CLIMATE-READY VICTORIA



How climate change will affect the Greater Melbourne region and how you can be climate-ready

The Greater Melbourne 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 Greater Melbourne region's climate-ready future.

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



temperatures to continu to increase year round



ewer trosts

more frequent and more intense downpours

rising sea leve

warmer and more acidic seas



more hot days and warm spells



less rainfall in winter and spring

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State Government





increased frequency and heigh

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

This publication highlights the impacts climate change will have on the Greater Melbourne 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

GREATER MELBOURNE AT A GLANCE



74% of the state



RECENT CLIMATE

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The region has mild to warm summers with an average maximum temperature of around 22 to 24°C near the coast and in the ranges to the east, and 25 to 27°C in the Melbourne area and further inland. In winter, average maximum temperatures are mostly around 12 to 14°C and frosts occur inland, but are rare near the coast and in inner urban areas.

On average, rainfall across the region is approximately 860 mm, but is less than 600 mm to the west of Melbourne and more than 1400 mm in the Dandenong Ranges.

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). 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

Melbourne

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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 Greater Melbourne region, the rate of warming has increased since 1960.

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.



HOW DO WE GET CLIMATE-READY?

Being climate-ready in the Greater Melbourne 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.

GREATER MELBOURNE CLIMATE RISKS



GETTING CLIMATE-READY AT A GLANCE

					P
()	Primary production	Infrastructure	Tourism	Health and community	Environment
KEY CLIMATE RISK	↓ rainfall	↑ sea level	↑ temperature	↑ heatwaves	↓ rainfall
	↑ temperature	↑ fire weather	↑ sea level	↑ flooding	↑ fire weather
	↑ hot days	↑ flooding	↑ fire weather	↑ fire weather	↑ hot days
	↑ fire weather	↑ hot days	↑ heatwaves	↑ solar radiation	↑ sea temperature
		↑ heatwaves			↑ ocean acidification
		↑ storm surges			
POTENTIAL IMPACTS	Earlier flowering and planting times	Increased flood damage	Increased threats to tourism infrastructure	More stress on health and emergency services	Amplification of existing threats to flora
	Changed distribution of pests and diseases	hanged distribution of ests and diseases costs arm business affected / bushfire Extreme heat impacts Increased disruption to services owth educed water security	Damage to popular environmental sites Impacts on outdoor and sporting events Risks to tourists unfamiliar with conditions	More heat-related deaths, particularly among the elderly and disadvantaged Mental health effects	and tauna Changes to habitat Altered disturbance
	by bushfire Changes in pasture				regimes Changing dynamics of invasive species
	growth Reduced water security			Changes in disease occurrence	
CLIMATE-READY ACTIONS	Consider enterprise diversification	Insure public assets Increase stormwater capacity Adopt water sensitive urban design solutions Diversify sources of power and water, including decentralised technologies Consider future climate and sea level rise when locating new infrastructure	Implement emergency planning for tourist sitesUse c pedes heatwUndertake business continuity planningUse e network vulner membreMulti-skill staffEstab plans influxeConsider enterprise diversificationEstab plans influxe and c heat staff	Use cost-effective pedestal fans in heatwaves	Target new and emerging diseases and pests
	Consider different crop varieties and sowing times			Use existing social networks to support vulnerable community	Increase green urban infrastructure and urban biodiversity
	Plan for a secure water supply Begularly access long			members Establish contingency plans for patient influxes in hospitals Increase green spaces	Link habitats to allow species to move
	and medium range outlooks, as well as short range weather forecasts				Consider moving selected populations to new areas
				and cool zones for heat stress	

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.

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



PRIMARY PRODUCTION

The region covers the vegetable farming areas of Werribee; dryland grazing land in the north; wine, fruit and nursery industries in the Yarra Valley; and the wine grape region of the Mornington Peninsula.

Horticulture and vegetables are highly sensitive to reduced water availability, and changes in temperature will alter planting and harvesting times. Intensive animal industries will require more power and water to cool facilities. The dairy industry is also sensitive to climate change impacts. 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.



Climate Kelpie is a 'one-stop shop' for the best available climate risk management information and tools for Australian farmers and farm advisors to inform business decisions.

The Managing Climate Variability Climate Champion Program aims to help farmers manage climate risk by providing the best climate tools, products, practices and seasonal outlooks, and an understanding of their use.

INFRASTRUCTURE

The region has airports, two major ports, and road and rail hubs. The major waterways and storages have water extracted for domestic supply, irrigation, industrial use and environmental purposes. A significant proportion of the coast in this area is low-lying. It is likely that predicted sea level rise will heighten conflict over space for native vegetation retreat and human needs for coastal protection, and threaten infrastructure with flooding and inundation.

Transport infrastructure will be increasingly exposed to periodic flooding and increased heat loading. Extremely high temperatures may also reduce the performance of the railway network, potentially leading to disruptions.

Harsher fire weather is likely to have considerable impact in the peri-urban fringe.

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The Growing Green Guide was produced by four inner Melbourne councils, led by the City of Melbourne. The guide provides advice on design, construction and maintenance of green roofs, walls and facades. Green infrastructure helps cool the urban area and decreases building energy use while improving air quality and property values.

The Eastern Alliance for Greenhouse Action has developed a Climate Change Adaptation Roadmap for decision makers in Melbourne's east. The project aims to raise awareness, build capacity and identify regional opportunities for addressing climate risks to council assets, operations and service delivery responsibilities.

TOURISM

Melbourne is a popular tourist destination with its many retail precincts, restaurants and major events. The waterways and beaches are recreational destinations for residents and tourists. Key natural tourism assets in the region include the Dandenong Ranges, You Yangs and the Brisbane Ranges.

The impacts of climate change on tourism are likely to include increased heatwaves and harsher fire weather. Significant reductions in stream flows will adversely affect water-based tourism.

The Australian Open is the only major tennis event to have an extreme heat policy in place, which includes threshold temperatures to guide when play stops. The policy, along with three roofed stadia – Rod Laver Arena, Hisense Arena and the new Margaret Court Arena – aims to protect the safety and comfort of players, spectators, workers and volunteers.

HEALTH AND COMMUNITY

More hot days and heatwaves will exacerbate existing health risks, putting greater pressure on hospitals and emergency services. The urban heat island will add to heat stress. Vulnerable 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 affect the mental health of the community.

Darebin City Council has partnered with Energy Matters and Positive Change in a Solar Saver Program designed to offer low-income households access to solar energy. Repayments have been structured so that most participants will save more on their electricity bills than what they will be repaying for their system.

The Hobsons Bay Heat Health Response Plan describes the way in which council, community groups and the state government can work together during extreme heat events to support people most vulnerable to heatwaves.

Mornington Peninsula Shire, City of Kingston and Bayside City Council with Federation University are creating Climate Ready, an online tool to help build long-term community resilience to climate change. Through Climate Ready, residents from the three council areas can learn about local climate change risks and create a personalised action plan to prepare for the impacts of climate change. The website will be launched in 2016.

ENVIRONMENT

Around 40% of the Greater Melbourne region retains native vegetation, with 40% of this located in parks or reserves managed for conservation. Climate change is likely to place increased pressure on this remnant vegetation.

There are four marine national parks and four marine sanctuaries, and a number of coastal areas and lakes listed as 'Wetland of International Significance' under the Ramsar Convention.

Warming seas and increased storm surges will have negative impacts on coastal ecosystems which have important recreation and biodiversity values. Mangroves and the saltmarshes, which provide habitat for the Orange-bellied Parrot, are vulnerable to sea level rise.

Warmer and drier conditions causing reduced stream flows, more severe droughts and extreme weather events may lead to ecosystem degradation. Loss of biodiversity will place greater stress on the personal and economic wellbeing of communities in Greater Melbourne.

The Port Phillip and Western Port Catchment Management Authority's Regional Catchment Strategy is being revised to include responses to climate change risk, challenges and opportunities. The revised plan will be available in 2016.

FUTURE CLIMATE

LOOKING AHEAD

Climate projections for the Greater Melbourne 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 2.6°C (2.1-3.1°C). In this case, the median temperature rise determined by all the models is 2.6°C: 90% of model results indicated a rise of at least 2.1°C and 90% of the model results indicated a rise of 3.1°C or less.



Projected annual average temperature changes for the Greater Melbourne 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.



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 3.1°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.





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 Greater Melbourne 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.



Sea level will continue to rise ****

By 2030 the projected sea level rise for studied locations is 0.08 to 0.17 m above the 1986–2005 level.

By 2070, sea level is projected to rise 0.20 to 0.45 m at studied locations under lower emissions and 0.25 to 0.54 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 1.3 to 2.5°C by 2070 under high emissions. The sea will also become more acidic, with acidification proportional to emissions growth.

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

PROJECTED SEASONAL RAINFALL CHANGE (%) FOR GREATER MELBOURNE



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

GREATER MELBOURNE 2050

In 2050, under high emissions, the climate of Melbourne will be more like Adelaide now.

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 Victoria's 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: Greater Melbourne. 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.



Melbourne

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