

# LODDON MALLEE



How climate change will affect the Loddon Mallee region and how you can be climate-ready

The Loddon Mallee 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 Loddon Mallee region's climate-ready future.

## LODDON MALLEE 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 Loddon Mallee 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](http://www.climatechange.vic.gov.au).

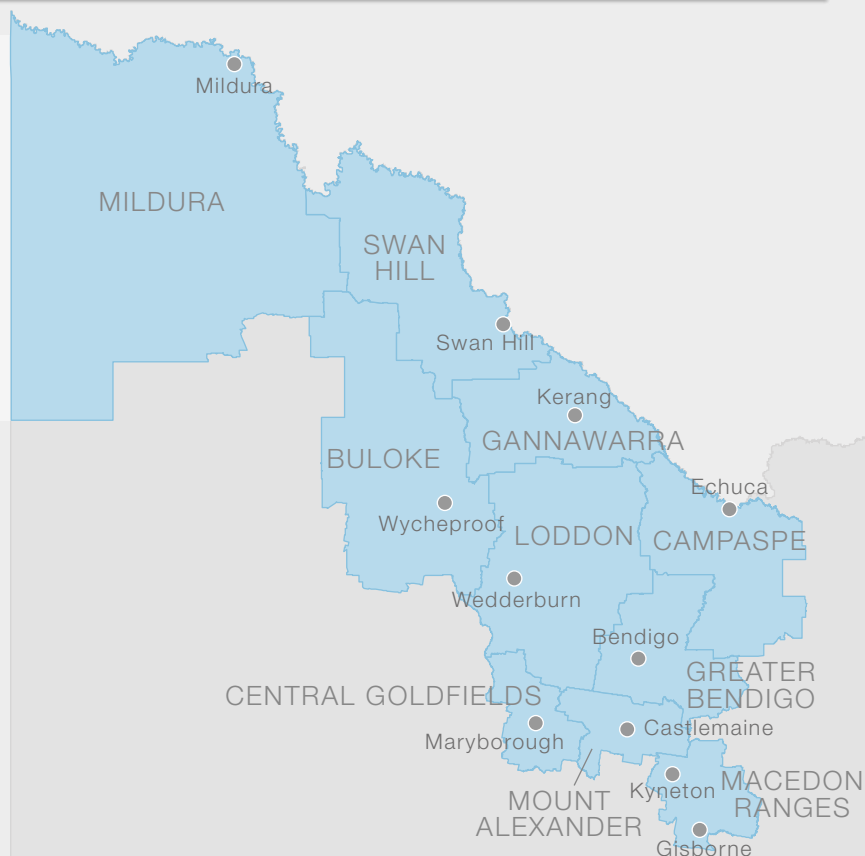
# OUR CHANGING CLIMATE

## LODDON MALLEE AT A GLANCE

**10** local government areas

approximately  
**309 000**  
6% of the state

58 986 km<sup>2</sup>  
**26%**  
of the state



## RECENT CLIMATE

The north of the region has hot summers with average maximum temperatures of 30°C. Winters are mild with an average daily temperature around 10°C. The southern part of the region experiences cool and relatively wet winters and warm, dry summers. Average maximum temperatures are less than 25°C in the elevated southern regions. Frosts are common throughout the Loddon Mallee region.

The north is dry, with just 330 mm of rainfall each year. Evaporation is high. Rainfall is considerably higher in the south, with the Macedon Ranges experiencing between 750 mm and 800 mm annually.

For more information about some of the drivers of Victoria's climate, visit the [Climatedogs website](https://www.climatedogs.com.au/).

## 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.

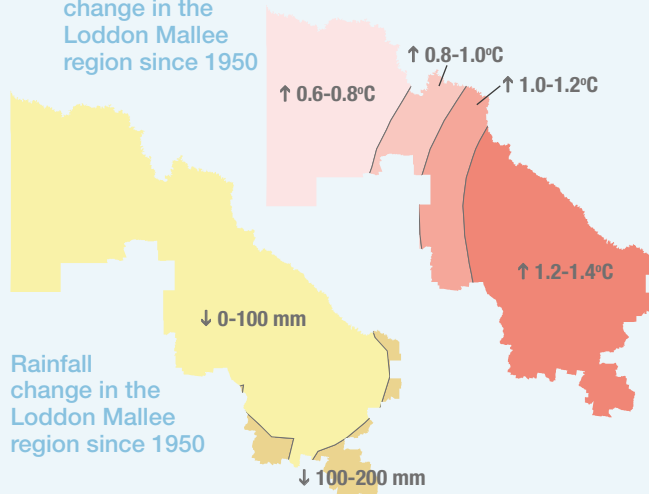
## IT'S GETTING WARMER AND DRIER

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 Loddon Mallee region, the rate of warming has increased since the 1960s.

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.

Temperature change in the Loddon Mallee region since 1950



## HOW DO WE GET CLIMATE-READY?

Being climate-ready in the Loddon Mallee 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.

### LODDON MALLEE CLIMATE RISKS



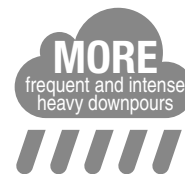
**MORE**  
days of  
extreme  
heat



**HARSHER**  
fire weather



**LESS**  
rainfall



**MORE**  
frequent and intense  
heavy downpours

## GETTING CLIMATE-READY AT A GLANCE



### KEY CLIMATE RISKS

#### Primary production

↓ rainfall  
↑ temperature  
↑ hot days  
↑ fire weather

#### Infrastructure

↑ fire weather  
↑ flooding  
↑ hot days  
↑ heatwaves

#### Tourism

↑ temperature  
↑ fire weather  
↑ heatwaves

#### Health and community

↑ heatwaves  
↑ flooding  
↑ fire weather  
↑ solar radiation

#### Environment

↓ rainfall  
↑ fire weather  
↑ hot days  
↑ temperature

### 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  
Consider different crop varieties and sowing times  
Plan for a secure water supply  
Re-sow pastures with varieties that account for changing seasonal and rainfall patterns

Insure public assets  
Consider future climate when locating new infrastructure  
Consider heat resilience in transport upgrades  
Increase stormwater capacity  
Diversify sources of power and water, including decentralised technologies

Communicate risk to visitors  
Undertake business continuity planning  
Multi-skill staff  
Diversify activity offerings  
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  
Implement monitoring and response plans for new vectors of communicable diseases

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 **i** links you directly to the source or visit [www.climatechange.vic.gov.au](http://www.climatechange.vic.gov.au) for a full list of links.



## PRIMARY PRODUCTION

Agriculture is the largest employer in the northern part of the region, and underpins the region's economy. The dominant agriculture activities are dryland farming, irrigated horticulture and fruit processing, and irrigated agriculture, including dairy processing. The region produces over 80% of Victoria's wine grapes.

Intensive animal industries are expanding in Loddon Mallee North. The Charlton Feedlot in Buloke Shire is one of the largest feedlots in Victoria, and the largest employer within the shire.

Horticulture and vegetables are highly sensitive to reduced water availability and increasing salinity. Changes in temperature will alter planting and harvesting times. Pest and disease incidence is likely to change. Intensive animal industries will need to provide increased protection for stock from extreme temperatures. 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.







## INFRASTRUCTURE

There are planned expansions of the airport and rail network and a large redevelopment of the hospital in Bendigo. Mildura is developing a major marina and conference centre.

The Loddon Mallee transport network underpins the regional economy, enabling transport of goods and commodities from and through the region to domestic and international markets. In addition to the road network, there are passenger and freight rail services and Mildura Airport.

Transport infrastructure will be increasingly exposed to periodic flooding and increased heat loading. Long hot spells will weaken road surfaces and exposure to extreme heat events could result in road rutting and cracking, and bridge expansion joint cracking.



The Goulburn-Murray Water Connections Project is creating a stronger, more sustainable, future for irrigation agriculture across the Goulburn-Murray Irrigation District. Victoria and the Commonwealth are investing more than \$2 billion to create a network that delivers water when and where it's needed.



## TOURISM

Loddon Mallee has a \$1 billion per annum tourism industry stimulated by 7.7 million visits to the area's rich natural and cultural assets, including rivers and waterways, forests and parks, food and wine, and unique heritage attractions.

Increased heatwaves, harsher fire weather and flooding risk will threaten growth in the industry. Significant reductions in river flows will adversely affect recreational use.



Mildura Tourism is addressing climate change through their Mildura Tourism Three Year Strategic Plan 2015-2017. The Plan includes actions to help the tourism industry adapt to the impacts of climate change, such as conducting campaigns focused on building visitation during all seasons.



## HEALTH AND COMMUNITY

The region has higher rates than the Victorian average of obesity, chronic disease, disability and high-risk health behaviours such as smoking. Vulnerable groups may need assistance to manage the impacts of climate change.

Increased hot days and heatwaves will exacerbate existing health risks, putting greater pressure on hospitals and emergency services. More frequent extreme weather events and impacts on the economy and jobs due to climate change may affect the mental health of the community.



Greater Bendigo Rural Support Network is a collaboration between the City of Greater Bendigo, the Victorian Government and a range of organisations involved in rural sector issues. The network seeks to enhance the social, financial, mental and physical well-being of individuals, groups and rural communities. It enables information sharing, collaboration between agencies and the provision of social and economic support to rural communities during and after extreme weather events.



Loddon Shire Council has developed a sport and recreational facilities strategy that lists approaches to reducing water use, improving security of supply, and reducing leakage. The ultimate aim is 'drought proofing' sports facilities.



## ENVIRONMENT

The Loddon Mallee region is part of the Murray-Darling Basin. There are numerous wetlands throughout the region, most of which only fill periodically in flood events. The Hattah-Kulkyne Lakes, Kerang Wetlands and Gunbower Forest wetland complexes are listed as a 'Wetland of International Significance' under the Ramsar Convention.

Increasing water demand for irrigation will add to pressure on wetlands and their surrounding environment. Warmer and drier conditions causing reduced stream flows, more severe droughts, and extreme weather events may lead to reduced ecosystem health. This will place greater stress on the personal and economic wellbeing of communities in the Loddon Mallee, as they are connected with the health of the environment.

The impacts of climate change are likely to increase pressure on already threatened biodiversity. Some species in the Loddon Mallee may be particularly sensitive to increasing bushfires, with the Malleefowl's specific habitat requirements affected by fire.



# FUTURE CLIMATE

## LOOKING AHEAD

Climate projections for the Loddon Mallee 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.

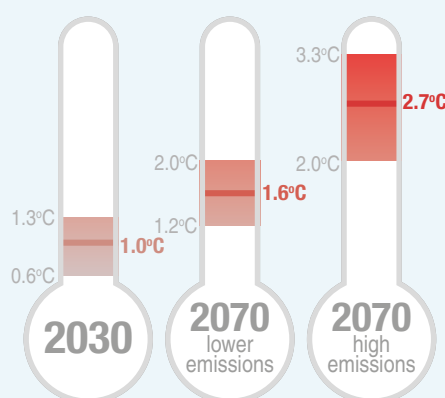
Maths and physics do not govern social and economic aspects of the future, so we don't know the impacts of population, the economy, policy decisions and technology on greenhouse gas emissions. To cover a range of possibilities, scientists use **emissions scenarios** called Representative Concentration 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](http://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 2.7°C (2.0–3.3°C). In this case, the median temperature rise determined by all the models is 2.7°C; 90% of model results indicated a rise of at least 2.0°C and 90% of the model results indicated a rise of 3.3°C or less.



Projected annual average temperature changes for the Loddon Mallee 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 1.3°C above the climate of 1986–2005. By the year 2070, the projected range of warming is 1.2 to 3.3°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 MILDURA

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 BENDIGO

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 experienced 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.

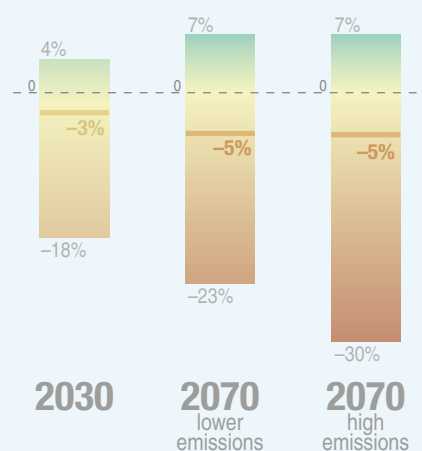
Conditions outside these projections are also possible, from either natural variability (such as extended drought) or climate changes that are outside the range we currently estimate.

**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 Loddon Mallee region*



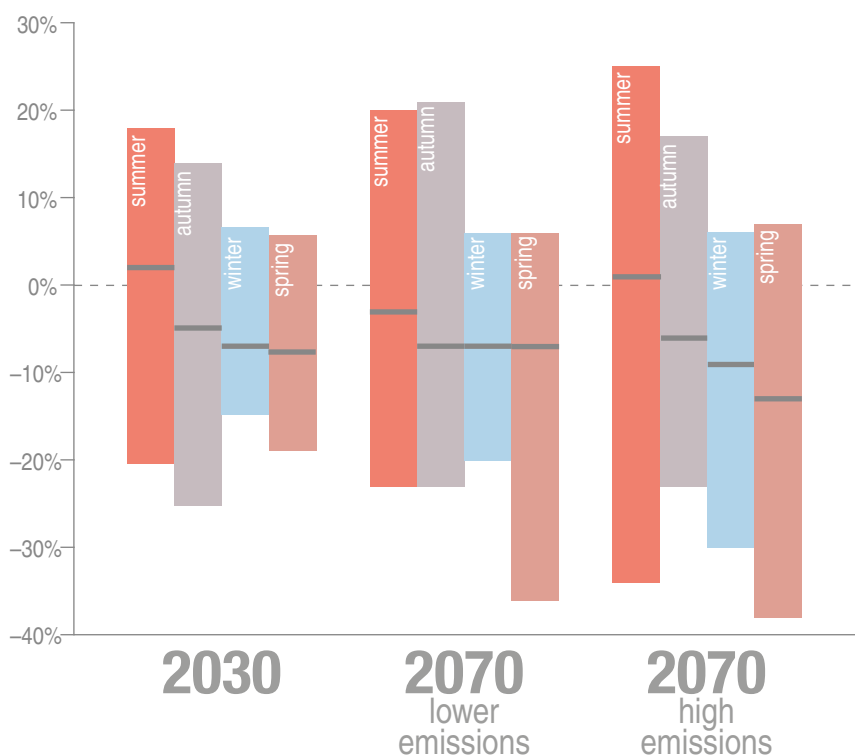
## FIRE WEATHER

**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](http://www.climatechange.vic.gov.au)

### PROJECTED SEASONAL RAINFALL CHANGE (%) FOR LODDON MALLEE



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





# LODDON MALLEE 2050

In 2050, under high emissions, the climate of Bendigo will be more like the climate of Shepparton now; Echuca will be more like Swan Hill; Swan Hill more like Hay; and Mildura more like Menindee.

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](http://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](http://www.climatechange.vic.gov.au).

There are similar brochures for other Victorian regions and a statewide brochure, available at [www.climatechange.vic.gov.au](http://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](http://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/](http://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](http://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](http://www.climatechangeinaustralia.gov.au).



Climate-ready Victoria: Loddon Mallee. 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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