2019–20

Major Incidents Report

An overview of major incidents that have involved the fire and emergency services sector from July 2019 to June 2020

Australian Government
Department of Home Affairs

Australian Institute for Disaster Resilience

The Australian Institute for Disaster Resilience (AIDR) is a disaster resilience knowledge centre. We develop, maintain and share knowledge and learning to support a disaster resilient Australia. We work with government, communities, non-government organisations, not-for-profits, research organisations, education partners and the private sector to enhance disaster resilience through innovative thinking, professional development and knowledge sharing.

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Foreword

Disasters and disruptions provide an opportunity to learn. Distilling the causes and sharing experiences of what contributed to each disaster, providing evidence or unpicking what happened, all provide important opportunities to learn so that measures can be taken to reduce the chance of the same thing happening again.

—— *Profiling Australia's Vulnerability 2018*

This fourth edition of the *Major Incidents Report* provides an overview of 19 events regarded as nationally significant by the emergency management sector, across the 2019–20 financial year. The report provides background information about each incident, the impact, the response to it and, where identified, observations to assist the emergency management and disaster resilience sectors identify key themes for improvement in practice at a national level, across all hazards and jurisdictions.

Australia experienced a protracted bushfire season across several jurisdictions in 2019–20. The Black Summer bushfire events in New South Wales and Victoria have been combined into jurisdictional summaries to reflect the gravity of the events and provide an overview of observations from this period.

While there is a large focus on bushfire events, the report also includes significant storm and tropical cyclone events. Communities experienced major impacts from flood and hail, which was reflected in substantial insurance claims. The report also includes the role Australia played in the evacuation of citizens following the Whakaari/White Island volcano eruption.

AIDR acknowledges the contribution of Damien Killalea Consulting in the development of this report, as well as the guidance provided by jurisdictional representatives from emergency service organisations and the Bureau of Meteorology who formed the Major Incidents Report Steering Committee. AIDR also thanks its partners, the Australian Government Department of Home Affairs, the Australasian Fire and Emergency Services Authorities Council (AFAC) and the Australian Red Cross.

Robert Cameron OAM
Director General
Emergency Management Australia

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National overview

Across Australia in 2019–20, responses by front-line emergency operation and disaster recovery services, provided by state and territory agencies, was one of the most significant of modern history. Independent but concurrent natural hazard impacts and their compounding effects, followed quickly by the arrival of a pandemic and its sustained influence on Australia's community and economy, required new levels of cooperation nationally and drew on a very broad range of services and capabilities from Australian Government agencies, including the Australian Defence Force (ADF).

In the 2019–20 reporting period Australia experienced a range of severe conditions, influenced by the following factors:

- 2019–20 financial year was the sixth driest on record, 24 per cent below the long-term average
- rainfall for the 24-month period ending in June 2020 was the second lowest for any 24-month period ending in June, slightly wetter than 1900–1902 during the Federation Drought
- spring 2019 was Australia's driest spring on record, and December 2019 the driest December on record
- it was the third warmest financial year on record, and the warmest 24 and 36-month period
- December 2019 was Australia's hottest ever month.
- 18 December 2019 was Australia's hottest ever day and 17-24 December 2019 the hottest ever week
- accumulated forest fire danger index (FFDI) for December 2019 was the highest ever recorded in December over most of the country
- root-zone soil moisture in December 2019 was in the lowest 10 per cent of all Decembers since 1900
- above-average rains in the early part of 2020 saw root-zone soil moisture return to near-average levels
- June 2020 was the third driest June on record for Australia, this resulted in drying of the soil over much of southern Australia
- Australian annual mean temperature has increased by around 1.4 degrees Celsius since 1910
- positive-phase Indian Ocean Dipole in spring 2019 one of the strongest such events ever recorded
- second consecutive below-average rainfall in the northern wet season
- third marine heatwave on the Great Barrier Reef in five years in early 2020
- second-latest start to Australia's tropical cyclone season on record, with Tropical Cyclone *Blake* in early January, and a late end with Tropical Cyclone *Mangga* in May.

Source: (Australian Government Bureau of Meteorology, Hazard Preparedness and Response - National Decision Support Services, 17 July 2020)

Australian Government activity

Through Emergency Management Australia (EMA), the Australian Government coordinates support, collaborates with and assists the states and territories to improve the overall resilience of Australia, Australians and the things that Australians value. The Australian Government Crisis Coordination Centre (CCC) provides stakeholders verbal and written notification on domestic and international security and emergency management events, where the event poses potential risk to the Australian community or Australian interests overseas.

During the period of 1 July 2019 to 30 June 2020 (2019–20), the CCC issued more than 1500 incident notifications to key stakeholders in Australian Government and state and territory government agencies. The CCC notified stakeholders of and coordinated whole-of-Australian Government responses, to a range of significant incidents including:

- 7.2 magnitude earthquake at Halmahera, Indonesia (**14 July 2019**) – notifications for situational awareness; multiple felt reports in Darwin resulted in some localised evacuations.
- Stabbing attack in the Sydney Central Business District (**13 August 2019**) – notifications to stakeholders for situational awareness.
- Bushfires including the fires referred to as the Black Summer bushfires (**September 2019 to February 2020**) – notifications and incident briefs for situational awareness; coordination of senior level Australian Government and state and territory government meetings; EMA liaison officers deployed into emergency operations centres to support state and territory requests for Australian Government non-financial assistance:
  - south-eastern Queensland (QLD)
  - north-eastern New South Wales (NSW)
  - south-eastern NSW and eastern Victoria (VIC)
  - southern coast and Kangaroo Island, South Australia (SA)
  - south-western areas of Western Australia (WA)
  - Australian Capital Territory (ACT).
- Measles outbreak in Samoa (**November 2019 to January 2020**) – the Australian Government deployed six Australian Medical Assistance Teams (AUSMAT) in support of the Government of Samoa's response to the measles outbreak; EMA deployed multiple liaison officers to support the security and safety of AUSMAT.
- Hong Kong riots (**throughout 2019 to present**) – ongoing monitoring to support situational awareness and engagement across the Australian Government.
- London Bridge stabbing, United Kingdom (**29 November 2019**) – notifications to stakeholder for situational awareness.
- Whakaari/White Island volcano eruption, New Zealand (**9 December 2019**) – EMA coordinated the repatriation to Australia of 13 injured Australian citizens commencing from the night of 11 December 2019 for treatment in hospitals in Sydney and Melbourne.
- 7.7 mag earthquake in Cuba (**28 January 2020**) – notifications to stakeholder for situational awareness.
- NSW floods (**February 2020**) – notifications to stakeholder for situational awareness; liaison officer deployed to the NSW State Emergency Service Operations Centre to support any requests for Australian Government non-financial assistance.
- Novel Coronavirus (COVID-19) pandemic (**December 2019 to present**) – information about pandemic included in daily briefs, activation of a Crisis Coordination Team (CCT) and deployment of Department of Home Affairs liaison officers to support state and territory governments responses.
- Black Lives Matter protests Australia and the United States of America (USA) and riots in USA (**May and June 2020**) – notifications to stakeholders for situational awareness.

The Australian Government Crisis Committee (AGCC) met on 28 occasions during 2019–20 with the National Crisis Committee (NCC) convening seven times.

A CCT was established on eight occasions for a total of 204 days to support the centralised approach of the Australian Government when a National Plan was activated. In the reporting period, the *Australian Government Disaster Response Plan* (COMDISPLAN) was activated on 10 occasions. Significantly, two of these were national activations to cover all states and territories. The Australian Government coordinated 76 requests for assistance from states and territories. In addition, the *Australian Government Overseas Assistance Plan* (AUSASSISTPLAN) was activated four times and the *Australian Government Response Plan for Overseas Mass Casualty Incidents* (OSMASSCASPLAN) and the *Australian Government Space Re-entry Debris Plan* (AUSSPREDPLAN) were both activated once each.

The National Security Hotline (NSH) received over 27,000 contacts, more than two and a half times the number from 2018–19, assisting state and territory law enforcement and intelligence agencies.

2019–20 bushfires

The CCC and by extension the CCT coordinated the Australian Government's response to the 2019–20 bushfires between 1 July 2019 and 16 March 2020. The Director General EMA activated COMDISPLAN eight times from 6 September 2019 to 20 March 2020 for bushfire events across all six states. For the first time, one of these COMDISPLAN activations was a national activation to facilitate transportation of fire retardant and Large Air Tanker spare parts from the USA to Australia by USA and Canadian military partners. The Australian Government coordinated 74 requests for assistance related directly to bushfire emergency response and recovery.

The CCC coordinated and disseminated more than 864 bushfire notifications and 121 detailed Incident Briefs. Twenty-five liaison officers were deployed, for a total of 149 days, to State Emergency Operations Centres in NSW, QLD, VIC, WA and SA in support of timely, efficient and effective advice about Australian Government assistance. A CCT was activated for 82 days, comprising liaison officers and surge personnel from across the Australian Government to ensure a centralised focus of government, including the coordination for international offers of assistance. The Department of Home Affairs' Crisis Communications Media Team supported CCC operations through the development and distribution of 235 sets of Australian Government talking points and 186 media releases.

To aid situational awareness and decision making across the Australian Government the AGCC met 19 times and for state and territory governments the NCC met twice.

At the request of the state and territory governments, and under the direction of the Australian Government, the Department of Defence (Defence) provided substantial contributions to bushfire emergency response and recovery efforts across the nation during the 2019–20 bushfire season. Defence raised three state/territory-based Joint Task Forces (JTFs), to facilitate ADF support to emergency services in VIC, NSW/ACT and SA/TAS. Significantly, on 4 January 2020, the Governor-General initiated a call out of reserve force elements to enhance the deployed JTFs as part of a wider call out of the ADF.

Novel Coronavirus (COVID-19)

In anticipation of a response by the Australian Government to COVID-19, the Director General EMA authorised a national COMDISPLAN activation. A CCT remains active, but for the purpose of this report has operated continuously for 119 days to 30 June 2020.

To support the unprecedented national coordination requirements across all areas of the Australian Government, state and territory governments and the commercial and private sector, the Prime Minister announced the activation of the National Coordination Mechanism (NCM) to respond to non-health issues related to COVID-19. The NCM was supported by coordination nodes within the Department of Home Affairs that included representatives from key agencies that covered domain-specific issues, and the capabilities available to address challenges. The nodes also brought together crisis planners from Australian Government agencies including Home Affairs and the ADF. The NCM coordinated 111 domain-specific sector meetings from 5 March to 30 June 2020.

Supplementary to the bushfire response, when requested by the Australian Government, Defence rapidly deployed to provide customised support to all state and territory authorities to reinforce, amplify and expand state and territory capacity to deal with the impacts of COVID-19. Defence is working in support of the Department of Health and the NCM. Support will continue to be provided domestically (to mainland Australia and all Australian territories) under the Defence Assistance to the Civil Community (DACC) framework.

Disaster recovery funding

Jointly funded Commonwealth, state and territory assistance under the Disaster Recovery Funding Arrangements (DRFA) was activated in response to 30 domestic disaster events (two in ACT, six in NSW, one in the Northern Territory, five in QLD, one in SA, one in TAS, nine in VIC and five in WA), during 2019–20. DRFA assistance was made available in 320 local government areas following 72 DRFA notifications issued from states and territories to the Australian Government. The Australian Government also made advance payments to bushfire affected state governments under the DRFA totalling $847,910,159. These payments were made to enable the states to expedite recovery assistance to communities devastated by the Black Summer bushfires.

In addition to the recovery assistance under the DRFA, in 2019–20 the Australian Government provided over $248 million directly to individuals and families through the Australian Government Disaster Recovery Payment and Disaster Recovery Allowance in response to the Black Summer bushfires.

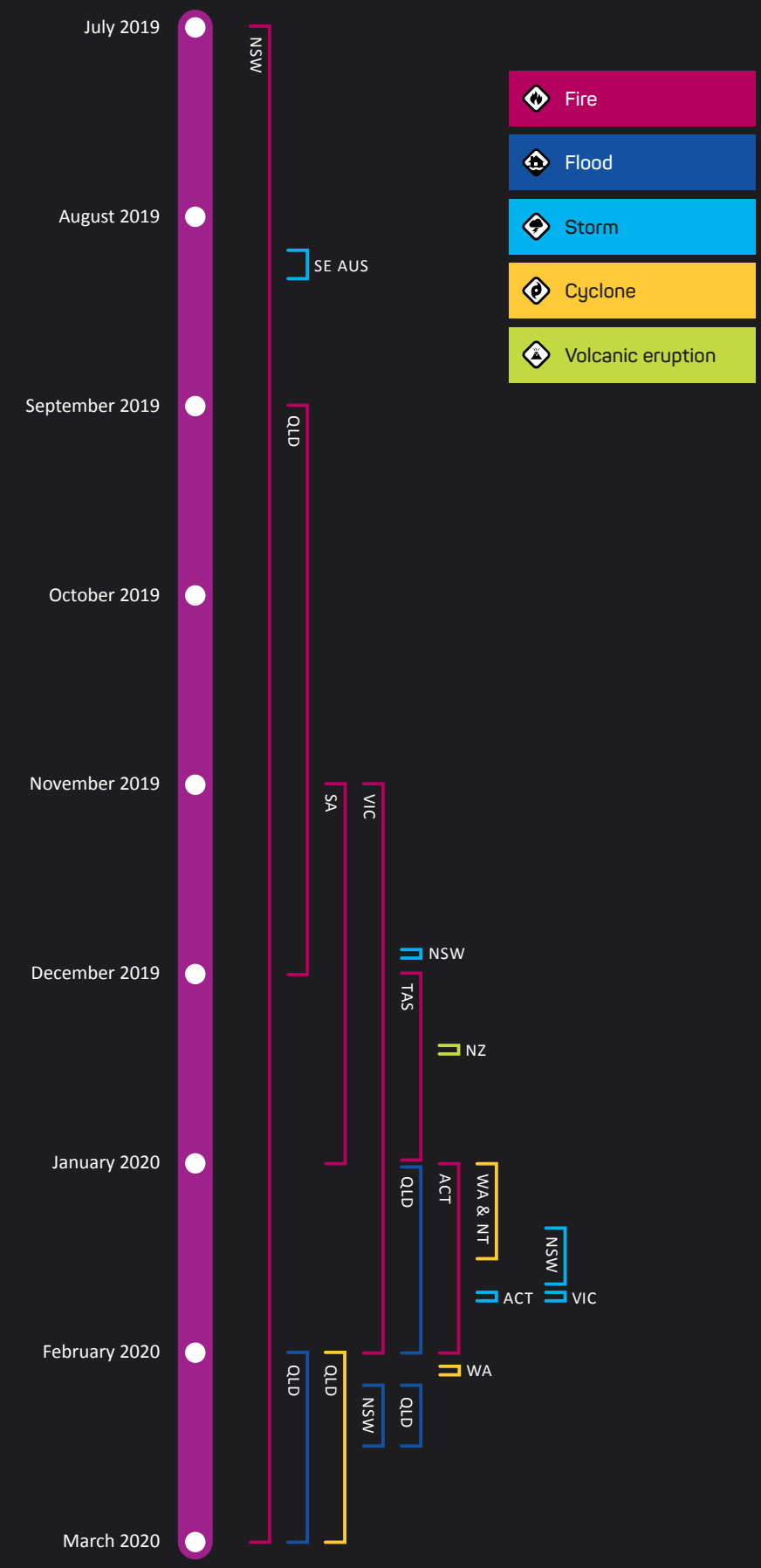


Figure 1: Timeline of incidents covered in this report.

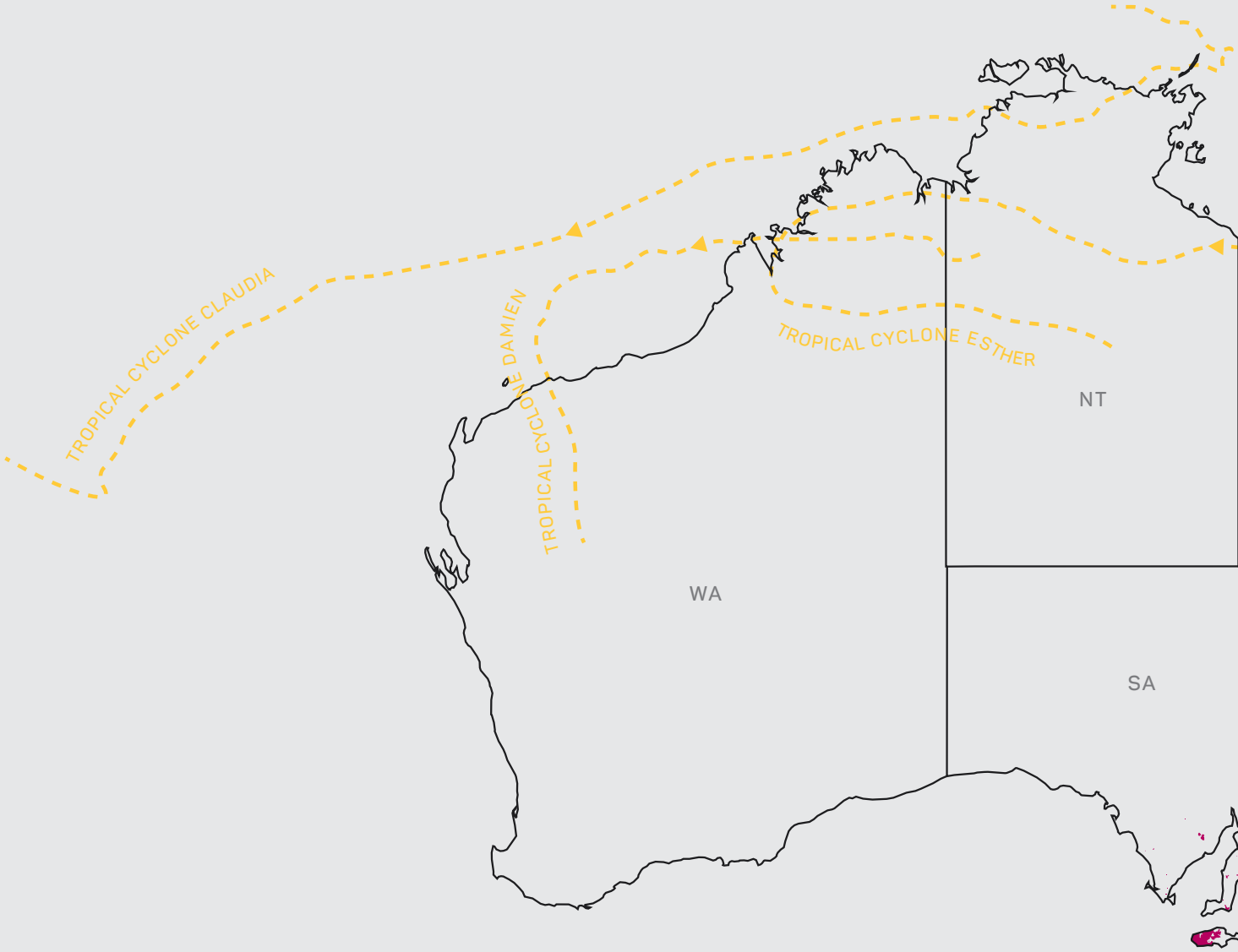
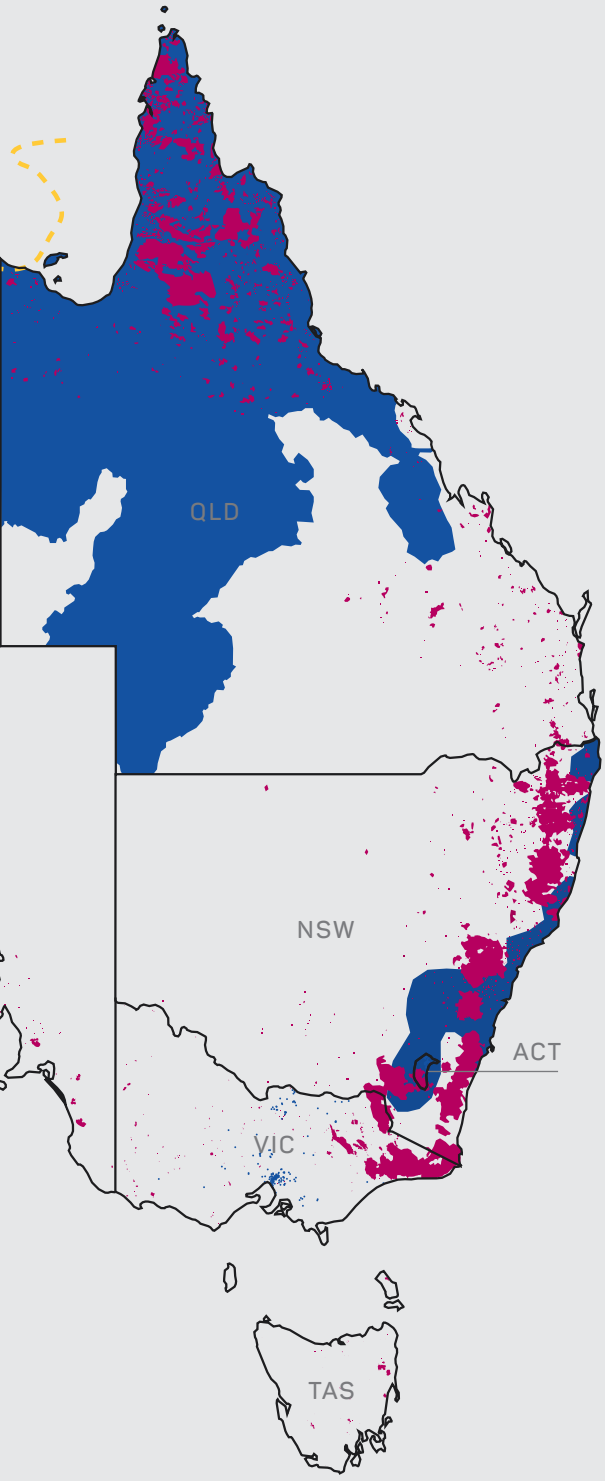


Figure 2: Map of incidents covered in this report.



Index of like-hazard summaries in this report


Thank
You
Firies

Images: Neal Herbert, US Department of Interior

Storms, floods and blizzards

South-east Australia

7–11 AUGUST 2019

A strong cold front produced a cold outbreak in south-east Australia for several days from 7 August 2019, bringing damaging winds, squally showers and storms. Strong winds temporarily grounded flights in Sydney and Melbourne, and led to hundreds of calls to emergency services across New South Wales (NSW), Victoria (VIC) and South Australia (SA).

The cold outbreak also brought widespread heavy snow to many elevated areas in NSW, VIC and the Australian Capital Territory (ACT).

Victoria

On 9 August, VIC's West and South Gippsland and the coastal south-west, sustained winds of 90–110 kilometres per hour (km/h) were experienced, with gusts of 128 km/h recorded at Wilsons Promontory and 120 km/h at Cape Otway.

A woman died that morning in the Yarra Ranges when a gum tree fell onto a car she was travelling in on the Maroondah Highway; three other occupants of the car were hospitalised. On the Mornington Peninsula, the end of the Frankston pier broke from its moorings and drifted across the bay.

By 6.00pm that evening, the VIC State Emergency Service (SES) had received more than 600 requests for assistance in the previous 24 hours, mostly due to fallen trees and some building damage, and more than 45 domestic flights had been cancelled at Melbourne Airport.

Widespread snow fell to lower levels in VIC, including at Mt Macedon and in the Dandenong Ranges. For VIC this was the most widespread low level snowfall since 2008.

Disaster recovery assistance for counter disaster operations and the restoration of essential public assets was made available from the Australian and state governments in the VIC local government areas of Banyule, Glen Eira and Hobsons Bay.

New South Wales

In NSW, the SES received 1,404 requests for assistance, mostly from the Blue Mountains and the Illawarra region. In Stockton near Newcastle, gale-force winds ripped the roof from an aged care facility; nobody was hurt.

Winds at Thredbo in the Australian Alps gusted to 118 km/h at 3.50am on 9 August, and Albion Park south of Wollongong recorded 100 km/h and Bellambi to Wollongong's north 93 km/h. The strong winds caused more than 180 domestic flights at Sydney Airport to be cancelled by 6.00pm that evening.

Moderate snowfalls occurred in the NSW highlands, with snow settling at many locations above about 600 metres on 10 and 11 August, including Orange, Guyra, Lithgow, the Barrington Tops, the Blue Mountains, and in the ACT.

Australian Capital Territory

In Canberra on the night of 9 August, snow fell on an Australian Football League (AFL) game between Hawthorn and Greater Western Sydney, the first time in history that snow had fallen on an AFL match.

South Australia

In SA, storms on 8 August brought severe winds and localised flooding to the Adelaide Hills, with power blackouts affecting more than 8,500 properties across the state. McLaren Vale had its highest August daily rainfall on record. Conditions eased early the following morning, but more than 5,500 customers remained without power.

The cold front brought strong wind gusts with the highest reading of 120 km/h recorded on Neptune Island. Wind gusts of 104 km/h were recorded at Hindmarsh Island, 98 km/h at Mount Gambier, 95 km/h at Point Avoid, and 93 km/h at Port Lincoln.

At Mount Barker, a police officer entered a fast-flowing creek on the night of 8 August to rescue a woman clinging to a tree branch after she fell in while checking on stock. She was rescued by the police officer with the help of her husband.

SAs SES received about 340 calls for assistance in 24 hours from 8 August into 9 August.

Observations

In NSW, the response to the event was managed within the capability of the NSW SES operational structure, processes and resources.

Acknowledgments

New South Wales State Emergency Service; Emergency Management Victoria; South Australia State Emergency Service; Bureau of Meteorology; The Guardian; the Advertiser.

Images: Victoria State Emergency Service

Bushfires

New South Wales

JULY 2019–MARCH 2020

The 2019–20 bushfire season was the worst New South Wales (NSW) has recorded. Higher than average temperatures and low moisture levels in bushfire fuels following several years of drought enabled devastating fires to burn across much of the state, with intense bushfire weather conditions continuing through most of the fire season. Over the course of a few months, 26 lives were lost, 2,448 homes were destroyed and 5.5 million hectares (ha) of land was burnt. The impact on NSW communities, farmers, local businesses, wildlife and bushland was unprecedented.

The length and intensity of the bushfire season and the scale of the fires challenged the NSW Rural Fire Service (RFS) and other NSW agencies like never before. On 8 November for example, there were an unprecedented 17 fires for which emergency warnings – the highest alert level – had been issued. Due to the unusually dry conditions, fire behaviour was more erratic and less predictable than in previous experience, often meaning that well-tested firefighting techniques were not always as effective as in the past. Such challenges were compounded by worsening drought conditions and an unprecedented number of fire-initiated thunderstorms.

From 1 July 2019 to the end of the bushfire season on 31 March 2020, there were more than 11,400 bush and grass fires across NSW. The fires burnt 6.2 per cent of the state – the largest burnt area recorded in a single fire season in eastern Australia.

Tragically, the season also resulted in the loss of several lives, including 20 civilians: three in October, five in November, four in December and eight in January. Six firefighters also died, including two RFS volunteers killed on 19 December when their fire tanker rolled down an embankment, one RFS volunteer who sustained fatal injuries in a freak weather event on 30 December, and three American citizens who were killed when their plane crashed during water-bombing operations on 23 January in the Snowy Monaro area.

In summary:

- In July 2019, 1,074 bush and grass fires occurred across NSW.

- In August, there were 1,801 bush and grass fires burning, and the RFS Commissioner declared four bushfire emergencies (under Section 44, *Rural Fires Act 1997*, NSW).
- In September, there were 1,304 bush and grass fires burning, four declared bushfire emergencies and four total fire bans.
- In October, there were 1,297 bush and grass fires, six declared bushfire emergencies, eight total fire bans and three civilian fatalities.
- In November, there were 1,939 bush and grass fires, 23 declared bushfire emergencies, 15 total fire bans (including three days of state-wide bans) and a seven-day state of emergency from 11 November. Five civilians died.
- In December, there were 2,027 bush and grass fires, five declared bushfire emergencies, 22 total fire bans (including four days of state-wide bans) and a seven-day state of emergency from 19 December. There were seven fatalities, including three RFS firefighters.
- In January 2020, there were 1,597 bush and grass fires, one declared bushfire emergency, 11 total fire bans (including three days of state-wide bans) and a nine-day state of emergency from 2 January. Eleven fatalities were recorded, including eight civilians and three aerial firefighting crew members.

Building impact assessments were conducted on 81 fires between 11 August 2019 and 1 March 2020. Assessments were completed on foot and by drone, helicopter, boat and trail bike by more than 70 RFS staff and 15 volunteers, assisted by numerous other agency personnel.

As well as burning down 2,448 homes, the fires destroyed 284 facilities and 5,469 outbuildings, and damaged 1,013 other homes, 194 facilities and 2,042 outbuildings, with the majority of property losses occurring in southern NSW. In areas assessed by the RFS, an estimated 14,519 homes, 1,486 facilities and 14,016 outbuildings were saved by firefighting protective measures.

Losses experienced by the agricultural community were also grave, with thousands of farms affected by significant losses of livestock, placing further strain on a sector already suffering wide-spread effects of drought.

More than three billion animals, more than one billion of them in NSW, were estimated to have been killed or displaced in the fires, including some rare or threatened animal, plant and insect species, with the complete loss of some species believed to be permanent.

The RFS was supported in its firefighting efforts by personnel from Fire and Rescue NSW, the National Parks and Wildlife Service, the Forestry Corporation of NSW, the State Emergency Service and the NSW Police Force. In addition, 5,728 interstate and overseas fire and emergency service personnel were deployed. Many other government and non-government agencies also supported the effort in many ways.[1]

On 8 November and following multiple bushfires across eastern and south-eastern Australia, the Insurance Council of Australia (ICA) declared the fires a catastrophe, enabling related insurance claims to be processed more rapidly. On 28 May 2020, the ICA advised that insurance claims from the bushfires in 2019–20 across NSW, Queensland, Victoria (VIC) and South Australia numbered 38,181, with estimated losses of $2.32 billion. NSW accounted for 81 per cent of these losses, or $1.88 billion.

A wide range of disaster assistance payments and allowances were made available through joint Commonwealth-State arrangements to assist individuals, primary producers, businesses, non-profit organisations and local governments that had been impacted by the bushfires.

Due to the ongoing and significant impact of the fires, on 6 January 2020 the Australian Government committed $2 billion to the National Bushfire Recovery Fund to provide further assistance to individuals and communities impacted by the fires, bringing total government assistance available to almost $2.65 billion.

On 20 February 2020 the Royal Commission into National Natural Disaster Arrangements was established.

1 Other NSW agencies included Corrective Services, Local Land Services, NSW Ambulance, Department of Education, Department of Justice, Department of Planning, Industry and Environment, Department of Primary Industries, Environment Protection Authority, Health, Public Works, Telecommunications Authority, Office of the Sheriff, Transport for NSW and WaterNSW. Other assistance was provided by Association of Independent Schools (NSW), Australasian Fire and Emergency Services Authorities Council, Catholic Schools NSW, Volunteer Marine Rescue NSW, NSW Volunteer Rescue Association, Surf Lifesaving NSW and St Johns Ambulance (NSW).

Northern NSW

Northern NSW experienced a long and hot fire season, commencing in early July in Chambigne in the Clarence Valley.

Total rainfall for NSW was the lowest on record, 55 per cent below average and well below the previous driest year of 1944. The north-east quarter and the far west of the state was especially dry, with numerous locations having their driest year on record and many of those more than 40 per cent below the previous driest year. Some locations had had less than a quarter of their average annual rainfall. Along with the rest of the state, northern NSW had been experiencing a prolonged drought, with higher than average temperatures and minimal rainfall. Several dry lightning storms occurred across northern NSW, igniting most of the fires occurring in that part of the state.

Several fires grew very much larger than usual, including the Long Gully Road fire in Tenterfield, the Bees Nest fire in Clarence Valley, Busbys Flat Road fire in the Richmond Valley, the Liberation Trail fire in the Clarence Valley, Carrai Creek in Armidale, Carrai East in Kempsey, Kian Road in Nambucca, Stockyard Flat in Armidale, Myall Creek Road in the Richmond Valley, Gulf Road in Tenterfield, Kangawalla in Glen Innes, and the Mt McKenzie fire in Tenterfield. In northern NSW, 1,136,815 ha burned, representing 20.6 per cent of the total area burned in NSW during the fire season, and 703 homes (21.3 per cent of the total) were lost in the area. Homes destroyed in the Liberation Trail fire in the Clarence Valley alone totalled 169.

The Long Gully Road fire had been burning for five weeks when it claimed the first two lives of the bushfire season on 9 October. At 3.00am that morning, the fire flared up in extreme conditions as a south-easterly wind change pushed it towards the Busbys Flat Road fire. An isolated spot fire was reported five kilometres (km) to the south-east of the main fire and properties were under threat to the east of the Keybarbin State Forest. Warnings of fire-induced lightning were sent to fire crews as they worked to protect homes and other property. It was expected that within 24 hours, the Long Gully Road and Busby Flat Road fires would merge.

The Local Government Areas (LGAs) of Tenterfield, Glen Innes, Armidale, Kempsey, Nambucca, the Richmond Valley and the Clarence Valley continued to suffer under extreme fire weather conditions, with more dry lightning storms crossing the area and causing several new outbreaks.

From July until the end of December, there were approximately 15 declared bushfire emergencies in northern NSW and 46 total fire bans affecting various LGAs. Several fires reached emergency warning status during the fire season, with some lasting for several days at a time.

Greater Sydney and the mid-north coast region

The Greater Sydney region experienced a warmer than average winter in 2019, with daytime temperatures the third warmest on record for the city. Night-time temperatures and rainfall were close to average too, with average rainfall in June, but below average rainfall in July and most of August. New records were set in July for the consecutive number of warm days above 20°C, with Sydney (Observatory Hill) recording eight straight days and Penrith Lakes recording ten straight days above 20°C.

For February 2020, Port Macquarie on the mid-north coast recorded its lowest rainfall in 23 years with just 48.2 millimetres (mm), much lower than the regional average of around 156 mm.

The fires that burned through the Greater Sydney and mid-north coast regions caused extensive and devastating damage to communities and wildlife, with several koala colonies destroyed in the Port Macquarie area. Fires that caused the most devastation included: on the mid-north coast, the Hillville Road, Bills Crossing Crowdy, Failford Road Darawank and the Rumba Complex fires; the Three Mile fire on the central coast; the Green Wattle Creek fire (Wollondilly), the Ruined Castle and the Green Valley fires in the Blue Mountains; the Morton fire (Wingecarribee); and the Gospers Mountain fire. Fires in this region burned 1,286,126 ha (23.3 per cent of the NSW total), and destroyed 308 homes (12.6 per cent of the total lost). The Gospers Mountain fire destroyed 90 homes across the Hawkesbury, Blue Mountains, Lithgow and Singleton LGAs.

Some of these fires threatened newly settled areas on Sydney's urban-rural interface, presenting additional challenges for firefighters. Many new homes had been built in undeveloped bushland, with many property owners unprepared for bushfires burning under catastrophic conditions. In addition, years of drought and prevailing weather conditions had reduced opportunities to conduct fuel reduction burns, with low fuel moisture and weather conditions causing planned burns to be postponed.

From 1 July to 31 December, the Greater Sydney and mid-north coast regions experienced approximately 11 declared bushfire emergencies and 26 total fire bans. Emergency warnings were issued for several fires, some lasting for several days at a time.

During the Green Wattle Creek fire south-west of Sydney, two volunteer firefighters were killed when their fire tanker rolled late during the night of Thursday 19 December at Buxton, leaving three others injured in the accident. Their truck had been part of a convoy when the accident occurred.

Southern NSW

High pressure systems dominated weather across southern Australia during the 2019 winter, leading to lower rainfalls than usual. A few sites on the south coast of NSW had their lowest total winter rainfall on record, with many more having their driest winter for several decades. Total winter rainfall for NSW was 62 per cent below average, the fourth lowest on record and the lowest since 1982.

Some of the more significant fires in the south coast region included the Badja Forest Road fire, the Currowan fire (the Tianjara fire had burned 21,452 ha before it joined the Currowan fire), the Dunns Road fire in the Snowy Valley, the Good fire in the Snowy Monaro region, the Green Valley Talmalmo fire, the Werri Berri fire in the Bega Valley, the Border fire in the far south and the Clyde Mountain Upper Turon fire. Combined, these fires burned 1,506,193 ha (27.3 per cent of NSW's total area burned) and 1,523 homes (58 per cent of the total). The Badja Forest Road fire destroyed 418 homes, of which 289 were lost in the Bega Valley alone. The community of Cobargo was the hardest hit, with 70 homes lost, five facilities destroyed, 168 outbuildings lost and a further 33 homes damaged. Of the areas assessed by RFS across these fires, 5,705 threatened homes remained untouched.

Firefighting efforts were hampered by difficult terrain, extreme fire weather conditions and exhausted firefighters, caught in a continuous rotation of deployments that had started in northern NSW in August and continued down eastern NSW and into the south as the season progressed.

Further challenges included large numbers of holiday-makers visiting the south coast during summer holidays, leading RFS to declare a 'tourist leave zone' that stretched from Batemans Bay south to the VIC border in anticipation of catastrophic conditions on 4 January. The Kings Highway and several other arterial roads were impacted by fire, and these and several other roads across the region were closed temporarily.

From 1 July to 31 December, southern NSW experienced eight declared bushfire emergencies and 21 total fire bans. Emergency warnings, some for several days, were issued for several fires during the fire season.

A volunteer RFS firefighter sustained fatal injuries at the Green Valley fire on 30 December. The fires also claimed the lives of three American crew members, killed when their aircraft crashed during water-bombing operations on the Good fire in the Snowy Monaro region.

Observations

- There is a need for an operational management system to streamline and simplify sourcing, management and movement of resources.
- Response team coordinators improve the management of strike teams.
- There is a need to improve the distribution and updating of maps and incident action plans from incident management teams (IMTs) to the field. Different electronic methods were used across the different incidents with varying success.
- The rural liaison officer role is beneficial for both communities and IMTs. Very positive feedback was received when rural liaison officers supported communities with current information and maps.
- Cooperation between agencies fighting the bushfires was excellent.

Acknowledgments

New South Wales Rural Fire Service; Bureau of Meteorology; Insurance Council of Australia.

Images: New South Wales Rural Fire Service

Bushfires

Queensland

SEPTEMBER–DECEMBER 2019

In coastal areas of south-east Queensland (QLD), September is historically the month with the year's highest bushfire danger. In early September 2019, the fire danger was higher than anything previously experienced in the region at that time of year. Rainfall from January to August 2019 had been very much below average or the driest on record, and mean maximum temperatures were very much warmer than average.

On 6 September, strong west to north-westerly winds produced extreme to catastrophic bushfire conditions in much of south-east QLD. By the following day, significant bushfires were burning at Stanthorpe, Applethorpe, Beechmont, Springbrook, Witheren, Numinbah Valley and Sarabah and by the afternoon of 8 September, there were more than 60 fires burning across the state.

The fires forced the closure of ten schools, many in the south-east's Granite Belt. People in several threatened Granite Belt towns were urged to evacuate, and prisoners and staff were evacuated from the women's correctional centre in the Numinbah Valley when it was threatened by fire. Despite hundreds of firefighters and several firefighting aircraft being deployed, several homes and other structures were destroyed in the extreme conditions, including the historic Binna Burra Lodge in the Gold Coast hinterland.

The most significant September fires, in the Sarabah/Scenic Rim area, the Stanthorpe area and Peregian Springs resulted in the burning of some 8,000 hectares (ha) of land, 17 homes and five commercial structures. The Peregian fire, which broke out on 9 September, required more than 100 fire crews to bring it under control.

On 17 September, lightning started a fire on North Stradbroke Island. Firefighters assisted by several water-bombing aircraft contained the fire, which burnt more than 2,000 ha.

On 8 October, a severe and fast-moving fire destroyed a house at Thornton and threatened the nearby township of Laidley,

Images: Queensland Fire and Emergency Services

west of Brisbane. A large, unpredictable fire also threatened the nearby community of Grandchester but was contained by fire crews by 7.00pm that evening. Other fires burning north of Dalby, at Mount Sylvia, Mount Morgan and Childers, were all under control by the following day.

Due to deteriorating bushfire conditions and fires threatening homes across the state, on 9 November a state of fire emergency was declared in 42 of QLDs local government areas. Two days later, a fire started in the Ravensbourne area near Toowoomba and burnt over 20,000 ha of bush over several days and destroyed four homes.

On 9 November, 15 homes were lost at Cobraball during severe ember attacks, and more than 6,000 ha of bush and farmland was burned. Many residents spent the night in an evacuation centre in nearby Yeppoon. Meanwhile on the Sunshine Coast, a bushfire at Cooroibah near Noosa caused the evacuation of 6,000 residents. Only one home was lost in the fire.

On 13 November, a water-bombing helicopter crashed while fighting a fire threatening the small community of Pechey near Toowoomba. While the Bell 214 helicopter was completely destroyed, the pilot walked away with only minor injuries.

By 23 November, fire conditions had eased and the state of fire emergency was revoked.

On 7 December, a house fire broke out in Bundamba and spread to nearby bushland that afternoon. On the following day and in worsening conditions, the fire threatened homes in the local community and destroyed a shipping container filled with fireworks. Residents within a three-square-kilometre exclusion zone were ordered to evacuate and one home was destroyed.

In mid-December, Peregian Springs and surrounding areas on the Sunshine Coast came under threat for the second time in a couple of months. About 100 firefighters and five water-bombing aircraft worked on the fire. Although 60 homes were evacuated, none were lost.

The bushfire season officially ended on 31 January 2020. More than 35,000 Queensland Fire and Emergency Services (QFES) personnel had fought the fires, which burned an estimated 6.6 million ha and destroyed 49 houses, 68 sheds and five commercial buildings. QFES used 72 aircraft flying more than 6,557 hours to fight the fires, about double the hours flown in the busy 2018–19 fire season.

By 7 September, very early in the bushfire season, the Insurance Council of Australia (ICA) had declared the QLD bushfires a catastrophe, enabling insurance claims from affected policy-holders in several parts of the state to be expediated. Following more widespread outbreaks, on 13 November the areas covered were extended. The ICA's estimated insurance loss for the 2019–20 Australian bushfire season as of 28 May 2020 was AU$2.32 billion, of which QLD represented 3 per cent.

Joint Commonwealth–State disaster recovery funding was made available for a wide range of measures in 23 local government areas across QLD that had been impacted by bushfires between 1 September and 31 December 2019.

Observations

- Aircraft are an invaluable resource for intelligence-gathering and water-bombing. Prepositioned aircraft, the establishment of air bases and the use of State Emergency Service personnel for air base management is an efficient use of resources that delivers efficient turnaround of aircraft.

- Interstate personnel are highly valued, providing a platform for skills and experience exchange. Many observed the professionalism of interstate crews and the camaraderie and positive relationships that developed. Operational effectiveness is improved when local knowledge is embedded in interstate crews.

- Pre-planning and pre-positioning of resources based on fire weather predictions, informed by pre-season assessment, risk and lessons from previous events, ensured effective response operations, although the magnitude of events sometimes challenged planning.

- There is extraordinary dedication and commitment from volunteers and staff to get the job done, giving the community a great deal of confidence in QFES.

- Intelligence gathered from aircraft and predictive modelling from fire behaviour analysts, shared freely between partner agencies, enhanced situational awareness.

- Radio communications black spots impact information sharing and firefighter safety. Additionally, the inability to communicate by radio with partner agencies is a significant impediment to operations.

- Fatigue management was a significant challenge during the fire season. Related issues included a limited resource pool, volunteers arriving on the fireground after a day's work, and long shifts exacerbated by sometimes lengthy travel times.

- The continued tempo of operational events impacted fleet maintenance and the ability to provide reliable vehicles, particularly for surge capacity. Heavy equipment was not always available when needed.

Acknowledgments

Queensland Fire and Emergency Services; Office of the Inspector-General Emergency Management; Bureau of Meteorology; ABC News; Nine News.

Bushfires

Victoria

NOVEMBER 2019–FEBRUARY 2020

Between 18 and 21 November 2019, many high temperature records were set across southern Australia and followed very much warmer than average and drier than average conditions through most of the year. Victoria's (VIC) bushfire season started in earnest on 21 November when a total fire ban was declared for the entire state and code red (catastrophic) fire danger conditions were forecast for the state's west. In Northern Country and the Mallee, 221 schools and early learning centres were closed as a precaution. Elsewhere, several national parks and state forests were also closed, before lightning ignited a series of fires in East Gippsland, initially endangering the communities of Buchan, Buchan South and Sunny Point.

Storm activity increased during the day, with the VIC State Emergency Service (SES) receiving 2,042 requests for assistance, primarily for fallen trees and building damage. The storms also caused power outages, with a peak of approximately 130,000 households without power.

One hundred and fifty fires started in Victoria that day, burning 326,000 hectares (ha). By day's end, around 60 fires remained active, including a large fire in the state's north near Shepparton, three large fires in East Gippsland, and a fast-moving grass fire at Mount Glasgow, north of Ballarat. By 25 November, two of the East Gippsland fires, near Bruthen and Gelantipy, had grown to 1,750 ha and 600 ha respectively, while in the north-east of the state, a 300 ha fire was burning in the Mount Bogong area.

On 20 December, another total fire ban was declared for Victoria and a new December maximum temperature record of 47.9°C was set at Hopetoun and Horsham. One hundred and ten new fires broke out that day; a fire near Marthavale grew rapidly, endangering the communities of Tambo Crossing, Ensay and others. The Great Alpine Road was closed between Ensay and Bruthen and by next morning, the fire had caused

power and mobile phone outages north of Ensay and from Bruthen to Omeo. Over the following days, several smaller fires began to combine, creating large fires that threatened several communities and critical infrastructure.

Due to predictions of worsening fire conditions, VIC authorities broadcast warnings to residents and visitors to leave high risk areas in a 15,000 square kilometre area stretching from Bairnsdale to Cann River and the New South Wales (NSW) border. More than 60,000 people are estimated to have evacuated the East Gippsland and Hume regions as a result.

On 30 December, another state-wide total fire ban was declared as multiple new fires started from dry lightning in the Grampians, Hume and Gippsland regions. Three fires in East Gippsland with a combined area of more than 130,000 ha remained active; some fires burned with sufficient intensity to create pyrocumulonimbus clouds that generated local thunder and lightning. The road network was significantly impacted by these fires and access was cut to a number of communities, sometimes for several days. A Forest Fire Management Victoria (FFMV) contractor died in a vehicle rollover.

Early in the morning on New Year's Eve, the Banana Track fire reached the coastal town of Mallacoota in the state's far east. Several thousand people were isolated in the town and more than 60 homes were destroyed. Escape routes were cut off and an estimated 4,000 people gathered on the town's foreshore, protected by the local Country Fire Authority (CFA) brigade, three CFA strike teams, FFMV firefighters and VIC Police personnel.

Seven emergency warnings were in place across East Gippsland for more than 80 communities that day. A fire approached the coastal town of Lakes Entrance and an emergency warning was issued for an estimated 30,000 residents and holidaymakers there and in surrounding areas. Many people heeded the warnings and evacuated.

For December, record warmth across Australia had been accompanied by record low rainfall over eastern Australia. The monthly accumulated forest fire danger index (FFDI) for December was the highest on record over most of the country, and for Australia as a whole, December FFDI was the highest on record for any month. On 30 and 31 December, FFDI values were highest on record for December over areas of south-eastern Australia, including regions of significant fire activity in East Gippsland. By the end of December, fires had burnt 400,000 ha across the state, more than 230,000 ha in East Gippsland, and many communities remained isolated, without power or telecommunications.

On 1 January 2020 there were unconfirmed reports of property and infrastructure losses in several communities, including Mallacoota, Genoa, Reedy Flat, Buchan, Bruthen, Sarsfield, and Gelantipy. The Princes Highway east of Bairnsdale was closed in several places, isolating many communities.

On the evening of 2 January with an estimated 50 fires still burning in the state, the VIC Premier declared a state of disaster for the shires of East Gippsland, Mansfield, Wangaratta Rural, Wellington, Towong and Alpine, and the alpine resorts of Mount Buller, Mount Hotham, Falls Creek and Mount Stirling. People were again warned to leave high risk areas ahead of predicted worsening conditions.

On 3 January, fourteen emergency warnings were issued in fire-affected areas and nearly 2,000 people were evacuated from Mallacoota by air and sea, part of the largest-ever maritime evacuation of Australian citizens following a natural disaster. Evacuations were carried out by the Australian Defence Force (ADF) supported by international defence partners and other agencies. Forty-one firefighters from the United States arrived to support firefighting operations, and a FFMV firefighter died in a two-vehicle collision.

The following day, 66 more emergency warnings were issued as community relief centres continued to operate in Bairnsdale, Sale, Morwell, Wangaratta, Corryong, Tallangatta and Wodonga.

On 9 January, 220,000 emergency alert SMS messages were sent to people in East Gippsland and the state's north-east encouraging them to move to safer locations. On 10 January, a further 28 emergency warnings were issued. The following day, a FFMV firefighter was killed by a falling tree.

Despite milder conditions, on 13 January two emergency warnings were issued, one for a fire about eight kilometres east of Abbeyard and the other for a fire in East Gippsland affecting Tamboon, Tamboon South and Furnel. On 14 January, VIC

recorded the worst air quality in the world as smoke from the East Gippsland fires spread and authorities warned vulnerable groups to stay indoors.

In mid-January, a multi-agency roads access taskforce consisting of fire agencies, ADF and Department of Transport representatives was established to coordinate efforts to re-open roads to isolated communities and enable power and telecommunications to be restored.

Operations to return residents to Mallacoota commenced on 19 January, with eight air missions flown that day.

By the time widespread rain fell in VIC on 20 and 22 January, bushfires had burnt more than 1.5 million ha, mainly in the state's east and noth-east. While the rain, humidity and cooler temperatures brought welcome relief to firefighters, fire-affected catchments in East Gippsland and the north-east were put on flood watch. Firefighters were withdrawn from some areas due to fears strong winds and flash flooding could topple trees, create landslides and block roads in areas damaged by fire. Fire-affected areas in Gippsland received between 20 millimetres (mm) and 60 mm of rain, and up to 40 mm was recorded in the state's north-east.

On 30 and 31 January, with several uncontrolled bushfires still burning, further hot weather again brought high fire danger. An emergency warning was issued for Bendoc and nearby communities on 30 January.

On 4 February, the Princes Highway was re-opened from Orbost to the NSW border, although with reduced speed limits in some areas. The Mallacoota-Genoa Road was re-opened and Mallacoota reconnected to the main power grid on 8 February.

By mid-February, the Snowy Complex fire in the far east of the state was the only major fire still burning. That fire, which had burned 663,000 ha, was declared contained on 27 February.

The 2019–20 VIC bushfires caused the loss of five lives and destroyed more than 300 homes and 6,632 head of stock. The fires burned more than 1.5 million ha of public and private land, including 1.39 million ha of forests and parks, plantations and native timber assets, critical animal habitats and water catchments.

A preliminary evaluation of the health burden of the VIC bushfires estimated that bushfire smoke was associated with 120 excess deaths, 331 hospitalisations for cardiovascular problems, 585 hospitalisations for respiratory problems and 401 emergency department presentations for asthma.

A range of joint Australian and VIC government disaster relief measures and payments were made available in 18 VIC local government areas affected by the bushfires, commencing from 21 November 2019.

As of 28 May 2020, the Insurance Council of Australia estimated that the VIC bushfires generated approximately 3,050 insurance claims with estimated insured losses of approximately $18.6 million.

Observations

- Given the scale and complexity of the bushfire season, significant relief operations for isolated communities were highly successful, and there were few civilian injuries during evacuation operations.

- The ADF demonstrated the significant value of their role providing surge capacity in relief and recovery operations, particularly where the scale of emergencies overwhelmed local agencies.

- Greater engagement with ADF before future events will provide a better understanding of what support they can provide and how best to frame requests for support, focussing on broad outcomes rather than detailed technical solutions.

- At times, differences in state and regional priorities led to delays allocating ADF resources to clear blocked roads, and may have resulted in the under-utilisation of ADF resources.

- The creation of a roads access taskforce enhanced multi-agency collaboration to remove barriers and focus on key issues.

- At times, there was confusion about the accuracy of road status information and how long it would take to re-open roads, and there were inconsistent approaches taken to re-open state-managed roads compared to municipal roads.

- There were challenges with the communication of consistent and accurate road status and access information, particularly for roads that crossed the NSW border. This sometimes led to conflicting decisions about the re-opening of cross-border roads.

- There is no single source of information that provides clear and consistent road and fire information for affected community members when fires cross state borders.

Acknowledgments

Emergency Management Victoria; Country Fire Authority; Forest Fire Management Victoria; Bureau of Meteorology; The Age.

Images: Emergency Management Victoria and Forest Fire Management Victoria

Bushfires

South Australia

NOVEMBER 2019–JANUARY 2020

On 24 October 2019, strong northerly winds combined with existing dry conditions and high temperatures to create dangerous bushfire weather in South Australia (SA). Several fires broke out across the state, including one at Wongulla in the Murraylands where several firefighters were injured.

Catastrophic fire conditions were forecast across the state for 20 November and the Country Fire Service (CFS) declared a state-wide total fire ban. A fire threatened Yorketown on the Yorke Peninsula that day before a wind change pushed the fire dangerously close to the township of Edithburgh. The fire destroyed seven homes and burned more than 5,000 hectares (ha).

Dangerous fire weather conditions continued from spring into summer. In December, strong winds, low humidity and high temperatures on several days again combined to create dangerous bushfire conditions, including some areas with catastrophic fire danger ratings. Nearly all of SA recorded its highest ever accumulated forest fire danger index for December.

On 20 December, catastrophic fire conditions were forecast as the state sweltered though its fourth day of extreme heat. Temperatures in the west of the state reached 49.9°C, several other sites exceeded 45°C, and Adelaide reached 43.9°C.

More than 200 bushfires burned across the state that day, including a major fire at Cudlee Creek in the Adelaide Hills that spread rapidly, threatening the townships of Mount Pleasant, Springton, Palmer, Cudlee Creek, Mount Torrens, Harrogate, Inglewood, Gumeracha, Lobethal and Woodside. Twenty-seven roadblocks were set up by SA Police to manage traffic entering threatened areas, and a Large Air Tanker from New South Wales (NSW), called in to assist firefighters, was grounded due to high winds.

Over the next few days, the fire burned 23,000 ha before being brought under control. An elderly man died in his home during the fire, and 84 homes were destroyed as well as over 400 outbuildings and 292 vehicles.

More than 40,000 ha were burned by fires that started that day and more than 1,500 firefighters responded; 31 firefighters and two police officers were injured. A 24-year-old man from Queensland (QLD) died in a car crash that started a fire in the Murraylands.

Kangaroo Island also experienced multiple dry lightning strikes on 20 December, sparking fires that took 11 days to contain. Several firefighting aircraft were deployed to assist hundreds of firefighters battling the blazes. The island's fire crews were still fighting these fires when more lightning strikes caused several more fires that merged to create the Ravine fire complex on 30 December. This fire burned through inaccessible parts of a wilderness park in the north-west of the island before strong northerly winds on 3 January caused the fire to spread to the island's south coast before a wind shift pushed it east.

The Kangaroo Island fires burned 211,500 ha including one of SA's most important ecological sites, Flinders Chase National Park, home to the endangered and endemic Kangaroo Island dunnart and the glossy black cockatoo. An estimated 25,000 koalas were killed too, with the habitats of numerous other animals destroyed.

The fires on Kangaroo Island killed two people who were trapped in their car, destroyed 56 homes and damaged hundreds of other buildings including a large eco-tourism facility. Twenty-three firefighters were injured battling the island's fires, and two CFS fire trucks were damaged.

From 1 November 2019 onwards, the Australian and SA governments made a wide range of disaster recovery funding available for individuals, non-profits and businesses financially impacted by the bushfires. Eleven local government areas were listed as eligible for assistance measures that included personal hardship and distress assistance, personal and financial counselling, counter disaster operations, reconstruction of essential public assets, and concessional interest rate loans for small businesses, primary producers and non-profit organisations.

On 8 November and following multiple bushfires across SA, NSW, QLD and Victoria, the Insurance Council of Australia declared the fires a catastrophe, enabling related insurance claims to be processed more rapidly. As of 28 May 2020, the estimated insured value of the national bushfire catastrophe was $2.32 billion from 38,181 claims. SA accounted for 8 per cent of the losses (approximately $186 million from 3,054 claims).

On 28 January, the SA Premier announced an independent review of the 2019–20 SA bushfire season, with a focus on the Cudlee Creek and Kangaroo Island bushfires. The SA Government also launched the SA Bushfire Appeal to raise funds for people directly affected by the Cudlee Creek and Kangaroo Island bushfires.

Observations

- The *Independent Review into South Australia's 2019–20 Bushfire Season* found that the state had the worst bushfire conditions on record, the fires burnt under conditions that exceeded the limits of firefighting capacity, and by most accounts the loss of life and property could have been far more severe.

- Weather conditions were such that no level of hazard reduction would have prevented the fires. Furthermore, overnight conditions provided none of the usual respite, with some of the worst conditions experienced during the night.

Key recommendations included:

- a stronger public information focus on preventable fires and high-risk activities, safe evacuation, and what to bring to safer places and places of last resort

- modernising the firefighting fleet, particularly with automatic vehicle locators and improved burn-over protection

- real-time lightning tracking and rapid response teams to prevent lightning-caused fires spreading out of control

- the need to develop policies to better manage firefighter fatigue when interstate deployments coincide with a busy SA bushfire season.

Acknowledgments

South Australian Country Fire Service; Bureau of Meteorology; ABC News; The Advertiser.

Images: South Australian Country Fire Service

Thunderstorms

New South Wales

26 NOVEMBER 2019

On the afternoon of 26 November 2019, severe, fast-moving thunderstorms travelled through the Sydney region, with strong and gusty winds bringing down powerlines, as well as trees and branches that damaged homes and cars and blocked roads. The most damage occurred in Sydney's northern suburbs. Gusts of 104 kilometres per hour (km/h) were reported at Fort Denison, closely followed by 95 km/h elsewhere on Sydney Harbour and 96 km/h in Holsworthy.

Earlier that day, Sydney residents had woken to a morning of smoky skies and hazardous air quality. Temperatures had reached a maximum of 35°C when the Bureau of Meteorology issued a severe thunderstorm warning at about lunchtime, warning of large hailstones and damaging winds during the afternoon as a cold front swept the Sydney area. The short, sharp storm hit at about 1.30pm and lasted just five to ten minutes.

In northern parts of Sydney and Newcastle about 20 millimetres (mm) of rain fell in just one hour. But the storm was swift and pinpointed, with Sydney suburbs south of the harbour not experiencing any rain while northern suburbs were drenched.

The New South Wales (NSW) State Emergency Service (SES) responded to 2279 requests for assistance that afternoon and evening across Sydney and the Blue Mountains, with a further 500 requests for assistance across the remainder of the state, mainly from residents seeking help for wind damage.

Ausgrid, one of three electrical energy distributors in Sydney, reported that 65,500 homes and businesses were without power: affected suburbs included Chatswood, Frenchs Forest, Engadine, Hornsby Heights, Villawood and Bass Hill. Ausgrid reported that the thunderstorm caused the largest power outage the network had seen in recent years.

Disruption to power supplies caused by lightning strikes and strong winds also brought some train services to a standstill, including sections of the North Shore, Central Coast and Newcastle lines where buses replaced trains before power was restored. However, traffic lights were also affected by power outages and several major roads were closed by fallen trees,

delaying buses and other traffic in several areas including Pymble, Gordon, Chatswood, Roseville, Willoughby and Hornsby Heights, and causing chaos for commuters returning home from work later that afternoon. Trains were running again later that night.

In other parts of NSW, lightning accompanying the thunderstorms ignited several fires: by day's end there were 110 bushfires burning across the state, up from 67 earlier that morning. It was a day of extremes for NSW: while the Sydney region suffered thunderstorms, severe fire danger conditions were declared for the Greater Hunter region due to the hot and windy conditions, and snow fell in Thredbo.

The following day, Sydney's Karonga Public School and Lindfield East Public School were closed, and parents at Davidson High School and Mimosa Public School were told to keep children at home due to clean-up operations on school grounds. In the meantime, traffic on roads in Sydney's north continued to be disrupted by fallen trees and blacked-out traffic lights.

Joint Australian and NSW government disaster recovery funding was provided in eleven local government areas impacted by the thunderstorms for a range of measures including:

- personal hardship and distress
- counter disaster operations
- the restoration of essential public assets
- concessional interest rate loans for small businesses, primary producers and non-profit organisations
- grants for non-profit organisations
- freight subsidies.

Observations

Following severe thunderstorms that impacted Sydney in 2018 and 2019 and a significant near-miss in 2019 involving live power-lines, the NSW SES and the Energy and Utility Services Functional Area Committee (EUSFAC), which includes NSW energy providers, identified differences in terms used by energy providers to indicate the status of power lines (e.g. live, disconnected, etc.). As this has the potential to cause confusion among emergency service responders that could result in injury or death to anyone at an incident involving power lines, the issue has been identified as a high risk for the sector and escalated to a lesson.

Acknowledgments

New South Wales State Emergency Service; Bureau of Meteorology; ABC News; The New Daily.

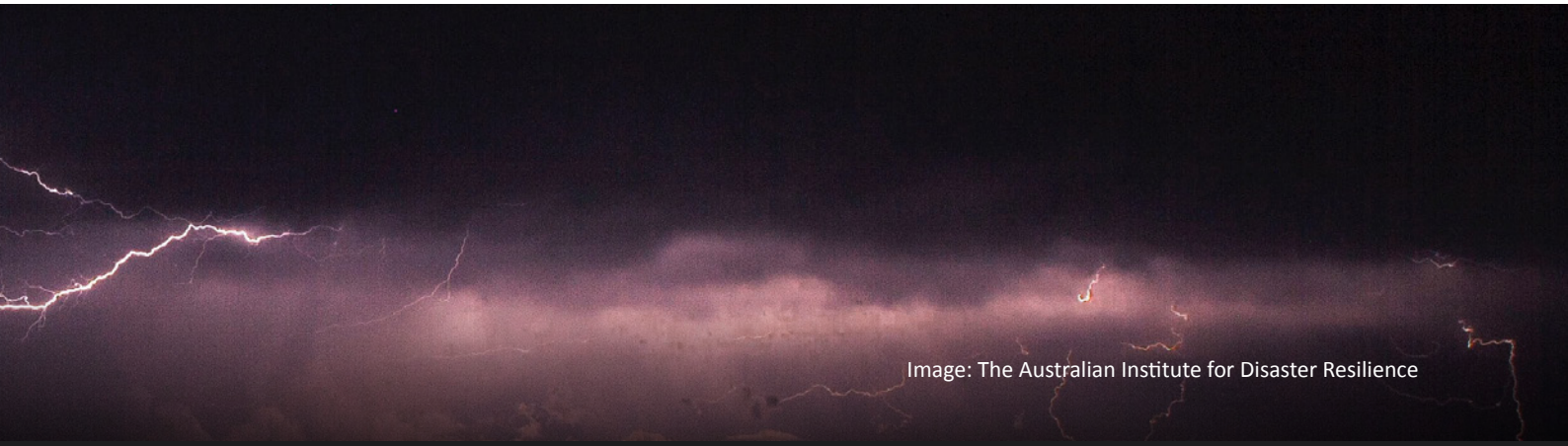


Image: The Australian Institute for Disaster Resilience

Volcanic eruption

Whakaari/White Island, New Zealand

9 DECEMBER 2019

Whakaari/White Island is the tip of a large volcano 48 kilometres (km) off the New Zealand coast in the Bay of Plenty, 230 km south-east of Auckland. The island, which measures about 2 km long by 1.6 km wide, is New Zealand's most active volcano and has been visited by more than 10,000 tourists each year.

On 9 December 2019 at 2:11 pm local time the volcano erupted, releasing steam, volcanic gases, rock and ash into the air. There were 47 people on the island at the time, including 38 passengers from the Ovation of the Seas cruise liner, four tour guides, one helicopter pilot and four helicopter passengers. Twenty-four Australians, nine Americans, five New Zealanders, four Germans, two Chinese, two Britons and one Malaysian were killed almost instantly or were severely injured.

New Zealand authorities were quick to respond after rescue services received a call for help at about 2:40 pm. Two helicopters were soon airborne and a third joined the rescue effort at 5:30 pm. Surviving victims were airlifted to nearby hospitals, many with burns to up to 90 per cent of their bodies.

Thirty-four victims were taken initially to the small Whakatāne Hospital; five were declared dead on arrival and several others were put into induced comas and on ventilators before being transferred to larger facilities. Seven of the most critically injured were flown to hospitals in Tauranga and Auckland. Three with minor injuries were treated and released.

By the following day, 25 victims had been transferred to the country's four burns units in Auckland, Hamilton, Lower Hutt and Christchurch, all of which were at capacity.

To support the New Zealand response, Australia's Department of Foreign Affairs and Trade (DFAT) requested Emergency Management Australia (EMA) to activate the *Australian Government Response Plan for Overseas Mass Casualty Incidents* (OSMASSCASPLAN). This plan describes the arrangements for the repatriation to Australia of casualties from overseas following a mass casualty incident. Under this plan, EMA coordinated the repatriation of 13 injured Australians commencing on the night of 11 December, for treatment at hospitals in Sydney and Melbourne. This operation was completed within 48 hours due to time-critical clinical consequences for patients.

EMA worked closely with the Department of Health (Health) and the National Health Emergency Management Standing Committee, DFAT, Australian Federal Police and the Australian Defence Force (ADF) to identify capabilities to support the repatriation. Aeromedical transportation, retrieval personnel and ground transportation was provided from Victoria, New South Wales, South Australia and the ADF.

DFAT provided essential consular assistance to the Australians in New Zealand and their families in Australia, and facilitated connections between the Australian and New Zealand health services to ensure the safe transfer of victims needing critical care.

In the week following the eruption, ongoing seismic and volcanic activity, heavy rainfall, low visibility and toxic gases hampered efforts to recover bodies still on the island. On 13 December, military personnel landed and recovered six bodies but were unable to locate two more.

Ultimately, there were 21 fatalities. Nineteen people died in New Zealand including two who remain missing, and two people died in Australia.

A further 25 people suffered injuries, many with severe burns. Of the 21 fatalities, 15 Australian citizens and three permanent Australian residents died, including one of the victims who remained missing.

Whakaari/White Island has been active for at least 150,000 years. Before this eruption, Whakaari/White Island had experienced several eruptions in the 1980s, a major eruption that formed a new crater in 2000, and small eruptions in 2012, 2013 and 2016.

The volcano had been showing signs of activity for several weeks before the 2019 eruption. In October, sulphur dioxide gas and tremors were at their highest levels since 2016, indicating an eruption was more likely to occur. On 18 November, GeoNet, which provides geological hazard information for New Zealand, upgraded Whakaari/White Island's alert level from level 1 (minor volcanic unrest) to level 2 (moderate to heightened volcanic unrest) indicating a potential for eruption hazards, the highest alert level before an eruption takes place.

On 24 November, two weeks before the eruption, a magnitude 5.9 earthquake lasting approximately one minute with an epicentre 10 km north-east of Whakaari/White Island occurred, and was felt by people as far away as Christchurch.

Observations

- The early activation of OSMASSCASPLAN to repatriate Australians in response to the volcanic eruption worked well. Conversations between senior executives at EMA, DFAT, Health and the Department of Defence enabled the rapid deployment of specialist medical capabilities and resources and the integration of liaison officers into New Zealand health agencies.
- Positive working relationships, particularly at the operational management and liaison officer levels, are also essential for plan implementation. These relationships help ensure that all follow-up actions are identified, processed and actioned in a timely and efficient manner, and highlight the value of whole of government coordination, collaboration and communication to achieve positive operational outcomes in a time-critical environment.
- The value of pre-existing professional relationships with international partners is invaluable when activating multi-national emergency response plans.
- The value of scenario-based discussions and multiple exercises involving all stakeholders during the development and revision of polices and plans is invaluable.

Acknowledgments

Emergency Management Australia; Department of Health, Fire and Emergency New Zealand; ABC News, GeoNet.

Images: Emergency Management Australia and Julius_Silver (pixabay.com)

Bushfires

Pelham and Fingal, Tasmania

DECEMBER 2019–JANUARY 2020

Record warmth in Australia during December 2019 was accompanied by record low rainfall over eastern Australia, and followed very much warmer than average and drier than average conditions across much of Australia through most of the year.

Almost all of Tasmania (TAS) recorded accumulated monthly forest fire danger indices (FFDI) in the highest 10 per cent of historical values for December, and much of the eastern half of the state recorded its highest-ever December FFDI on 30 December. Several locations recorded temperatures in the high 30s and low 40s that day, with several experiencing a temperature record for December.

TAS registered 406 lightning strikes that ignited dozens of bushfires that day, including a fire south of Pelham in the Upper Derwent Valley, 45 kilometres (km) north-west of Hobart. In extreme fire weather conditions, the fire spread rapidly south-east in dry forests and grasslands towards the rural communities of Elderslie and Broadmarsh.

One hundred and twenty firefighters from nearby communities, supported by water-bombing aircraft, responded quickly to protect 30 homes threatened that afternoon, although steep terrain in some sectors made firefighting difficult. A number of residents spent the night at an evacuation centre established in nearby Broadmarsh.

Within two days, the fire had grown to a perimeter of 26 km and had burnt out more than 1,300 hectares (ha) of farmland and forest, including two nature reserves. Several spot fires ahead of the main fire made it difficult to bring under control.

Firefighters, earth-moving equipment and aircraft supported by a multi-agency incident management team consolidated fire boundaries ahead of warmer weather expected later that week and by 11 January the fire, which ultimately burned over 2,100 ha and had a perimeter of 42 km, was considered safe. One home near Elderslie and a number of outbuildings, boats, machinery, 13 cars, a sawmill and a taxidermy business had been destroyed.

On the same day the bushfire started at Pelham, another was started, this time deliberately and despite a total fire ban, in north-east TAS near the village of Mangana in the Fingal Valley.

The fire spread rapidly south-east towards the township of Fingal, approaching to within a kilometre of the town in the early hours of the following day. Firefighters stopped the fire entering Fingal by backburning from the golf course to the town's north-west.

People living in the path of the fire were encouraged to leave, and tens of thousands of sheep were relocated to safe open paddocks near Fingal. Several dozen residents threatened by the fire used evacuation centres established at Fingal and nearby St Marys, with the St Marys hospital also providing beds for evacuees.

By the following day, the fire had grown to 4,000 ha and was burning in pine plantations to Fingal's north when a significant spot fire started in difficult terrain on Mt Malcolm to the township's south. This new fire put $150 million (m) worth of coal deposits and mining infrastructure at risk on Fingal's eastern outskirts, and long range weather forecasts indicated that the Douglas Apsley National Park would be under threat in coming days.

Over the next three weeks, several hundred firefighters supported by tankers, machinery and aircraft continued to fight both fires in eucalypt forests and pine plantations to Fingal's north, east and south. The fires eventually burnt 22,000 ha of plantation (valued at $70m) and bushland, and destroyed one dwelling. Mangana residents were not able to return home until 7 January, once the village was deemed safe.

Over the course of the 2019–20 bushfire season, an estimated 36,000 ha burned in TAS.

Australian Government disaster recovery payments were offered to eligible people impacted by the Pelham and Fingal fires.

Observations

- Early engagement and clear communication of risk will help ensure better safety outcomes for communities at risk.

- Many people are choosing to leave on receipt of 'watch and act' messages. Evacuation centres may need to be available once these messages, rather than emergency warnings, are broadcast. Planning for staged and progressive evacuations may alleviate pressure on evacuation centres.

- Computer-based fire modelling should inform pre-planning for both expected and unexpected scenarios, enabling appropriate strategies to be applied quickly even when unexpected events occur.

- Understanding aerial firefighting capabilities and how best to use them once initial attack is completed, based on shared agencies' experiences, will help ensure more effective and less expensive aircraft use.

Acknowledgments

Tasmania Fire Service, Bureau of Meteorology; ABC News; The Examiner; Nine News.

Images: Tasmania Fire Service

Bushfires

Australian Capital Territory

JANUARY–FEBRUARY 2020

Record warmth in Australia during December 2019 was accompanied by record low rainfall over eastern Australia, and followed very much warmer than average and drier than average conditions across much of Australia through most of the year. In south-east Australia, above average temperatures and below average rainfall continued during January 2020, while in February, temperatures and rainfall returned to near-average conditions.

Canberra Airport reached 44.0°C on 4 January 2020, the highest temperature ever recorded in the Australian Capital Territory (ACT). Extensive smoke from bushfires in neighbouring regions of New South Wales (NSW) affected the ACT at times, particularly in the first half of the month.

Given the high potential for damaging bushfires and with multiple fires burning close to ACT's western and southern borders, a state of alert was declared for the ACT on 2 January and remained in place until the start of February. Several total fire bans were declared during this period.

Bushfires burning in NSW threatened the ACT's Namadgi National Park and Brindabella Ranges, prompting authorities to prepare access trails and containment lines, and to protect several historic huts. Military personal assisted land managers and firefighters to complete this work amid concerns that lightning storms could also start fires in the ACT.

The first major bushfire occurred on 16 January next to Canberra Airport. The Beard fire burned through dry grassland and stands of timber heading towards the ACT/NSW border and threatening the town of Queanbeyan. Several aircraft and fire appliances from NSW and the ACT brought the fire under control within a couple of hours. A second fire nearby the following day was quickly controlled by air and ground forces. However, some flights at Canberra Airport were cancelled until the fire was brought under control, and some vehicles were reportedly damaged in the airport carpark.

Just before 2.00pm on 27 January, a fire started and swept out of the Orroral Valley and through the Namadgi National Park, burning east and north-east towards Canberra and growing

at about 400 hectares (ha) per hour. The hot dry weather and enormous fuel loads made it difficult to fight the blaze and by late the following day, residents of the small rural village of Tharwa to the east of the national park were told it was too late to leave their homes and they should seek shelter.

By early on 31 January, the fire had grown to 18,000 ha. Within just a few hours, it grew to 21,510 ha and at 3.00pm was upgraded to emergency warning level. As temperatures soared into the 40s, the air was filled with towering columns of dark smoke and pyrocumulonimbus clouds developed overhead. Spot fires ahead of the main fire approached Canberra's far southern suburb of Banks, and residents of Banks and adjacent suburbs were told to activate their bushfire survival plans. Some residents decided to leave their homes and an evacuation centre was established at Erindale College.

At one point, 27 fire tankers, eight helicopters, six small aircraft, two Large Air Tankers and one Very Large Air Tanker fought the fire. State Emergency Service and Department of Defence personnel were deployed to doorknock residents to warn them of the approaching threat and assist with other firefighting efforts.

At around noon that day, a spot fire suspected to be from the Orroral bushfire jumped the border into NSW and sparked the Clear Range fire to the ACT's east. The NSW Rural Fire Service (RFS) deployed ground crews and aircraft to the Clear Range fire and prepared to defend properties west of the Monaro Highway.

The Orroral Valley fire was the most serious Canberra had faced since the deadly 2003 fires. The extreme conditions caused the first state of emergency to be declared in Canberra in 17 years and remained in place for 72 hours, providing authorities greater power to advise the community, close roads and help prepare private property.

Offers of assistance to fight the Orroral fire were accepted from NSW and Queensland. The fire eventually burned 82,700 ha of Namadgi National Park (about 80 per cent of the park's total area), 1,444 ha (22 per cent) of the Tidbinbilla Nature Reserve, and 3,350 ha of rural lands, making it one of the biggest ecological disasters in the ACT's history.

The fire was accidentally ignited by a military helicopter. The helicopter's crew had been conducting aerial reconnaissance and ground clearance to enable access for emergency services personnel when heat from the aircraft's landing light started a grassfire underneath it while it was on the ground. The crew was unable to extinguish the blaze.

The Australian Government offered a disaster recovery allowance to employees, primary producers and sole traders in the ACT who experienced loss of income as a direct result of the bushfires. Other assistance measures available included:

- personal hardship and distress assistance
- counter disaster operations
- concessional loans for directly and indirectly affected small businesses, primary producers and non-profit organisations
- restoration of essential public assets.

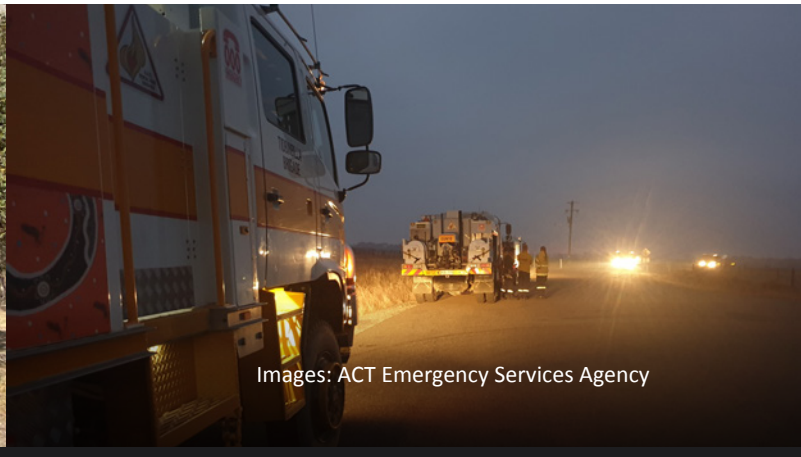
Observations

- Use of Department of Defence personnel before bushfires broke out in the ACT facilitated planned and comprehensive preparations.

- For the first time, an emergency controller was appointed in the ACT.

Acknowledgments

ACT Emergency Services Agency; Bureau of Meteorology; ABC News.



Images: ACT Emergency Services Agency

Tropical Cyclone *Blake* and Severe Tropical Cyclone *Claudia*

Western Australia and Northern Territory

JANUARY 2020

On 4 January 2020, a tropical low formed off Western Australia's (WA) northwest Kimberley coast, about 300 kilometres (km) north of Cape Leveque. The low was initially very slow-moving, travelling south-west and then stalling before moving east and developing into Tropical Cyclone *Blake* at 8.00am local time on 6 January, 120 km north-west of Cape Leveque. *Blake* then moved southwards at 15-20 kilometres per hour (km/h) and briefly moved over land on the Dampier Peninsula for approximately six hours on the evening of 6 January.

Broome Port recorded a peak wind gust of 102 km/h late in the afternoon of 6 January. This brief period over land weakened *Blake* although it remained a category 1 tropical cyclone and redeveloped after moving offshore.

In the 24 hours to 9.00am on 7 January, Derby recorded 152 millimetres (mm) of rain, Broome recorded 148 mm and several roads were cut by floodwaters. Early on 7 January, *Blake* moved back over water around 30 km north of Broome and then travelled in a south-westerly direction parallel to the west Kimberley coast, crossing Eighty Mile Beach 17 km east of Wallal Downs at 11.00pm on 7 January.

The remnant tropical low tracked west and then south through the eastern Pilbara, producing heavy rainfall before dissipating on 10 January. Moderate to major flooding was recorded over numerous tributaries of the De Grey river catchment and there were widespread road closures. The Coongan River peaked at its highest level since 1988.

Tropical Cyclone *Blake* was the first tropical cyclone in the Australian region for the 2019–20 season.

While *Blake* was forming off the Kimberly coast on 5 January, another tropical low formed in the Arafura Sea, about 480 km north-east of Darwin. The low slowly tracked towards the south-east, then turned west-south-west, crossing the Northern Territory coast about 40 km east of Maningrida early on 8 January. The low tracked westwards over the Top End, slowing

briefly on the coast south of Darwin on 10 January before moving further west into the Timor Sea.

Intense rainfall was recorded at automatic weather stations on the coast south of Darwin, with a new Northern Territory record daily rainfall total of 562 mm on the island of Dum-In-Mirrie in the 24 hours to 9.00am on 11 January. The island experienced rainfall rates at times that had an annual exceedance probability of 2 per cent, roughly equivalent to a one-in-fifty-year event. Other 24-hour rainfall totals in the area included 515 mm at Wagait Beach weather station, 194 mm at Geriatric Park (Dundee Forest) weather station and 185mm at Charles Point.

The low continued to move westwards north of Western Australia's Kimberley region into the Indian Ocean where it intensified into category 1 Tropical Cyclone *Claudia* at 11:00pm local time on 11 January.

Claudia continued to intensify, reaching category 2 as it moved through the western Timor Sea. Browse Island, 370 km north of Derby, recorded a wind gust of 126 km/h just after 7.00am the following day as *Claudia* passed only 12 km to the north of the island.

Just after midnight on 13 January, Rowley Shoals recorded a wind gust of 102 km/h and very soon after, *Claudia* reached severe category 3 intensity. Severe Tropical Cyclone *Claudia's* estimated maximum wind gust was 195 km/h and sustained wind speeds were estimated at 140 km/h.

During 14 January, *Claudia* reached cooler waters northwest of Exmouth and began to weaken, and by 11:00pm on 15 January, was downgraded to a tropical low.

Claudia remained more than 400 km off the Pilbara coast, never crossing the WA coast and not impacting the WA mainland.

Claudia was the second tropical cyclone and the first severe tropical cyclone in the Australian region for the 2019–20 season.

Observations

- Cyclones and high intensity storms are travelling further south along the WA coastline and further inland. Predictive data modelling, intelligence gathering and climate adaptation planning should consider this for cyclone and flood disaster mitigation.
- Vulnerability assessments should be conducted and reviewed to better understand the people and places that are exposed to disasters. They should be used by government agencies, businesses, communities and individuals to increase awareness of their shared responsibility to act before, during and after emergencies.
- Accurate, clear and consistent public information to warn communities of impending cyclones and flood risks is vital for improving public safety. Message content should provide clear direction and help people decide what action to take.

Acknowledgments

Western Australia Department of Fire and Emergency Services; Bureau of Meteorology.

Images: WA Department of Fire and Emergency Services

Monsoonal floods

Queensland

JANUARY–FEBRUARY 2020

Queensland's (QLD) annual monsoon was several weeks late when a monsoonal low over the Northern Territory (NT) brought heavy rainfalls and associated flooding to much of northern, central and western QLD in late January and early February 2020, ending months of dry conditions across the state.

In late January, the Bureau of Meteorology issued a severe weather warning for heavy rain and flash flooding across the Gulf Country and a severe thunderstorm warning, also with flash flooding, for the Herbert and Lower Burdekin region south-east of Townsville. Flood warnings were issued for a number of rivers including the Norman, Paroo, Thomson, Barcoo, and upper Flinders rivers and Cooper Creek. Minor flood warnings were issued for the Cloncurry, Cape and Upper Herbert rivers, and Wallam and Mungallala creeks.

Subsequently, torrential rainfall of more than 300 millimetres (mm) over several days fell across much of northern QLD and produced significant flooding in numerous river catchments, as well as localised flash flooding.

On 25 January, a 61-year-old man drowned while swimming near Big Millstream Falls south-west of Ravenshoe when he was dragged underwater by a fast-flowing current after 300 mm of rainfall in preceding days. His body was found by police divers the following day.

On 27 January, a severe thunderstorm dumped more than 100 mm of rain on Townsville causing localised flooding and a rockslide, and the State Emergency Service (SES) received about 20 calls for assistance, mainly for leaky roofs and requests for sandbags.

In Burdekin Shire to Townsville's south-east that same day, floodwaters closed the Bruce Highway near Ayr, which received 421 mm of rainfall, and on nearby Rita Island, 529 mm of rain fell in the 24 hours to 9.00am, more than three times the area's average January rainfall in just one day. Police rescued a man stranded in his car in floodwaters at Giru and a number of schools were closed on what was meant to be the first day of the new school year.

In the 24 hours to 9.00am on 29 January, Cairns Airport recorded 217 mm of rainfall and the SES received 44 calls for assistance, mainly for sandbags to stem rising water levels. Elsewhere, Normanton received 193 mm of rainfall, Hughenden 130 mm and Magnetic Island 218 mm.

Following several days of the monsoon rains, several QLD towns were cut off by rising floodwaters. Roads were closed in areas around Charters Towers, Cloncurry and Mount Isa, and floodwaters affecting rail lines closed freight services between Townsville and Mount Isa. Police closed the road west from Camooweal to the NT after around 40 cars were forced to wait for waters to recede at a river crossing west of the town.

Floodwaters resulting from the rainfall flowed downstream during February, some eventually reaching south-west QLD and north-east South Australia by late February. While the downpours and associated floodwaters caused widespread damage and disruption to services, farmers reliant on water for crops and livestock welcomed the soaking rains.

Joint Commonwealth-State disaster recovery funding was made available for counter disaster operations and the reconstruction of essential public assets in 23 local government areas in QLD impacted by the monsoonal flooding event between 23 January and 3 February.

Acknowledgments

Queensland Fire and Emergency Services; Bureau of Meteorology; ABC News.

Images: Queensland Fire and Emergency Services

Storms

New South Wales

15–21 JANUARY 2020

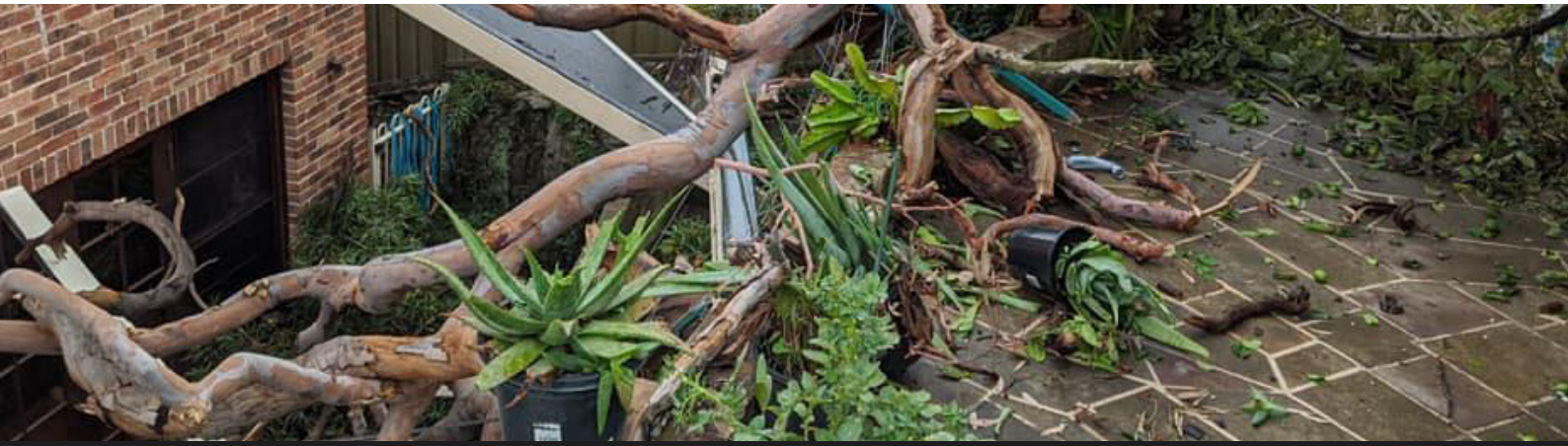
Between 15 and 21 January, severe storms affected parts of Victoria and much of eastern New South Wales (NSW) and the Australian Capital Territory (ACT), bringing short bursts of intense rain, damaging wind gusts and golf to cricket ball sized hailstones to large areas of NSW. At different times during the storms, thousands of properties were without power.

During the storms, the NSW State Emergency Services (SES) received 2,001 requests for assistance with over 1,000 of those calls coming during a storm from 19 to 21 January. The majority of calls related to the removal of fallen trees, the patching of damaged roofs, and sandbagging to protect buildings from localised flooding.

Heavy rain fell in Sydney on 16 January. By the following day, other parts of the state were also affected, with flash flooding in Tingha and Glen Innes in the north of the state.

Two days later, on 18 January, parts of eastern NSW were hit by severe thunderstorms that caused road closures and flash flooding and cut power to many homes. The heavy downpours provided relief for many parts of NSW stricken by drought and helped firefighters slow the spread of bushfires and build containment lines before increased fire danger expected later that week. By the time the storms had arrived, the 2019–20 bushfire season in NSW had seen 4.9 million hectares of the state devastated by bushfires; 75 fires were still burning and 25 were yet to be contained.

The following day, the Bureau of Meteorology issued a series of severe thunderstorm warnings for Sunday evening for inland NSW. The thunderstorms whipped up strong winds that created huge dust storms carrying topsoil from drought-stricken farms in western NSW. A 300-kilometer wide cloud of red dust descended on the drought-affected towns of Dubbo, Broken Hill, Nyngan and Parkes, turning day into night. A gust of 94 kilometres per hour (km/h) was recorded at Parkes at about 6.30pm while a gust of 107 km/h was recorded at Dubbo at about 7.45pm. The winds and the dust storms had eased by the next day.



In contrast, many towns on the NSW mid-north coast and the northern rivers regions received between 100 millimetres (mm) and 180 mm of rainfall from 9.00am to 10.30pm that same day. But in the southern part of the state, high winds saw storms race overhead quickly, resulting in lower rainfall totals.

On 20 January, a severe thunderstorm warning was issued at 1.46pm for people in parts of Sydney, the Blue Mountains/Hawkesbury, Maitland/Cessnock, Gosford/Wyong and Wollondilly/Wingecarribee. Almost 20,000 customers lost power after destructive winds, lightning, rain and giant hailstones struck the Sutherland Shire and Sydney's northern beaches areas, and a freak storm ripped the roof off a city shopping centre.

In the Blue Mountains, two people were struck by lightning. A 16-year-old boy and a 24-year-old man sustained electric shocks and were hospitalised, both in a stable condition.

The following day, the Insurance Council of Australia declared the event a catastrophe, enabling the rapid assessment of storm-related claims. As at 23 March, the estimated cost of damage caused by hailstorms that had struck NSW, the ACT and eastern Melbourne on 19 and 20 January was $1.2 billion from 107,932 lodged claims, more than 60,000 of them for damaged motor vehicles. An estimated 13 per cent (or 14,000) of the claims arose in NSW.

Joint Australian and NSW government disaster recovery funding was provided in 64 local government areas impacted by the thunderstorms for a range of measures including:

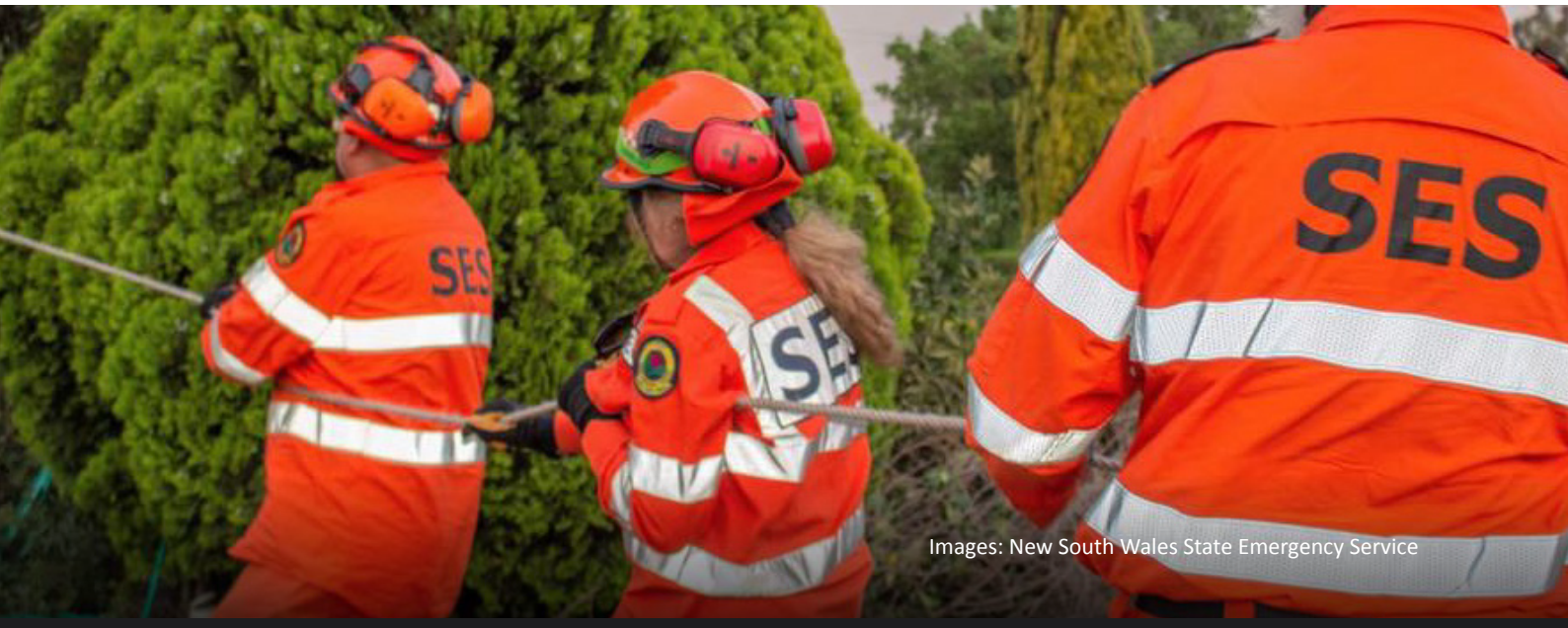
- personal hardship and distress
- counter disaster operations
- the restoration of essential public assets
- concessional interest rate loans for small businesses, primary producers and non-profit organisations
- grants for non-profit organisations
- freight subsidies.

Observations

The response to the event was managed within the capability of the NSW SES operational structure, processes and resources.

Acknowledgments

New South Wales State Emergency Service; Bureau of Meteorology; National Insurance Brokers Association.



Images: New South Wales State Emergency Service

Hailstorms and heavy rainfall

Victoria

19 JANUARY 2020

Severe thunderstorms developed over central and eastern Victoria (VIC) on 19 January 2020, bringing hailstones up to 5.5 centimetres in diameter to parts of south-east Melbourne, and damaging winds, heavy rainfall and flash flooding to broader areas of the state over the following days.

The hailstones damaged cars and homes late on the Sunday afternoon in several south-eastern Melbourne suburbs, caused part of a supermarket ceiling to collapse, and brought Monash Freeway traffic to a standstill as thunderstorms and heavy rain moved across southern Victoria. Glen Iris, Warrandyte, Malvern East and Templestowe were the worst hit when the hailstorm swept through Melbourne's eastern suburbs just after 4.00pm. Large hailstones were also reported in Malvern, North Balwyn, Camberwell and Balaclava.

By 9.00pm that evening, the State Emergency Service (SES) had received more than 1,000 calls to attend building damage, more than 200 calls for fallen trees and 140 calls for flooding. SES crews remained busy throughout the night as a band of storms continued to move across the state.

On 20 January, the Bureau of Meteorology issued a series of warnings for more severe weather and thunderstorms, which delivered heavy rain over many parts of VIC that afternoon and evening. Melbourne received about a month's rain in less than 24 hours, and many road, rail and tram services in central and eastern parts of the city were affected, creating headaches for commuters heading home from work. All east-bound lanes of the Princes Highway were closed at Pakenham just after 4:00pm, and buses were brought in to replace trains on the Sandringham train line due to flooding across the tracks at North Brighton.

While the thunderstorms were occurring, 15 bushfires were still burning across VIC. While the rain, humidity and cooler temperatures brought welcome relief to some firefighters, fire-affected catchments in East Gippsland and north-east VIC were put on flood watch. Firefighters were withdrawn from some areas due to fears strong winds and flash flooding could topple trees, create landslides and send debris onto roads in areas damaged by fire.

Fire-affected areas in Gippsland received between 20 millimetres (mm) and 60 mm of rain, and up to 40 mm was recorded in the state's north-east. In Brewster, west of Ballarat, a farmer reportedly received 205 mm of rain overnight after losing 50 hectares of pasture to fire the previous Wednesday. Several areas around the state recorded more than 100 mm of rain, including 136 mm at Mount Moornapa, west of Bairnsdale.

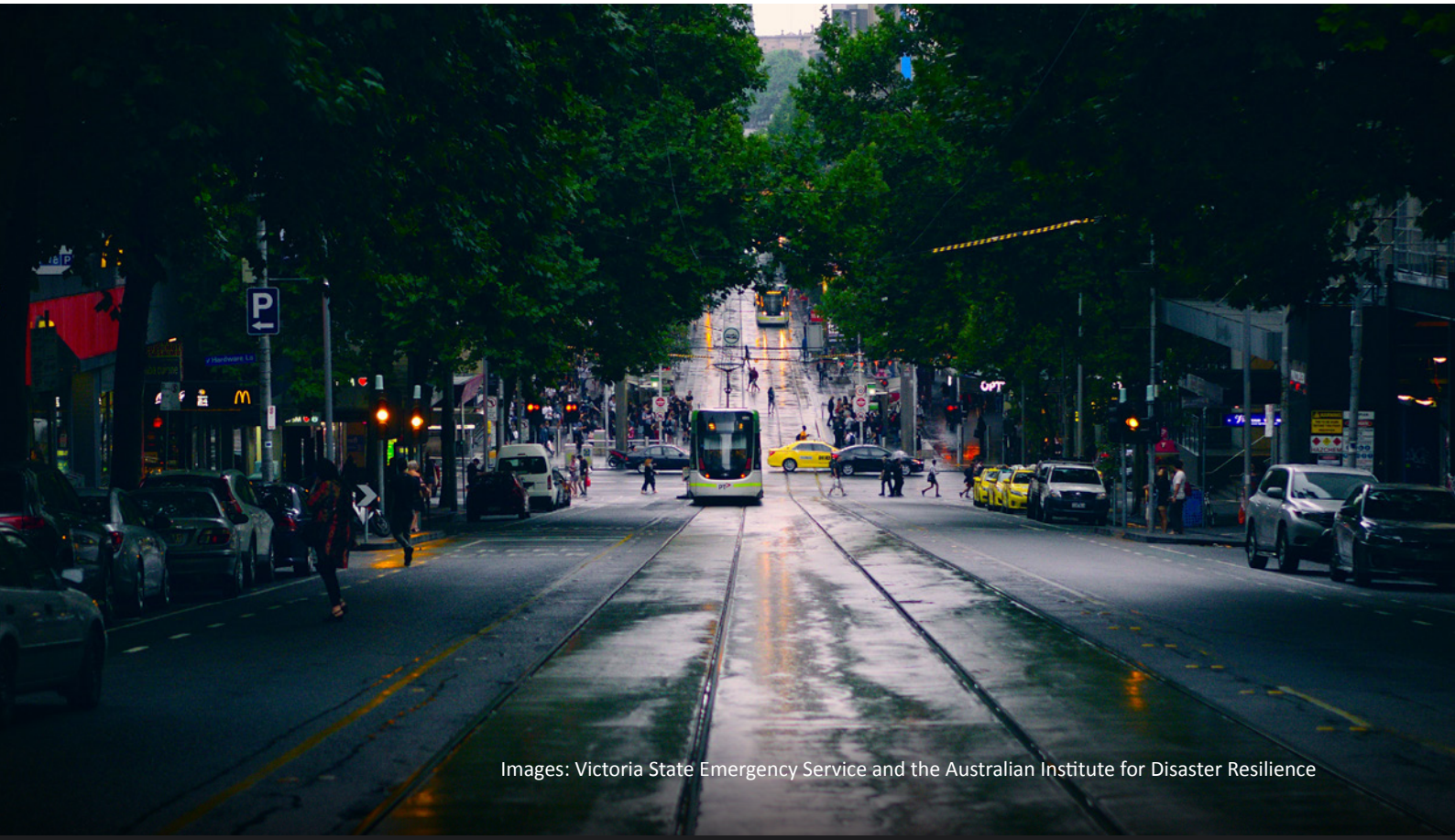
By the night of 20 January, the SES had received more than 1,800 requests for assistance in the previous 24 hours.

On 21 January, the Insurance Council of Australia declared the event a catastrophe, enabling the rapid assessment of storm-related claims. As at 23 March 2020, the estimated cost of damage caused by storms that had struck the Australian Capital Territory and parts of VIC and New South Wales on 19 and 20 January was $1.2 billion from 107,932 lodged claims, more than 60,000 of them for damaged motor vehicles. An estimated 30 per cent (or 32,000) of the claims arose in VIC.

Following the storms, joint Australian and VIC disaster recovery funding was made available for counter disaster operations and the restoration of essential public assets in the local government areas of Boroondara, Manningham, Murrindindi and Nillumbik.

Acknowledgments

Emergency Management Victoria; Bureau of Meteorology; ABC News.



Images: Victoria State Emergency Service and the Australian Institute for Disaster Resilience

Hailstorm

Australian Capital Territory

JANUARY 2020

One of the most severe hailstorms recorded in Canberra in the Australian Capital Territory (ACT) occurred on 20 January 2020. Hailstones of four to six centimetres in diameter fell across a region extending from the southern half of Belconnen north-west of the city centre, through Acton to the inner southern suburbs.

In the same storm, Canberra Airport reported a wind gust of 117 kilometres per hour, its strongest since 1996 and the second strongest on record in the ACT for January.

A warning was issued before the storm by the Bureau of Meteorology for 'damaging, locally destructive winds, large, possible giant hailstones and heavy rainfall that may lead to flash flooding' and advising residents to move cars undercover and stay indoors. The storm was expected to hit the city at about 12:30pm.

The storm arrived in the early afternoon and lasted just 15 minutes, but more than 1,000 homes lost power, with outages reported in Florey, Griffith, Deakin and Kambah, and dozens of other suburbs across the city. Other areas suffered damage from hailstones and very strong winds including Belconnen, the city, the Australian National University and several inner southern suburbs.

Widespread damage included fallen trees, branches and power lines, flooding, blocked roads, broken windows and sky lights in homes and commercial buildings, and thousands of cars damaged by hailstones.

The CSIRO was among the worst hit institutions, where 65 glasshouses were damaged and two to three years of research was lost, most aimed at improving crop sustainability by reducing the amount of water, chemical and fertiliser needed. The National Museum of Australia was forced to close due to structural damage, and the Australian National University issued a shelter-in-place alert and closed for a day.

Several species of wildlife were severely affected, including more than 300 flying foxes, a protected species, which were killed by hailstones and falling trees.

The Emergency Services Agency (ESA) received approximately 2,100 requests for assistance, and the ACT Ambulance Service treated two people for minor injuries sustained during the storm.

This record number of requests occurred during protracted ESA operations in response to bushfires that had been burning in New South Wales (NSW) for several weeks, and required incident management team (IMT) staff and on-ground emergency responders to be reallocated to the hailstorm. More than 300 ACT State Emergency Service (SES) members, assisted by NSW SES, Transport Canberra and City Services, the Australian Defence Force and ACT Fire and Rescue responded to calls for help throughout the afternoon and into the evening. The sheer number of calls meant that by late Monday, many people were still waiting for the SES to visit their homes, where hailstones had penetrated roofs and caused flooding.

The Insurance Council of Australia declared the event a catastrophe, enabling the rapid assessment of storm-related claims. As at 23 March 2020, the estimated cost of damage caused by hailstorms that had struck the ACT, eastern Melbourne and parts of NSW on 19 and 20 January was $1.2 billion from 107,932 lodged claims, more than 60,000 of them for damaged motor vehicles. An estimated 57 per cent (or 61,000) of the claims arose in the ACT.

Following the hailstorm, joint Australian and ACT disaster recovery funding was made available for counter disaster operations and the restoration of essential public assets.

Observations

- The January 2020 hailstorm was one of three large storms to impact the ACT in January and February 2020 that resulted in ACT SES establishing a storm division within the ESA IMT to manage multi-day operations. Given ongoing bushfire operations, the IMTs were multi-hazard focused and demonstrated the ESA's capacity to conduct coordinated, collaborative and interoperable operational responses.

- A focused use of social media platforms ensured the community was well-engaged and informed, with significant positive feedback subsequently received from the community. ESA recorded 2.5 million engagements and 12.5 million people reached across the operational period for all hazards.

- Given significant bushfire damage in NSW, access to builders to carry out repairs in the ACT was limited. Hence repairs took longer than usual, which added to the ACT SES workload as damaging weather events continued to occur while homeowners waited for permanent repairs to be completed.

Acknowledgments

ACT Emergency Services Agency; Bureau of Meteorology; ABC News.

Images: ACT State Emergency Service

Severe Tropical Cyclone *Damien*

Western Australia

FEBRUARY 2020

A tropical low formed in the Kimberley region near the Western Australia (WA) – Northern Territory border, about 190 kilometres (km) south-east of Kununurra on 3 February 2020. The low tracked west and moved offshore near the Dampier Peninsula north of Broome during 5 February. Once over water it gradually intensified till it reached cyclone category 1 strength at 2.00pm on 6 February and was named Tropical Cyclone *Damien*. As *Damien* moved west-south-west during the morning of 7 February it intensified rapidly, developing from a category 1 to a category 3 system in just nine hours.

In preparation for *Damien's* impact, WA's Department of Fire and Emergency Services (DFES) deployed additional resources to the region. Public information and emergency warnings were issued regularly, evacuation centres were set up in Karratha and South Hedland, and residents urged to activate their cyclone plans.

Damien moved south towards the Pilbara coast on 7 February and made landfall as a category 3 severe tropical cyclone around 3:30pm on 8 February over the Karratha-Dampier region; the strongest cyclone to make landfall in the area since 2013.

Damien's eye moved directly over Karratha, population approx. 16,000, on the afternoon of 8 February. Destructive winds gusting close to 200 kilometres per hour (km/h) blew for two hours either side of the cyclone's eye as it passed over the city. Accompanied by torrential rain, trees were uprooted, windows smashed and roofs lost, and the cyclone left about 9,500 customers temporarily without power across the Pilbara.

Wide-spread damage prompted many calls to the State Emergency Service requesting assistance. There were 180 reports of damage from wind, 68 from fallen trees and 116 reports of damage from water ingress. The Bureau of Meteorology's Dampier radar also sustained significant damage during the passage of *Damien*.

Barrow Island, Mardie, Varanus Island, Karratha Airport, Roebourne Airport and Legendre Island all reported sustained gales that day, with Karratha Airport recording the highest wind gust of 194 km/h at 2:31pm, the strongest gust for that site in 17 years of records.

The system continued to move inland, weakening on 9 February, and the remnant tropical low then tracked south-east over WA's inland Pilbara, eastern Gascoyne and Northern Goldfields regions.

Heavy rainfall caused flooding initially through the Kimberley when the system was a tropical low, then through the Pilbara and eastern Gascoyne regions. Widespread totals of 100 to 200mm and isolated falls up to 235mm were recorded near the Pilbara coast. Notable rainfall totals in the 48 hours to 9.00am on 9 February included Karratha Airport 235.2mm and Roebourne Airport 234.8mm. Ginginjibby recorded 153.2mm in the 72 hours to 9.00am on 11 February.

Rivers and catchments that experienced increased flows included the west, north and eastern Kimberley, Ashburton, Pilbara coastal streams, Fortescue, Gascoyne, Murchison, De Grey and the Salt Lake Rivers District.

Damien delivered rainfall and river flows to pastoral areas that had been drier than average for at least two years, and filled many dams and water resources including the Harding Dam, the main water supply for the Karratha and Dampier areas.

Severe Tropical Cyclone *Damien* was the third tropical cyclone and the second severe tropical cyclone in the Australian region for the 2019–20 season.

The Australian Government made disaster recovery funding available for individuals, primary producers and small businesses in seven local government areas in WA impacted by *Damien*, as well as for counter disaster operations and the reconstruction of essential public assets.

Observations

- There is an absence of river level gauges on the upper Gascoyne River, limiting the early prediction of river level flows. Installing gauges will improve data collection and monitoring of rainfall and river levels and better inform flood forecasts, early warning systems and emergency warnings for the public.

- The FIRESCAN infra-red line-scanner was used to provide intelligence when satellite imagery was not available due to cloud cover. There are benefits to increasing the use of the line-scanner for wide-area reconnaissance and surveillance, capturing high quality and accurate imagery to enhance planning and decision making.

- James Cook University's Cyclone Testing Station, the Department of Mines, Industry, Regulation and Safety and DFES collaborated to investigate damage to buildings in WA's Pilbara region immediately after *Damien*. Investigations after cyclones in WA, including *Damien*, indicate that some houses built before the early 1980s do not perform as well as most newer houses. Some damage to newer houses in *Damien* indicated that more post-cyclone research is needed to better understand what types and parts of buildings perform well during severe weather events. This work will provide data that can be used to improve building design and construction, support changes to codes and standards, and promote the importance of building inspection and maintenance to reduce future building damage.

Acknowledgments

WA Department of Fire and Emergency Services; Bureau of Meteorology; ABC News; James Cook University Cyclone Testing Station.

Images: WA Department of Fire and Emergency Services

Heavy rainfall and floods

New South Wales

7–16 FEBRUARY 2020

Torrential rain for several days from 7 February 2020 caused flooding on numerous rivers in eastern New South Wales (NSW) and south-east Queensland (QLD), with significant disruptions to road and rail traffic. In NSW, major flooding occurred on the Orara, Hawkesbury-Nepean and Georges Rivers, with the Hawkesbury River at North Richmond reaching its highest level since 1992.

The heavy rains were accompanied by strong winds and rough seas. Several people were injured when winds brought down trees and powerlines, which also caused thousands of homes to be temporarily without power. Flash flooding occurred in some areas, and waves more than five metres high lashed the coast, causing significant beach erosion. Up to 25 metres of beach at Collaroy and Narrabeen was swept away by huge surf.

As river levels rose on 9 February, the NSW State Emergency Service (SES) issued evacuation orders for towns along the Hawkesbury River, as well as Moorebank, Chipping Norton and Milperra along the Georges River on 11 February.

On 10 February, energy distribution crews continued to deal with thousands of hazards, including fallen trees and powerlines, damaged wires and extensive flash flooding. Electricity distributors Ausgrid and Endeavour Energy reported that more than 100,000 customers had lost electricity across Sydney, the Central Coast, the Blue Mountains, Newcastle and the Southern Highlands.

During this event, among the largest that NSW SES has dealt with, they received 15,680 requests for assistance, most in the Sydney Basin with northern NSW also significantly impacted. The majority of assistance related to leaking roofs, fallen trees and flooded roads. The NSW SES had 379 flood rescue activations, with the majority in the Sydney metropolitan area. Fire and Rescue NSW received 16,000 calls for help, many of them flood-related, between 8.00am on 8 February and 8.00am on 10 February, a record number of calls over a 48-hour period.

Sydney received 391.6 millimetres (mm) of rain between 7 and 10 February, more than three times the average rainfall for the month and the city's wettest period since 1990. Other areas of

the state also experienced torrential rain; in a 24-hour period covering 9–10 February, several locations along the central and southern coast recorded more than 350 mm of rain.

The rainfall had a marked effect on Greater Sydney's water supplies, with major dam levels at 64.2 per cent by 10 February, up from 41.9 per cent in seven days. The Warragamba Dam, which can hold 80 per cent of Sydney's water storage, received a year's worth of water in just one weekend, rising 17.7 percentage points to 60.7 per cent by 10 February. An estimated 360,000 megalitres of water had been added, almost as much as 150,000 Olympic-size swimming pools.

On that day, the NSW Rural Fire Service announced that the Gospers Mountain, Myall Creek Road, Erskine Creek, Kerry Ridge, Green Wattle Creek, Morton and Currrowan bushfires, which had been burning for several weeks, had been finally extinguished by the rains. By 13 February, several bushfires that were still burning in parts of southern NSW were also declared under control.

On that day too, the Insurance Council of Australia (ICA) declared the storms and associated flooding a catastrophe, enabling insurance claims to be processed more rapidly. On 28 May, the ICA reported that 96,594 claims for homes and businesses damaged by the rain and floods had been lodged in NSW and south-east QLD, with estimated combined insurance losses of $896 million. Most claims were for property damage caused by storm runoff, flooding, strong winds and heavy rain.

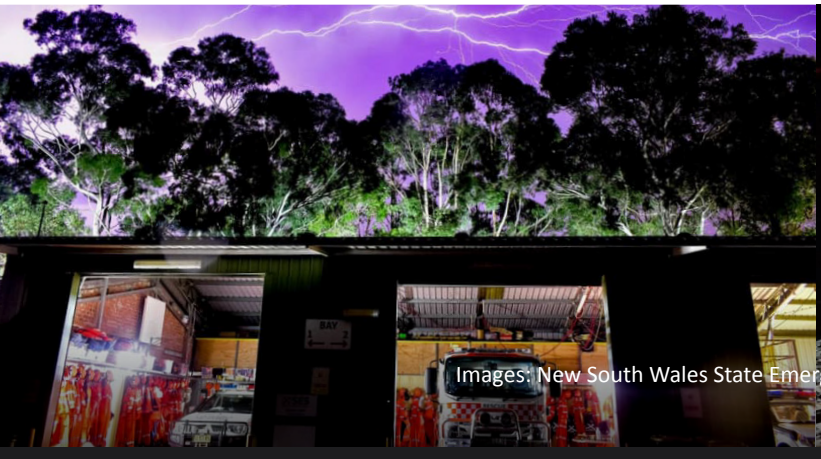
Observations

- NSW SES utilised personnel from other emergency services to fill roles in incident management teams and the state operations centre, enabling NSW SES to better provide support to impacted communities. Members from all agencies worked well together although some minor issues were noted, including the need for initial familiarisation with work practices and familiarisation with and access to SES systems.

- Public information has been highlighted in nearly all state and national reviews into emergency management as a critical function that requires improvement. It is vital that NSW SES can issue accurate and timely information to the public during severe weather events. During the severe weather events of February 2020, NSW SES experienced several challenges issuing warnings. Processes and systems to release warnings are labour intensive and require multiple steps and systems. NSW SES is working to improve its processes for issuing public information and warnings and will align these to the recommendations of the National Warnings Project.

Acknowledgments

New South Wales State Emergency Service; Bureau of Meteorology; Floodlist; Insurance Council of Australia; The Guardian; Sydney Morning Herald.



Images: New South Wales State Emergency Serviceand the Australian Institute for Disaster Resilience

Heavy rainfall and floods

South-east Queensland

8–14 FEBRUARY 2020

A near-stationary coastal trough over south-east Queensland (QLD) from 6 February 2020 generated persistent showers and thunderstorms until the middle of the month, with locally heavy falls in some areas.

Heavy rains produced significant flooding in a number of creeks and rivers, including the Logan/Albert, Condamine, Coomera, Noosa and Mary Rivers as well as their tributaries. River level rises in these catchments caused flooding at several townships downstream, including heavily populated areas around Logan City, Warwick, Dalby, Chinchilla, Tewantin and Gympie.

Some of the heaviest rainfall was experienced at Coolangatta, which on 8 February recorded 201 millimetres (mm) in 24 hours.

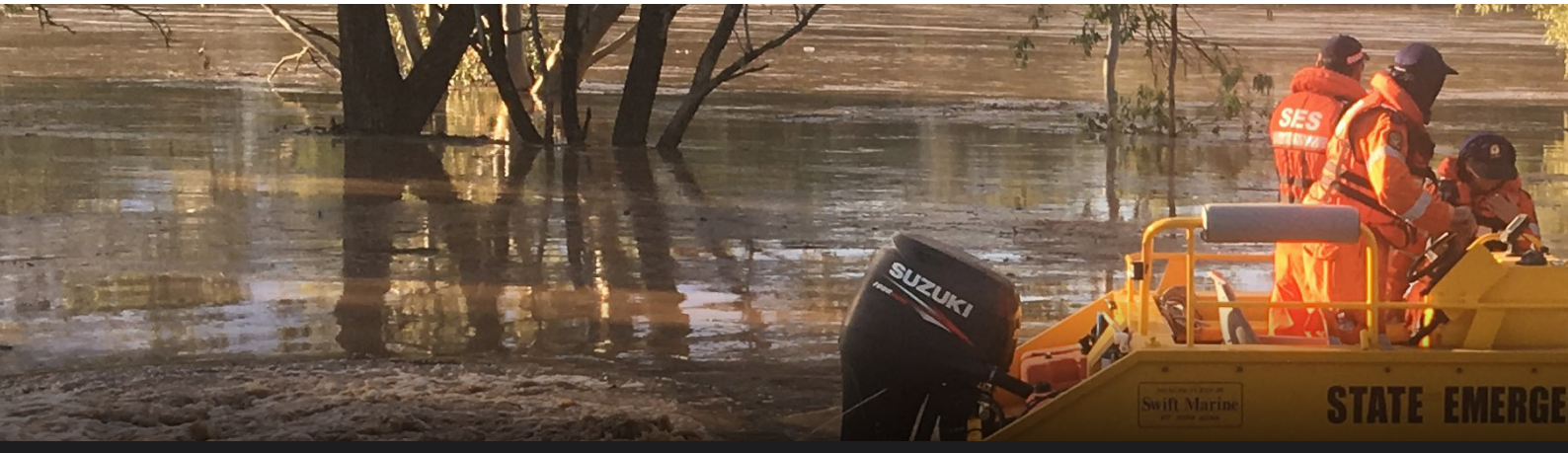
The Bureau of Meteorology reported that severe thunderstorms had also created intense downpours around Warwick, 140 kilometres west of the Gold Coast, with more than 80 mm falling in an hour and providing some relief from drought conditions.

The town received more than two years of water supply from the downpours, with water flowing into the nearby Leslie Dam.

While several other areas received more than 200 mm of rain in the same 24 hours, no records were broken. The Gold Coast and Stradbroke Island were the most affected that day, and the Darling Downs experienced totals exceeding 100 mm.

The following day, BOM issued a severe storm warning for several parts of south-east QLD. Later that day, two people had to be rescued from a car in floodwaters at Greenmount, south of Toowoomba, and about ten homes were evacuated in Jondaryan, a few kilometres to the north-west.

The State Emergency Service (SES) received hundreds of requests for assistance, most commonly for flood-affected properties and damage to roofs. The busiest local government areas (LGAs) in the south-east were Brisbane (210 RFAs), Gold Coast City (151), Redland City (100), Logan City (96) and Moreton Bay Regional (62). And between the night of 7 February and the morning of 10 February, QLD Fire and Rescue Service carried out 32 swift-water rescues across the region.



By 10 February, the widespread storms and heavy rain had flooded many parts of south-east QLD and the Darling Downs. Heavy rain had hit parts of Brisbane (220mm), with numerous cars parked in streets now underwater, and several roads and train lines had been cut by floodwaters. Trains on the Ipswich/Rosewood line were suspended between Wacol and Gailes stations in both directions due to flooding of the rail line. Brisbane suburbs including Pullenvale, Kenmore, Woolloongabba, Moorooka, Holland Park, Tarragindi and Durack all experienced flash flooding.

On 11 February severe flooding affected parts of the Western Downs region, with warnings issued for Dalby where the Myall Creek broke its banks, and for Jandowae and Warra, where the Jandowae Creek overflowed. Myall Creek peaked at 3.2 metres and caused widespread flooding in Dalby.

Several parts of the Sunshine Coast and Gold Coast areas recorded more than 170 mm of rain in 24 hours to 13 February. Marcoola recorded 232 mm of rain during this period, Nambour 201 mm and Southport 177 mm. In both areas, heavy rain continued to fall: in the 24 hours to 9.00am on 13 February, the northern Gold Coast experienced between 100-200 mm of rainfall. Ten schools and 18 early childhood centres were closed on the Gold Coast that day, as well as all Gold Coast beaches and most of the region's theme parks. That same day, a nursing home at Mt Coolum on the Sunshine Coast was evacuated due to concerns about flooding.

Sadly, a 75-year-old kayaker was found dead on the Sunshine Coast after going onto the Mary River in the Sunshine Coast hinterland on 9 February. The man's body was found just after 10.30am on 13 February, near Cooks Road at Conondale.

On 10 February, the Insurance Council of Australia (ICA) declared the storms and associated flooding a catastrophe, enabling claims to be processed quickly. On 28 May 2020, the ICA reported that 96,594 claims for homes and businesses damaged by the storms had been lodged in south-east QLD and eastern New South Wales, with estimated combined insurance losses of $896 million. Most claims were for property damage caused by storm runoff, flooding, strong winds and heavy rain.

Joint Commonwealth-State disaster recovery funding was made available for counter disaster operations and the restoration of essential public assets in the QLD LGAs of Brisbane City, Gold Coast, Goondiwindi, Logan, Scenic Rim, Somerset, South Burnett, Southern Downs, Toowoomba and Western Downs following the February rainfall and floods.

Acknowledgments

Queensland Fire and Emergency Services; Bureau of Meteorology; ABC News.

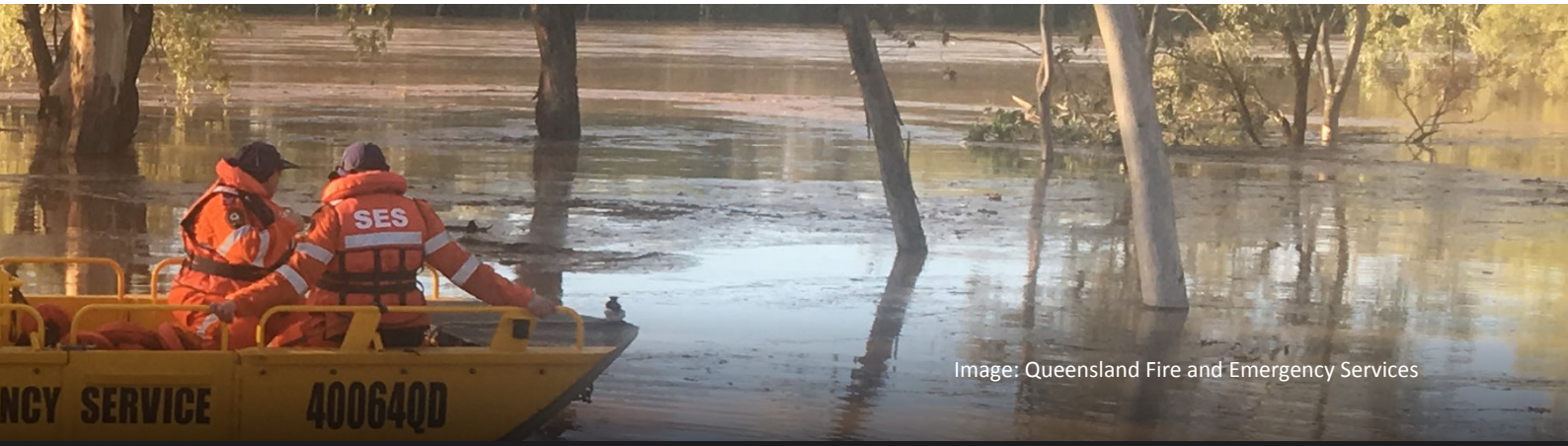


Image: Queensland Fire and Emergency Services

Floods

Southern and south-west Queensland

FEBRUARY–MARCH 2020

From 20–26 February 2020, a surface trough extending through the interior of Queensland (QLD) interacted with an upper-level trough to produce showers and thunderstorms that generated moderate to locally heavy falls through southern inland QLD and over to the Capricornia coast.

Some sites in the state's south-west had their highest total February rainfall on record or their highest total February rainfall for at least 20 years. The rainfall produced very significant river levels in catchments across the Warrego and Maranoa district, resulting in the highest river levels since the significant floods of 2012.

Major flood levels were recorded across the Balonne River catchment including at the townships of Surat, St George and Dirranbandi. In the nearby Wallam Creek catchment, major flood levels were recorded at Bollon and also further west in the Bulloo River at Quilpie. Significant river levels were also recorded on the Maranoa River at Mitchell and in the Warrego River catchment where moderate flooding peaked just below the major flood level at Charleville.

By 25 February, floodwaters in the Warrego River at Charleville were falling after reaching a peak of 5.7 metres the previous night, below the expected 6.3 metres.

That same day at St George 300 kilometres (km) to the south-east and about 500 km west of Brisbane, QLD Police issued an emergency declaration for the Balonne River from Beardmore Dam to the QLD-New South Wales border and urged residents to avoid using personal watercraft in the water system. The State Emergency Service (SES) deployed four extra swift water rescue crews to the area and SES volunteers visited residents, advising them to prepare to evacuate after dozens of homes in low-lying areas were threatened by rising floodwaters.

The SES also delivered medical supplies from Roma to towns and outlying properties north of St George already cut off by floodwaters. Boat operators around the Maranoa assisted pharmacies resupply essential medications to elderly residents.

The following day, floodwaters at St George continued to rise and closed one of the main arterial roads. The Balonne River, which runs through the town, was expected to peak at about 12.5 metres on the 27 February.

Further west at Quilpie on the Bulloo River, up to 200 millimetres of rain fell, cutting the town off and causing evacuations in nearby Adavale and Eromanga. Trucks were stranded on remote cattle stations and livestock was moved to higher ground. The only way to move around the district and to get supplies to remote farming properties after floodwaters cut roads was by air.

Until these significant rains arrived, QLD southern interior and south-west had been crippled by about ten years of drought. Most locals welcomed the rain.

Joint Commonwealth-State disaster recovery funding was made available for counter disaster operations and the restoration of essential public assets in six local government areas in southern and south-west QLD impacted by the heavy rainfall and flooding.

Acknowledgments

Queensland Fire and Rescue Service; Bureau of Meteorology; ABC News.

Images: Queensland Fire and Emergency Services

Tropical Cyclone *Esther*

Northern Australia

FEBRUARY–MARCH 2020

Tropical Cyclone *Esther* was the third tropical cyclone to cross the Australian coast in the 2019–20 season and the first to strike the Northern Territory (NT). During its brief life on 24 February, *Esther* brought heavy rainfall and category 1 winds to the southern Gulf of Carpentaria coast, then became a long-lived and intense tropical low which delivered significant rainfall to the northern half of the NT, the Kimberley region of Western Australia (WA) and south-western Queensland (QLD) from late February to early March.

Esther began when a tropical low formed in a monsoon trough over the northern Gulf of Carpentaria on 21 February and remained slow moving for the next two days. On 23 February, the low intensified while moving slowly south and Tropical Cyclone *Esther* was named at 4.00am AEST on 24 February when about 80 kilometres (km) north of Mornington Island. *Esther* turned towards the south-west and its centre crossed the coast just east of the NT-QLD border at category 1 intensity at around 11.00am on 24 January. *Esther* then weakened into a tropical low later the same day as it passed around 120 km south-east of Borroloola in the NT.

The remnant tropical low maintained a strong circulation with central pressure around 996 hectopascals (hPa) during the following week as it travelled west across the NT and into WA's Kimberley region on 27 February. The low traversed the northern Kimberley then tracked south-west while deepening to 993 hPa as it approached the coast north of Derby on 29 February. The low turned south and then east, staying over land and re-entered the NT near the Tanami desert for a second time, passing close to Tennant Creek before dissipating over south-western QLD on 5 March.

Very heavy rainfall associated with the system resulted in flood watches and warnings being issued in both the NT and WA. Large increases in water levels were observed in major rivers across the Top End resulting in minor incidents including a swift water rescue, but no fatalities or injuries were recorded.

Roads throughout the two regions and south-west QLD were impacted by the *Esther* weather system, and numerous towns, small communities and homesteads were isolated for an extended period, with several requiring resupply by air. The McArthur River at Borroloola reached minor flood level from 26-29 February. Other NT impacts included highways and roads being cut by floodwaters in the Carpentaria, Barkly, Gregory and Simpson districts.

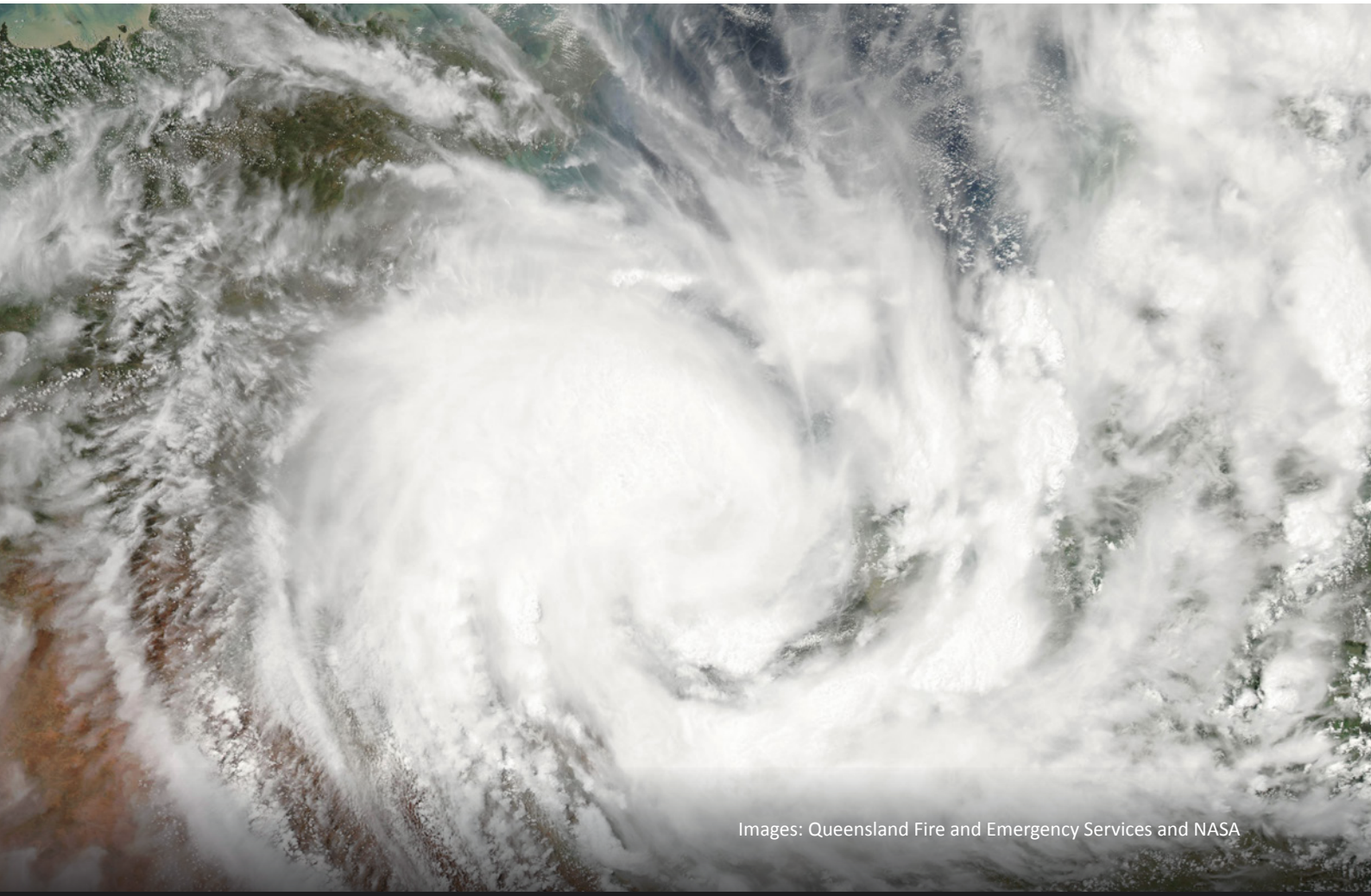
Widespread falls between 150 and 250 millimetres were recorded in many areas. The outback town of Thargomindah in south-west QLD broke its 21-year-old record for its wettest day as torrential rain swept across much of drought-declared western QLD. Thargomindah and Birdsville recorded more rain in two days than their rainfall total for the past two years.

The prolonged rainfall associated with *Esther* and the remnant low provided relief rain for many pastoralists but not drought-breaking rains, easing a prolonged dry period but not preventing a below-average wet season. Within days of the rain commencing, grass began shooting in recently parched paddocks.

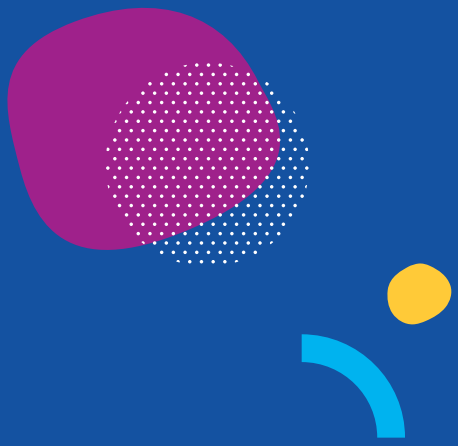
The Australian Government made disaster recovery funding available for counter disaster operations and the reconstruction of essential public assets in five local government areas in the NT and QLD impacted by *Esther* and related flooding.

Acknowledgments

Queensland Fire and Emergency Services; Bureau of Meteorology; ABC News.



Images: Queensland Fire and Emergency Services and NASA



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