

BARWON SOUTH WEST



How climate change will affect the Barwon South West region and how you can be climate-ready

The Barwon South West 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 Barwon South West region's climate-ready future.

BARWON SOUTH WEST 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, and fewer frosts



less rainfall in winter and spring



more frequent and more intense downpours



harsher fire weather and longer fire seasons



rising sea level



increased frequency and height of extreme sea level events

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

This publication highlights the impacts climate change will have on the Barwon South West 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.

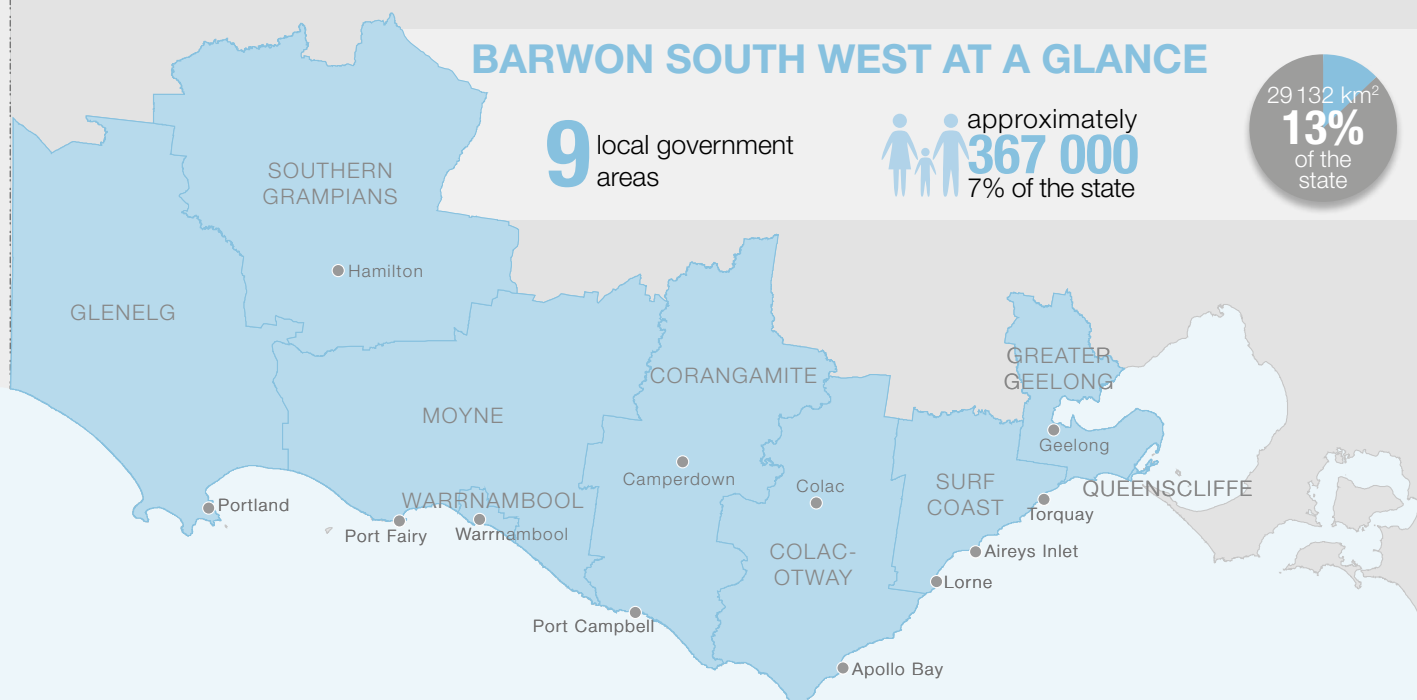
OUR CHANGING CLIMATE

BARWON SOUTH WEST AT A GLANCE

9 local government areas

approximately
367 000
7% of the state

29 132 km²
13%
of the state



RECENT CLIMATE

The Barwon South West region has a temperate climate, with mild to warm summers and cold winters. Summer average maximum temperatures are around 22 to 24°C near the coast and in elevated areas, and 25 to 27°C inland. Winter average maximum temperatures are around 12 to 14°C.

Rainfall occurs mostly in winter and spring and is generally the result of rain-bearing weather systems coming from the west. The area around Hamilton and Warrnambool receives around 600–700 mm of rain per year, with Cape Otway receiving around 1000 mm annually.

For more information about some of the drivers of Victoria's climate, visit the [Climatedogs website](#).

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.

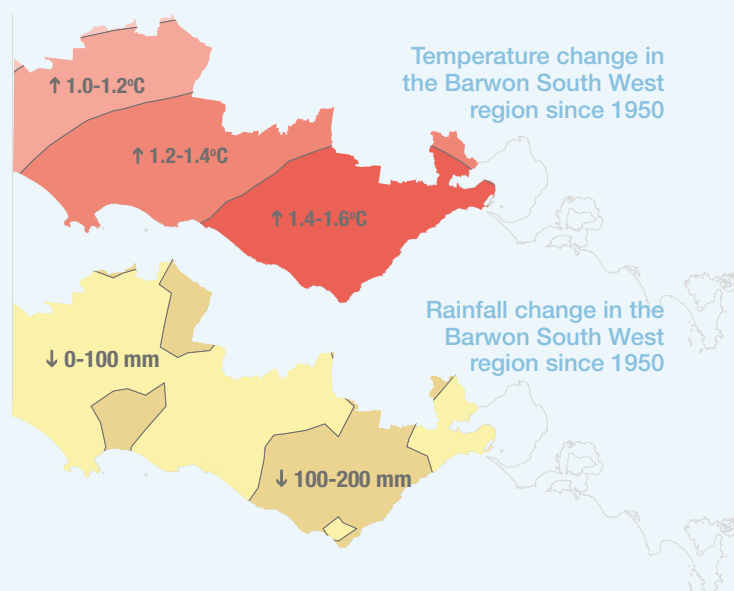
In the Barwon South West region, the rate of warming has increased since 1960.

On average, rainfall has declined since the 1950s, especially in autumn. The harsh Millennium Drought (1996 to 2009) followed the wet decades of the 1950s and 1970s.

Sea level today is approximately 225 mm higher than in 1880.

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). However, due to climate change, the long-term average is changing. Future climate will be different from that in the past.



HOW DO WE GET CLIMATE-READY?

Being climate-ready in the Barwon South West 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.

BARWON SOUTH WEST CLIMATE RISKS



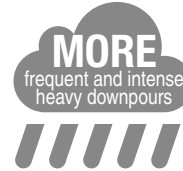
MORE
days of
extreme heat



HARSHER
fire weather



LESS
rainfall



MORE
frequent and intense
heavy downpours



RISING
sea level

GETTING CLIMATE-READY AT A GLANCE



KEY CLIMATE RISKS

Primary production

- ↓ rainfall
- ↑ temperature
- ↑ hot days
- ↑ fire weather

Infrastructure

- ↑ sea level
- ↑ fire weather
- ↑ heatwaves
- ↑ storm surges

Tourism

- ↑ temperature
- ↑ sea level
- ↑ fire weather

Health and community

- ↑ heatwaves
- ↑ fire weather
- ↑ solar radiation

Environment

- ↓ rainfall
- ↑ sea level
- ↑ fire weather
- ↑ temperature
- ↑ ocean acidification

POTENTIAL IMPACTS

- Changed fodder or pasture production pattern
- Changed distribution of pests and diseases
- Heat stress on livestock and crops
- Farm business affected by bushfire
- Reduced water security
- Reduced area suitable for forestry

- Erosion and infrastructure damage along the coastline
- Increased maintenance cost
- 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, e.g. for dairy cows
- Consider different crop varieties and sowing times
- Plan for a secure water supply

- Consider future climate and sea level rise when locating new infrastructure
- Increase road heights
- Adopt water sensitive urban design solutions
- Insure public assets

- Implement emergency planning for tourist sites
- Adopt appropriate cancellation policies
- Consider enterprise diversification
- Prepare for changing seasonal demand

- Use existing social networks to support vulnerable community members
- Implement/use rural mental health care programs
- Undertake emergency planning for schools, hospitals, services
- Increase green spaces and cool zones for heat stress

- Target new and emerging diseases and pests
- Increase green urban infrastructure and urban biodiversity
- Link habitats to allow species to move
- Consider moving species 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 winter and spring rainfall, more time in drought, decreased water availability or flooding?
 - sea level rise, increased height of extreme sea level events and coastal erosion?
 - 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 **i** links you directly to the source or visit www.climatechange.vic.gov.au for a full list of links.



PRIMARY PRODUCTION

Agriculture and forestry are the region's largest employers, together accounting for around 16% of the workforce. Commercial fishing is also important.

Dairy, beef and sheep grazing, broadacre cropping and viticulture are important components of agriculture. Barwon South West is Australia's largest milk production area, producing 38% of Victoria's milk and 25% of the national production, contributing about \$1 billion annually to the regional economy. The dairy industry is sensitive to reduced water supply and higher temperatures.

Forestry is an increasingly important sector with nearly 20% of the nation's plantation forests here or nearby. Warmer and drier conditions will challenge forestry, as will harsher fire weather.

Drying will lead to reduced water logging in some parts of the region, which will be beneficial for cropping.

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.



Dairy Australia's Dairy Climate Toolkit provides details of practices that profitably reduce greenhouse gas emissions from dairy farm systems and adaptation strategies such as addressing heat stress and responding to changes in pasture.





INFRASTRUCTURE

Significant infrastructure includes an oil refinery (Geelong), aluminium smelter (Portland), gas fields in the Otway Basin and wind farms. Bulk ports at Portland and Geelong provide direct access to national and international markets.

Rising sea level threatens coastal infrastructure, houses and beaches, with flow-on effects to transport, tourism and the natural environment. Coordination and strategic planning across municipalities will be essential to manage this risk, as action by one council may affect the efforts of neighbouring councils.

Extreme weather events will threaten critical infrastructure and increase maintenance costs. Hot weather increases the risk of roads melting and train lines buckling. Critical services, such as power, water, sewerage and telecommunications, are susceptible to extreme weather.



The Port Fairy Local Coastal Hazard Assessment is providing a detailed assessment of sea level rise impacts on the community and developing a comprehensive response plan.



TOURISM

Barwon South West includes iconic tourism destinations such as the Great Ocean Road, Port Campbell (featuring the Twelve Apostles and Loch Ard Gorge), Grampians and Great Otway National Parks, surf beaches, the Kanawinka Geotrail and the Budj Bim cultural heritage precinct. Almost half of all international visits to regional Victoria are in the Great Ocean Road region.

Sea level rise and coastal erosion will threaten infrastructure, such as low-lying roads, caravan parks and Surf Life Saving clubs. Heavy rainfall can cause landslips on access roads to popular tourist areas, such as the Grampians and Great Ocean Road. Extreme weather events, in locations such as along the Great Ocean Road, can threaten community and visitor safety, tourism infrastructure and damage popular environmental sites.



Countrywide Cottages in the Otway Ranges is a member of the CFA East Otways Tourism Fireguard group. Working together with others with similar businesses, Countrywide Cottages made several changes to their business to improve bushfire safety, including updating and strengthening their fire plan and providing clear information to guests.



HEALTH AND COMMUNITY

The region's population is older than the Victorian average, with several locations of social disadvantage. These groups may need assistance to manage extreme heat, bushfires and flooding. 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.



Ten local governments are collaborating with the State Government and other agencies to help communities respond to future extreme weather events. Climate Resilient Communities of the Barwon South West is using region-specific data to publicise the risks and opportunities.



South Grampians Shire Council has engaged with the community to assess vulnerability to extreme weather events, weather and emergencies. The project explored how vulnerability is likely to change in the future and the actions that can be taken to manage the impacts of climate change.



The Millennium Drought had a major impact on the farming sector. In response, the Western District Health Service established the Sustainable Farm Families Program. The objective was to improve mental wellbeing and encourage sustainable and balanced farming lifestyles.



ENVIRONMENT

The region contains highly productive agricultural land, natural lakes, wetlands and waterways. The major rivers include the Hopkins, Glenelg and Barwon. The Great Otway, Port Campbell and Grampians National Parks contain large areas of remnant vegetation and significant biodiversity. The region's 800 km of coastline stretches from the South Australian border past the Queenscliff Heads in the east.

The coasts of the Barwon South West have significant recreational and biodiversity value. They are highly sensitive to climate change impacts such as sea level rise, increased storm surge and coastal erosion.

The region is home to many species and ecological communities that are already threatened. The native grasslands of the Victorian Volcanic Plains, for example, are one of the most threatened ecological communities in Victoria, and home to iconic species such as the Striped Legless Lizard, the Eastern Barred Bandicoot, Golden Sun Moth and Grassland Sun-orchid. The impacts of climate change are likely to increase stresses on species that are already under threat.

The region's diverse landscapes and natural systems are under threat from sea level rise, changes in water availability, heat stress and extreme weather events. This will place greater stress on the personal and economic wellbeing of communities in the Barwon South West.



Glenelg Hopkins and Corangamite Catchment Management Authorities are developing 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 Barwon South West 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.

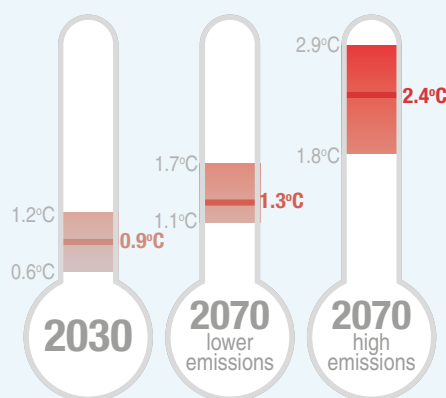
Maths and physics do not govern social and economic aspects of the future, so we don't know the impacts of population, the economy, policy decisions and technology on greenhouse gas emissions. To cover a range of possibilities, scientists use **emissions scenarios** called Representative Concentration 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, temperature is projected to rise by 2.4°C (1.8–2.9°C). In this case, the middle temperature rise determined by all the models is 2.4°C; 90% of model results indicated a rise of at least 1.8°C and 90% of the model results indicated a rise of 2.9°C or less.



Projected annual average temperature changes for the Barwon South West region

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 1.2°C above the climate of 1986–2005. By the year 2070, the projected range of warming is 1.1 to 2.9°C, depending on future emissions.

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

Extreme temperatures are likely to increase at a similar rate to average temperature. 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 HAMILTON

Average number of days per year

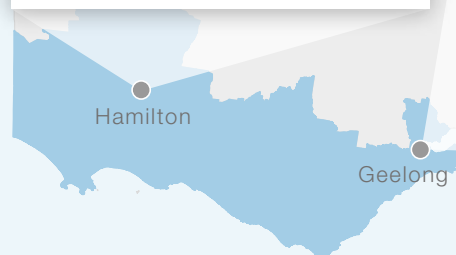
Hot days (over 35°C)



Frost days (under 2°C)



Current 2030 2070 lower emissions 2070 high emissions



FUTURE CLIMATE GEELONG

Average number of days per year

Hot days (over 35°C)



Frost days (under 2°C)



Current 2030 2070 lower emissions 2070 high emissions



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.

There is projected to be less rainfall in winter and spring ***

By the middle of the century, and under high emissions, winter and spring rainfall reductions will become evident against natural variability.

Changes to summer and autumn rainfall are possible but not clear, although there is a tendency for a decrease in autumn.

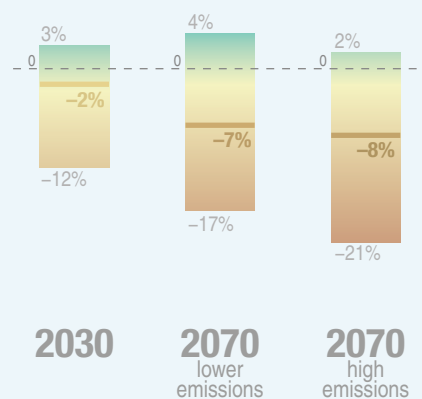
Conditions outside these projections are also possible, from either natural variability (such as extended drought) or climate changes that are outside the range we currently estimate.

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 Barwon South West 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.



MARINE AND COAST

Sea level will continue to rise ****

By 2030 the projected sea level rise for studied locations is 0.08 to 0.18 m above the 1986–2005 level.

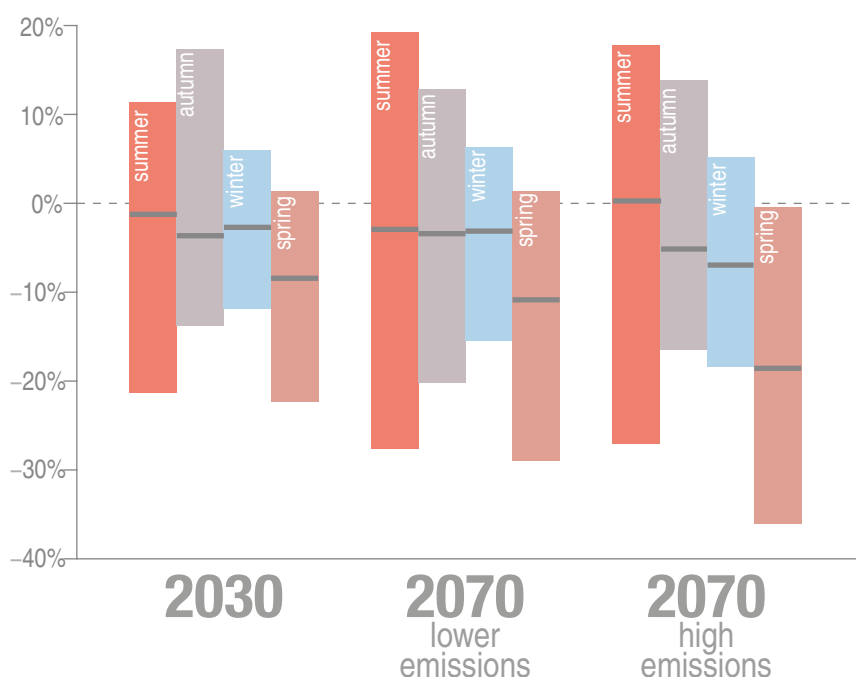
By 2070, sea level is projected to rise 0.20 to 0.46 m at studied locations under lower emissions and 0.25 to 0.56 m under high emissions. However, depending how much the Antarctic ice sheet melts, these levels may be higher.

Height of extreme sea level events will also increase ****

The ocean will get warmer and more acidic ****

Sea surface temperature is projected to increase in the range of 1.1 to 2.3°C by 2070 under high emissions. The sea will also become more acidic, with acidification proportional to emissions growth.

PROJECTED SEASONAL RAINFALL CHANGE (%) FOR BARWON SOUTH WEST



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

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

BARWON SOUTH WEST 2050

In 2050, under high emissions, the climate of Hamilton and Colac will be more like the climate of Melbourne; and Warrnambool will be more like Lakes Entrance.

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: Barwon South West. 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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