***Exception - Tasmania*** Wind gusts ≥ 110 km/h (59 knots) for easterly winds
Heavy Rainfall	Rainfall over a period between 30 minutes and 6 hours which exceeds the 10% AEP depth
Intense Rainfall	Rainfall over a period between 30 minutes and 6 hours which exceeds the 2% AEP depth ***Exception - NSW*** As above or if lower than 2% AEP depth, ≥ 70 mm in 1 hour or less ≥ 150 mm in 3 hours or less
Blizzards	NSW and Victoria for elevations ≥ 1200 metres

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	* Included in text of existing warning when conditions are identified as favourable.

Table 3: Land phenomena definitions associated with severe weather.

Coastal Phenomenon	Definition	
Damaging Surf	Qld	SWH ≥ 4 metres, when from directions 0 to 150 degrees
	NSW	SWH ≥ 5 metres in surf zone and from onshore directions.
	Vic	SWH ≥ 7.5 metres at Portland
	Tas	Cape Grim clockwise to South East Cape ONLY SWH ≥ 6 metres and from onshore directions or Southeast coasts when primary swell is from S to SE and SWH ≥ 7 metres at Cape Bruny
	WA	SWH ≥ 5 metres or SWH ≥ 7 metres for locations south of North West Cape when primary direction from W to S
	NT	SWH ≥ 2 metres
	SA	No service
Abnormally High Tides	Qld	Sea levels > 0.5 metres above HAT **or** Sea levels > HAT Torres Strait Islands
	NSW	Sea levels > 0.5 metres above HAT
	Vic	No service
	Tas	Sea levels ≥ 1.9 metres above LAT at Battery Point (Hobart) or and ≥ 4.0 metres above LAT at Burnie
	WA	Sea levels > 0.5 metres above HAT
	NT	Sea levels > HAT
	SA	For Gulf St Vincent and Spencer Gulf coastlines, sea levels ≥ 3.75 metres above LAT at Outer Harbor (Adelaide)

Table 4: Coastal severe weather phenomena definitions

* SWH, HAT and LAT correspond to Significant Wave Height, Highest Astronomical Tide, and Lowest Astronomical Tide respectively. Damaging surf is referred to as 'dangerous surf' in Queensland.

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2.3. Severe Weather Seasonality

There is no distinct severe weather season in Australia. Severe weather can occur across Australia throughout the year, with some types of severe weather more seasonal than others.

Severe thunderstorms can occur at any time of the year. However, for most parts of the country, they are more common during the warmer months between October and March.

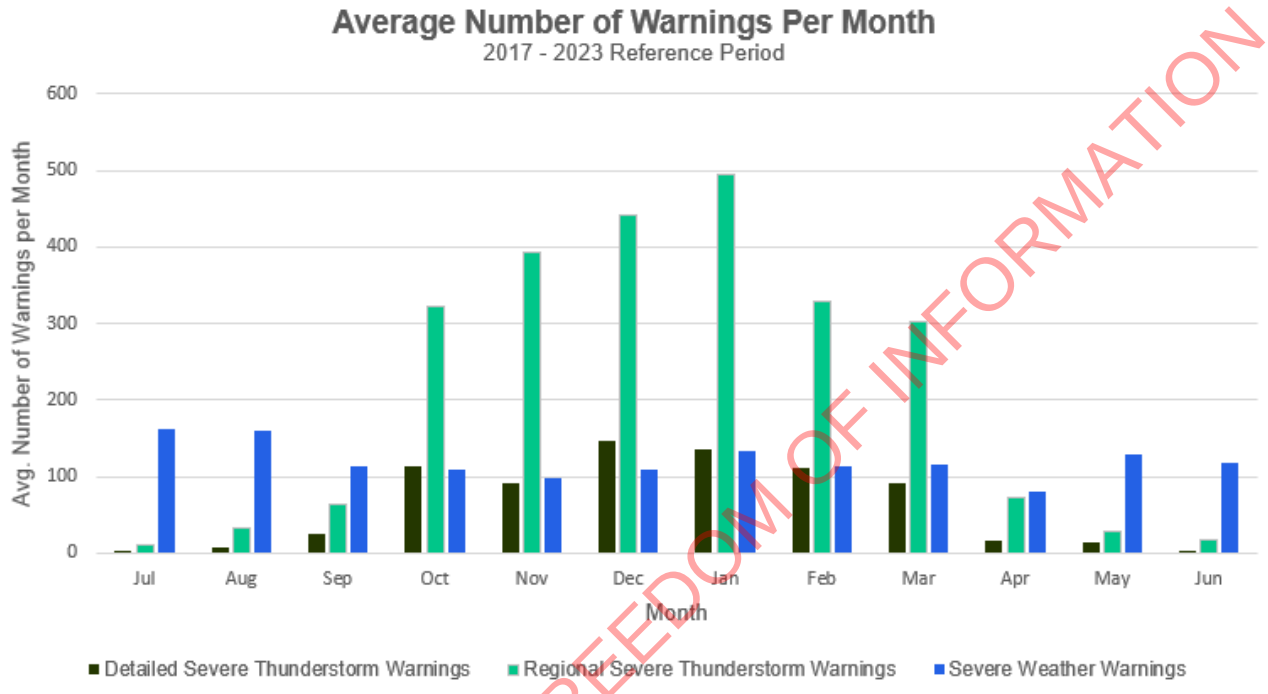


Figure 2: Average number of warnings per month across all mainland states and territories of Australia for the 2017-2023 reference period

2.4. Area of Responsibility

The Bureau's thunderstorm and severe weather services cover all Australian states and mainland territories. Severe weather services are also provided for Lord Howe Island and Norfolk Island.

2.5. Dissemination of Products

The Bureau thunderstorm and severe weather products are disseminated primarily through the Bureau's website and app. Products are also disseminated via email and are available as a recorded voice via the Bureau's telephone weather service.

Severe Thunderstorm and Severe Weather Warnings are issued directly to a list of stakeholders with emergency management responsibilities. This list is maintained by the Bureau but is not detailed in this document. The direct dissemination methods supported include email, fax, and internet protocols such as File Transfer Protocol (FTP).

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2.6. Briefing Services

The Bureau provides briefings to emergency management partners to assist planning, response, and coordination. The format, timing and frequency of briefings is agreed through national, state and territory-based arrangements.

2.7. Embedded Meteorologists

The Bureau has arrangements with several emergency service organisations to provide services through an embedded meteorologist to support operational awareness and communication. In each instance, the services provided are agreed between the Bureau and the organisation and provided on a cost recovery basis.

2.8. Communication and Adoption Activities

In addition to issuing products through standard communication channels such as the website, app and via email, the Bureau undertakes a range of complementary communication and adoption activities in partnership with emergency management agencies. The purpose of these activities is to increase the uptake and effectiveness of the forecasts and warnings, and to ensure consistent weather safety messages are provided to the community.

Activities include community and industry preparedness briefings, social media campaigns and the Bureau's "Severe Weather Knowledge Centre" web pages. Ahead of, during and following significant severe thunderstorm and severe weather occurrences, this extends to joint press conferences and media interviews, as well as continuing social media public safety campaigns and additional community and industry briefings.

2.9. Service Continuity

The Bureau maintains service continuity through its Business Continuity Plans. Most pertinent to thunderstorm and severe weather services is the built-in redundancy of being able to transfer operations between offices, as required.

To maintain service continuity the Bureau uses a large and diverse range of observational and forecast data in the delivery of all its thunderstorm and severe weather services. This provides redundancy if any data source is unavailable during operations and ensures all products and services are based on the best available information at the time.

As per 2.6(2) of the IGA, the Bureau will aim to provide a continuity of services across the nation subject to the Bureau's available resources, operational limitations and any applicable policy considerations.

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3. Quality Assurance and Performance

3.1. Hazards Services Forum

The IGA established the Hazards Services Forum (HSF) in 2018. The HSF facilitates consultation with state and territory operational emergency service agencies to guide current and future strategic development of the Bureau of Meteorology's hazard services.

The forum provides a pathway for states and territories to request and prioritise changes to the standard services and to refer services that could be considered supplementary services to the Bureau for consideration. The HSF also assists with the process of consulting on modifications to services schedules.

3.2. Commonwealth, State and Territory Liaison and Consultation

The Bureau maintains ongoing liaison and engagement at a Commonwealth, state and territory level with emergency management organisations to ensure all parties maintain awareness of thunderstorm and severe weather operations and procedures. This occurs through regular meetings between team leaders and operations managers in the Bureau and the emergency service. The format, timing and frequency of these meetings is agreed through state and territory-based arrangements.

3.3. Performance Statistics and Reporting

3.3.1. Verification

All official forecast and warning products are verified against available observations and compiled into routine reports. Key performance measures are reported in the Bureau's Annual Report.

3.3.2. Damage Assessments

The Bureau may choose to undertake damage assessments after severe thunderstorm and/or severe weather events, to advance knowledge and understanding of these high impact occurrences, and for verification and reporting purposes. At times, the Bureau may ask emergency service organisations and local governments (councils) to provide additional information, reports, and intelligence about a specific event, which may ultimately improve the final damage assessment. The Bureau of Meteorology will liaise with the relevant emergency service organisation if access is desired to any restricted areas impacted by severe weather and will always respect the directions of emergency services.

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3.4. Lessons Management

The Bureau conducts an internal debrief and lessons management process after the occurrence of severe thunderstorms and severe weather which have had a significant community or operational impact.

The insights and recommendations gained from these post event reviews are used to improve processes, systems and services delivered by the Bureau.

Depending on the impact from the severe thunderstorm or severe weather event, the process may include a debrief with external partners. Upon request, the Bureau also contributes to post incident reviews conducted by emergency services and government.

3.5. Meteorologist Training and Competency

The Bureau undertakes competency-based training and assessment programs for qualified meteorologists involved in forecast, warning, and decision support operations.

This includes a public weather warning training and assessment program, and a specific severe thunderstorm training and competency-based assessment program. These programs ensure that staff involved in analysing, forecasting, and warning for severe thunderstorms and severe weather have the qualifications, training and demonstrated ability to provide a high standard service to the Australian community.

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4. National Thunderstorm and Severe Weather Routine Product Suite

Unless otherwise noted, all issue times are quoted as local time for the relevant jurisdiction and time of year.

4.1. Real-time Data Services & Australian Digital Forecast Database

The Bureau's real-timed data services provide tailored delivery of real-time Bureau of Meteorology products including datasets such as numerical output grids, satellite and radar data and web map service layers.

Part of these services is the Australian Digital Forecast Database (ADFD), which provides detailed forecast information across all states and mainland territories, including grids that are relevant to thunderstorms. These grids are available all year round.

The ADFD files are updated routinely twice per day at approximately 6:00 am and 6:00 pm local time and updated at other times, as required. If the forecasts are updated, the ADFD grids are not necessarily updated at the same time as the changes to the forecasts. Priority is given to updating the forecasts and warnings issued directly to the public through the media or internet.

Further details on real-time data services and the ADFD, including information on data bundles, can be found at http://reg.bom.gov.au/reguser/ or http://reg.bom.gov.au/catalogue/adfdUserGuide.pdf.

4.2. Thunderstorm Forecasts

The Bureau routinely provides geospatial thunderstorm forecasts to emergency services as a planning and operational decision support resource. These thunderstorm forecasts provide a graphical depiction of the geospatial areas which may be affected by thunderstorms and severe thunderstorms for the remainder of the current day (Day 1) and the following day (Day 2).

Thunderstorm forecasts are published to various Bureau registered user websites, from where they can be accessed by emergency services and are also provided to specific registered users by email.

Thunderstorm forecasts are published via social media from respective state or territory Bureau accounts, typically when severe thunderstorms are considered possible or likely and/or there is potential for significant community impact.

4.2.1. Issue Criteria, Times, and Validity

Thunderstorm forecasts are issued routinely, once a day, during selected periods of the year, as listed in Table 5. In some jurisdictions, forecasts may be issued outside this period when severe thunderstorms are considered possible and/or likely and/or there is potential for significant community impact.

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Separate forecasts are issued for each state and mainland territory (ACT are included in NSW thunderstorm forecasts).

The issue times for thunderstorm forecasts are set to meet the needs of emergency services, and account for Bureau workflow processes and priorities.

State/Territory	Seasonal Coverage	Day 1 Issue Time	Day 2 Issue Time
Queensland	All year round	09:45 am (23:45 UTC)	11:30 am (01:30 UTC)
NSW/ACT	All year round	By 11:00 am (00:00 UTC)	By 11:00 am (00:00 UTC)
Victoria	All year round	By 7:00 am, updated by 11:30 am (00:30 UTC), if required	1:45 pm (02:45 UTC)
Tasmania	Not provided		
South Australia	1/10 to 30/04, ad hoc at other times	12:00 pm (01:30 UTC)	12:00 pm (01:30 UTC)
Western Australia	1/10 to 30/04	10:30 am (02:30 UTC)	10:30 am (02:30 UTC)
Northern Territory	1/10 to 30/04, ad hoc at other times	12:00 pm (02:30 UTC)	2:00 pm (04:30 UTC)

Table 5: The seasonal coverage and local issue times for the thunderstorm forecasts for each state and mainland territory

4.2.2. Content

The thunderstorm forecast comprises of a national map and accompanying text description.
The map uses shaded polygons that depicts geospatial areas where thunderstorms are possible as well as areas where severe thunderstorms are considered possible or likely, as defined in Table 6.

Forecast polygon category	Definition
Thunderstorms Possible	10% to 30% probability of lightning within 10 km of a point
Severe Thunderstorms Possible	If a thunderstorm occurs, the probability of it being severe is 10% to 30% within 10 km of a point
Severe Thunderstorms Likely	If a thunderstorm occurs, the probability of it being severe is ≥ 30% within 10 km of a point

Table 6: Definition and shading of polygon categories on the thunderstorm forecast

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4.2.3. Amendment Criteria

There is no requirement to update thunderstorm forecasts after issue. However, at times, it may be beneficial to do so, to ensure significant changes to the thunderstorm forecast policy can be effectively communicated to emergency services, and possibly to the community via social media.

5. National Thunderstorm and Severe Weather Non-Routine Product Suite

5.1. Severe Thunderstorm Warnings

A Severe Thunderstorm Warning is issued whenever there is sufficient meteorological evidence to suggest that severe thunderstorm development is likely, or when a severe thunderstorm has been directly reported or observed, or inferred through various observational datasets, and a Severe Thunderstorm Warning is not already current.

The Bureau issues two types of Severe Thunderstorm Warnings that alert the community, emergency services and other organisations about the threat of severe thunderstorms.

- Regional Severe Thunderstorm Warnings
- Detailed Severe Thunderstorm Warnings

If severe thunderstorms develop within an area that is already described by a Severe Weather Warning (refer Section 5.2), a separate Severe Thunderstorm Warning will only be issued if a hazard (as defined by section 2.2.2) other than those already included in the Severe Weather Warning is occurring or expected to occur. This may include escalations of hazards mentioned in the Severe Weather Warning, e.g., Severe Thunderstorm Warning for intense rainfall associated with thunderstorms within a broader Severe Weather Warning for heavy rainfall.

5.1.1. Warning Content

A Severe Thunderstorm Warning consists of information that highlight threat areas and potential phenomena in a graphical and textual format.

Title
The title states the warning type and lists potential phenomena and the affected weather forecast districts.

Issuance Time
The issuance time and date of the severe thunderstorm warning.

Headline Statement
A succinct one-line statement that describes the *'where, what, and when'* of key severe thunderstorm threats.

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Graphical Warning Content
Displays a geospatial map of weather forecast district boundaries overlain with one or more yellow shaded polygons depicting the spatial extent of the warning.

Weather Situation
A brief description on the current and/or developing severe thunderstorm situation. It lists the synoptic drivers producing the severe thunderstorms and may provide an overview on the spatial and temporal extent of the severe thunderstorm activity.

Warning Details
The main body of the warning lists potential phenomena and affected locations.

Observations
Any significant observations recorded relevant to the hazards listed in the warning.

Action Statements
Automatically generated action statements that have been agreed upon by state and territory-based emergency services.

Warning Updates
The update time of the next severe thunderstorm warning.

Warning Accessibility
Automatically generated text that provides a brief statement on the additional channels where the severe thunderstorm warning is broadcast.

5.1.2. Regional Severe Thunderstorm Warnings

The Bureau provides Regional Severe Thunderstorm Warnings for all states and mainland territories. Warning areas are based on one or more weather forecast districts and/or parts of weather forecast districts.

Issue Criteria and Validity
Regional Severe Thunderstorm Warnings are issued whenever there is sufficient meteorological evidence to suggest that severe thunderstorm development is likely within the next 3 hours. They are also issued when a severe thunderstorm has been observed, or when a severe thunderstorm outside the warning domain is expected to move into the area.

Regional Severe Thunderstorm Warnings are valid for a three-hour period from the issuance time and will be updated routinely every one to two hours but may be updated more frequently during rapidly evolving situations. Depending on forecast confidence and the level of threat, Regional Severe Thunderstorm Warnings may be issued with shorter lead times.

If a current Regional Severe Thunderstorm Warning does not adequately describe the situation, it will be updated immediately. Examples for when this is necessary are an escalation or de-escalation of the hazard threat or a change in the communities expected to be impacted.

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Once the threat of severe thunderstorms has passed, the Regional Severe Thunderstorm Warning will be cancelled.

5.1.3. Detailed Severe Thunderstorm Warnings

The Bureau provides Detailed Severe Thunderstorm Warnings for all capital cities and surrounding areas, as shown in Appendix 6.2. They provide time and location-specific information about the severe thunderstorm threat.

Issue Criteria and Validity
Detailed Severe Thunderstorm Warnings are issued when one or more severe thunderstorms are detected within the warning domain, or an existing thunderstorm is forecast to become severe within the next 60 minutes. They are also issued when a severe thunderstorm outside of the detailed severe thunderstorm warning domain is expected to move into the area.

Detailed Severe Thunderstorm Warnings are valid for 30 or 60 minutes from the issuance time and will be updated routinely every 30 to 60 minutes. If a current Detailed Severe Thunderstorm Warning does not adequately describe the situation, it will be updated immediately. Examples for when this is necessary are an escalation or de-escalation of the hazard threat or a change in the communities expected to be impacted.

When the threat of severe thunderstorms has eased within a metropolitan area but further development is possible within the next 60 minutes, and the Regional Severe Thunderstorm Warning which includes the metropolitan area remains current, the Detailed Severe Thunderstorm Warning will be suspended. The text of the suspended warning will advise that severe thunderstorms have eased but the situation will be closely monitored. Only once no further severe thunderstorms are anticipated, the Detailed Severe Thunderstorm Warning will be cancelled, following an update of the Regional Severe Thunderstorm Warning to remove the metropolitan area.

Additional Graphical Warning Content
If a Regional Severe Thunderstorm Warning is in effect over parts of the relevant Detailed Severe Thunderstorm Warning domain, the Detailed Severe Thunderstorm Warning graphic will include the area of the Regional Severe Thunderstorm Warning as well as a depiction of the areas under immediate threat from individual severe thunderstorm cells.

The graphic transmitted to the emergency services contains additional information and shows all thunderstorms (severe or otherwise) and automated tracks depicting the past movement of these thunderstorms.

Additional Warning Text Details
In addition to the information described in Section 5.1.1, the warning will also specify current and future impacted locations that correspond to an existing severe thunderstorm (red shaded ellipses) and an immediate threat area (orange-hashed shaded polygons).

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5.2. Severe Weather Warnings

The Bureau issues Severe Weather Warnings that alert the community, emergency services and other organisations about the threat of severe weather. They are issued whenever there is sufficient meteorological evidence to suggest that severe weather, that is not the direct consequence of thunderstorms, is occurring or expected to develop.

Severe Weather Warnings are issued for all states and mainland territories where all warning areas are based on one or more weather forecast districts and/or parts of weather forecast districts.

Severe Weather Warnings for Lord Howe Island and Norfolk Island are issued for the whole island and are text-based warnings.

5.2.1. Issue Criteria and Validity

Severe Weather Warnings are issued when severe weather is occurring or is expected to develop. Note that in addition to the definitions of severe weather provided in Section 2.2, some discretion may be applied based on input from emergency management agencies to drive an appropriate response in the community to the weather event.

The lead-time provided for a Severe Weather Warning will depend on the nature of the event, the ability to forecast it with reasonable certainty and the time of day. In general, severe weather events will fall into two categories:

- Broad-scale phenomena such as east coast lows, recently decayed tropical cyclones, widespread land gales or vigorous cold fronts
- Local-scale phenomena such as localised heavy rain or damaging wind gusts caused by topography

For broad-scale phenomena, Severe Weather Warnings will aim to be issued 24 to 36 hours ahead of the expected onset of severe weather conditions. Depending on forecast confidence and the level of threat, Severe Weather Warnings may be issued with shorter lead times.

Local-scale phenomena are more difficult to forecast with significant lead-time and in some instances, Severe Weather Warnings will be issued with shorter lead times.

Severe Weather Warnings do not have a prescribed validity period, this is described in general terms within the warning details section.

Once a Severe Weather Warning is issued, routine updates will be issued at least every six hours until the threat has passed. They are typically updated at the standard times of 4:30 - 5:00 am, 10:30 - 11:00 am, 4:30 - 5:00 pm and 10:30 - 11:00 pm in local time, but may be updated more frequently, during rapidly evolving situations or periods of high-impact severe weather.

Severe Weather Warnings are provided for abnormally high tides and damaging/dangerous surf (for most states and territories - refer to Table) in a dedicated Severe Weather Warning for coastal hazards. As a result, there may be two Severe Weather Warnings in place for overlapping areas for

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concurrent severe weather phenomena. In this instance, one warning would be covering land-based phenomena while the second warning would be covering coastal-based phenomena. When concurrent Severe Weather Warnings for coastal-based phenomena and land-based phenomena occur, the warning products will reference each other.

Once the threat of severe weather has passed the Severe Weather Warning will be cancelled.

5.2.2. Warning Content

A Severe Weather Warning consists of various sections that highlight threat areas and potential phenomena in a graphical and textual format.

Title
The title states the warning type and lists potential phenomena and the affected weather forecast districts.

Issuance Time
The issuance time (local time) and date of the severe weather warning.

Headline Statement
A succinct one-line statement that describes the 'where, what, and when' of key severe weather threats.

Graphical Warning Content
Displays a geospatial map of weather forecast district boundaries overlain with one or more yellow shaded polygons depicting the spatial extent of the warning.

Weather Situation
A description of the current and/or developing severe weather situation. It generally covers the current and future synoptic pattern along with the major weather systems that will produce the severe weather.

Warning Details
The main body of the warning lists potential phenomena and describes their upper limits or ranges, probability, and temporal characteristics. It may describe the current situation and the spatial distribution of the weather indicated by radar and satellite.

Locations
A summary of locations which may be affected by the severe weather event.

Observations
Any significant observations recorded relevant to the hazards listed in the warning.

Action Statements
Automatically generated action statements that have been agreed upon by state and territory-based emergency services.

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Warning Updates
The update time of the next severe weather warning in local time.

Warning Accessibility
Automatically generated text that provides brief statement on the additional channels where the severe weather warning is broadcasted.

5.3. Warning Escalations

5.3.1. Very Dangerous Storm (VDS)

If there is an expectation or a report of one or more high-end severe phenomena listed in the VDS criteria from Section 2.2.2, a label that states **'This thunderstorm is very dangerous'** will be added to the Detailed Severe Thunderstorm Warning graphic. An example has been provided in Section 6.3.3.

The warning details will also declare that a very dangerous storm has been detected on the weather radar with an updated list of destructive phenomena.

Once the threat of high-end severe phenomena listed in the VDS criteria from Section 2.2.2 has passed, the label will be excluded from the warning graphic.

5.3.2. Standard Emergency Warning Signal

The Standard Emergency Warning Signal (SEWS) is a siren sound used as an alerting signal in Queensland, Victoria, and Tasmania. The SEWS is designed to alert the community to the broadcast of an urgent safety message relating to a VDS with one or more confirmed high-end severe phenomena from Section 2.2.2 on the Australian Broadcasting Corporation (ABC) radio stations.

The signal is sounded immediately prior to an emergency warning message being played on ABC broadcasts, in the potential or likely impacted areas. As part of a coordinated national emergency plan, the SEWS is used to attract attention to emergency warnings.

The Bureau can request the use of the SEWS by including a standardised SEWS statement in a Severe Thunderstorm Warning. In the event where a request is warranted, SEWS text will be added above the title section on either or both Regional and Detailed Severe Thunderstorm Warnings. It will explicitly state the major towns, suburbs, cities or local government areas where the SEWS should be directed, transmitted, and broadcast on the ABC. An example has been provided in Section 6.3.3.

The official activation of the SEWS is at the discretion of the ABC.

Once the threat of high-end severe phenomena listed from Section 2.2.2 has passed, the SEWS request will be cancelled by excluding the associated text from the warning.

The following criteria is to be satisfied before requesting the use of the SEWS:

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- A confirmed report of **one or more high-end severe phenomena** listed in the VDS criteria from Section 2.2.2 by a reliable source such as a Bureau observer, automatic weather station, storm spotter and/or trustworthy social media outlet.
- It is of sufficient scale where a significant number of people will be warned. This includes all towns and cities that have a designated Bureau forecast (see Figure 4, 6 and 7 in Appendix 6.1), and all areas within the respective Detailed Severe Thunderstorm Warning domain.
- Is expected to continue for 30 minutes or more.

5.3.3. Emergency Weather Alerts

An Emergency Weather Alert (EWA) is a verbal notification provided to Queensland Fire and Emergency Services (QFES) and Queensland Police Service (QPS). It is done at the meteorologist's discretion when they believe there are special circumstances requiring notification but there is insufficient evidence such as a confirmed high-end severe report to trigger a request of the SEWS, as described in Section 5.3.2.

An EWA can be invoked for any area across Queensland, irrespective of known population.

Once the threat of high-end severe phenomena listed from Section 2.2.2 has passed, the meteorologist will provide a verbal notification of cancellation to QFES and the QPS.

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6. Appendices

6.1. Weather Forecast District Maps



Figure 3: Weather Forecast Districts for Queensland

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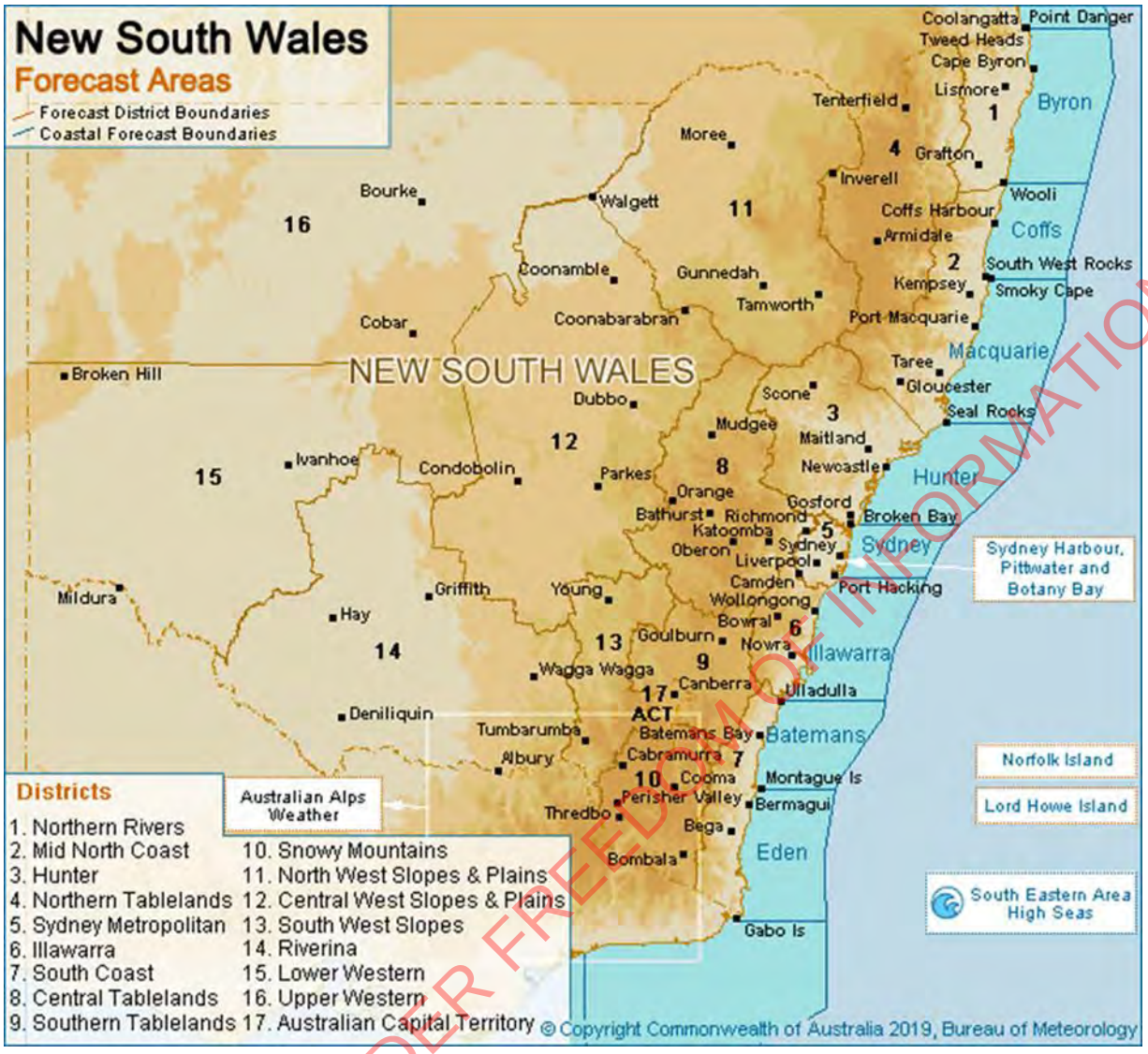


Figure 4: Weather Forecast Districts for New South Wales

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Figure 5: Weather Forecast Districts for Victoria

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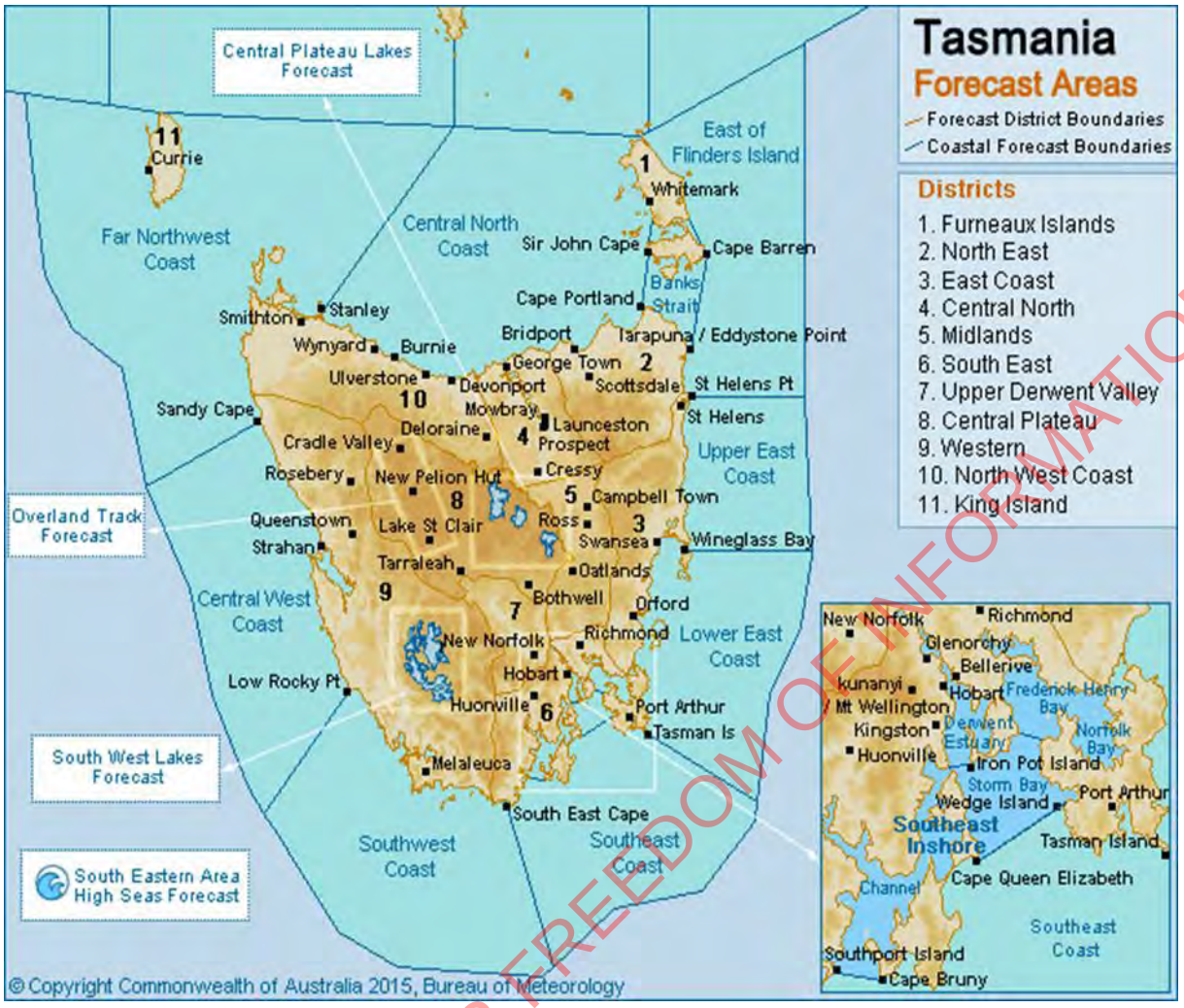


Figure 6: Weather Forecast Districts for Tasmania

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Figure 7: Weather Forecast Districts for South Australia

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RELEASED UNDER FREEDOM OF INFORMATION

Figure 8: Weather Forecast Districts for Western Australia

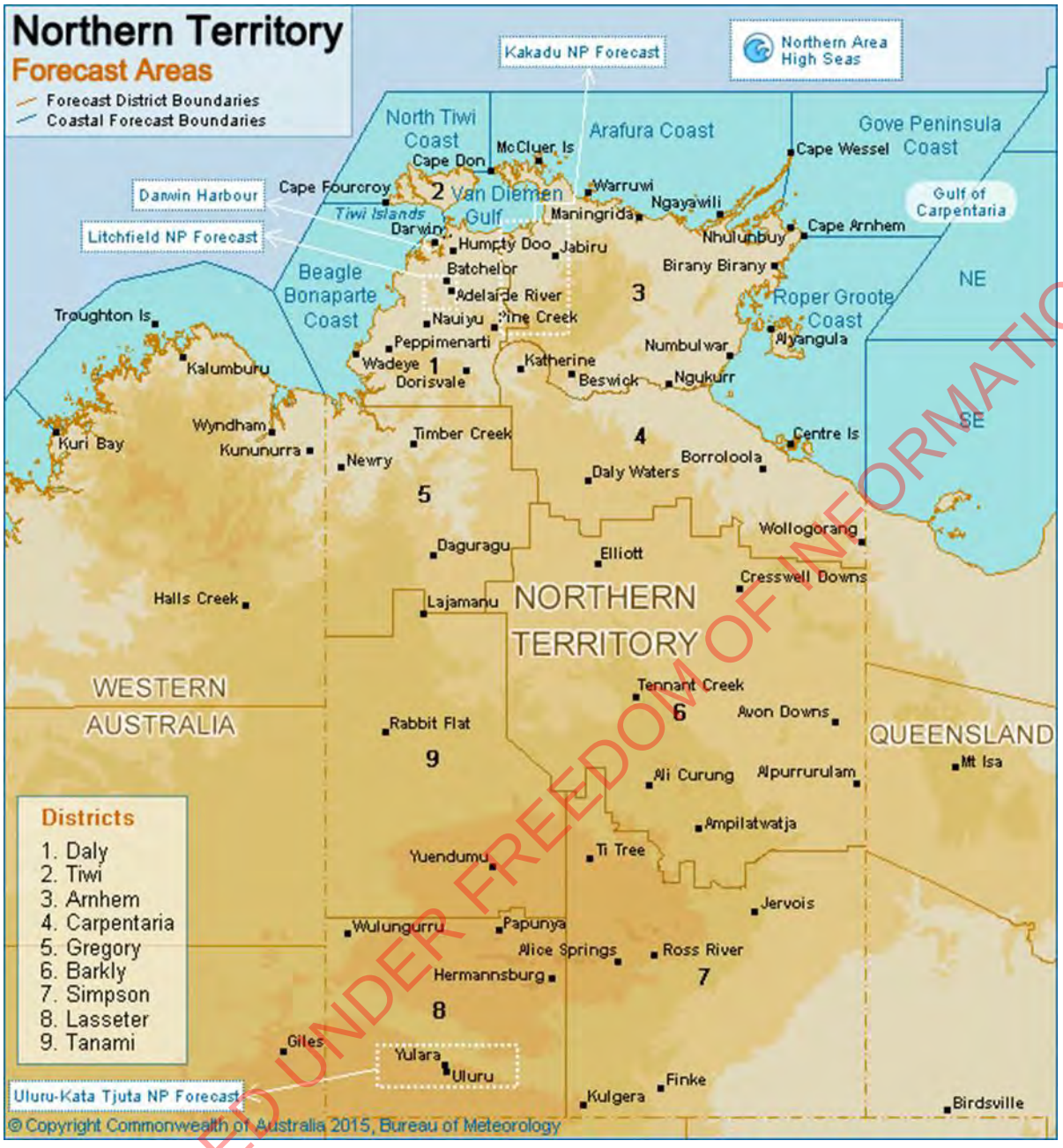


Figure 9: Weather Forecast Districts for Northern Territory

6.2. Detailed Severe Thunderstorm Warning Domains

Detailed Severe Thunderstorm Warnings are provided for all Australian capital cities and surrounding areas. The domains covered by this service are shown here.

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Figure 10: Detailed Severe Thunderstorm Warning domain – Brisbane and Southeast Queensland

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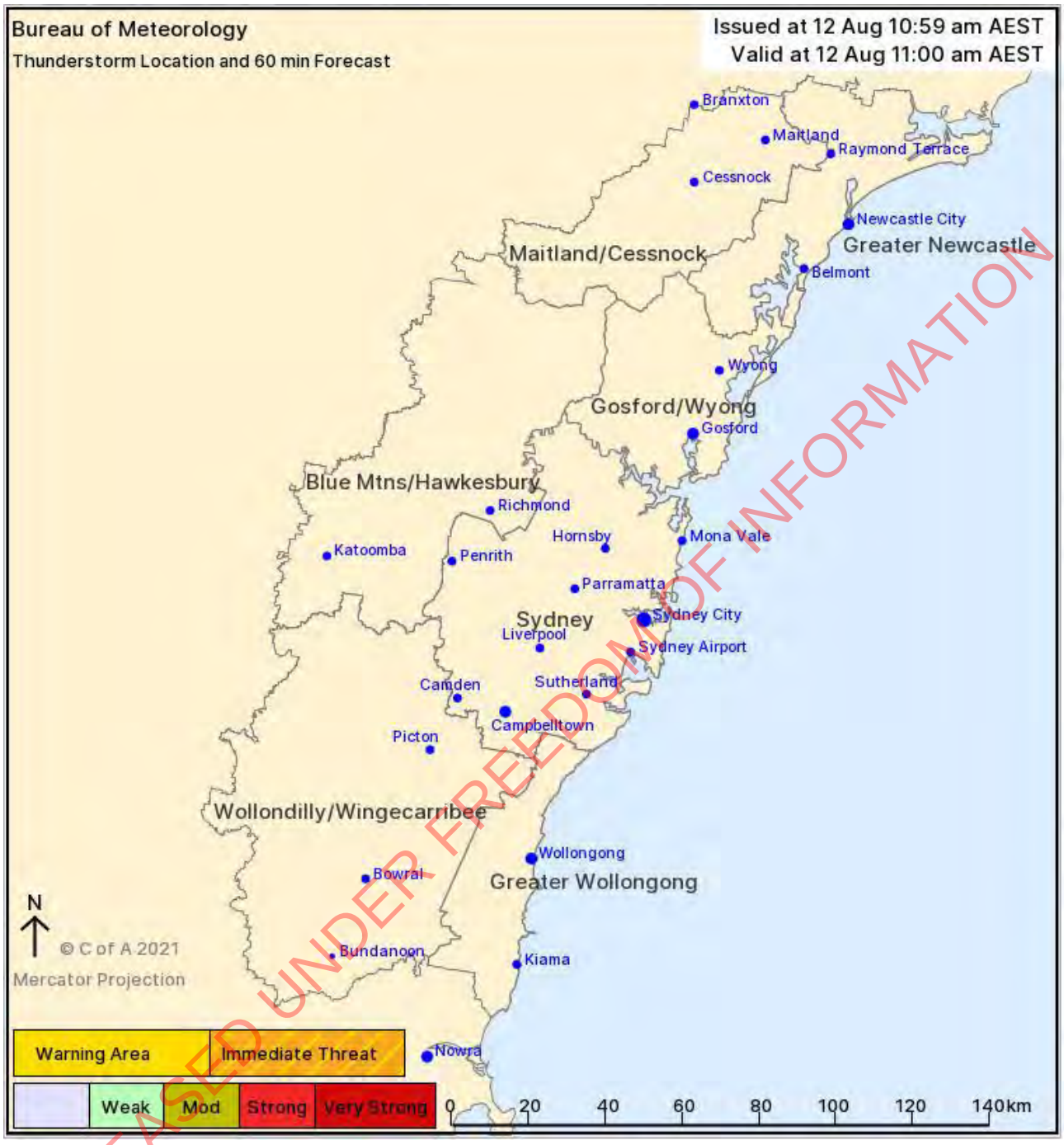


Figure 11: Detailed Severe Thunderstorm Warning domain – Sydney, Newcastle, Wollongong

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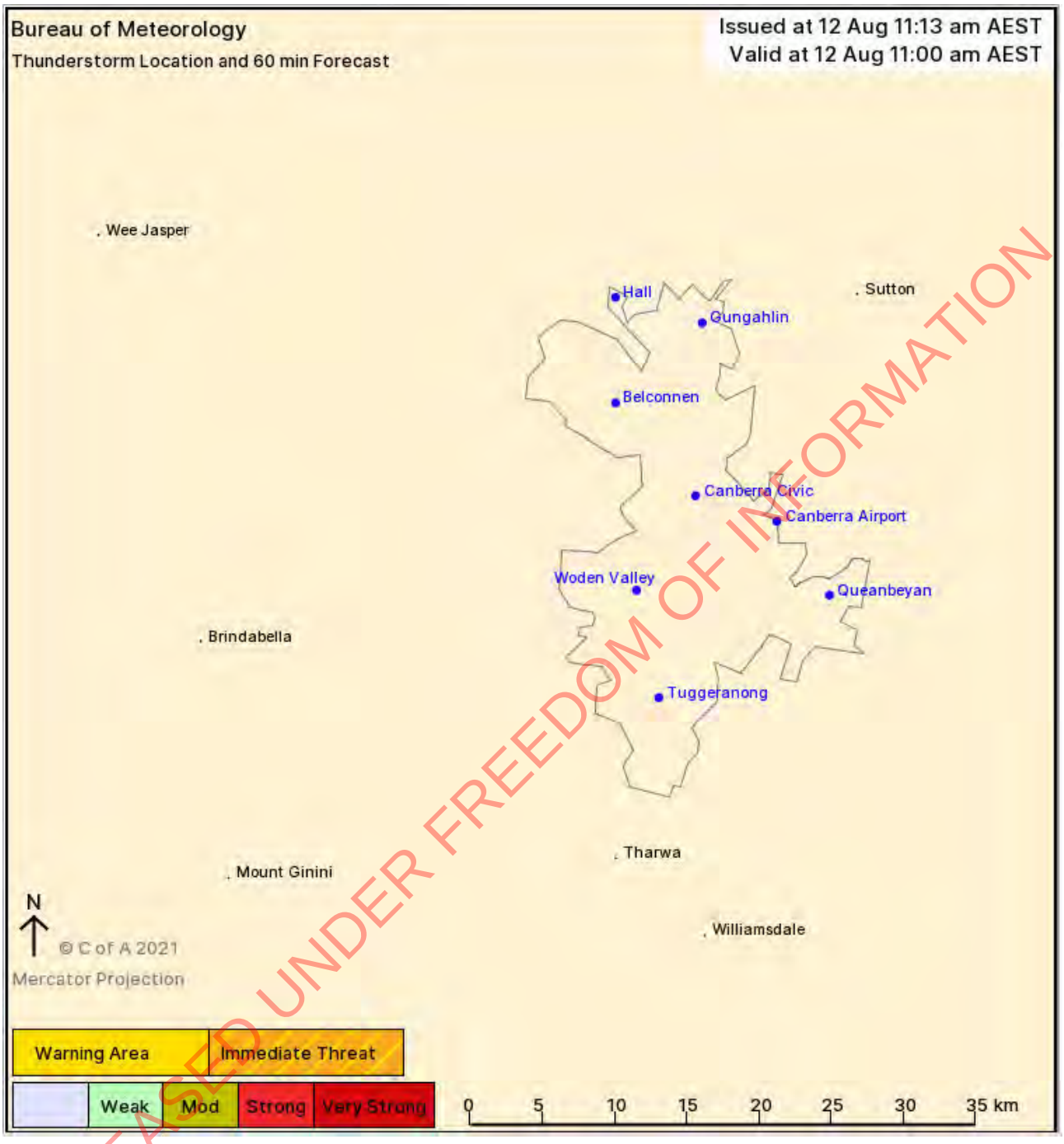


Figure 12: Detailed Severe Thunderstorm Warning domain – Canberra

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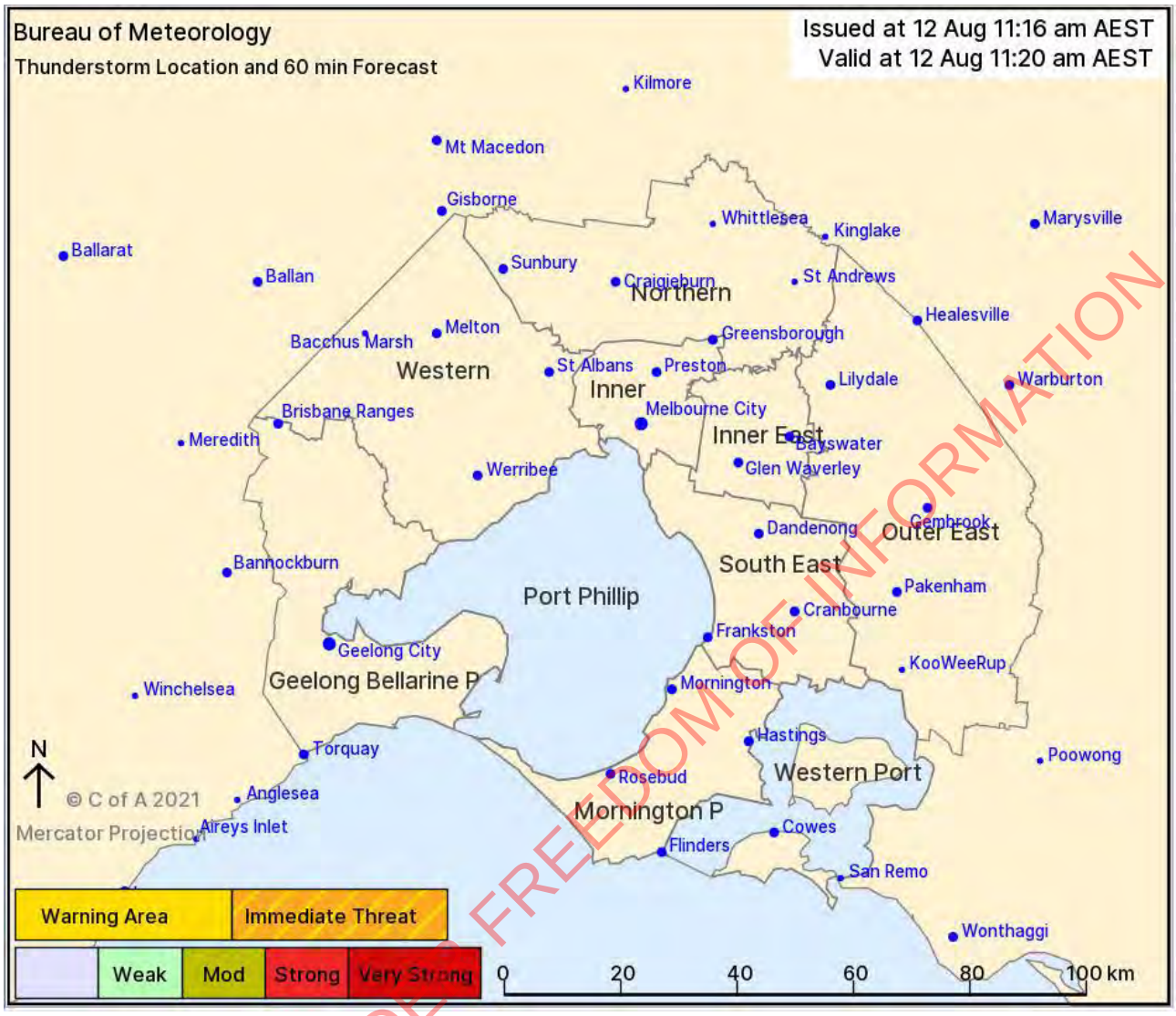


Figure 13: Detailed Severe Thunderstorm Warning domain – Melbourne

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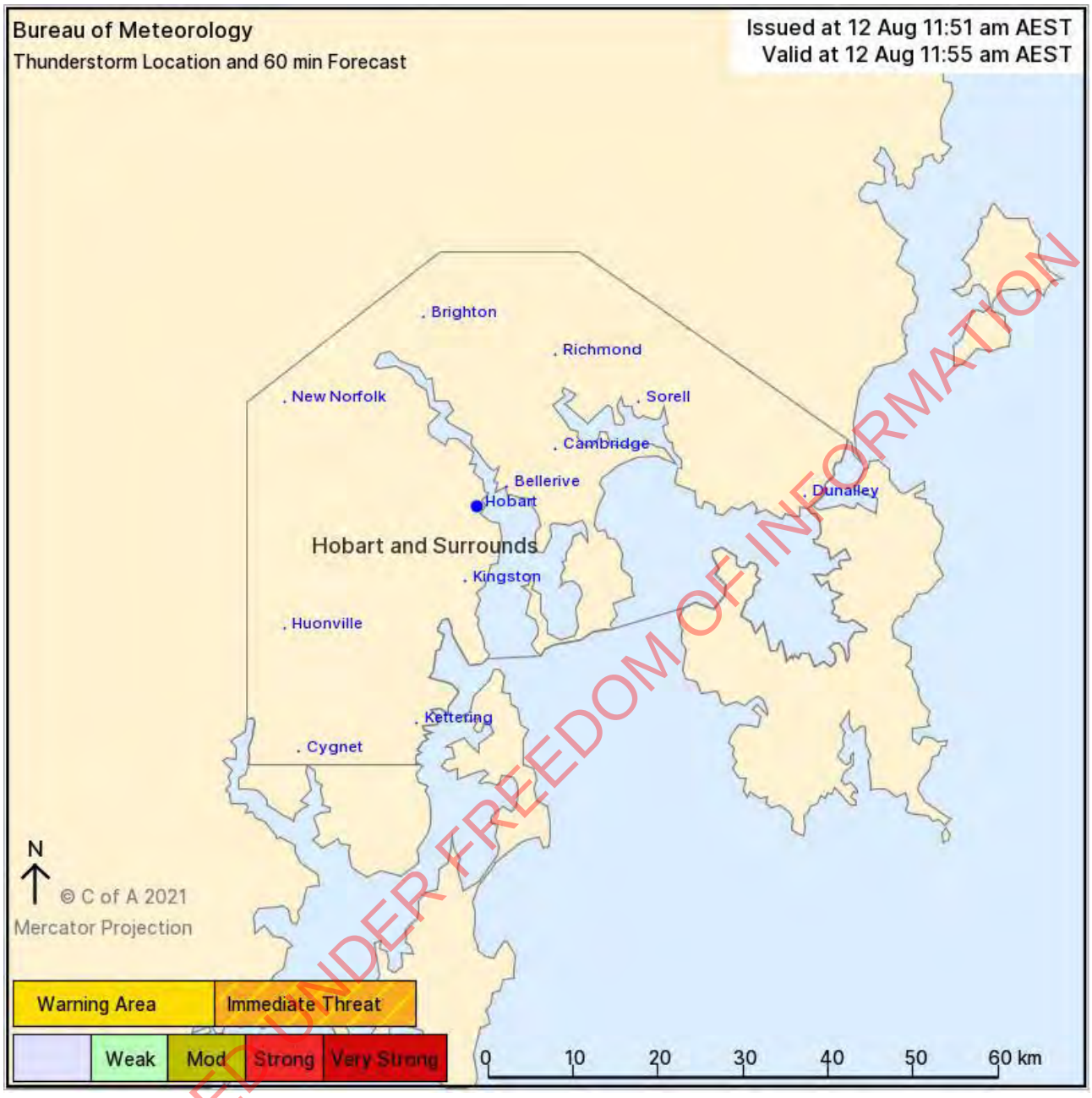


Figure 14: Detailed Severe Thunderstorm Warning domain – Hobart

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Figure 15: Detailed Severe Thunderstorm Warning domain – Adelaide

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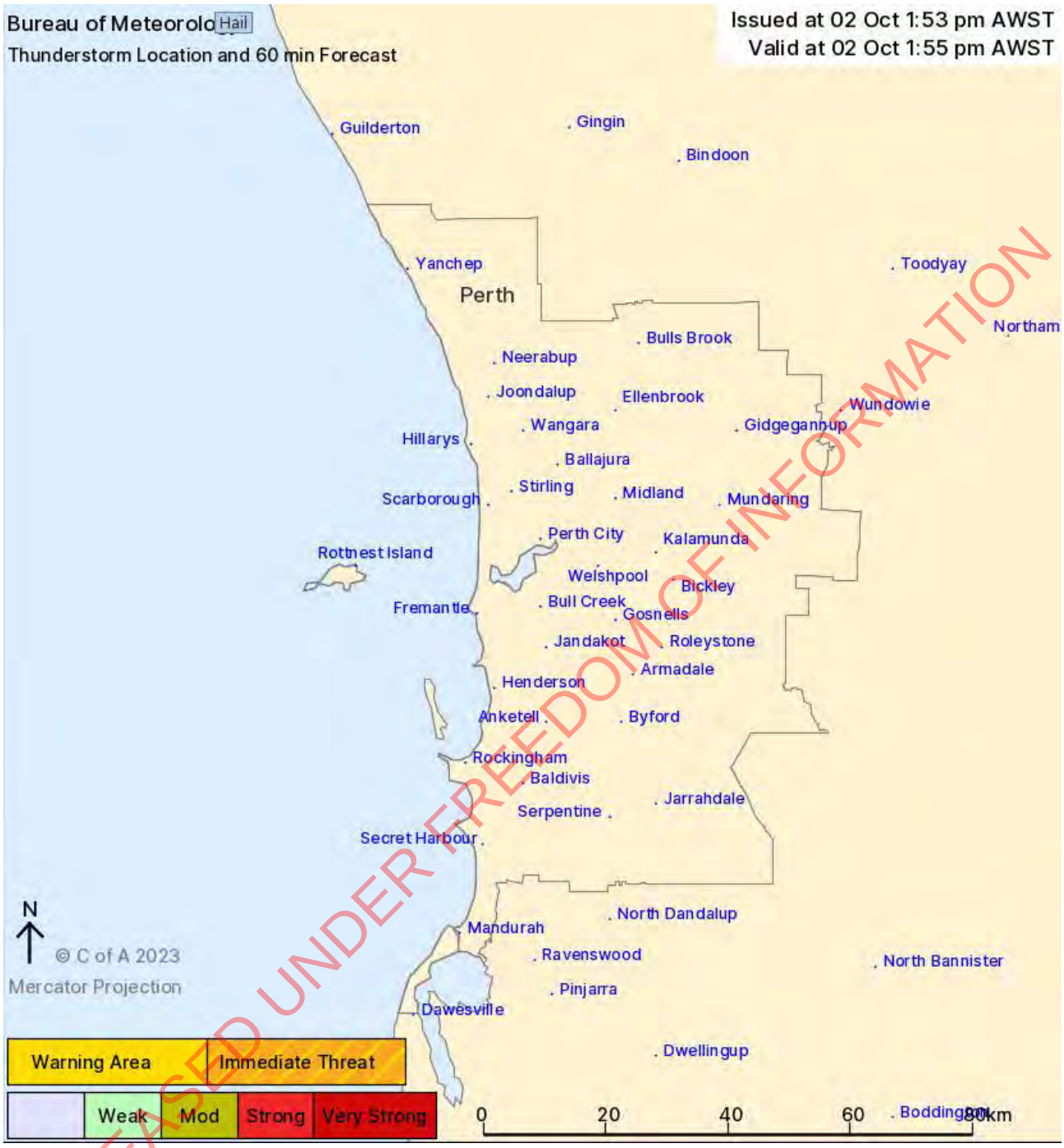


Figure 16: Detailed Severe Thunderstorm Warning domain – Perth

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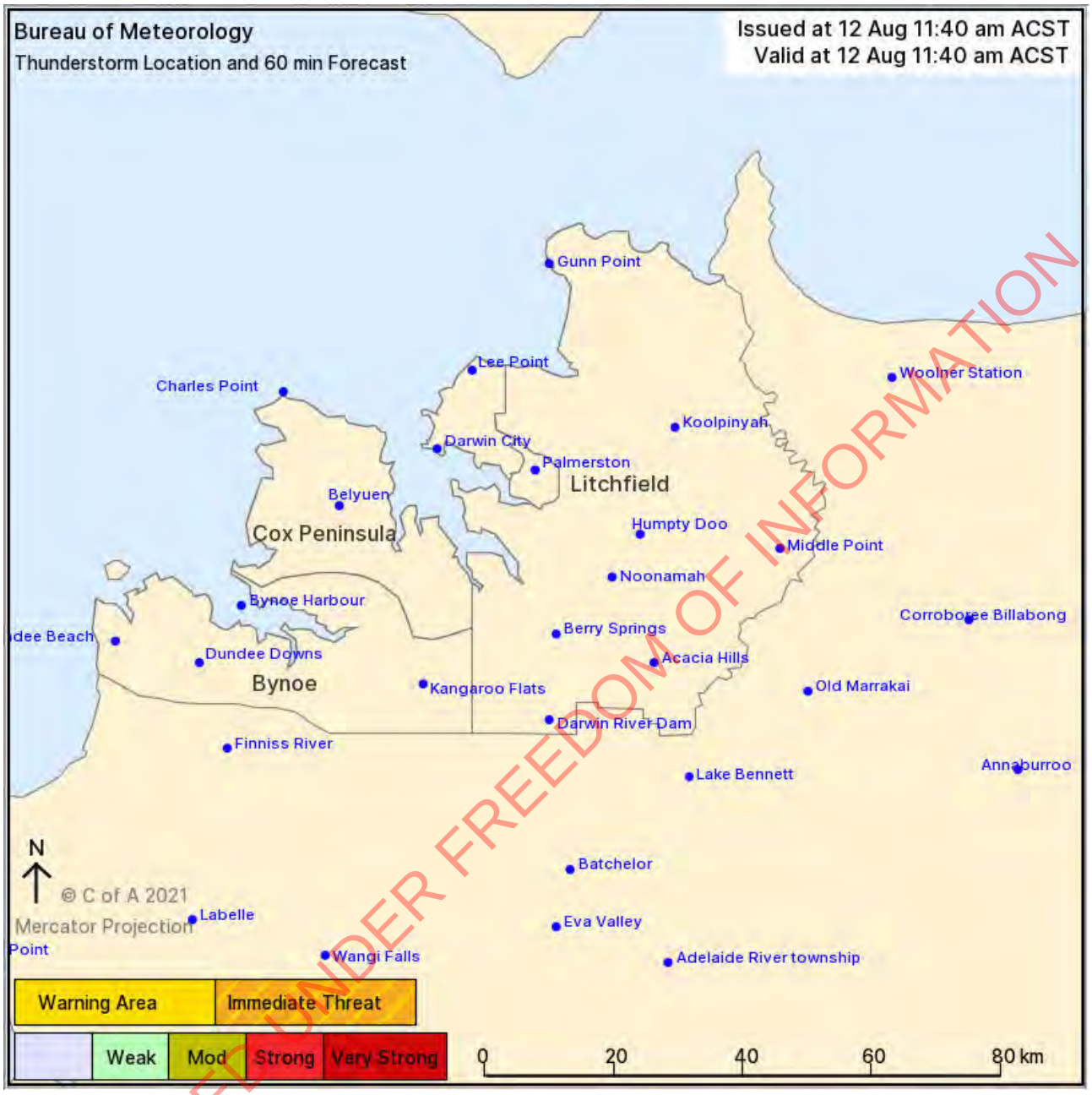


Figure 17: Detailed Severe Thunderstorm Warning domain – Darwin

6.3. Product Samples

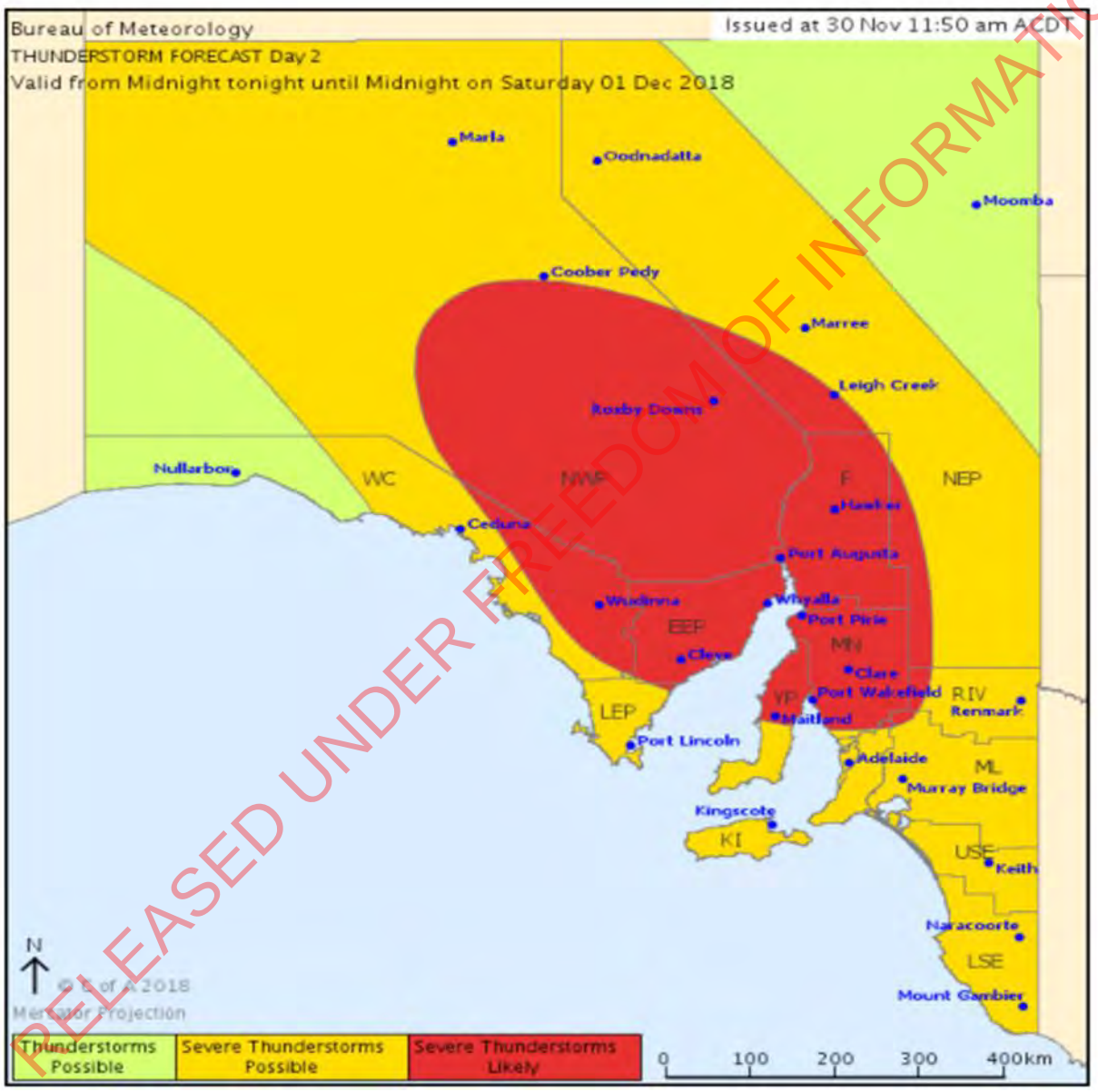
6.3.1. Thunderstorm Forecast Map

IDS21032
Australian Government Bureau of Meteorology
South Australia

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Day 2 Thunderstorm Forecast
Issued at 11:00am Friday, 30 November 2018,
Valid from midnight tonight until midnight on Saturday, 1 December 2018.

Thunderstorms are possible across SA on Saturday with severe thunderstorms possible across a broad swathe. There is a slight risk of damaging winds from the morning in the west and south. In the afternoon, severe thunderstorms are forecast to develop near the front over the Eyre Peninsula and the North West Peninsula district, moving eastward across central parts late afternoon and evening. Damaging to destructive wind gusts are possible. Large hailstones are also possible, particularly in the severe likely area.



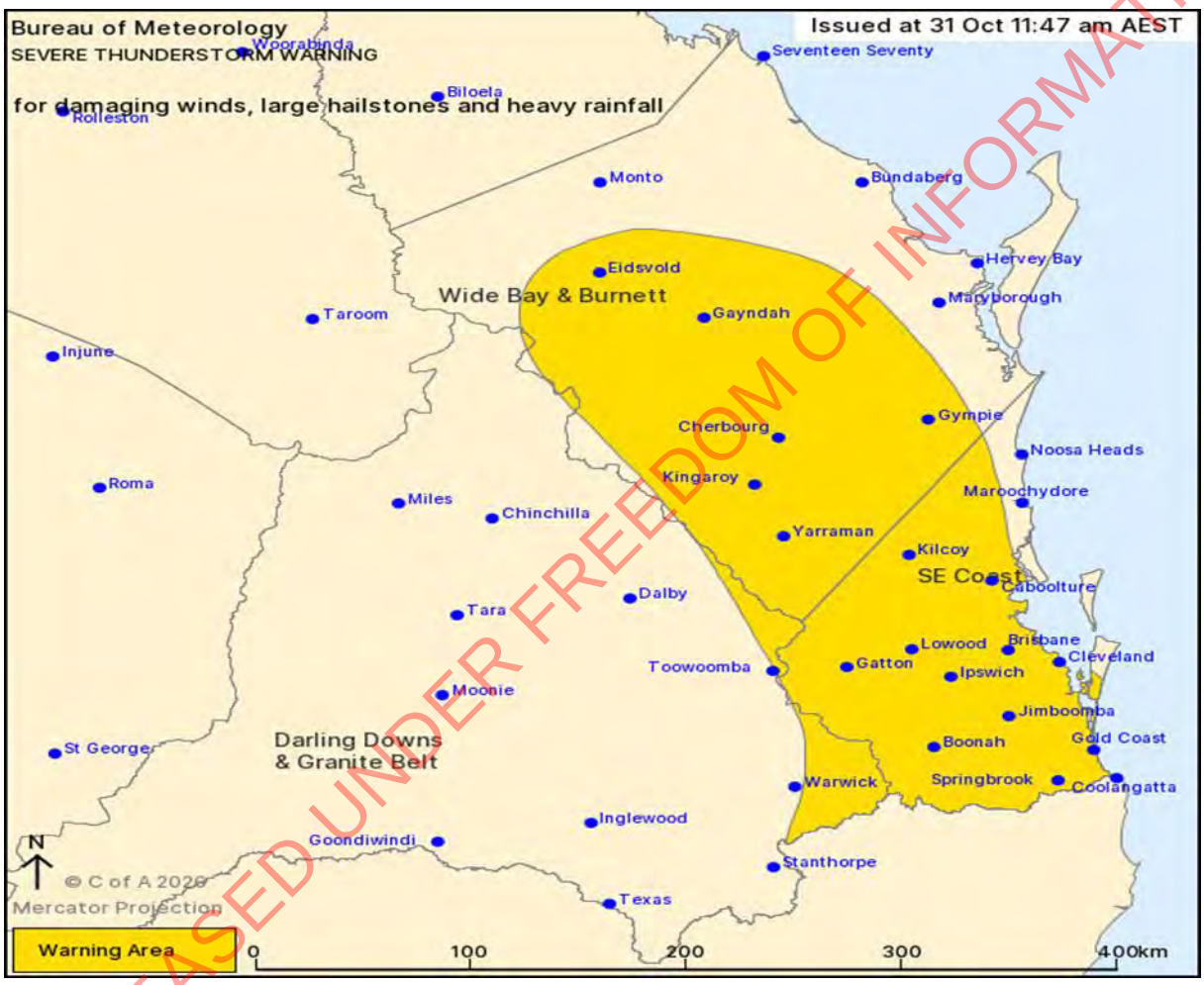
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6.3.2. Regional Severe Thunderstorm Warning

IDQ21033
Australian Government Bureau of Meteorology
TOP PRIORITY FOR IMMEDIATE BROADCAST

Severe Thunderstorm Warning
for DAMAGING WINDS, LARGE HAILSTONES and HEAVY RAINFALL
For people in Southeast Coast and parts of Wide Bay and Burnett and Darling Downs and Granite Belt Forecast Districts.
Issued at 11:47 am Saturday, 31 October 2020.
Severe thunderstorms forecast to rapidly develop across Southeast Queensland.



Weather Situation: Severe thunderstorms will rapidly develop over the coming hours with very dangerous thunderstorms with giant hail and destructive winds likely to initiate along the dryline and extend eastward during the afternoon period.
Severe thunderstorms are likely to produce damaging winds, large hailstones and heavy rainfall that may lead to flash flooding in the warning area over the next several hours. Locations which may be affected include Gold Coast, Brisbane, Gympie, Kingaroy, Caboolture, Coolangatta and Ipswich.

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Queensland Fire and Emergency Services advises that people should:
* Move your car under cover or away from trees.
* Secure loose outdoor items.
* Never drive, walk or ride through flood waters. If it's flooded, forget it.
* Seek shelter, preferably indoors and never under trees.
* Avoid using the telephone during a thunderstorm.
* Beware of fallen trees and powerlines.
* For emergency assistance contact the SES on 132 500.

The next warning is due to be issued by 2:50 pm.

If severe thunderstorms develop in the Southeast Queensland area (east of Dalby from Rainbow Beach to Stanthorpe), a more detailed Severe Thunderstorm Warning will be issued to people in this area. Warnings are also available through TV and Radio broadcasts, the Bureau's website at www.bom.gov.au or call 1300 659 210. The Bureau and Queensland Fire and Emergency Services would appreciate warnings being broadcast regularly.

6.3.3. Detailed Severe Thunderstorm Warning

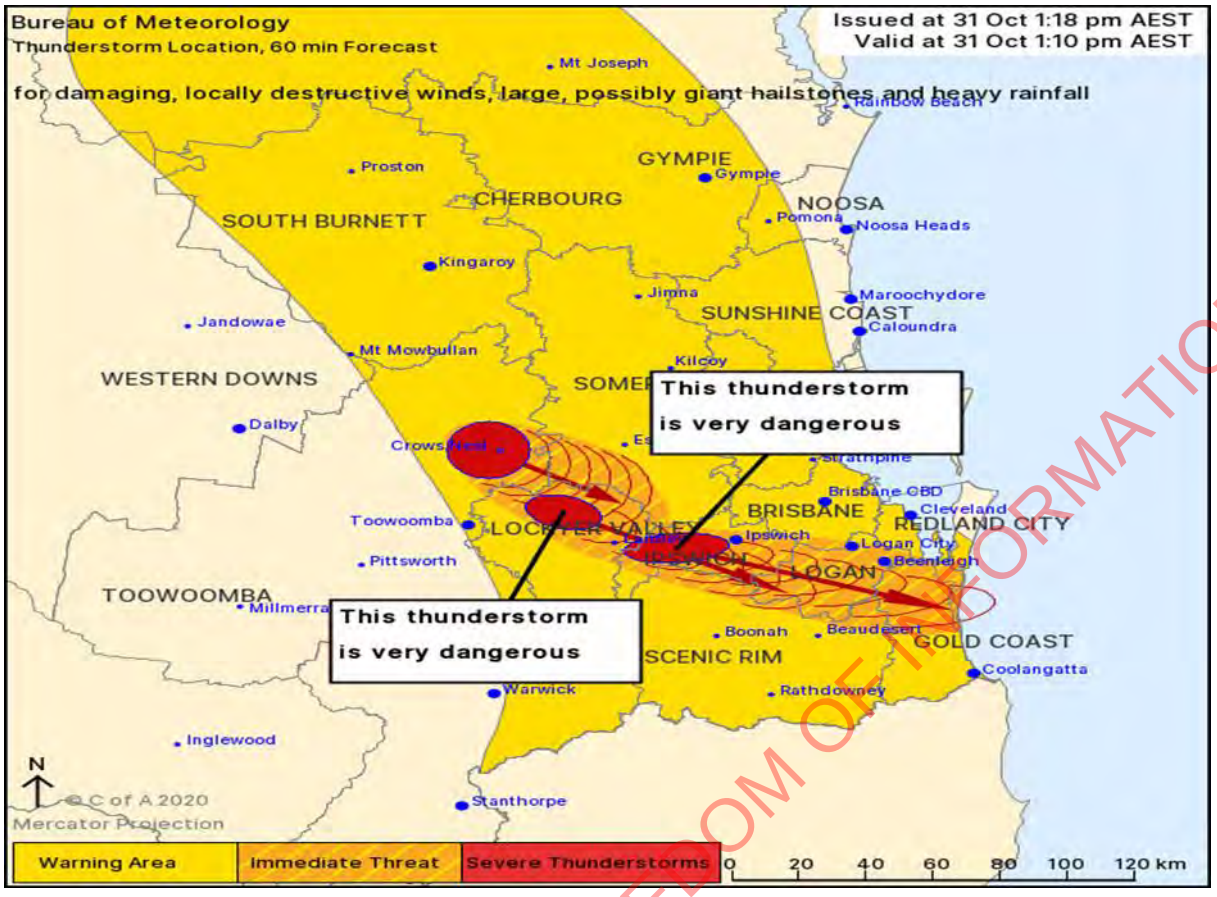
DQ21035
Australian Government Bureau of Meteorology
Transmitters serving the area Ipswich, Greenbank, Logan area are REQUESTED TO USE THE STANDARD EMERGENCY WARNING SIGNAL BEFORE BROADCASTING THIS MESSAGE.

TOP PRIORITY FOR IMMEDIATE BROADCAST

Severe Thunderstorm Warning - Southeast Queensland
for DESTRUCTIVE WINDS, GIANT HAILSTONES and HEAVY RAINFALL
For people in Ipswich, Logan and parts of Scenic Rim, Lockyer Valley, Gold Coast, Redland City and Brisbane City Council Areas.
Issued at 1:18 pm Saturday, 31 October 2020.

VERY DANGEROUS STORMS WITH GIANT HAIL LOCATED OVER AND NEAR GATTON AND IPSWICH.

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The Bureau of Meteorology warns that, at 1:10 pm, very dangerous thunderstorms were detected on the weather radar near Gatton, Rosewood and Grandchester. These thunderstorms are moving towards the east to southeast. Very dangerous thunderstorms are forecast to affect Laidley, Redbank Plains and Hatton Vale by 1:40 pm and Hope Island, Jimboomba and South Stradbroke Island by 2:10 pm.

Other severe thunderstorms were detected on the weather radar near Crows Nest and Hampton. They are forecast to affect the area southwest of Esk by 1:40 pm and the area south of Esk and the area west of Esk by 2:10 pm.

Damaging, locally destructive winds, large, possibly giant hailstones, and heavy rainfall that may lead to flash flooding are likely.

4-7cm has been observed around Gatton and Adare around 12:30pm

Queensland Fire and Emergency Services advises that people should:
* Move your car under cover or away from trees.
* Secure loose outdoor items.
* Never drive, walk or ride through flood waters. If it's flooded, forget it.
* Seek shelter, preferably indoors and never under trees.
* Beware of fallen trees and powerlines.
* For emergency assistance contact the SES on 132 500.
The next warning is due to be issued by 2:20 pm.

RELEASED UNDER FREEDOM OF INFORMATION

Warnings are also available through TV and Radio broadcasts, the Bureau's website at www.bom.gov.au or call 1300 659 210. The Bureau and Queensland Fire and Emergency Services would appreciate warnings being broadcast regularly.

6.3.4. Severe Weather Warning

IDQ21037
Australian Government Bureau of Meteorology
Queensland
TOP PRIORITY FOR IMMEDIATE BROADCAST

Severe Weather Warning
for HEAVY RAINFALL
For people in parts of North Tropical Coast and Tablelands, and Herbert and Lower Burdekin Forecast Districts.
Issued at 1:00 pm Wednesday, 30 January 2019.

HEAVY, LOCALLY INTENSE, RAINFALL CONTINUING ACROSS THE HERBET AND LOWER BURDEKIN.



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Weather Situation: A convergent zone embedded along the monsoon trough has developed to the west of Townsville, producing a swath of very heavy, locally intense, rainfall across the Herbert and Lower Burdekin district. The convergence zone is expected to remain near-stationary for the remainder of the day.

Heavy rainfall, which is likely to lead to flash flooding, will continue for the remainder of today and into Friday across the warning area. Six-hourly rainfall totals between 150mm to 200mm are likely, with locally intense rainfall totals up to 300mm possible.

Locations which may be affected include Townsville, Palm Island, Ingham, Cardwell, Woodstock and Lucinda.
Rainfall totals between 9am to 1pm on Wednesday:
274mm at Upper Black River
202mm at Blue Water

Queensland Fire and Emergency Services advises that people should:
* Never drive, walk or ride through flood waters. If it's flooded, forget it.
* Keep clear of creeks and storm drains.
* For emergency assistance contact the SES on 132 500.

The next Severe Weather Warning will be issued by 5:00 pm AEST Wednesday.

Warnings are also available through TV and Radio broadcasts, the Bureau's website at www.bom.gov.au or call 1300 659 219. The Bureau and Queensland Fire and Emergency Services would appreciate warnings being broadcast regularly.

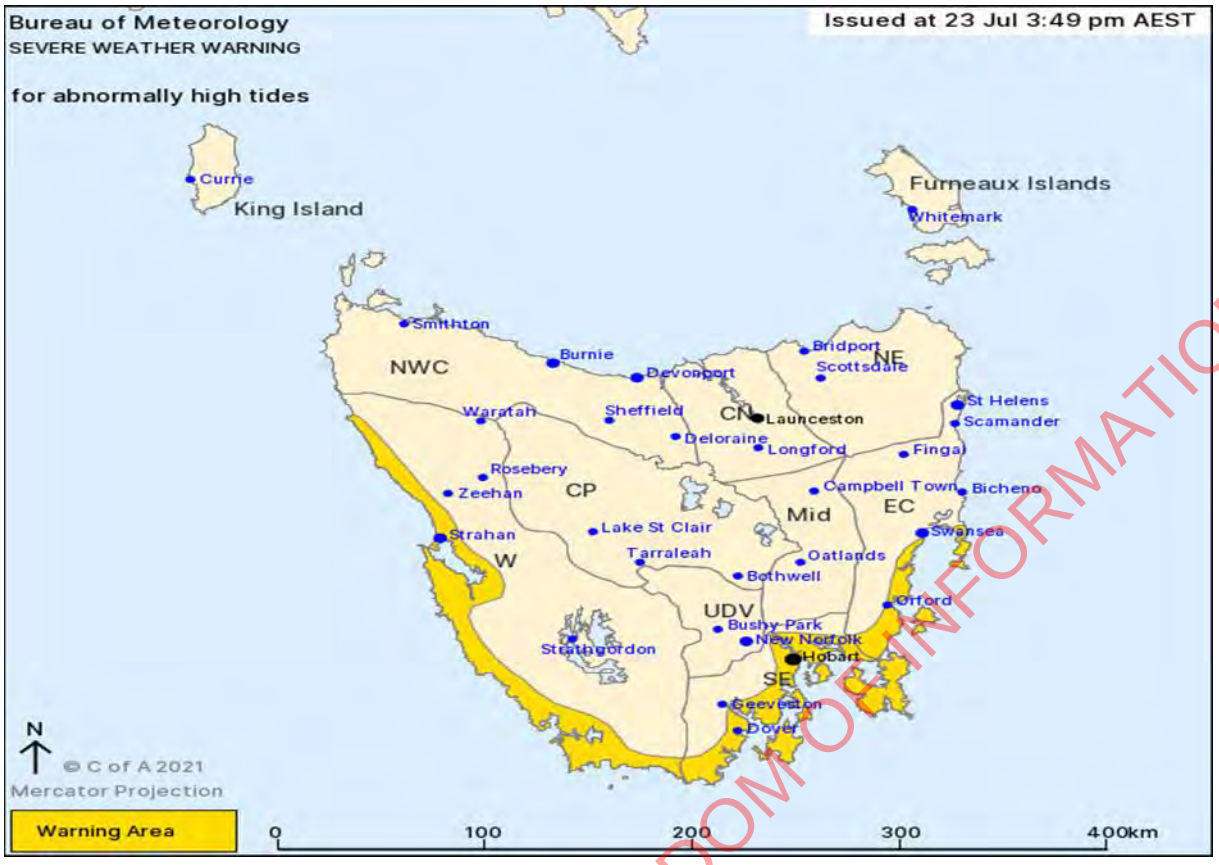
6.3.5. Severe Weather Warning

IDT21137
Australian Government Bureau of Meteorology
TOP PRIORITY FOR IMMEDIATE BROADCAST

Severe Weather Warning
for ABNOMRALLY HIGH TIDES
For people in parts of Western, South East and East Coast Forecast Districts.

Issued at 1:00 pm Wednesday, 30 January 2019.

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Abnormally high tides are expected along western, southern, and lower eastern Tasmania coasts
Weather Situation: High astronomical tides over the coming days are expected to coincide with a low pressure system, resulting in abnormally high tides that may lead to localised inundation.

ABNOMALLY HIGH TIDES, which may cause sea water flooding of low-lying areas, are expected along western, southern and lower eastern Tasmania coasts and tidal rivers during Friday, Saturday and Sunday. The high tides along the southeast and lower east coasts are expected during the evening on all three days. The high tides along the west coast are expected during the afternoon on all three days.

The highest tides will occur during Saturday and will bring the highest risk of inundation. Tides are expected to be about 40 to 50 cm higher than the standard astronomical tides during this time and may be the highest experienced across southeastern Tasmania since 1994.

Locations which may be affected include Orford, Strahan, Hobart, and Dover.

The State Emergency Service advises that people should:
* Supervise children closely.
* Manage pets and livestock.
* Be prepared in case of power outages and report any outages to TasNetworks on 132 004.
* Do not walk, ride, or drive through flooded waters.
* For emergency assistance contact the SES on 132 500.

The next Severe Weather Warning will be issued by 11:00 pm AESR Friday.

RELEASED UNDER FREEDOM OF INFORMATION

Warnings are also available through TC and Radio broadcasts, and Bureau's website at www.bom.gov.au or call 1300 659 210. The Bureau and State Emergency would appreciate warnings being broadcast regularly.

6.3.6. Severe Weather Warning for offshore Islands

IDN28504
Australian Government Bureau of Meteorology
New South Wales

Severe Weather Warning
for DAMAGING SURF
for Lord Howe Island

Issued at 10:54 pm LHST on Thursday 5 August 2021

LARGE AND POWERFUL SURF ON THURSDAY

Weather Situation
Large and powerful southwesterly swell has been generated by a deep complex low pressure system over the southern Tasman Sea and will slowly decrease as the low moves further east

Damaging surf conditions, with waves exceeding 5 metres in the surf zone, may produce significant beach erosion for southwest facing beaches during Thursday evening and early Friday morning. Surf conditions are expected to ease during Friday morning.

The State Emergency Services advises that people should:
* Check your property regularly for erosion or inundation by sea water, and if necessary, raise goods and electrical items.
* Stay out of the water and stay well away from surf-exposed areas.

For emergency help in floods and storms, ring the Lord Howe Island Police on [02] 6563 2199

The next warning will be issued by 5:00am LHST on Friday 6th August 2021.

6.4. Product Identifiers

Product ID	Description
New South Wales	
IDN21031	Thunderstorm Forecast Day 1
IDN21032	Thunderstorm Forecast Day 2
IDN21033	Regional Severe Thunderstorm Warning
IDN21035	Detailed Severe Thunderstorm Warning - Sydney, Wollongong, Newcastle
IDN21036	Detailed Severe Thunderstorm Warning - Canberra
IDN21037	Severe Weather Warning - 1
IDN21038	Severe Weather Warning - 2
IDN21137	Severe Weather Warning - 3
IDN28503	Severe Weather Warning – Norfolk Island

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IDN28504	Severe Weather Warning – Lord Howe Island
Northern Territory	
IDD21031	Thunderstorm Forecast Day 1
IDD21032	Thunderstorm Forecast Day 2
IDD21033	Regional Severe Thunderstorm Warning - 1
IDD21034	Regional Severe Thunderstorm Warning - 2
IDD21035	Detailed Severe Thunderstorm Warning – Darwin City and Outer Darwin
IDD21037	Severe Weather Warning - 1
IDD21038	Severe Weather Warning - 2
IDD21137	Severe Weather Warning - 3
Queensland	
IDQ21031	Thunderstorm Forecast Day 1
IDQ21032	Thunderstorm Forecast Day 2
IDQ21033	Regional Severe Thunderstorm Warning -1
IDQ21035	Detailed Severe Thunderstorm Warning – Southeast Queensland
IDQ21037	Severe Weather Warning - 1
IDQ21038	Severe Weather Warning - 2
IDQ21137	Severe Weather Warning - 3
	Thunderstorm Tracker – Southeast Queensland
South Australia	
IDS21031	Thunderstorm Forecast Day 1
IDS21032	Thunderstorm Forecast Day 2
IDS21033	Regional Severe Thunderstorm Warning -1
IDS21035	Detailed Severe Thunderstorm Warning – Adelaide Region
IDS21037	Severe Weather Warning - 1
IDS21038	Severe Weather Warning - 2
IDS21137	Severe Weather Warning - 3
Tasmania	
IDV21031	Thunderstorm Forecast Day 1
IDV21032	Thunderstorm Forecast Day 2
IDV21033	Regional Severe Thunderstorm Warning -1
IDV21035	Detailed Severe Thunderstorm Warning – Melbourne Area
IDV21037	Severe Weather Warning - 1
IDV21038	Severe Weather Warning - 2
IDV21137	Severe Weather Warning - 3
Victoria	
IDV21031	Thunderstorm Forecast Day 1
IDV21032	Thunderstorm Forecast Day 2

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IDV21033	Regional Severe Thunderstorm Warning -1
IDV21035	Detailed Severe Thunderstorm Warning – Melbourne Area
IDV21037	Severe Weather Warning - 1
IDV21038	Severe Weather Warning - 2
IDV21137	Severe Weather Warning - 3
Western Australia	
IDW21031	Thunderstorm Forecast Day 1
IDW21032	Thunderstorm Forecast Day 2
IDW21033	Regional Severe Thunderstorm Warning - 1
IDW21034	Regional Severe Thunderstorm Warning - 2
IDW21035	Detailed Severe Thunderstorm Warning – Greater Perth
IDW21037	Severe Weather Warning - 1
IDW21038	Severe Weather Warning - 2
IDW21137	Severe Weather Warning - 3

Table 7: Product Identifiers

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