CLIMATE-READY VICTORIA

VICTORIA State Government

GRAMPIANS

How climate change will affect the Wimmera Southern Mallee and Central Highlands and how you can be climate-ready

The Grampians region has already become warmer and drier – a climate trend likely to continue into the future. Local residents, businesses and communities are changing the way they do things in response. Getting climate-ready involves understanding how climate change is likely to affect you and your region, and working out ways to adapt. Everyone can contribute to the Grampians region's climate-ready future.

GRAMPIANS HAS BEEN GETTING WARMER AND DRIER. IN THE FUTURE THE REGION CAN EXPECT:

- temperatures to continue to increase year round
- more hot days and warm spells
- fewer frosts
- less rainfall in autumn, winter and spring
- more frequent and more intense downpours
- harsher fire weather and longer fire seasons

HOW WILL THESE CHANGES AFFECT YOU, AND WHAT CAN YOU DO ABOUT THEM?

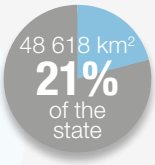
This publication highlights the impacts climate change will have on the Grampians region. It gives examples of how people are already becoming climate-ready, with links to more detailed information.

While this publication is about adapting to climate change, reducing your carbon emissions by reducing energy use and switching to renewable energy sources is also important in getting climate-ready. For more information on reducing your emissions, visit www.climatechange.vic.gov.au.

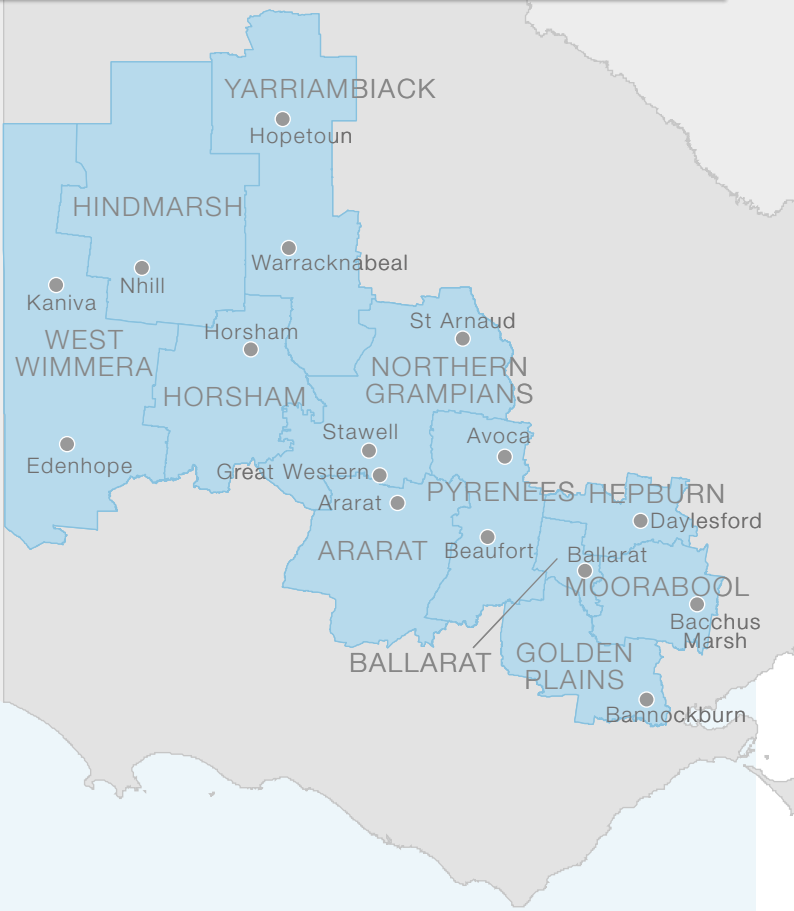
OUR CHANGING CLIMATE

GRAMPIANS AT A GLANCE

11 local government areas



approximately **224 000**
4% of the state



RECENT CLIMATE

Summers are warm to hot in the Grampians region, with an average maximum temperature of around 27 to 30°C in the west and 25°C in the east. In winter, average maximum temperatures in the west are mostly around 13 to 15°C and around 10°C in the east. Frosts are common. Average annual rainfall varies from up to 1000 mm in the Grampians to as low as 300 mm in the northern plains. Generally, rainfall is greatest in winter and spring.

For more information about some of the drivers of Victoria's climate, visit the Climatedogs website.

CLIMATE VARIABILITY AND CHANGE

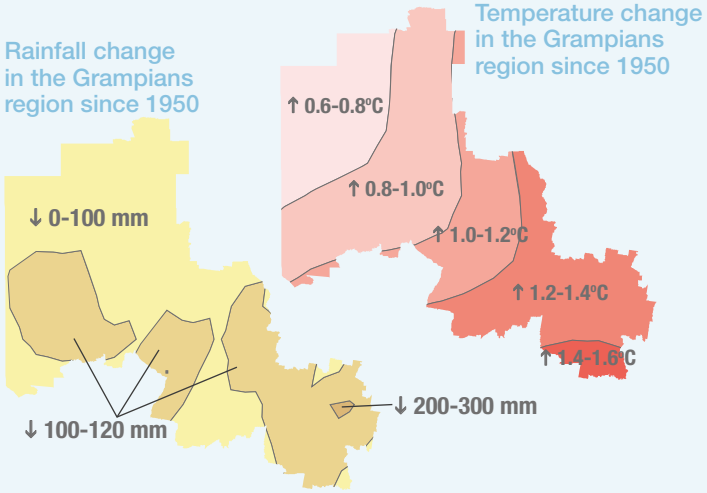
Our climate varies – it always has and always will. This climate variability means that some periods are cooler and wetter than average (as was the case in the 1970s), while others are hotter and drier (such as during the Millennium Drought, 1996–2009). However, due to climate change, the long-term average is changing. Future climate will be different from that in the past.

IT'S GETTING WARMER AND DRIER

Over the past 100 years, global surface air temperatures have risen by almost 1°C. Both the atmosphere and the oceans have warmed. Human activity is causing climate change, through our release of greenhouse gases from the burning of fossil fuels, land use change and agriculture. Atmospheric concentrations of carbon dioxide are now more than 40% higher than they were before industrialisation.

In the Grampians region, the rate of warming increased since 1960.

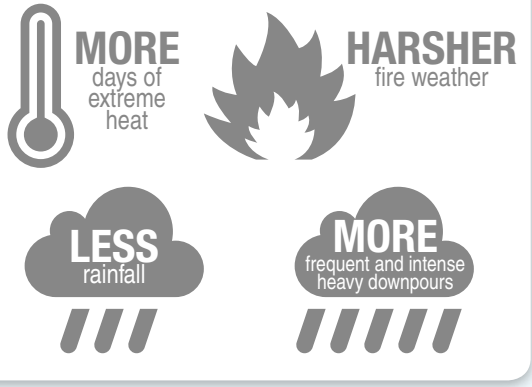
On average, rainfall has declined since the 1960s, especially in autumn. The harsh Millennium Drought (1996 to 2009) ended with two of the wettest years on record in 2010–11.



HOW DO WE GET CLIMATE-READY?

Being climate-ready in the Grampians region involves knowing the climate risks and impacts for the region, and making changes so that we can take advantage of the opportunities and reduce the negative impacts.

GRAMPIANS CLIMATE RISKS



GETTING CLIMATE-READY AT A GLANCE

	Primary production	Infrastructure	Tourism	Health and community	Environment
KEY CLIMATE RISKS	↓ rainfall ↑ temperature ↑ hot days ↑ fire weather	↑ fire weather ↑ flooding ↑ hot days ↑ heatwaves	↑ temperature ↑ fire weather ↑ heatwaves	↑ heatwaves ↑ flooding ↑ fire weather ↑ solar radiation	↓ rainfall ↑ fire weather ↑ hot days
POTENTIAL IMPACTS	Earlier flowering and planting times Changed distribution of pests and diseases Farm business affected by bushfire Changes in pasture growth Reduced water security	Increased flood damage Increased maintenance costs Increased disruption to services	Increased threats to tourism infrastructure Damage to popular environmental sites Risks to tourists unfamiliar with conditions	More stress on health and emergency services More heat-related deaths, particularly among the elderly and disadvantaged Mental health effects Changes in disease occurrence	Amplification of existing threats to flora and fauna Changes to habitat Altered disturbance regimes Changing dynamics of invasive species
CLIMATE-READY ACTIONS	Consider enterprise diversification Establish shelter belts to increase shade Diversify feed and fodder sources Plan for a secure water supply Regularly access long and medium range outlooks, as well as short range weather forecasts	Consider future climate when locating new infrastructure Consider heat resilience in transport upgrades Increase road heights Increase stormwater capacity Diversify sources of power and water, including decentralised technologies	Communicate risk to visitors Implement emergency planning for tourist sites Undertake business continuity planning Multi-skill staff Consider enterprise diversification Prepare for changing seasonal demand	Use cost-effective pedestal fans in heatwaves Use existing social networks to support vulnerable community members Implement/use rural mental health care programs Undertake emergency planning for schools, hospitals, services	Target new and emerging diseases and pests Increase green urban infrastructure and urban biodiversity Link habitats to allow species to move Consider moving selected populations to new areas

GETTING CLIMATE-READY

HOW CLIMATE-READY ARE YOU?

Getting climate-ready is an ongoing process, and there's no single recipe for success. Many of the risks we face are not new. However, there are likely to be changes in duration, frequency and severity of some weather events, as well as changes to the climate.

To determine what's important to you and what climate change responses might work for your situation, consider these questions:

- How might you – your health, property, business, community, industry – be affected by:
  - higher temperatures and more frequent heatwaves?
  - less autumn, winter and spring rainfall, more time in drought, decreased water availability or flooding?
  - harsher fire weather?
- How might your services, suppliers, clients or customers be affected?
- Are you making any long-term decisions now that will be impacted by future climate change?
- What action could you take now to prepare? What are others in your region doing? What benefits have they experienced?
- Can you prioritise actions that also have other benefits, such as emissions reduction, financial, community or environmental advantages?
- Does climate change present any opportunities you can take advantage of?

The information, case studies and links in this brochure can help get you started.

CLIMATE-READY NOW

Victorians have always been good at managing the ups and downs of climate. Now that we have a clearer picture of the way in which climate is likely to change in future, there's lots that we can do to become climate-ready. Decisions we make now will affect how well we cope with the changing climate, which in turn will affect future economic and employment conditions. Decisions range from simple to complex, and some will need to be made sooner than others. Your decisions may depend on the local climate in your part of the region.

There are many good examples of communities in your region and in Victoria preparing for and adapting to climate change. The ⓘ links you directly to the source or visit www.climatechange.vic.gov.au for a full list of links.

PRIMARY PRODUCTION

The north of the region is highly dependent on agriculture, which represents up to 45% of employment in some areas. Agriculture is centred on dryland farming, including cereals, wool and sheep meat industries.

The Wimmera Southern Mallee benefited from a major upgrade to the Wimmera Stock and Domestic water supply through the piping of the entire channel network. The water savings are supporting the development of new businesses within the network.

This relatively undiversified economy means that the Wimmera Southern Mallee faces challenges as a result of climate change impacts, particularly for cereal cropping and the wool and sheep meat industry. These include lower cereal and wool production, more heat stress, less reproduction, and lower growth rates. For cropping, the lower incidence of frost may allow for earlier planting and lead to increased yields if there is enough soil moisture. However, while the total annual number of frost days is expected to decrease, an increase in spring frosts is possible, especially over the next decade or so.

Through the Birchip Cropping Group, researchers worked with farmers to assess how different climate change scenarios are likely to affect cereal crop yields. The costs and benefits of different adaptation options were examined, including changed crop varieties and planting schedules, to see the extent to which farmers could offset the adverse impacts of climate change. ⓘ

The Australian Grain Free Air CO_2 Enrichment (AGFACE) facility, based in Horsham, studies the interactions of increased carbon dioxide levels on crop productivity in an open field setting. This world leading research is identifying how to take advantage of increased crop growth rates, without compromising quality and nutritional value. ⓘ

INFRASTRUCTURE

The region has significant infrastructure assets. The Wimmera Mallee Pipeline supplies water to townships, farms and industry. The Dooen Intermodal Freight Terminal includes bulk container and grain handling facilities. Ararat and Stawell house large abattoirs. There are wind farms at Waubra, Challicum Hills and Daylesford.

The Stawell airport has recently been upgraded as a strategic location for air-based firefighting operations. Critical services, such as power, water, sewerage and telecommunications will be susceptible to extreme weather events.

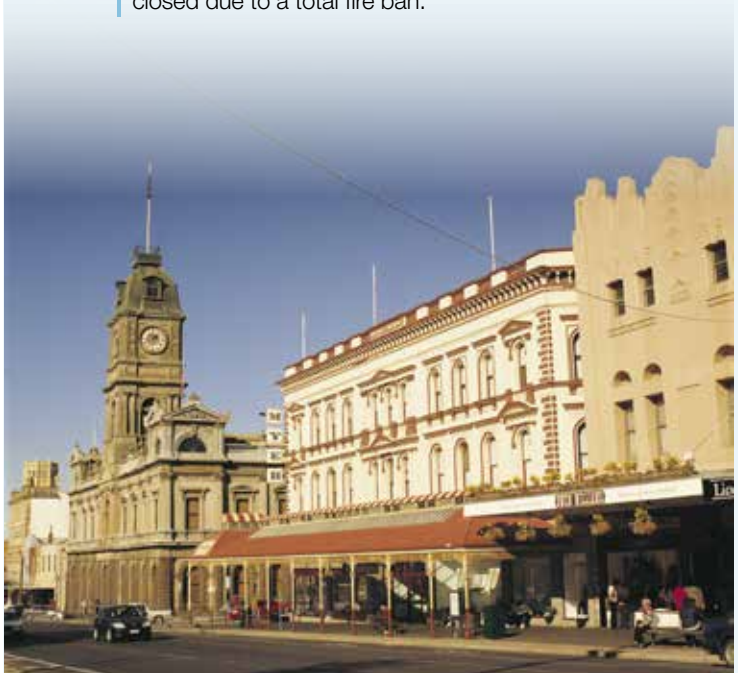
The Stawell Stormwater Alternative Natural Solutions project demonstrates how stormwater can be used to drought-proof community assets. The project constructed a series of water quality treatment ponds, storage dams and transfer infrastructure to irrigate sporting facilities, gardens and public open spaces. The project saves over 74 megalitres per year.

TOURISM

The region contains renowned natural attractions such as the Grampians National Park, and other tourist focal points such as Halls Gap and the Daylesford mineral springs areas, which support a wide variety of tourism businesses. The region's wetlands and lakes provide fishing, camping and bushwalking.

Harsher fire weather in warmer conditions, especially during peak summer tourist seasons, and reduced water availability in wetlands and lakes pose serious challenges for this region.

Tourism operators are collaborating with Grampians Tourism, Northern Grampians Shire Council and Parks Victoria to identify alternative tourist revenue streams for when the Grampians National Park is closed due to a total fire ban.



HEALTH AND COMMUNITY

The region will continue to experience a rise in its ageing population, coupled with an increase of older 'tree changers' moving into the south-east of the region. These groups may need assistance to manage extreme heat, bushfires and flooding, increasing pressure on health and community care services. Managing heatwaves and heat stress will be an increasing priority due to the region's older housing infrastructure.

More frequent extreme weather events and impacts on the economy and jobs due to climate change may also affect the mental health of the community.

The Beaufort Hospital has installed a woodchip-fired bioenergy demonstration plant, building the resilience of the community by providing energy security for essential health services. It also reduces operating costs for the hospital, diversifies the local economy and uses a local waste product as fuel.

ENVIRONMENT

The Grampians region runs from Victoria's southern Central Highlands west to the broad expanse of the Wimmera Mallee.

The Grampians region is home to many species and ecological communities that are already under threat, such as the Wimmera Bottlebrush, the Smoky Mouse and the Red-tailed Black Cockatoo. The pressures on these species and communities will be increased by impacts of climate change, such as rising temperatures. Some species, such as the Brolga which lives in freshwater meadows or shallow freshwater marshes, may be particularly sensitive to changes in water availability.

The regional environment is threatened by warmer and drier conditions, reduced stream flows, more severe droughts, extreme weather events and harsher fire weather. This is likely to lead to reduced ecosystem health. Loss of biodiversity as a result of climate change will place greater stress on the personal and economic wellbeing of communities in the Grampians which depend on nature-based tourism and a healthy environment.

The Wimmera and North Central Catchment Management Authorities are developing climate change adaptation plans to provide further information about the impacts of climate change on natural resources. The plans will also identify priority actions for adaptation and mitigation and will be available in 2016.

FUTURE CLIMATE

LOOKING AHEAD

Climate projections for the Grampians region are based on sophisticated national and international **global climate models**. These models use the physical laws that govern the way the world's climate works to simulate the climate from high in the atmosphere to the depths of the oceans. The models run on some of the world's most powerful supercomputers, and successfully represent the important features of today's climate as well as those of past climate.

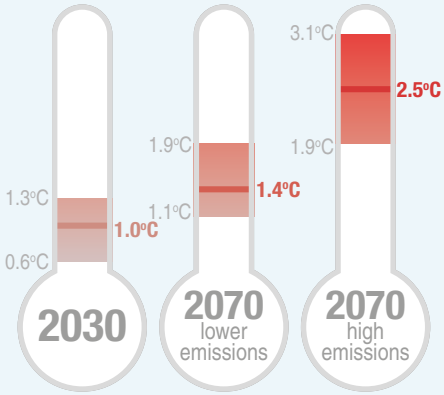
Maths and physics do not govern social and economic aspects of the future, so we don't know the impacts of population, the economy, policy decisions and technology on greenhouse gas emissions. To cover a range of possibilities, scientists use **emissions scenarios** called Representative Concentration Pathways (RCPs) to develop climate projections. These projections describe a **high emissions** future (using RCP8.5) and a **lower emissions** future (using RCP4.5). For the past 10 years we've tracked along the high emissions pathway. More information about how the projections were produced and guidance on their application are at climatechangeinaustralia.gov.au.

The climate is projected to continue to change over the coming century. The projections are given for **20-year periods centred on 2030 and 2070**, so the 2030 projections are for the period 2020–2039 and the 2070 projections are for the period 2060–2079. Given the similarity of the emissions scenarios up to 2030, only projections for the high emissions scenario for 2030 are used in this publication. Projections are represented as a change relative to the period 1986–2005.

UNDERSTANDING THE PROJECTIONS

The projections are presented as a **median (middle) value and a range** that excludes the lower and upper 10% of results.

For example, in 2070 under a high emissions scenario, average annual temperature is projected to rise by 2.5°C (1.9–3.1°C). In this case, the median temperature rise determined by all the models is 2.5°C; 90% of model results indicated a rise of at least 1.9°C and 90% of the model results indicated a rise of 3.1°C or less.



Projected annual average temperature changes for the Grampians region

FUTURE CLIMATE HORSHAM

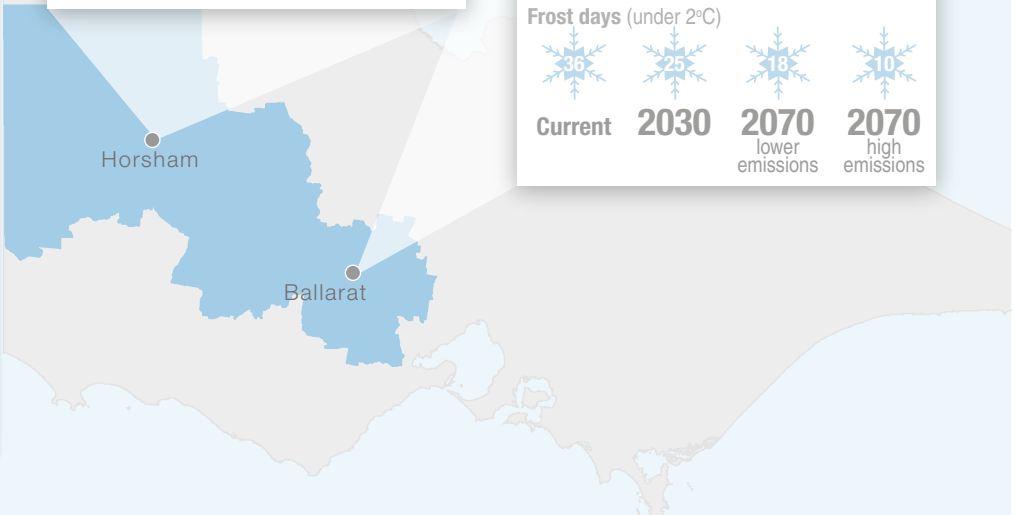
Average number of days per year

Hot days (over 35°C)

Current	2030	2070 lower emissions	2070 high emissions
18	25	29	36

Frost days (under 2°C)

Current	2030	2070 lower emissions	2070 high emissions
33	23	17	10



Our **confidence** in the projections is based on a combination of scientific understanding, past climate changes, evaluation of climate model performance and the extent of climate model agreement. Very high confidence indicates robust evidence and high model agreement.

very high confidence	****
high confidence	***
medium confidence	**

TEMPERATURE

Average temperatures will continue to increase in all seasons ****

For the near future (2030), the annually averaged warming is projected to be around 0.6 to 1.3°C above the climate of 1986–2005. By the year 2070, the projected range of warming is 1.1 to 3.1°C, depending on future emissions.

There will be more hot days and warm spells ****

There will be a substantial increase in the temperature reached on hot days. There will be more hot days (greater than 35°C), and warm spells will last longer.

There will be fewer frosts ***

Frost-risk days will decrease.

FUTURE CLIMATE BALLARAT

Average number of days per year

Hot days (over 35°C)

Current	2030	2070 lower emissions	2070 high emissions
5	8	10	13

Frost days (under 2°C)

Current	2030	2070 lower emissions	2070 high emissions
36	25	18	10

RAINFALL

Natural climate variability will dominate any projected changes in the near future ***

In the near future (2030), year to year changes in rainfall will dominate trends caused by greenhouse gases. Recent research partly links the observed cool season rainfall reductions to climate change.

By 2070 there is projected to be less rainfall in the cool season *** but no rainfall changes in the warm season **

Overall, rainfall is likely to decrease, with the greatest decreases expected in spring and winter.

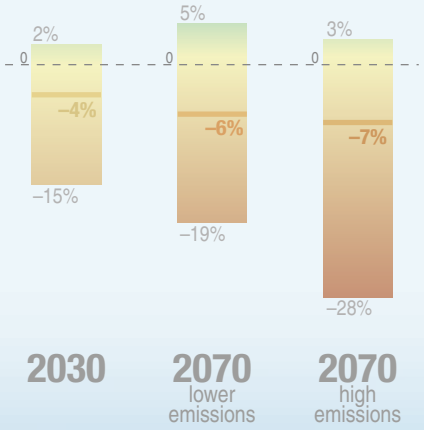
Conditions outside these projections are also possible, from either natural variability (such as extended drought) or climate changes that are outside the range we currently estimate.

Frequency and intensity of extreme rainfall events are projected to rise ***

Despite an overall trend of declining rainfall, more of the rain that does fall will be in increasingly extreme downpours. This is likely to lead to an increase in the incidence of flooding events, particularly in urbanised and small catchments.

Time spent in drought is projected to increase over the course of the century **

Projected annual average rainfall changes for the Grampians region



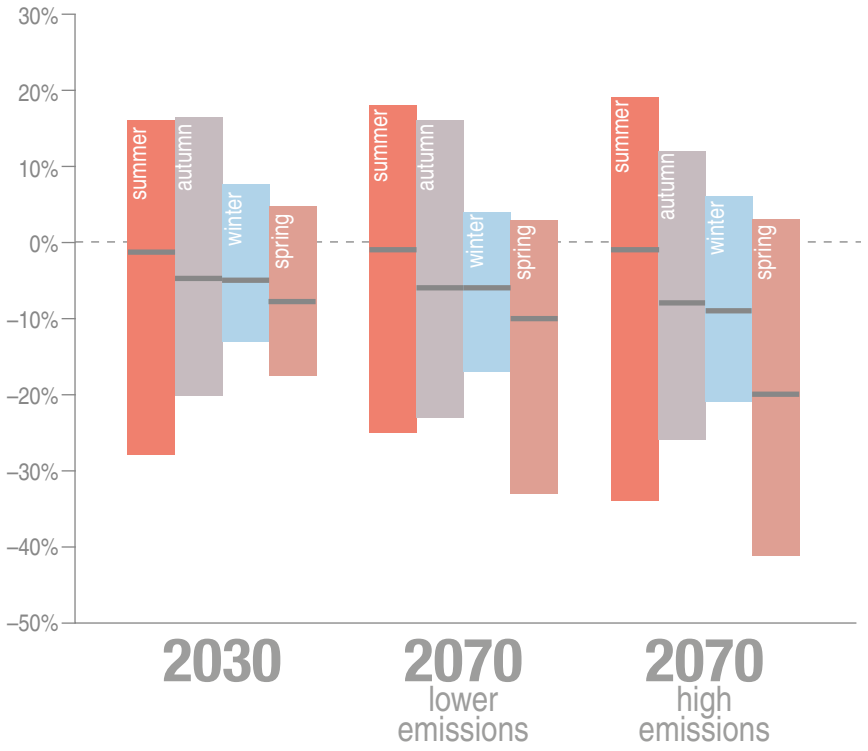
FIRE WEATHER

Fire weather is projected to be harsher in the future ***

Fire weather is a measure of fuel dryness and hot, dry, windy conditions. An increase in frequency of very high and extreme fire danger days is projected.

More detailed information on these and other climate variables is available at **www.climatechange.vic.gov.au**

PROJECTED SEASONAL RAINFALL CHANGE (%) FOR GRAMPIANS



The bar indicates the range and the middle value is shown by the horizontal line.

GRAMPIANS 2050

In 2050, under high emissions, the climate of Ararat will be more like the climate of Bathurst now; Horsham more like Echuca; and Warracknabeal more like Swan Hill.

To find out what the climate will be like in the future where you live, use the Climate Analogues tool on the Climate Change in Australia website at www.climatechangeinaustralia.gov.au. The tool matches projected rainfall and maximum temperature with the current climate experienced in another location for 20-year periods centred on 2030, 2050 and 2090.

ARE YOU CLIMATE-READY?

There are many resources available to help you get climate-ready.

A full list of links to projects mentioned in this brochure is available at www.climatechange.vic.gov.au.

There are similar brochures for other Victorian regions and a statewide brochure, available at www.climatechange.vic.gov.au.

To find out more about what the Victorian Government is doing to make the state more climate-ready, or for more information about Victorian Government climate policy, visit www.climatechange.vic.gov.au.

Information about the impacts of climate change on water availability and supply is available from the Victorian Climate Initiative website at www.cawcr.gov.au/projects/vicci/.

Information about the changes in our climate since the beginning of last century and trends we're seeing now is available from the Bureau of Meteorology website at www.bom.gov.au.

Information about the future climate and its impacts, and adaptation strategies, is available from the Climate Change in Australia website, produced by CSIRO and the Bureau of Meteorology, at www.climatechangeinaustralia.gov.au.

Climate-ready Victoria: Grampians. November 2015.

Climate change projections in this publication have been generated by CSIRO on behalf of the Victorian Government, and are based on national projections released by CSIRO and the Bureau of Meteorology. The Bureau of Meteorology has kindly supplied data on climatic trends. CSIRO has reviewed this publication.

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