Incorporating Climate Change Risk into CMA Emergency Management Planning

Victorian water sector climate trends, amplified risks, and actions

Objective: Climate change is a business-as-usual consideration in water sector emergency management

Victorian catchment management authorities (CMAs) have a long history of managing extreme weather events, particularly floods. CMAs develop local floodplain management and flood response action plans and develop and implement a flood response manual[1].

CMAs also support response agencies by collecting flood data, field data on flood events when they occur, and through the provision of flood advice; and act as interim flood analysts to provide technical advice about flood behaviour both locally and across the state until the State Emergency Service has arrived[2].

The Royal Commission into National Natural Disaster Arrangements heard that climate-driven hazards are expected to become more frequent and intense[3]. This has implications for the Victorian water sector.

Climate change in Victoria: observed trends

Victoria is already experiencing the impacts of climate change and Victoria's climate is expected to continue to change in the future[4567]. As climate amplified emergency events represent a real and foreseeable risk to service provision, CMAs have a duty of care to incorporate climate change into emergency planning and mitigate those risks[8]. Observed climate change impacts in Victoria include, but are not limited to:

- a 1.2°C increase in average temperatures since 1910, with a 1.6°C increase in the south-west since 1950;
- an increased rate of warming since the 1960s. Eight of Australia's 10 warmest years have occurred since 2005;
- a lengthened heatwave season and an increase in the number of heatwave days;
- rising sea levels increasing inundation risk;
- average rainfall reductions and significant cool season reductions across all parts of Victoria since 1950;
- increase in the intensity of extreme rainfall events; and
- a long-term increase in extreme weather conducive to fire and in the length of the fire season since 1950.

Climate change is amplifying emergency risks to the water sector

Extreme rainfall and flood events

- Despite average rainfall reductions, the number of extreme rainfall events in Victoria is increasing.
- Research suggests rainfall intensity is increasing for sub-daily events[9] and for events lasting under 1 hour[10].
- Based on our understanding of these processes, the intensity of extreme rainfall should increase by at least 7% for each degree of warming. Observations show an average increase of 14% per degree of warming[7,10].
- Increased flooding due to increasing rainfall intensity is most likely to occur in urban catchments, in small and steep catchments, and during rare to extreme events.
- Viewbank received 40mm of rain in 15 minutes while Bundoora received over 100mm in one day - its highest December daily rainfall on record[10]. Increasing rainfall intensity may make such events in urbanised areas more likely in future.
- While evidence suggests that rainfall extremes are increasing, there is a lack of corresponding evidence to suggest that flood magnitudes have increased in rural catchments, particularly for relatively frequent events.
- Prolonged dry conditions are reducing soil moisture, which may be offsetting expected increases in floods in

[1] Emergency Management Victoria. *State Emergency Management Plan,* 2020, available at: https://www.emv.vic.gov.au/responsibilities/semp.

[2] At the time of this guidance note's release, the exact nature of the role is not standardised across all CMAs.

[3] Commonwealth, Royal Commission into National Disaster Arrangements, *Report*, 2020.

[4] Clarke JM, Grose M, Thatcher M, Hernaman V, Heady C, Round V, Rafter T, Trenham C & Wilson L. *Victorian Climate Projections 2019 Technical Report*. CSIRO, 2019.

[5] Steffen, W, Hughes, L, Perkins, S. *Heatwaves: Hotter, Longer, More Often*. The Climate Council, 2014.

[6] Hope, P, Timbal, B, Hendon, H, Ekström, M, Potter, N. *A synthesis of findings from the Victorian Climate Initiative (VicCI).* Bureau of Meteorology, 2017.

[7] Bureau of Meteorology & CSIRO. *State of the Climate 2018*, 2018.

[8] See "*Managing Climate Change Risk: Guidance for Board Members and Executives of Water Corporations and Catchment Management Authorities*".

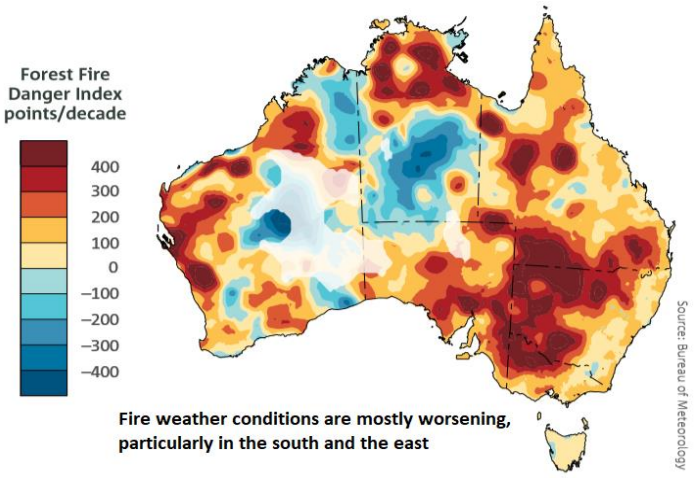
[9] Westra, S, Sisson, SA. *Detection of non-stationarity in precipitation extremes using a max-stable process model*. J. Hydrol. 406, 119-128, 2011.

[10] Bureau of Meteorology. '*Rainfall extremes are getting more extreme' – are they?. Victorian Water and Climate Initiative*, 2019.

less urbanised catchments from increasing intensity of rainfall events.

Bushfire risk in our catchments and regions

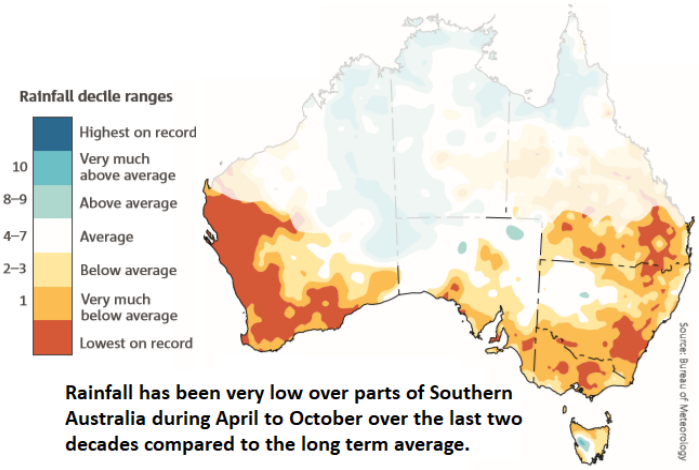
- The number of days with a Forest Fire Danger Index (FFDI) over 25 (very high risk) per year is increasing[11].
- 1972-2002 had only five years where Victoria's fire season started earlier than September, and there were on average 66 days per year with FFDI ratings above 25[11].
- Between 2002-2017 there were 10 years where the fire season started before September. There are now on average 94 days per year with FFDI ratings above 25[11].
- Ash and debris inflow contamination has significant impacts on water availability and quality.
- Post bushfire heavy rainfall increases the risk of secondary water contamination due to algal blooms or black water events. This can result in fish death events.
- While fires in our catchments can result in short-term increases in catchment inflows, they can also result in a long-term decrease in inflows as vegetation regrows.



Trend between 1978-2017 in the annual sum of the daily FFDI[7]. The decadal trend highlighted shows fire danger is increasing in Victoria.

Water quality concerns: algal bloom events and emerging water contaminants such as e-coli

- More warmer days, reductions in stream flows, and increased CO_2 are linked to an increase in algal blooms.
- The Murray River experienced no algal blooms between 1978-2006. Between 2006-2016, the Murray river experienced four major blooms[12].
- The cause of the 2016 bloom was directly linked to elevated water temperatures[13].
- Increases in large scale fish kills have been observed in recent years, caused in some cases by algal outbreaks.
- Some Victorian regions are experiencing an increase in environmental e-coli, particularly in warmer months during periods of low rainfall and runoff.



1999-2018 rainfall variation compared to long-term average[7]. Despite this trend, extreme rainfall events are becoming more likely.

The impact of climate change on catchment management authorities' ability to respond to climate enhanced emergencies

Emergency management planners should consider the impacts of climate change both on the emergency event itself, and the systems, processes, and people responding to the event. Climate-related risks which impact an organisation's ability to respond to climate enhanced emergencies can increase and compound the physical risks resulting from climate enhanced emergencies.

With that in mind, emergency planners should consider how climate change may impact the ability of the business itself to respond to longer, more frequent, overlapping, and/or compounding emergency events.

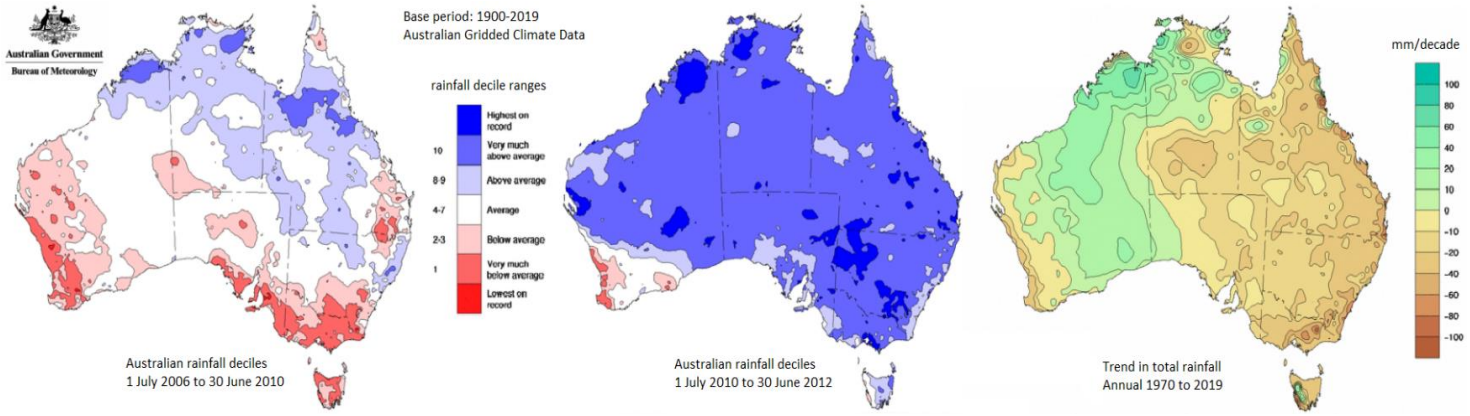
Examples of climate impacts on a catchment management authority's emergency management workforce:

- higher potential for staff to be exposed to emergency conditions/health and safety issues;
- longer periods spent in emergency mode at the expense of business-as-usual activities and projects;
- emergency management workforce fatigue may result from longer periods at surge capacity;
- increased fatigue for non-emergency management staff as they cover more business-as-usual activities;

[11] Harris, S, Mills, G, Brown, T. *Victorian Fire Weather Trends and Variability*, 2019.

[12] Baldwin, D. *Are toxic algal blooms the new normal for Australia's major rivers?*. CSIRO, 2016.

[13] Clune, T, Eburn, M. *Blue green algae in the Murray Darling Basin: a case for Commonwealth leadership*. Australian Journal of Emergency Management, 2017.



Natural climate phenomena make Australia's climate highly variable. The record breaking 1997-2009 millennium drought was followed in 2010 and 2011 by record breaking rainfall and flooding. Climate change can exacerbate climate extremes. Figure adapted from Bureau of Meteorology.

- adverse and compounding psychological impacts on staff faced with more frequent emergency situations;
- reduced willingness and capability of personnel to respond to events the longer those events continue;
- an inability to retain staff trained in emergency management roles due to more consistently heightened levels of stress, increasing risk to personal safety, and more time spent responding to events; and
- increased degradation of non-human resources, such as assets and infrastructure, through increased usage.

Examples of climate impacts on a catchment management authority's emergency management assets, information and communication systems, and processes:

- increasing number and severity of extreme heat days may increase the amount of time assets are undergoing maintenance and the likelihood of asset failure;
- increasing number and severity of extreme heat days may increase the number of days where conditions exceed safe operating levels;
- increasing number and severity of extreme heat events may increase the number of days where conditions exceed safe asset operating levels;
- increasing severity, likelihood, or compounding nature of emergencies mean increased risks to key response (such as roads) and communications (such as powerline) infrastructure;
- static and inflexible emergency planning and response tools may entrench or exacerbate climate related emergency risks (for example, as sea levels rise and flood risks change due to climate change, are our flood hazard maps reflecting this changing risk?);
- more frequent, intense, and complex climate related emergencies may mean system resources and attention are more often diverted away from other systems, increasing the sector's vulnerability to non-climate emergencies and impacting on service delivery;
- increasing climate-related risks may place pressure on the insurability of assets – with flow on effects for the maintenance and operability of assets critical to effective emergency management response; and
- cross-border systems and processes are stretched as individual agencies are unable to lend the support they have in the past to neighbouring, or partner, agencies.

Key actions to improve catchment management authorities' ability to respond to climate enhanced emergencies

Prepare for unprecedented conditions in both the scale and intensity of events

- Where possible, response and recovery teams should be ready for a rapid scale up in resources and have surge capacity resources available to call in for quick response.
- Ensure safety, welfare and fatigue guidelines are in place and well understood by the emergency workforce.
- Improve the robustness of models for the prediction of emergency events such as floods, water contamination events and bushfire by investing in data capture across Victoria's varying geographical regions.
- Engage in municipal land use planning and development to ensure climate change is appropriately factored into land use planning, particularly in flood prone areas.
- CMAs should consider forecasting the change in risks resulting from climate change alongside existing risks in emergency management plans guiding prevention, preparedness, response and recovery.
- Response and recovery planning should incorporate an assessment of multiple contingencies, scenarios with consequences potentially beyond the norm, and a broad range of response options with contingencies.

Undertake climate risk assessments and scenario planning to determine risks to business continuity, public safety, key assets (infrastructure and environmental), and emergency event mitigation strategies

- Factor climate change into emergency risk assessment as an assumed business-as-usual consideration.

- Establish current risks and apply plausible future climate change scenarios to determine where risks amplify.
- Rank and prioritise critical assets for protection and assess likely consequences to those assets.
- Consider how climate change impacts may affect the life, durability and performance of these prioritised assets, and adjust designs and maintenance accordingly.
- Determine mitigation strategies to maintain business continuity, and to protect public safety and assets.
- Build in interdependency risks into risk management processes. Under increasingly complex emergencies, more risks may "belong" to other organisations.

Improve arrangements with neighbouring regional and municipal agencies

CMAs have strong and well-established relationships with their regional and municipal partners and the local community. However, cross-border emergencies are likely to become more complex – requiring more participants with different organisational responsibilities and divergent roles to become involved in response. As such, strong partnerships are now as important as ever. CMAs should:

- identify the entities within and outside the water sector which they are dependent on for key service delivery;
- determine their criticality and identify key priority areas for action to improve collaboration and resilience;
- engage with priority agencies to ensure alignment of plans and test collective emergency response; and
- examine and test the mutual aid arrangements and agreements in place with other emergency responders.

Useful resources: climate impacts & adaptation

The Victorian Water and Climate Initiative

Building on the *Victorian Climate Initiative*, the *Victorian Water and Climate Initiative* reports on research into the impact of climate change on Victoria's water resources. Contact hcs.team@delwp.vic.gov.au for more information on these initiatives and information on plausible future climate scenarios for rainfall for Victorian water sector use.

The Victorian Climate Projections initiative 2019

The *Victorian Climate Projections 2019* provides various plausible scenarios of future climates to 2090 for use. The projections cover Victoria at a 5km by 5km scale and include a range of variables for moderate and high greenhouse gas emissions scenarios. The initiative produced data sets of projected changes for 12 climate variables for 10 regions on annual, seasonal and monthly time scales, as well as 10 regional reports outlining climate projections for different regions across Victoria.

WSAA's climate change adaptation guidelines (**click here**)

While evidence suggests that rainfall extremes are increasing, there is a lack of corresponding evidence to suggest that flood magnitudes have increased in rural catchments across Victoria. Despite this, catchment management authorities will need to ensure they are prepared for more likely, more intense, more frequent, and overlapping emergency events under climate change. Credit: Corangamite CMA (top), Horsham Rural City Council (middle), Victoria State Emergency Service (bottom)