

Grampians Region

Climate Adaptation Strategy 2021–2025





Who is this document for?

Victoria's Climate Change Act requires 'strong action to build resilience to, and reduce the risks posed by, climate change and protect those most vulnerable.'¹ Development of this community-led Grampians Region Climate Adaptation Strategy and coordination of its implementation has been funded by the Department of Environment, Land, Water and Planning (DELWP).

This Strategy is for people across the Grampians Region – individuals, groups, and agencies that have a stake in the life of the Region, extending well into the future. It speaks to all people who are interested in how this Region can best come to grips with changing climate. Rich engagement with local stakeholders has been vital in ensuring that actions create multiple benefits, as well as managing any potentially perverse outcomes.

The Strategy has been developed collaboratively over two years by members of Regional Climate Adaptation Groups (RCAG) representing state government, agencies, local government, universities, farmers, business and community in close consultation with key stakeholders throughout the Grampians Region. It is intended that everyone involved can see their own climate adaptation aspirations reflected and efforts across the Region can be better coordinated, leading to improved outcomes for communities and the environment.

Community groups, local governments, agencies and organisations can use this document to:

- Align their own climate adaptation planning and projects to regional goals and outcomes, providing opportunities for partnerships and collaboration to maximise collective impact.
- Support funding applications for government, corporate and philanthropic grants. Activities aligned with these goals and outcomes will be able to demonstrate a high level of strategic thinking at a regional level, stakeholder engagement and community support.
- Prompt conversations and planning within and between organisations to reduce the risks that will arise from climate change.

We acknowledge Victorian Traditional Owners and their Elders past and present as the original custodians of Victoria's lands and waters and commit to genuinely partnering with them and Victoria's Aboriginal community to progress their aspirations.

The development of the Grampians Region Climate Change Adaptation Strategy was supported by the Victorian Government and funded through the Sustainability Fund – Supporting Our Regions to Adapt program.



¹ Climate Change Act 2017 (Vic), Preamble.



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Introduction

We start from four key assumptions:

- Adapting to a changing climate requires a strategic and coordinated approach, mobilising the people, organisations and communities of the Grampians Region around shared goals and outcomes.
- Climate change is complex, affecting the landscapes, built environments, businesses, communities and people of the Region in diverse ways.
- There are multiple plausible climate futures for the Region, depending in part on global factors (especially the extent of greenhouse gas emissions worldwide) and in part on local factors (especially the quality of the strategic approach to adaptation).
- Community cohesion and behaviour change are necessary for successful adaptation in the Region and must be factored into every goal and action.

In collectively writing this Strategy, stakeholders reflected on plausible future scenarios and how these might play out in key themes for climate change in the Region: agriculture; biodiversity; economy; heat; health and wellbeing; fire; storms and flooding; and water.

The Grampians Region Climate Adaptation Strategy is accompanied by an academically researched [Situation Analysis](#), which brings together current science and an overview of adaptation work already underway to ensure this Strategy builds upon existing knowledge and efforts.

While many of the likely consequences of climate change are reasons for genuine concern about the future, working together to produce this document shows how adapting to those risks can motivate hope and determination for those who commit to it.

The closing section of this document synthesises those investigations into a long-term vision and seven mid-term goals for climate adaptation in the Region. Each goal contains a series of outcomes and indicators that will guide implementation and monitoring of the Strategy.

In this five-year horizon it is critical to build upon the existing climate adaptation work already underway and focus effort on the actions that will best set the Grampians Region up to meet the present, coming and cumulative challenges of climate change. DELWP has committed initial implementation funding for this purpose.

Grampians Region adaptation vision

**Grampians Region
communities,
organisations and
natural systems are
thriving in a changing
climate because
we are adapting
well together.**



Grampians Region adaptation goals

- Our regional responses to climate change are coordinated, resourced and evidence-based.
- Our Region's biodiversity and natural ecosystems are protected and resilient.
- The Grampians economy is sustainable and climate-ready.
- Regional farming is well-adapted to the changing climate.
- Our built environment is more resistant to weather extremes.
- Individuals and communities proactively reduce their climate-related risk.
- Our vulnerable people are supported to adapt to climate change.

Grampians Region profile

The Grampians Region stretches from the South Australian border to Bacchus Marsh in the east (Figure 1). It covers 4,861,944 hectares, with a population of over 220,000. Ballarat is its largest centre with just over 100,000 residents. Boasting a diverse geography of mountains, desert, forests, grasslands and wetlands, the Region is named after the Grampians National Park – an ancient, mountainous landscape attracting large numbers of tourists.

The Region comprises the 11 local government areas of Ararat, Ballarat, Golden Plains, Hepburn, Moorabool and Pyrenees (Central Highlands) and Hindmarsh, Horsham, Northern Grampians, West Wimmera and Yarriambiack (Wimmera Southern Mallee). This spans traditional lands of the Dja Dja Wurrung, Eastern Maar, Gunditjmara, Wadawurrung, Wurundjeri and Wotjobaluk (Jaadwa, Jadawadjali, Jupagulk, Wergaia and Wotjobaluk) peoples.



Figure 1: Grampians Region map with Registered Aboriginal Party (RAP) and local government boundaries

Jadawadjali rock art in the Grampians National Park (Gariwerd) is over 20,000 years old,² indicating the ancestors of today's Wotjobaluk peoples lived through the last ice age. This is true of other Grampians Region first nations people as well.^{3,4}

The last ice age took place between 25,000 and 12,000 years ago,⁵ where 'average temperatures fell by 10°C, rainfall decreased, and cold, dry winds blew across the land.'⁶ Since then global temperatures have increased⁷ to be higher than humans may have ever experienced in Australia.

The climate throughout the Region varies tremendously. The drier, warmer climate of the Murray Basin natural resource management (NRM) bioregion, north west of the Great Dividing Range (Wimmera Southern Mallee), contrasts with the cooler, wetter climate of the Southern Slopes NRM bioregion (Central Highlands) to the south east, with many different landscapes visibly representing the Region's natural diversity. The availability of water for human uses and for regional ecosystems will depend on the incidence of drought, local population sizes and the way whole catchments are managed.

The Situation Analysis sets out key demographic and economic features of the Grampians Region that inform this Strategy (see especially pp. 11–16 in that document). Overall, the Region is becoming more populated, but that picture is not consistent across all municipalities. Ballarat is growing its services industries, along with a significant manufacturing base. Moorabool and Golden Plains shires are playing an important role in the growth of metropolitan Melbourne. Some Wimmera Southern Mallee communities have been shrinking, while others are experiencing shortages of housing stock. Both population growth and decline present challenges when adapting to climate change.

Due to these and many other factors this Strategy is deliberately written at a regional scale. It can also be used as a tool to trigger discussion and assist coordination of effort to mitigate the risks of climate change at various other scales across the Grampians Region, from household and business to community and municipal.

2 Brambuk National Park and Cultural Centre, 'Aboriginal Rock Art Sites – Northern Gariwerd', Brambuk, accessed 25 June 2020: www.visitgrampians.com.au/see-do/culture/indigenous-culture/aboriginal-rock-art-sites.

3 M Bourke, A Atkinson & T Neale, 'Putting Country back together: a Conversation about Collaboration and Aboriginal Fire Management,' Postcolonial Studies, DOI: 10.1080/13688790.2020.1751909.

4 C Barras, 'Is an Aboriginal tale of an ancient volcano the oldest story ever told?' Science, 11 February 2020, accessed 25 June 2020: www.sciencemag.org/news/2020/02/aboriginal-tale-ancient-volcano-oldest-story-ever-told?fbclid=IwAR2mdmohNZy8BejqZYvPn0jTPnEmxr0qn2c6Sd_jiGKVpMX11_PLmPoOYPs.

5 Australian Academy of Science, 'How Has Climate Changed?', AAS, accessed 25 June 2020: www.science.org.au/learning/general-audience/science-climate-change/2-how-has-climate-changed.

6 Bureau of Meteorology, 'Indigenous Weather Knowledge', BOM, accessed 25 June 2020: www.bom.gov.au/iwjk/culture.shtml.

7 Barrows, Timothy & Alloway, Brent & Reeves, Jessica. (2013). The Australasian-Intimate Project. Special Volume. Quaternary Science Reviews. 74. 10.1016/j.quascirev.2013.05.021.



Background and context

The Victorian Climate Change Act defines adaptation to climate change as:

Any process of adjusting to actual or expected climate and its effects that—

- a) in human systems, seeks to moderate or avoid harm or exploit beneficial opportunities; and
- b) in natural systems, may be facilitated by human intervention; ...⁸

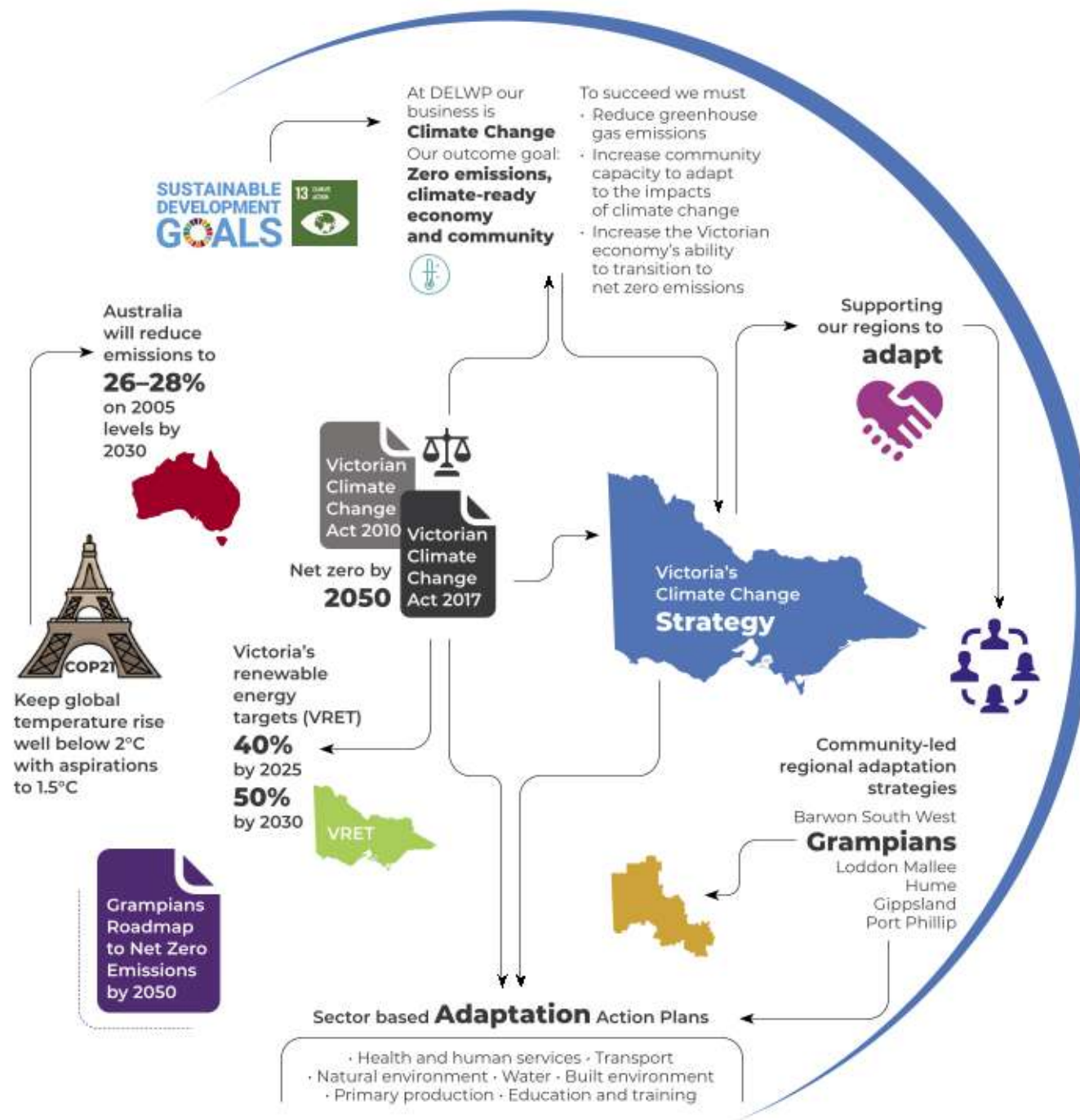
Supporting our Regions to Adapt is a \$9.32 million four-year Victorian Government program, funded through the Sustainability Fund. The program provides practical support for regional communities to strengthen their resilience to climate change by building adaptive capacity and supporting the delivery of targeted adaptation action in Victoria's regions.

DELWP is supporting the development and implementation of regional adaptation strategies in each of its six regions

- Barwon South West, Gippsland, Grampians, Hume, Loddon Mallee and Port Phillip.

This document, the Grampians Region Climate Adaptation Strategy, will guide priority climate change adaptation action in the Grampians Region over the next five years and will inform the state-wide, sector-based Adaptation Action Plans specified in the Climate Change Act: built environment; education and training; health and human services; natural environment; primary production; transport; and water. Figure 2 captures the policy context dynamics governing this Strategy. Proposed actions will be assessed by the Regional Climate Adaptation Groups that have worked together to develop this Strategy, supported by DELWP. An annual scorecard has been produced to monitor and evaluate how well the Region is adapting to climate change by tracking some key metrics, listed as indicators on pages 34–36 of this document.

⁸ Climate Change Act 2017 (Vic), S 3.



While the focus of this Strategy is adapting to the changing climate, reducing greenhouse gas emissions locally and regionally is vitally important. The Victorian Government has legislated net zero emissions by 2050⁹ and has a target of 50 per cent renewable electricity by 2030.¹⁰ The Australian Government has ratified the Paris Agreement to 'keep global temperature rise well below 2°C with aspirations to 1.5°C'.¹¹ Regionally, the Grampians New Energy Taskforce (GNET) is leading climate change mitigation efforts via the Grampians Roadmap to Net Zero Emissions by 2050 (R2Z).¹²

Reducing reliance on fossil fuels (coal, gas, petrol and diesel) is a positive adaptation action that empowers households and businesses while also increasing thermal efficiency, reducing energy bills and improving air quality. On site energy generation and carbon storage can provide new sources of income for landholders. The R2Z identifies the agriculture sector as the emissions reduction hero for Grampians Region. With their ability to revegetate marginal land, store carbon in soil and turn waste into bioenergy, farmers can help the region to become net zero by 2044.

⁹ Climate Change Act 2017 (Vic).

¹⁰ Renewable Energy (Jobs and Investment) Act 2017 (Vic).

¹¹ United Nations, Paris Agreement (English language version), UN, New York, 2015.

¹² Grampians New Energy Taskforce, Grampians Regional Roadmap to Net Zero Emissions, GNET, Ballarat, 2020.

Figure 2: Diagram of climate change policy context



The adaptation challenge

Humanity thrived in the relatively stable climate experienced over the past 8,000 years.¹³ Now, the pace of climatic change threatens natural systems, built environments, social structures and human health and wellbeing in ways that have not been experienced before.

Horsham and Hindmarsh are forecast to be in the top ten localities of Victoria to be most affected by climate change by 2100, in terms of property values, due to flooding and soil subsidence during drought.¹⁴ Halls Gap was rated the top postcode for bushfire peril in Australia in November 2019.¹⁵ Some communities in Pyrenees Shire and the Wimmera are already dependent upon groundwater as local reservoirs are no longer viable with diminished rainfall.

The economy of Wimmera Southern Mallee is expected to be the third most impacted by heatwaves in the state¹⁶ and local governments have been directed to consider climate change in their 2021 municipal health and wellbeing plans.¹⁷

We can no longer build, farm, plan or do business without the future climate in mind and we cannot rely on modelling based on historic trends.¹⁸

¹³ Australian Academy of Science, 'How Has Climate Changed?', AAS, accessed 25 June 2020: www.science.org.au/learning/general-audience/science-climate-change/2-how-has-climate-changed.

¹⁴ Climate Council, Compound Costs: How Climate Change Is Damaging Australia's Economy, Climate Council of Australia, Canberra, accessed 25 June 2020: www.climatecouncil.org.au/wp-content/uploads/2019/05/costs-of-climate-change-report-v3.pdf.

¹⁵ A Gissing and F Langbein, 'What areas of Australia are most at risk from natural perils?' Risk Frontiers Newsletter, Vol 18 No 4 (October 2019), accessed 25 February 2021: riskfrontiers.com/rf2018/wp-content/uploads/2019/10/newsletter_V18_Issue4_Oct_2019.pdf.

¹⁶ Natural Capital Economics (2018), Heatwaves in Victoria: a vulnerability assessment. Report prepared for the Department of Environment, Land, Water and Planning, Victoria, accessed 25 February 2021: www.climatechange.vic.gov.au/_data/assets/pdf_file/0029/399440/Heatwaves_VulnerabilityAssessment_2018.pdf.

¹⁷ Health.Vic, Victorian Public Health and Wellbeing Plan 2019-2023, Government of Victoria, Melbourne, accessed 25 February 2021: www2.health.vic.gov.au/about/publications/policiesandguidelines/victorian-public-health-wellbeing-plan-2019-2023.

¹⁸ Munich RE, Australia and Climate Change: A summary of the current situation and future prospects, Munich RE, Sydney, accessed 25 February 2021: www.munichre.com/topics-online/en/climate-change-and-natural-disasters/climate-change/australia-faced-with-climate-change.html.

In 2019 the Victorian Government partnered with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to help communities prepare for climate change by developing local-scale climate projections data for Victoria at a five-by-five-kilometre scale. Projections for Central Highlands and Wimmera Southern Mallee are depicted in figures 3 and 4. They conclude the climate of Horsham may be more like the current climate of Deniliquin by 2050 and Ballarat's climate may be more like that of Hamilton.

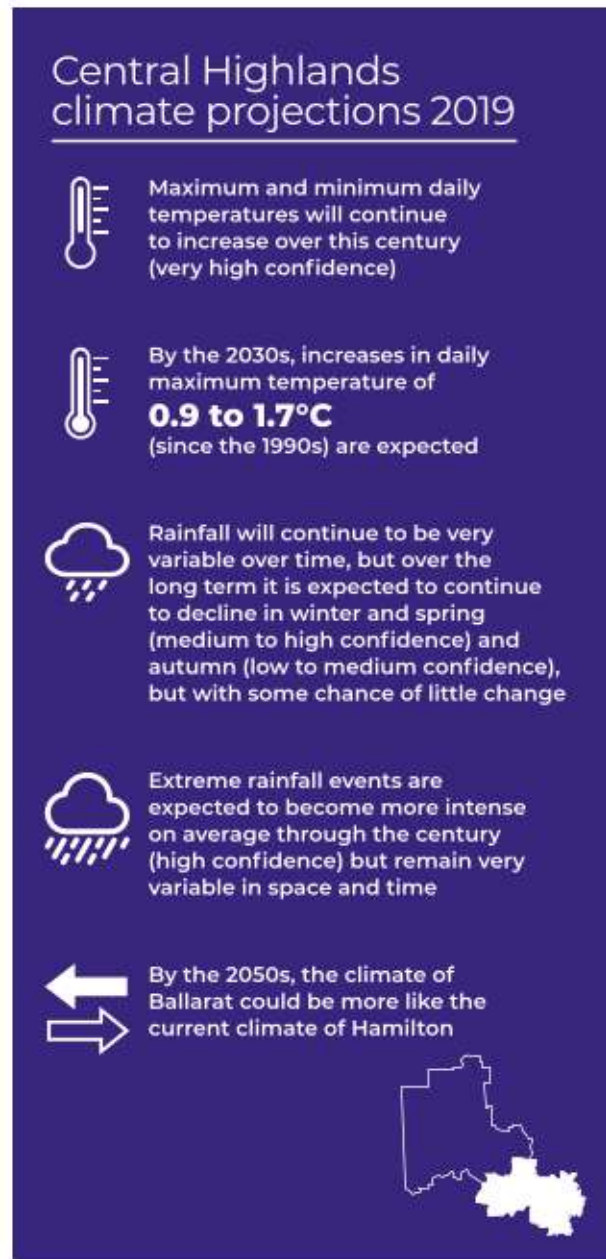


Figure 3: CSIRO climate projections for Central Highlands

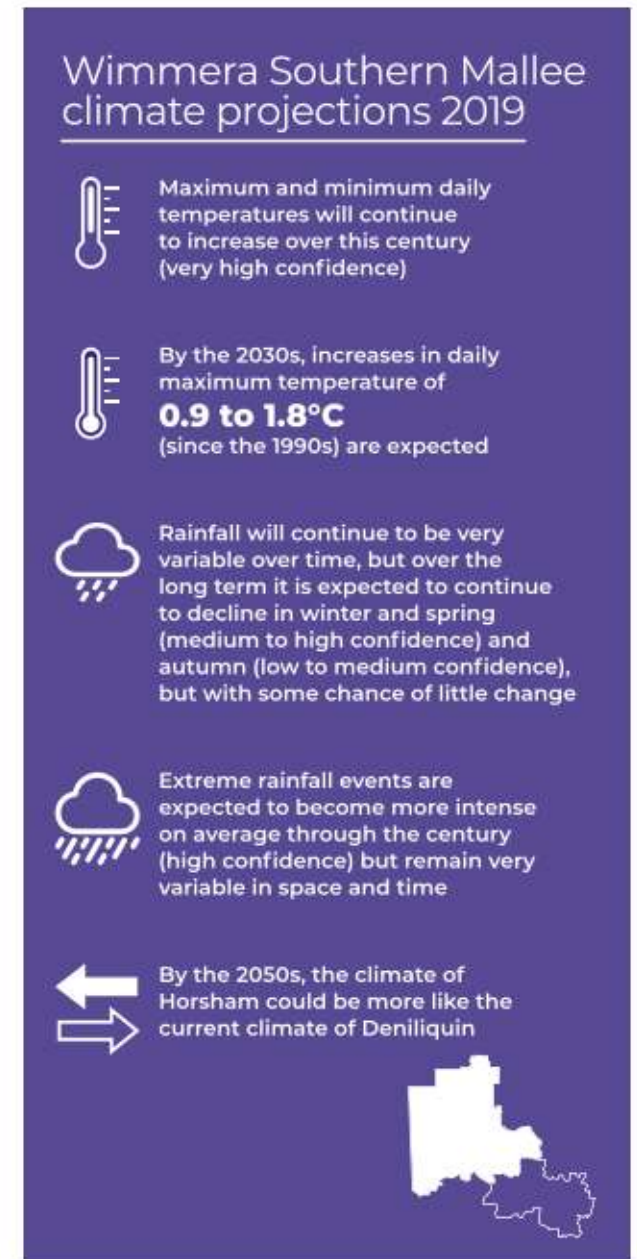


Figure 4: CSIRO climate projections for Wimmera Southern Mallee

In developing this Strategy, stakeholders explored plausible future scenarios both for the extent of climate change, based on CSIRO projections, and for the decisiveness of the Region's adaptive responses (see Appendix 1). Scenarios are a method for making sense of a complex, dynamic environment to improve decision making. They allow us to reconsider our current actions and identify and test new ideas to help shape the future, even though there is more than one possible version of the future for which we need to plan. Figure 5 depicts the scenarios explored:

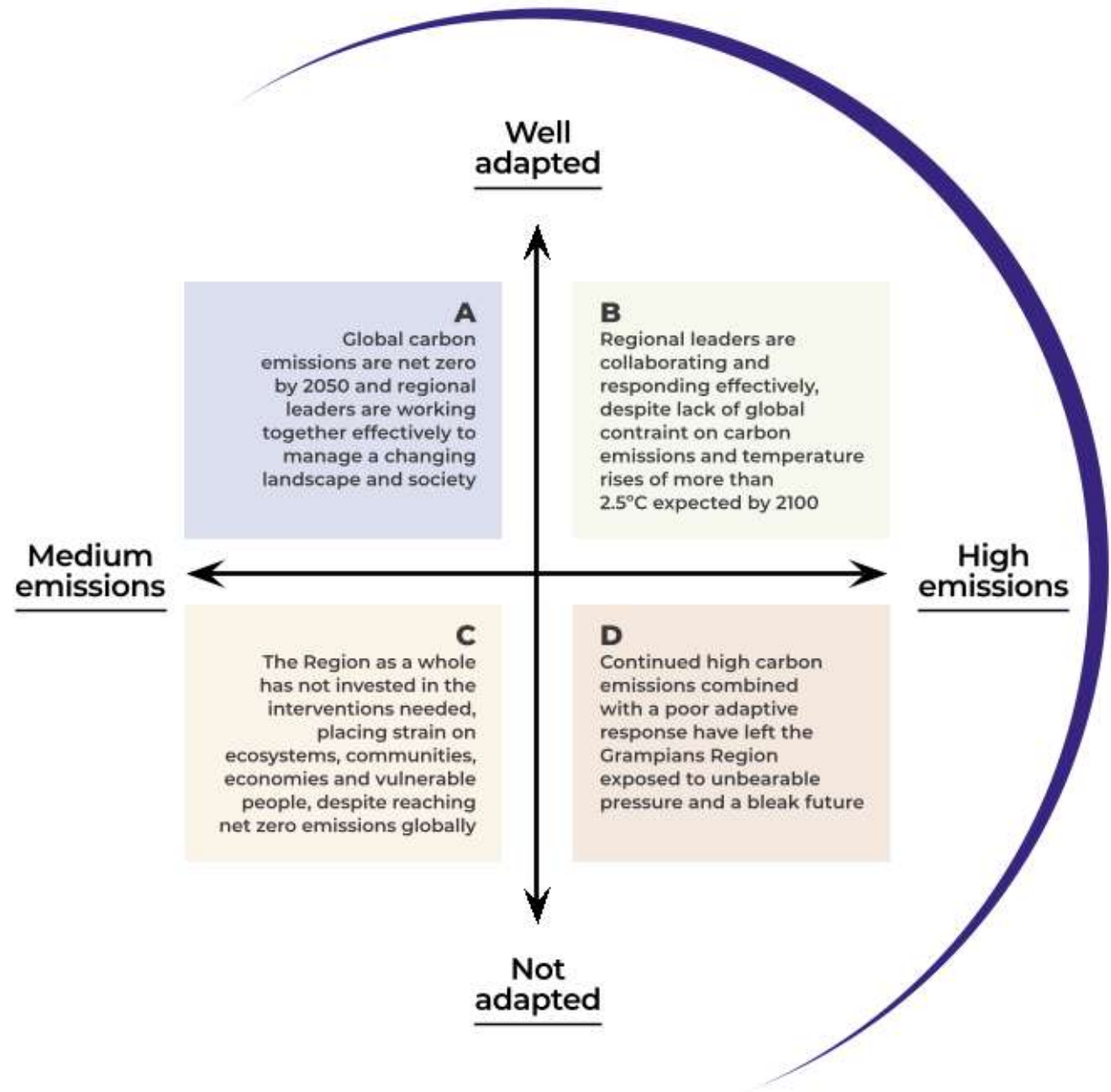


Figure 5: Plausible future scenarios for the Grampians Region in 2050



Image: Corellas over Natimuk Creek by Glenn Tempest



Adaptation themes

This section of the Strategy highlights current climate adaptation planning and work under way, as well as opportunities and barriers for each of eight themes: agriculture; biodiversity; economy; fire; health and wellbeing; heat; storms and flooding; and water. Like the Situation Analysis, it distinguishes between 'adaptation focuses' and 'hazards' for each of the themes it discusses.

While this Strategy details each theme separately, they are in fact interconnected. The complexity of climate change requires systems thinking to understand how each theme affects the others and what this may mean in an uncertain future.¹⁹ Appendix 2 addresses this complexity directly, seeking to ensure a climate response in one sector does not have unintended negative consequences for another.

Community-led action is a powerful way to adapt, promoting social cohesion, behaviour change and protecting individual and community wellbeing in the face of climate change.²⁰ It also makes a vital contribution to the economy.²¹

¹⁹ L. Acaroglu, 'Tools for Systems Thinkers: The 6 Fundamental Concepts of Systems Thinking,' Disruptive Design (blog), accessed 25 February 2021; medium.com/disruptive-design/tools-for-systems-thinkers-the-6-fundamental-concepts-of-systems-thinking-379cdac3dc6a.

²⁰ S. Burke, *The Climate Change Empowerment Handbook: Psychological strategies to tackle climate change*. Australian Psychological Society, Melbourne, 2017.

²¹ Victoria Department of Planning and Community Development, *The Economic Value of Volunteering in Victoria*, Victorian Government, Melbourne, 2012.

Much of the work listed on the following pages relates to that of governments and agencies but it is important to recognise the importance of community-led action. This organic and dispersed understanding of leadership is central to the Strategy – which aims to draw on people's efforts across the Region, just as it will benefit people across the Region.

Unlocking this potential is key to scaling timely adaptation. However, traditional models of dependence on volunteerism are not sustainable and the complexity of climate change and the cumulative impact it may have on individuals and groups and their ability to contribute must be considered.

Local Country Fire Authority (CFA) brigades and Victoria's State Emergency Service (SES) volunteers are pivotal to the Grampians Region's local response to extreme climatic events. As these events rise in frequency and bushfire seasons extend in length and regularity, how these important groups remain resilient is of particular importance.²²

Community organisations in the Region are working on local solutions through programs, pilots and educational initiatives that address local food production, energy security, retrofitting homes to improve thermal efficiency, water conservation, fire management techniques and provision of free or low-cost services for our most vulnerable.²³

Much expertise exists within the Region around practices for permaculture, community energy and regenerative farming, as well as the broader themes of biodiversity and land conservation.

This grassroots expertise and associated community actions frequently cross multiple areas of the eight adaptation themes addressed in this Strategy and can simultaneously deliver on climate change mitigation needs.

The Australian ClimateWorks report, *Decarbonisation Futures*, states that a 1.5 degree limit is 'within reach', but only 'if governments, businesses and individuals go "all-in" by 2035'.²⁴

In many cases, local groups in the Grampians Region have been working on climate change mitigation and adaptation actions for decades.

One pertinent example of community-led action is the Hepburn shire masterplan for their Zero Net Emission Transition (Z-NET). As the location of the first community-owned wind farm and the first and still the only zero-net energy town of Daylesford, the plan is to make the entire shire zero-net energy by 2025 and zero-net emissions by 2030.

²² A Davies, 'As bushfire season approaches, we need to take action to recruit more volunteer firefighters,' *The Conversation*, 17 September 2020, accessed 25 February 2021: theconversation.com/as-bushfire-season-approaches-we-need-to-take-action-to-recruit-more-volunteer-firefighters-146290.

²³ Parliament of Victoria, *Inquiry into Tackling Climate Change in Victorian Communities (Final Report)*, Parliament of Victoria, Melbourne, 2020, accessed 25 February 2021: www.parliament.vic.gov.au/epc-la/inquiries/inquiry/967.

²⁴ C Butler, A Denis-Ryan, R Kelly, I Stewart, and T Yankos, *Decarbonisation Futures: Solutions, actions and benchmarks for a net zero emissions Australia*, ClimateWorks Australia, Melbourne, 2020, accessed 25 February 2021: www.climateworksaustralia.org/resource/decarbonisation-futures-solutions-actions-and-benchmarks-for-a-net-zero-emissions-australia/.



Agriculture

The agricultural sector is already making a major contribution to the Region's efforts to adapt to a changing climate. CSIRO projections show how much regional agriculture has at stake in the success of adaptation efforts.

Agriculture in the Grampians is increasingly science-driven and sophisticated in its responses to changing environmental and economic circumstances. With government and community support and with clear strategic coordination, this contribution will continue to grow. For more information on this topic see Appendix 3.

Adaptation is protecting agricultural land, managing risks, profitability, resilience and opportunities in a changing climate.

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Assessing impacts of extreme temperatures on wheat crops in north western Victoria	Monash University
Climate signals and variety development	Grains Research and Development Corporation
Smart Farms Initiative	Multi agency approach
Grains Innovation Park world-class research facility	State government with research partners
Strong, Innovative, Sustainable agriculture strategy and Agriculture Energy Investment Plan	Agriculture Victoria
Biochar trials	Glenelg Hopkins Catchment Management Authority
Annual trials	Birchip Cropping Group
Public-private partnerships	Eg. Longerenong DATA farm
Regenerative agriculture programs, regional catchment strategies and NRM plans for climate change	Catchment management authorities
Soil Moisture Network	Wimmera Catchment Management Authority
AgTIDE data project	Regional Development Victoria with Wimmera Southern Mallee Regional Partnership

Leading opportunities

- Greater knowledge/understanding of rural wellbeing can support more sustainable farms, farm workers, and farm families.
- Optimising soil functionality by maintaining or increasing soil carbon levels.
- Conserving soil moisture by maintaining ground cover in pasture and cropping systems.
- Embracing new technology, including better access to digital infrastructure (the 'internet of things') and data driven improvements to production systems.
- Sharing agricultural adaptation knowledge.
- Reversing population trends by providing employment opportunities for rural youth.
- Sustainable agriculture improving insurance outcomes.
- Farm diversification including biochar, bio-fuels, agritourism and niche industries.
- Water efficient food production systems – opportunities for pipeline/reuse water.
- Intensification of agriculture eg horticulture, aquaculture, intensive animal industries.

Main barriers

- Market disincentives to adaptation.²⁵
- Regulatory and policy frameworks that discourage innovation and lack of stimulus that can be relied on for long-term change and commercial investment.
- Road and rail freight distances and cost.
- Lack of practical and proven models for agriculture under climate change.
- Lack of development of a bio-economy to provide a market for agricultural biomass.
- Lack of experienced consultants, contractors, and suppliers/installers of advanced systems; also lack of broader awareness about developments/innovations and their benefits.
- Lack of financial stimulus for carbon sequestration.
- Policy settings do not yet directly support agricultural adaptation.
- Water utilities have limited capacity and permission to invest in climate adaptation except where externally funded.

²⁵ Farmers for Climate Action, Our Vision: Farming Forever, FCA, Melbourne, 2018.



Biodiversity

The preservation of biodiversity values and enhancement of environmental resilience is of vital importance for the function of ecosystems, persistence of wildlife, public health and agriculture, as well as for urban amenity and visitor attraction.

Changes to temperature, rainfall, storm and fire patterns are already putting species and ecosystems at risk²⁶ across the Region. There are strong and viable strategies to respond, but they will require urgent, focused coordination and a greater willingness to invest than has been the case to date.

Adaptation is building species and ecosystem resilience and functionality to ensure long-term viability.

²⁶ Impacts of Climate Change, South West Climate Change portal, viewed 30 March 2021
www.swclimatechange.com.au/cb_pages/environmental_impacts.php

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Biodiversity 2037 and Biodiversity Response Planning	DELWP
Biolinks	Community networks and alliances
Future Landscapes ²⁷	Deakin University
Municipal biodiversity strategies	Local governments across the Region
Regional catchment strategies, NRM plans for climate change, regional waterway strategies and adaptation pathways	Catchment management authorities and DELWP Aboriginal water programs
Revegetation and other projects	Landcare networks
Victorian Land Cover Time Series	DELWP and CSIRO
Cultural flows studies (catchment level)	DELWP, CMAs and Traditional Owners
Climate Future Plots	Universities, catchment management authorities and local conservation groups
Wetland conservation	CMAs and Nature Glenelg Trust
Threatened species management	Government, non-government organisations and universities

²⁷ Faggian et al., Central Highlands Plan, 2016.

²⁸ Intergovernmental Panel on Climate Change (IPCC), Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems, United Nations, New York, 2019, accessed 25 February 2021: www.ipcc.ch/site/assets/uploads/2019/08/Edited-SPM_Approved_Microsite_FINAL.pdf

Leading opportunities

- Protecting existing natural assets and remnants.²⁸
- Climate-sensitive restoration/revegetation.
- Connected habitats and protection of refugia.²⁸
- Coordinated threat management at the landscape scale (pest, plant, animal, disease).
- Online natural resource management (NRM) portals and public information sources eg. South West Climate Change Portal.
- Adaptation pathways approaches to NRM planning for natural assets.
- Optimal environmental water flows.
- Incentivise land use practices that value biodiversity.
- Identify the transformational actions and tipping points that might be required to improve biodiversity outcomes for the Region.
- Research to overcome key knowledge gaps at species, community and landscape scales.
- Better management of plague/pest animal species.

Main barriers

- Declining wildlife and genetic diversity due to fragmentation and maladaptation.
- Scarcity and pollution of water.
- Increases in fire activity leading to prevalence of fire-tolerant ecosystems and loss of diversity.
- Land use change, human population growth and development.
- Lack of coordination across funding streams and policy settings, and amongst stakeholders, leading to missed opportunities at the local level.
- Biodiversity values impacted by other climate adaptation responses and competing priorities eg. Bushfire Management Overlays, land clearing for housing development, water diversions.



Economy

A changing climate drives changes to the regional economy, which can be forced upon unprepared businesses and used opportunistically by others. Many now see the cost-effectiveness of taking action to mitigate and adapt to climate change.

How the Grampians Region can manage these changes as it moves towards a circular economy will be a major factor in determining the quality of the Region's adaptive efforts overall. For more information on this topic see Appendix 4.

Adaptation is embracing the circular economy by redesigning processes, recycling waste materials and water, and generating local renewable energy.

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Community-owned energy	Hepburn Wind, Natimuk Community Energy
Onsite energy generation eg. solar, biomass	Gekko Systems, McCain, Meredith Dairy, Trigg Farm, Berrybank Farm, Beaufort Hospital, Skipton Hospital, Frew Foods and others
Power purchase agreements (PPAs)	Mars with Kiamal Solar Farm, Melbourne Renewable Energy Project with Crowlands and Yaloak South wind farms
Public-private partnerships	Eg. Longerenong DATA Farm, Grains Innovation Park
Crop substitution with more climate-tolerant grape varieties	Wine industry
Cultivation of indigenous foods	Dja Dja Wurrung with Dalki Garringa Nursery
Guidance notes for governance of climate risk	Reserve Bank of Australia, Australian Securities and Investments Commission and Australian Prudential Regulation Authority
Insurance accessibility and cost implications for not addressing climate risk to business	Insurance companies
Grampians Regional Roadmap to Net Zero Emissions (R2Z)	Grampians New Energy Taskforce

Leading opportunities

- Regional processing of agricultural product.
- Onsite energy generation with solar panels, methane recovery (eg. landfill) and/or bioenergy.
- Upgrades to improve thermal efficiency and reduce energy use/cost of buildings.
- Use of recycled water.
- Power purchase agreements (PPAs) with local renewable energy developments.
- Resource-efficient food production systems.
- Grow artisanal food sector and community supported agriculture.
- Microgrids and virtual power plants.
- Municipal Recovery Facility (MRF) to sort and process recyclable materials regionally.
- Develop markets for waste products and recycled materials including plastics, glass and food/organic waste.
- Circular economy food hub as outlined in the R2Z.

Main barriers

- Limited access to affordable energy sources and long-term price agreements.
- Limited electricity grid infrastructure capacity.
- The vulnerability of electricity supply to outages and impacts on worker productivity during heatwaves.
- Large distances make transporting materials and goods costly or unviable.
- Thermally inefficient commercial premises.
- Limited incentives to incorporate climate adaptation measures in new buildings, including thermal efficiency and solar power.
- Complex relationships across the three tiers of government reduce capacity to respond innovatively to changing circumstances.



Fire

Fire activity in the Grampians Region is growing more frequent and severe. Spring seasons in south eastern Australia are generally growing hotter and drier, while rainfalls generally are declining or arriving later.²⁹ The imperative for adaptation is to support prevention and preparedness efforts on private land and make investments in fire-prone communities.

This will include innovations in building, land and water management approaches and increasing resilience of communities. These may draw on traditional knowledge, local practices and research.

Adaptation is preparing for earlier and longer seasons of more intense and widespread fire.

²⁹ Bureau of Meteorology, State of the Climate 2020, Australian Government, Canberra, 2020, accessed 25 February 2021: www.bom.gov.au/state-of-the-climate/australias-changing-climate.shtml

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Municipal emergency management plans	Local governments across the Region
Grampians Regional Emergency Management Plan	Regional Emergency Management Planning Committee (REMPC)
State Emergency Management Plan	Emergency Management Victoria (EMV)
Fire emergency response	Country Fire Authority (CFA), Fire Rescue Victoria (FRV) and Forest Fire Management Victoria (FFMV)
VVP Aboriginal burning project	Wadawurrung Traditional Owners Aboriginal Corporation
Victorian Traditional Owner Cultural Fire Strategy ³⁰	Victorian Traditional Owner Cultural Fire Knowledge Holder Group
Goathand Cooperative	Hepburn Shire Council with Federation University
Phoenix RapidFire simulator	Bushfire & Natural Hazards Cooperative Research Centre
Strategic Bushfire Management Planning	DELWP, CFA and FRV
Community Based Bushfire Management	DELWP, CFA and FRV
Community Fireguard	CFA
Victorian Emergency Management Reform White Paper	EMV

Leading opportunities

- Increase fire resistance of the built environment.
- Improve the resilience of fire prone communities so they can recover more quickly if impacted by fire.
- Early detection, response and monitoring of fires.
- Embedding climate change researchers within disaster risk management agencies.³¹
- Sustaining the volunteer base of rural and remote communities is essential for social and economic recovery from exogenous shocks, such as natural disasters and pandemics.³²
- Cultural burning practice is led by Traditional Owners.

Main barriers

- Dwindling populations in rural and remote communities reduce available personnel at the same time as fire seasons are becoming longer.
- Availability of water for fire-fighting due to sustained drought.
- Increasing population and more buildings in fireprone areas.
- Some land management practices increase vulnerability to fire.
- Public understanding of the benefits of fire prevention measures.

³⁰ Victorian Traditional Owner Cultural Fire Knowledge Holder Group, The Victorian Traditional Owner Cultural Fire Strategy, DELWP, Melbourne, 2018.

³¹ M Howes, D Grant-Smith, K Reis, K Bosomworth, P Tangney, M Heazle, D McEvoy & P Burton, Rethinking disaster risk management and climate change adaptation, National Climate Change Adaptation Research Facility, Gold Coast, 2013.

³² R Wyatt, S Young, Y Medani & M Rielly, Volunteering, Participatory Action and Social Cohesion: Reimagining volunteering for contemporary Australia, ThinkImpact, Melbourne, 2020.

Health and wellbeing

Climate change affects health in many ways, as the [Situation Analysis](#) makes clear (see especially pp. 46–55). Its direct effects include the increased intensity and frequency of extreme weather events such as prolonged heatwaves, drought, floods and bushfires. Its indirect effects include worsening air quality, changes in the spread of infectious diseases, risks to food safety and drinking water quality, and effects on mental health.

The impacts of climate change are now being experienced by everyone, acknowledging that these risks are especially pronounced among people who are vulnerable to heat and other climate related illnesses and their impacts. The Grampians Region will need to adapt its housing and infrastructure in order to protect communities and support mental health across the Region.

Adaptation is minimising the direct and indirect impacts of climate change on people's health and wellbeing.



ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Victorian Public Health and Wellbeing Plan ³³ and guidance for tackling climate change	Department of Health
Municipal health and wellbeing plans	Local governments across the Region
Climate action and health promotion programs	Primary care partnerships
Vulnerable Persons Register	Emergency Management Victoria
Place-based community education programs	Neighbourhood houses
Rural outreach programs	Health providers partnerships
Rural People; Resilient Futures pilot project	RMIT Centre for Urban Research
Support programs for communities impacted by extreme weather eg. flood, fire, drought	Federal, state and local governments
Food Strategy 2019–2022	City of Ballarat
Community food swaps and community gardens	Neighbourhood houses and community groups

Leading opportunities

- Influence municipal '10-year community vision' and other local government plans and strategies.
- Improving awareness of the health effects caused by current and future climate impacts.
- Telehealth can support conversations about climate-related health impacts and how to adapt.
- Capitalise on opportunities when communities are together to promote health and wellbeing.
- Local place-based groups adapting to health and wellbeing impacts of climate change.
- Empower communities to grow local produce and improve their access to fresh and nutritious food.
- Climate adaptation education and training for municipal, health sector and community planners.
- Increased use of active transport options.
- Low cost town infrastructure and asset upgrades eg. bus stop shelters and public drinking water fountains.

Main barriers

- Risk perception lags behind impact, meaning the window for adaptation action may be easily missed.
- Costs associated with mental health-related impacts of climate change, such as impacts due to drought.
- The connection between mental ill health and climate change is not well understood by communities.
- Climate change increases the disincentives for people to undertake outdoor activity.
- Health funding is not sufficiently flexible to respond to emerging health needs arising from climate change.
- Community participation is further limited by the effects of climate change, on top of population ageing and decline.
- Adaptability of community services to respond to climate change effects.
- Limited community understanding of the link between climate and health.



Heat

Increased heat is the most direct consequence of climate change and heatwaves are the cause of more deaths than any other natural hazard.³⁴

The Grampians Region will experience increasingly frequent, lengthy and intense heatwaves.

They will drive disruptions to agricultural production, supply of fresh food, industry productivity, outdoor work, sport/recreation, energy security in times of peak demand and transport delays across the Region, as well as to ecosystems and biodiversity. As the Situation Analysis notes, a combination of increasing heat and more frequent drought means there is a growing urgency for adaptive actions across the Region.

Adaptation is preparing for more extreme heat in the built environment and its impacts on people.

³⁴ Health.Vic, Extreme Heat and Heatwaves (web page), Victorian Government, accessed 25 February 2021: www2.health.vic.gov.au/public-health/environmental-health/climate-weather-and-public-health/heatwaves-and-extreme-heat/heatwave-research.

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Public Health and Wellbeing Plan 2019–2023	Department of Health
Municipal health and wellbeing and emergency management plans	Local governments across the Region
Grampians Regional Emergency Management Plan	Regional Emergency Management Planning Committee (REMPC)
State Emergency Management Plan	Emergency Management Victoria (EMV)
Cool It	Central Victorian Greenhouse Alliance
Urban tree canopy projects	Local governments across the Region
Municipal renewable energy targets and power purchase agreements	Local governments across the Region
Heat Health Plan (2020), heat health advice/communications and local heat planning	Department of Health and local governments
Strategic use of shade for outdoor work areas	Eg. Horsham Livestock Exchange
Victoria Energy Upgrades	Department of Environment, Land, Water and Planning

Leading opportunities

- Embed heatwave planning into municipal health and wellbeing and emergency management plans.³⁵
- Using green financing options to encourage uptake of energy efficiency and climate adaptation measures.
- Increased urban tree canopies, river green links, water sensitive urban design and refuges from the heat and cold weather for vulnerable people.
- Community resilience strategies that emphasise looking out for our neighbours can increase the social capital of those communities.³⁶
- Working with developers to improve the quality of new housing stock above minimum standards.
- Retrofitting existing buildings for thermal efficiency.

Main barriers

- Many of the heat management challenges are with existing buildings and infrastructure, especially heritage buildings.
- Criteria for inclusion on the Vulnerable Persons Register are restrictive.
- Tree planting programs may not select drought-tolerant species or allow for ongoing maintenance costs.
- Economic settings and planning rules do not always readily accommodate community solutions, which makes heat harder and more expensive for communities to manage.
- Old housing stock lacks thermal efficiency resulting in high household energy costs.
- Electricity network reliability is compromised on hot and high fire danger days, reducing residents' ability to manage heat load using air-conditioning.

³⁵ Yarriambiack Shire Council, Yarriambiack Heatwave Plan 2015–2018 (revised version), Yarriambiack Shire Council, Warracknabeal, 2016.

³⁶ National Climate Change Adaptation Research Facility, Flooding in Australia: Enhancing disaster resilience and adaptability, NCCARF, Southport (Qld), 2013.



Storms and flooding

The Grampians Region will most likely experience increasingly frequent and severe storm activity over the coming decades, including increased incidence and severity of riverine, urban stormwater and flash flooding.

This will have disruptive consequences for households, industry and public infrastructure, transport and power transmission, as well as the environment. Clever adaptation can head off the foreseeable productivity downturns and health impacts around storm and flood events.

**Adaptation is
preparing for increased
and more intense
storms and flooding.**

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
FloodZoom	DELWP
Flood damage emergency response	State Emergency Service (SES)
Local flood guides	SES, catchment management authorities and local governments
Municipal flood emergency plans	SES and local governments across the Region
Grampians Regional Emergency Management Plan	Regional Emergency Management Planning Committee (REMPC)
State Emergency Management Plan	Emergency Management Victoria (EMV)
Integrated water management forums	Water corporations and catchment management authorities
Municipal emergency management plans ³⁷	Local governments across the Region
Floodplain management strategies	Catchment management authorities
Victorian Rural Drainage Strategy	DELWP

Leading opportunities

- Using sophisticated research and monitoring to inform planning and preparation for storms and floods.
- New approaches to floodplain management mean less severe flood events, and more productive retention of water in the land between events.
- Using blue-green infrastructure to decrease the impacts of flooding as a result of impermeable surfaces.
- Data-driven approaches can enable more optimal deployment of emergency services and better workload management for their personnel.
- Building preparedness for emergencies also builds community resilience and social capital.³⁸
- Switch the planning focus onto predicted flood levels, rather than historical maximum levels.

Main barriers

- Much of the existing building stock is vulnerable to storms and flooding.
- Mitigating flood risks requires cooperation from diverse public and private land users who may have limited experience working collaboratively across the landscape.
- Conflicts in land use (eg draining/cropping wetlands for agriculture) that increase flood vulnerability.
- Historic land management attitudes and practices have a negative legacy impact, such as the lack of suitable planning to avoid flood risks.
- Declining and ageing populations in rural and regional communities tend to diminish the resources available for emergency preparedness and response in those locations.
- Recovery funding only rebuilds 'like for like', rather than more climate adapted infrastructure.

³⁷ Victoria Department of Environment, Land, Water and Planning (DELWP), Guidelines for Assessing the Impact of Climate Change on Water Supplies, Victorian Government, Melbourne, 2016.

³⁸ Moorabool Shire Council, Moorabool Shire Sustainable Environment Strategy 2016–26, Moorabool Shire Council, Ballan, 2016.



Water

Water use in Western Victoria already offers strong illustrations of adaptation in response to a changing climate. Lower than average regional rainfall since the 1990s has affected the health of aquatic systems and supplies, and the [Situation Analysis](#) offers a detailed analysis of the challenges of drought in this Region. It notes that strategic water infrastructure (such as pipeline projects) already enables towns and communities to keep their meters ticking with less reliance on household-level water restrictions than previously. This also offers benefits for water-dependent ecosystems.

Mineral springs are a particularly iconic water resource in the Grampians Region, since 80 per cent of Australia's catalogued mineral springs are found in the Daylesford and Macedon Ranges area.³⁹ Understanding that we need to maximise the value of water for the environment and communities is a core value for the Strategy. For more information on this topic see Appendix 5.

Adaptation is changing the way we think about and use water to increase resilience to long-term climate change.

³⁹ Hepburn Shire Council, *Fertile Ground: Hepburn Shire Economic Development Strategy 2016-2021*, Hepburn Shire Council, Daylesford, 2016, p. 67.

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Pipeline projects	Water corporations
Integrated Water Management forums	Water corporations and catchment management authorities
Pilot Water Sector Adaptation Action Plan	DELWP
Victorian Rural Drainage Strategy	DELWP
Regional catchment and waterway strategies	Catchment management authorities
NRM plans for climate change	Catchment management authorities
Stormwater reuse for recreational watering	Local governments across the Region
Western Sustainable Water Strategy	DELWP
Cultural flows studies (catchment level)	DELWP, CMAs and Traditional Owners
Water for Victoria and the Victorian Waterway Management Strategy	DELWP

Leading opportunities

- Increased use of recycled water or alternative water supplies to reduce ecological pressure on waterways.
- Upgrading water infrastructure for water efficiency gains ensure impacts of less water are spread equitably.
- Protecting water quality to maintain waterway health and water supply for communities.
- Integrated water management maximises biodiversity, social and cultural benefits.
- Reconnecting Traditional Owners with water for cultural, economic, customary and spiritual purposes.
- Consider climate change impacts when defining flood levels.
- Manage rural drainage to increase agricultural production, protect built infrastructure and minimise environmental impacts.⁴⁰

Main barriers

- Less winter and spring rainfall resulting in reduced surface water and groundwater. This will require the ability to balance the needs of all users with scarcer water supplies.
- Population growth (particularly in the Central Highlands) and land use change will place greater demand on water resources.
- Increased frequency of wildfires is likely to reduce catchment water yields and supply quality, while exacerbating the fragility of many waterways as ecosystems.
- Drought tests individual resilience, but it does not typically build community resilience.⁴¹
- River flows come under increasing threat with successive dry years.
- Blue-green algae is more prevalent in warmer weather and can affect the natural ecosystem and potentially affect human health.⁴²

⁴⁰ Victoria Department of Environment, Land, Water and Planning (DELWP), Victorian Rural Drainage Strategy, Victorian Government, Melbourne, 2016, 90 pp.

⁴¹ HJ Boon, J Millar, D Lake, A Cottrell & D King, 'Recovery from disaster: Resilience, adaptability and perceptions of climate change. Its effect on perceptions of climate change risk and on adaptive behaviours to prevent, prepare, and respond to future climate contingencies,' National Climate Change Adaptation Research Facility, Gold Coast, 2012.

⁴² Victoria Department of Environment, Land, Water and Planning (DELWP), Blue-green Algae (webpage), Victorian Government, Melbourne, accessed 25 February 2021: www.water.vic.gov.au/waterways-and-catchments/rivers-estuaries-and-waterways/blue-green-algae.

Grampians Region vision

This Strategy is guided by short, medium and long-term timeframes for adaptation. While the Strategy itself covers a five-year timeframe, it consciously looks ahead to milestones more than a decade from now. The vision is our aspiration for the future state of a climate-adapted Grampians Region in 2050. Goals centre on the 2030s horizon, which dominates much of the international

community's discussions about climate change. Outcomes and indicators describe what we aim to achieve within the five-year timeframe of the Strategy and how we will be able to tell if we were successful. Actions taken in specific years will take the form of yearly delivery plans and an annual scorecard will monitor progress. Figure 6 sets out these timeframes schematically.

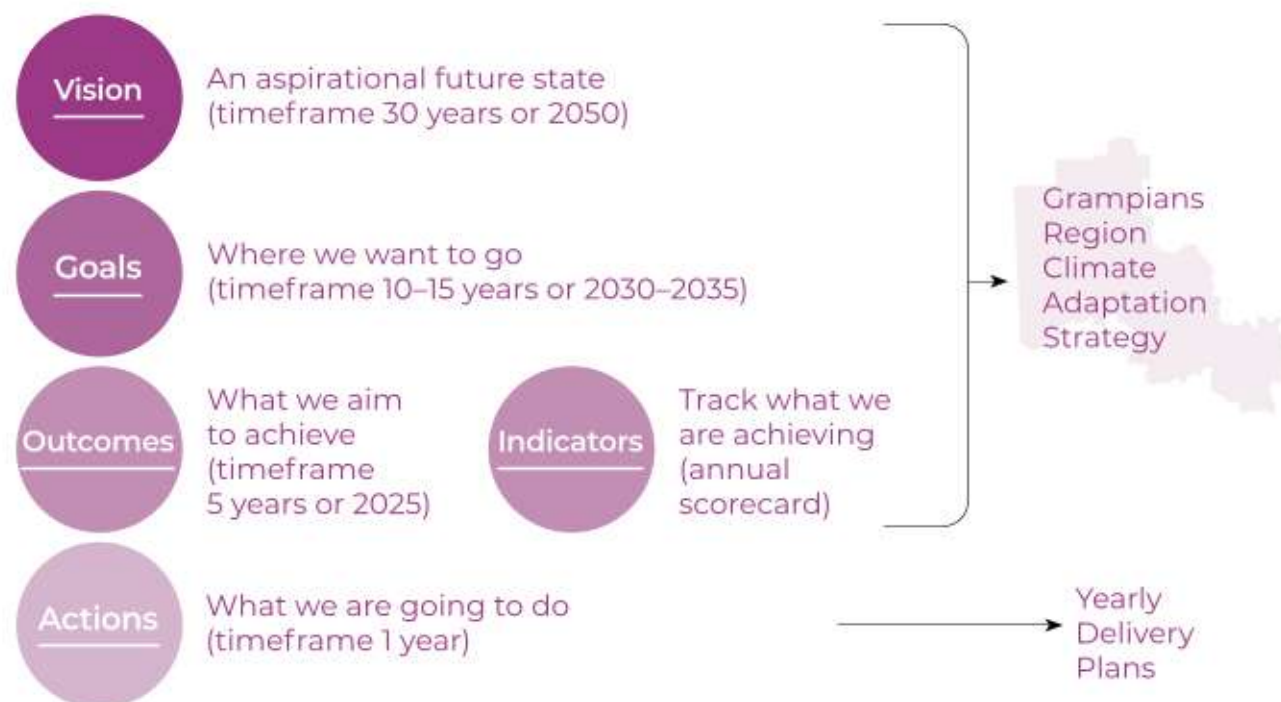


Figure 6: Short, medium, and long-term timeframes for adaptation

Grampians Region 2050 climate adaptation vision

Grampians Region
communities,
organisations and
natural systems are
thriving in a changing
climate because
we are adapting
well together.



Global mitigation of greenhouse gas emissions is largely beyond the control of the Grampians Region, the state of Victoria or even the federal government. Yet climate change already affects the Region—and will continue to.

We cannot know for sure what climate future is ahead, but our decision-makers, leaders, communities, businesses, farmers, researchers and people can all act to adapt.

Change is hard but we can do this in a way that unites us towards shared goals; to minimise the impact of climate change on us and our unique environment and maximise any funding available to invest with the future climate in mind.

**If we can all begin this work now,
and continue it into the future, our
vision is possible.**

Goals, outcomes and indicators

GOALS	OUTCOMES	INDICATORS
Our regional responses to climate change are coordinated, resourced and evidence-based	1 Regional leaders coordinate their climate adaptation efforts to find synergies and maximise positive outcomes.	a Number of stakeholders participating in development and implementation of the Grampians Region Climate Adaptation Strategy.
	2 DELWP's available climate adaptation project funding is leveraged eg. via partnerships, grants, corporate and philanthropic contributions.	b Amount of funds (\$) and in-kind support (hours) leveraged for climate adaptation projects in the Grampians Region.
	3 Region-specific climate change research is prioritised, monitored and communicated.	c Research monitor of regional research projects and their implementation.
Our Region's biodiversity and natural ecosystems are protected and resilient	4 Protection and restoration of natural ecosystems are enhanced by connectivity and include varieties likely to be suited to future climates.	d Extent of ecosystem protection and restoration (area protected, Ecological Vegetation Class).
		e Overall environment score (a composite measure of inundation, stream flows, hot days, tree cover, vegetation condition, exposed soil and vegetation growth).
	5 Environmental watering objectives are met using alternate supplies, water conservation, efficiency measures, sharing frameworks and supply infrastructure.	f Percentage of water released for the environment.
	6 Traditional Owners are empowered and resourced to care for Country.	g Case studies of projects incorporating Traditional Owner-led land and waterway management practices.

GOALS	OUTCOMES	INDICATORS
The Grampians economy is sustainable and climate-ready	7 More efficient and sustainable use of materials, energy, water and waste (circular economy).	h Average energy efficiency of housing stock based on Residential Efficiency Scorecard.
		i Solar photovoltaic energy installations and capacity.
		j Percentage of waste recycled (waste diversion).
		k Solar batteries and solar water heating installations.
		l Average annual water use per capita.
Regional farming is well-adapted to the changing climate	8 Businesses understand and proactively reduce their climate-related risk.	m Participation in business events and programs addressing climate risk.
	9 Increased adoption of sustainable land management practices to improve soil health.	n Soil moisture.
		o Land use: change and soil moisture.
		p Participation in sustainable land management programs.
	10 Evidence-based and innovative approaches to farming are demonstrated in the Grampians Region.	q Case studies of on-ground implementation of research and innovative farm practices.

GOALS	OUTCOMES	INDICATORS
Our built environment is more resistant to weather extremes	11 We understand the emergency risk profile of the Region and mitigate risks with the greatest probability of impacting human health.	r Indicators under development.
	12 Environmentally Sustainable Design policies are integrated into Planning Schemes in the Grampians Region.	s Number of councils with Environmentally Sustainable Design policies in their Planning Scheme.
	13 The existing built environment is retrofitted to better resist extreme weather.	t Victorian Energy Efficiency Certificates (VEECs). u Case studies of climate-related retrofitting projects.
Individuals and communities proactively reduce their climate-related risk	14 Individuals and communities understand and proactively reduce their climate-related risk.	v Participation in events and programs addressing climate and emergency risk.
		w Visits to adaptgrampians.com.au website.
Our vulnerable people are supported to adapt to climate change	15 Climate vulnerability in the Region is investigated and programs are developed to target those likely to be most impacted.	x Indicators under development.
	16 Local governments, health and community services embed climate change thinking in planning and provide practical advice and support to vulnerable people.	y Number of actions and outcomes addressing climate vulnerability included in planning documents.



Implementation

A successful strategy for Region-wide change will be community-led. Victoria's Climate Change Strategy commits to supporting place-based adaptation and Government will continue to play a role in supporting and coordinating efforts made to implement this Strategy.

Regional organisations are encouraged to seek additional resources from governments, businesses and philanthropic funds. Also encouraged are community organisations who can help in the co-design of communications about climate adaptation to engage and inform the Region's remote and disadvantaged communities.

If you have a climate adaptation project idea that aligns with our goals and outcomes please send an email to engage.grampians@delwp.vic.gov.au and we will get back to you.

Visit adaptgrampians.com.au and subscribe for updates to make sure you have the latest information.

Building local partnerships around adaptation projects is a major way to mobilise stakeholder investment in adaptive futures for the Region.



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Appendices

Appendix 1: Plausible future scenarios and change narrative

Appendix 2: Adaptation theme opportunities

Appendix 3: Agriculture working group

Appendix 4: Impacts on the Grampians economy

Appendix 5: Water working group

Appendix 6: Documents reviewed

Appendix 7: Stakeholders consulted



Appendix 1:

Plausible future scenarios and change narrative

Scenario A: medium emissions, well adapted

A medium emissions future will bring significant pressures of climate change. Even in this relatively mild scenario, there will be major challenges to researchers, planners, and policy makers over the coming decades. Participants imagined how this might affect the Region:

- Annual rainfall will continue to decline, while its timing will be less predictable. That poses major challenges to agriculture and to civic infrastructure.
- Changes to rainfall also threaten to disrupt many ecosystems that are highly season-dependent, such as wildlife migrations or pollination cycles. The changing weather will put pressure on regional species, threatening some with extinction.
- Catastrophes of fire and flood will increase in their frequency. That means emergency services staff and volunteers must spend more of each year on ready alert for critical incidents, and their critical work will grow steadily more resource-intensive.
- Warmer and more volatile weather will challenge the health and productivity of communities across the Region, and will increase the incentives for populations to migrate from rural and remote communities to larger urban centres.
- Crucially, this scenario imagines a shared willingness for creativity and adaptation that would improve the Region's quality of life—not merely remove the pressures on it.
- Households and communities would be more proactive with their health and lifestyles.
- Crop diversity and risk-based farming practices would underscore a more research-driven and tech-savvy agricultural sector.
- Continual revegetation and 'biolinks' (connected habitats) would help to limit species loss, aided by citizen scientists across the Region.
- Better landscape management, often informed by traditional practices on the land, would significantly reduce reliance on emergency services volunteers.
- Better-connected communities would support a greater shared sense of hope about the future, as well as less partisan division about policy.

Scenario A is doubly optimistic, imagining a medium emissions future that meets with a regional appetite for adaptation. In other words, it assumes that global forces will achieve an effective reduction in carbon emissions towards 'net zero by 2050,' and that regional actors will combine effectively to manage a changing landscape and society.

Scenario B: high emissions, well adapted

A future of high emissions, leading to rapid climate change, will have profound consequences for life in the Grampians Region. Temperature changes may be manageable for humans across much of the Region, but declining rainfall and its declining predictability will bring acute challenges:

- Many species will come under threat and habitats will hold markedly less biodiversity.
- Natural catastrophes will be more frequent and more intense.
- Hotter days will present acute danger for many people, as well as the Region's fauna and flora. They will disrupt infrastructure and workforce productivity more frequently and more severely and will pose increasing challenges for power supply.
- On the other hand, the prospect of adapting cleverly and inclusively to such a future affirms that the people of the Grampians can exert control over how they live under changing conditions.
- Improved water infrastructure will alleviate population pressures on the larger urban centres.
- A more proactive planning approach will guide population shifts, helping industry to use water, energy, and other critical resources more efficiently over time.
- Well-targeted investments in education and research, in public infrastructure and in community planning will support resilient and flexible communities, confident to focus on their strengths in a changing global economy.
- Year-round preparation and emergency management systems will help communities to plan for and survive more frequent natural catastrophes such as fires, storms and floods, as well as less common emergencies such as pandemics and plagues.
- Governments will work to maximise 'social capital,' supporting an integrated approach to health and wellbeing with strong public health communications.

Scenario B is pessimistic about external forces but optimistic about the Region's willingness to respond and adapt, so the participants were simultaneously scared and proud of it. It imagines a future in which humankind has failed to curb carbon emissions adequately, with temperature rises of more than 2.5° Celsius by the end of the century, but where the resilience and ingenuity of communities across the Grampians Region come to the fore in strategically brilliant adaptations.

Scenario C: medium emissions, not adapted

Imagining a lack of will to adapt brings the population pressures of a medium emissions future to the fore. In scenario C, rural and small town economies will undergo sustained pressure on many fronts, driving a population shift towards large urban centres:

- A drying landscape and price volatilities will drive out all but the most resilient or opportunistic farmers.
- The growing urban population will be increasingly susceptible to extreme weather and to compromised public hygiene, while the internal migration towards large urban centres will leave rural communities less protected and less resilient in the face of catastrophes.
- Underscoring these pressures, more variable weather patterns will disrupt lives and reduce comfort and liveability. Even a medium emissions future will lead to an increased demand on emergency services.
- Fire and weather will become more volatile and fire seasons will grow longer and more dangerous—meaning fatigue will grow deeper as the effects of emergencies become more pronounced.
- Poor adaptation means inadequate insurance, damaged waterways and water-bearing infrastructure, along with poor hygiene and increased disease.
- Species declines and extinctions will continue, including the declining populations of pollinators.
- Variable weather will disrupt seasonal patterns and disorient some migratory species, with flow-on consequences for the diversity and resilience of ecosystems.
- A lack of shared resolve will be the main reason for ineffective adaptation across the Region. A patchwork of individuals, organisations, and local communities may intervene in line with their knowledge and passion, but they will not achieve the scale or the recognition that publicly coordinated action could realise.
- If the Region as a whole cannot resolve to invest in the interventions needed to accommodate climate change, even a medium emissions future will put intolerable strains on regional ecology, on local economies, and on vulnerable and marginal people.

Scenario C captures a fear of the complacency that may take hold if climate change proves less severe than many currently fear. A future with medium emissions but little or no effective adaptation in response to them may be as dangerous for this Region as a future with higher emissions but a more adaptive response.

Scenario D: high emissions, not adapted

Quality of life will come under severe strain when government-led actions around the world fail to meet agreed limits on carbon emissions and on global warming. For the Grampians Region, rural and small town economies will be under sustained pressure on many fronts, driving a population shift towards large urban centres:

- Temperature extremes will put great pressure on public and commercial infrastructure, including power and transport.
- The number of fires will increase and become more severe and fire seasons will grow longer.
- A more volatile climate will also bring increased storm activity. This in turn will bring challenges to public hygiene, increased loss of life, and growing pressure on insurance.
- Continuous emergencies will lead to increased fatigue in relief agencies, people under increased stress and detrimental consequences for public health.
- Displaced people and animals will need remedial (not strategically proactive) relocating.
- The consequent reductions in urban amenity will compound other health pressures.
- Life in rural communities will face mounting challenges. These threats will severely challenge generational renewal in agriculture.
- A drying landscape will accelerate depopulation outside of large urban centres, encouraging 'fly in fly out farming' and intensifying desertification.
- Global price volatility, reduced runoff and threats to pollinator populations will diminish crop yields and stock levels.
- Ecosystems will likewise be under threat.
- Climatic extremes will combine with higher fire activity to drive increased extinctions of flora and fauna species.
- Eucalyptus and invasive non-native species will increasingly dominate the landscape, further exacerbating fire activity and the loss of diverse habitats.
- Migration towards large urban centres will decrease the human presence in landscape, reducing the level of efforts to care for it.

Scenario D was called the *Mad Max* scenario by several participants, largely because it reminds us of bleak futures that people have imagined previously. Continued high carbon emissions combined with a poor adaptive response will leave the Grampians Region exposed to unbearable pressure across a range of fronts.

Change narrative

This Strategy identifies aspects of climate change that will be particularly significant for the Grampians Region, and anticipates targeted ways its communities can respond to sustain life and the quality of life in this Region. As this document has explained, those adaptive responses stand out for their values of inclusiveness, of respect for traditional knowledge, of enthusiasm for learning new approaches and technologies, and of care for the environment and its ecology.

Across the Grampians Region, stakeholders contributing to this Strategy have articulated a need to get on with the work of adapting. Many regional stakeholders have voiced a need for clear goals and targets immediately. They sense an urgent need for work, and are ready to commit their own efforts.

Strong leadership from state and federal government is needed. Many stakeholders are keen to lock in a climate adaptation strategy quickly, taking action while Victoria has a government committed to it.

How might a well-adapted Grampians look in the years to come? It will be characterised by:

- A Region-wide commitment to adapt strategically.
- Pride and strength in local communities.
- Inclusive approaches, mobilising and supporting entire communities.
- A culture of continuous improvement, refusing to be complacent.
- Flexible approaches to adaptation that span public and private agencies.
- Investing in biodiversity and actively curtailing land-clearing.
- Strategic and innovative use of resources, especially water.
- Improved planning and infrastructure.
- Investment in education and research.
- Actively confronting the challenges of generational renewal – of younger people coming into local responsibilities as a previous generation grows older – especially in rural and remote communities.
- Supportive policy and regulation (including economic incentives).
- An effective consensus about the adaptation imperative – the need for change in response to climate change.

This Strategy's change narrative revolves around a core understanding of the values that will motivate people across the Grampians Region to carry out the important work of adaptation, and to have pride in doing so. Those values are a moral purpose that guides the formation of this Strategy. They are reflected in the Strategy's 'adaptation vision'. They also inform the specific adaptation goals for this Strategy.

Appendix 2:

Adaptation theme opportunities

The opportunities listed here have been taken from the adaptation theme pages within this Strategy, as developed by working groups. Each has been cross-checked against the other adaptation themes for complementarity and possible unintended consequences. The relevant strategic outcomes have also been referenced for each opportunity to clarify alignment between the themes, goals and outcomes of this Strategy.

LEADING OPPORTUNITIES	AGRI-CULTURE	BIO-DIVERSITY	ECONOMY	FIRE	HEALTH AND WELL-BEING	HEAT	STORMS AND FLOODING	WATER	OUTCOMES
Greater knowledge/understanding of rural wellbeing can support more sustainable farms, farm workers, and farm families.	✓		✓		✓	✓			8, 11, 14, 15, 16
Optimising soil functionality by maintaining or increasing soil carbon levels.	✓	✓	✓	✓			✓	✓	9, 14
Conserving soil moisture by maintaining ground cover in pasture and cropping systems.	✓	✓	✓		✓	✓	✓	✓	7, 9
Embracing new technology, including better access to digital infrastructure and data driven improvements to production systems.	✓	✓	✓	✓	✓	✓	✓	✓	10
Sharing agricultural adaptation knowledge.	✓	✓	✓	✓	✓	✓	✓	✓	1
Reversing population trends by providing employment opportunities for rural youth.	✓	✓	✓	✓	✓	✓			1
Sustainable agriculture improving insurance outcomes.	✓		✓						8
Farm diversification including biochar, bio-fuels, agritourism and niche industries.	✓	✓	✓		✓				10
Water efficient food production systems – opportunities for pipeline/reuse water.	✓	✓	✓	✓	✓			✓	7
Intensification of agriculture eg horticulture, aquaculture, intensive animal industries.	✓		✓						7, 10
Protecting existing natural assets and remnants.	✓	✓	✓						9
Climate-sensitive restoration/revegetation.		✓							3, 4, 9, 13, 15
Connected habitats and protection of refugia.		✓							3, 4, 5, 6, 7, 15
Coordinated threat management at the landscape scale (pest, plant, animal, disease).		✓							3, 4, 5, 6, 9, 10, 14, 15, 16
Online Natural Resource Management portals and public information sources eg south west climate change NRM portal.		✓		✓		✓	✓	✓	3, 4, 5, 6, 9, 14, 15

LEADING OPPORTUNITIES	AGRI-CULTURE	BIO-DIVERSITY	ECONOMY	FIRE	HEALTH AND WELL-BEING	HEAT	STORMS AND FLOODING	WATER	OUTCOMES
Adaptation pathways approaches to NRM planning for natural assets.		✓							3, 4, 5, 6, 7, 9, 10, 11, 14
Optimal environmental water flows.	✓	✓	✓	✓	✓	✓	✓	✓	4, 5, 6, 7
Incentivise land use practices that value biodiversity.	✓	✓	✓		✓	✓		✓	1, 4, 6, 9, 10, 12, 14
Identify the transformational actions and tipping points that might be required to improve biodiversity outcomes for the Region.	✓	✓	✓	✓	✓	✓	✓	✓	2, 4, 5, 9
Research to overcome key knowledge gaps at species, community and landscape scales.	✓	✓							2, 3, 4, 5, 9
Better management of plague/pest animal species.	✓	✓							2, 4
Regional processing of agricultural product.	✓		✓		✓				7, 8, 10, 16
Onsite energy generation with solar panels, methane recovery (eg Landfill) and/or bioenergy.	✓		✓		✓				1, 2, 3, 7, 8, 10, 12, 13, 16
Upgrades to improve thermal efficiency and reduce energy use/cost of buildings.	✓		✓		✓	✓			1, 2, 5, 7, 8, 9, 10, 12, 13, 14, 15, 16
Use of recycled water.			✓				✓	✓	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16
Power purchase agreements (PPAs) with local renewable energy developments.			✓						1, 2, 3, 5, 7, 8, 15, 16
Resource-efficient food production systems.			✓						1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15
Grow artisanal food sector and community supported agriculture.	✓		✓		✓				1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15
Microgrids and virtual power plants.			✓						1, 2, 3, 7, 8, 10, 12, 13, 14, 15, 16
Municipal Recovery Facility (MRF) to sort and process recyclable materials regionally.			✓						
Develop markets for waste products and recycled materials including plastics, glass and food/organic waste.			✓						
Spending by governments in response to the pandemic should consider climate implications.			✓						
Circular economy food hub as outlined in the R2Z.	✓		✓		✓				
Increase fire resistance of the built environment.			✓	✓	✓	✓		✓	13

LEADING OPPORTUNITIES	AGRI-CULTURE	BIO-DIVERSITY	ECONOMY	FIRE	HEALTH AND WELL-BEING	HEAT	STORMS AND FLOODING	WATER	OUTCOMES
Improve the resilience of fire prone communities so they can recover more quickly if impacted by fire.			✓	✓	✓				15
Early detection, response and monitoring of fires.		✓	✓	✓	✓			✓	3
Embedding climate change researchers within disaster risk management agencies.				✓					3
Sustaining the volunteer base of rural and remote communities is essential for social and economic recovery from Covid and other shocks.				✓	✓				14
Cultural burning practice is led by Traditional Owners.		✓		✓	✓				6
Streamline replacement and compensation arrangements for households that get burnt out (especially where no permit to rebuild is likely, due to fire risk).			✓	✓					11, 14
Influence municipal '10-year community vision' and other local government plans and strategies to have a climate change adaptation lens.					✓				
Improving awareness of the stress caused by the current and future climate impacts.					✓				
Telehealth can support conversations about climate-related health impacts and how to adapt.					✓				
Capitalise on opportunities when communities are together to promote health and wellbeing.	✓	✓	✓	✓	✓	✓	✓	✓	1, 3, 5, 6, 7, 8, 9, 11, 14, 15, 16
Local place-based groups adapting to health and wellbeing impacts of climate change.	✓	✓	✓	✓	✓	✓	✓	✓	1, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16
Climate adaptation education and training for municipal and community planners.	✓	✓	✓	✓	✓	✓	✓	✓	1, 2, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15
Increased use of active transport options.	✓	✓	✓	✓	✓	✓	✓	✓	1, 2, 3, 4, 6, 7, 8, 11, 13
Low cost town infrastructure and asset upgrades eg bus stop shelters; public drinking water fountains.	✓	✓	✓	✓	✓	✓	✓	✓	1, 2, 4, 5, 6, 7, 8, 11, 12, 13, 14, 16
Embed heatwave planning into municipal health and wellbeing and emergency management plans.			✓		✓	✓			1, 15, 16
Mitigation strategies to reduce household energy consumption are also good adaptation strategies, emphasising the thermal qualities of buildings.					✓	✓			7
Using green financing options to encourage uptake of energy efficiency and climate adaptation measures.			✓		✓	✓			7, 8
Increased urban tree canopies, river green links, water sensitive urban design and refuges from the heat and cold weather for vulnerable people.		✓			✓	✓	✓	✓	13, 16

LEADING OPPORTUNITIES	AGRI-CULTURE	BIO-DIVERSITY	ECONOMY	FIRE	HEALTH AND WELL-BEING	HEAT	STORMS AND FLOODING	WATER	OUTCOMES
Community resilience strategies that emphasise looking out for our neighbours can increase the social capital of those communities.					✓	✓			14
Working with developers to improve the quality of new housing stock above minimum standards.			✓		✓	✓			12
Research can identify affordable and accessible ways to retrofit established buildings for greater thermal performance and energy efficiency.	✓		✓		✓	✓			3, 7
Using sophisticated research and monitoring to inform planning and preparation for storms and floods.	✓	✓	✓				✓	✓	1, 2, 3, 7, 11, 15
New approaches to floodplain management mean less severe flood events, and more productive retention of water in the land between events.	✓	✓	✓	✓	✓	✓	✓	✓	1, 2, 3, 4, 5, 11, 12, 14
Using blue-green infrastructure and augmenting urban environments to decrease the impacts of flooding as a result of impermeable surfaces.	✓	✓	✓				✓	✓	2, 3, 7, 11, 15
Data-driven approaches can enable more optimal deployment of emergency services and better workload management for their personnel.	✓	✓	✓	✓	✓	✓	✓	✓	1, 2, 3, 11, 12, 14, 15
Building preparedness for emergencies also builds community connectedness, resilience and social capital.				✓	✓	✓	✓		1, 2, 7, 8, 11, 12, 14
Streamline replacement and compensation arrangements for flooded homes (especially where no permit to rebuild is likely, due to flood risk).			✓				✓		8, 11, 13
Switch the planning focus onto predicted flood levels, rather than historical maximum levels.							✓	✓	3, 11, 13
Increased use of recycled water or alternative water supplies to reduce ecological pressure on waterways.	✓	✓	✓	✓	✓	✓	✓	✓	1, 5, 7, 8, 10, 14
Upgrading water infrastructure for water efficiency gains to balance future needs of all water users and the environment.	✓	✓	✓	✓	✓	✓	✓	✓	1, 5, 7, 8, 13
Protecting water quality to maintain waterway health and water supply for communities.	✓	✓	✓	✓	✓	✓	✓	✓	1, 5, 11, 15
Integrated water management achieves multiple benefits, maximising biodiversity, social and cultural benefits.	✓	✓	✓	✓	✓	✓	✓	✓	1, 4, 5, 7
Reconnecting Traditional Owners with water for cultural, economic, customary and spiritual purposes.	✓	✓	✓	✓	✓	✓	✓	✓	1, 2, 4, 6, 10, 16
Manage rural drainage to increase agricultural production, protect built infrastructure and minimise environmental impacts.	✓	✓	✓	✓	✓	✓	✓	✓	1, 5, 7, 9, 10, 14

Appendix 3:

Agriculture working group

Agriculture in the Grampians Region is about:

- being a major source of cereal grains, oilseeds, pulses, wool, livestock, timber.
- contributing to state and national self-sufficiency in food and fibre supply.
- export of product outside the region, with income circulating in the regional economy.
- creation of permanent jobs within agriculture, generating spin-off employment in communities, service providers and agribusiness.

Leading opportunities

Carbon Sequestration

- Minimising carbon emissions in the first place should be our primary goal.
- A price on carbon or a tax on farm greenhouse gas emissions would be a stimulus to engage in carbon farming and significant planting of trees, including within an integrated farm forestry model, with this resulting in improved microclimates and shelter around farm dams.

- Soil carbon credits providing direct income to landholders. Provides land health benefits as well.
- Dollars provide the incentive for change. Carbon having a value will drive adaptation activity. Croppers adopting minimum till systems are heading for this. People will guard their carbon in the soil. Increased value and resilience of farm assets.
- Building soil carbon builds resilience for the bad years – increased soil carbon levels contribute to enhanced soil health.
- Monetising carbon has risks for western Victorian croppers. Build soil carbon as an adaptation response rather than a stand-alone economic activity.

Conserving Soil Moisture

- Rising summer temperatures would be a stimulus to increasing the amount of ground cover, improve pasture management to maintain a level of cover, use of perennials, and to change cropping management.

Embracing New Technology

- Improvement in access to high speed digital connections mean farmers will be able to manage markets and marketing, and access information more reliably.
- Farmers may be well-placed to earn income from production of energy as liquid and gas fuels, power, or sale of feedstocks (straw, wood chip) for production of energy and biochemicals.
- Gathering and collection of data to improve farm businesses. Eg. more detailed animal production data to drive profitability, yield mapping in cropping.
- Agricultural data aggregation, sharing and sale.
- Linked soils moisture probe network.
- Use of drone technology for sensing plant health/disease.

Sharing Agricultural Adaptation Knowledge

- Work with catchment management authorities, Agriculture Victoria and agronomists to build knowledge around adaptation practices for agriculture and share this with farmers.

- Opportunities to learn from existing agricultural systems that are already hotter than the Grampians—for example, climate adaptations in the wheatbelt of Western Australia.

Reversing Population Trends

- The pressures of life in the cities (including high cost of housing and negative impact on family life) will mean a significant flow of people back to the rural areas, bringing energy and skills.
- Farms being aggregated, renewable energy development – build industries closer to where its generated rather than expensive distribution networks.
- Use of new and improved technology – more reliable internet connections with adequate download speeds.

Sustainable Agriculture

- Wimmera Development Association work on mosaic farming – farmers refining their areas of production, decisions on lower productivity areas.
- Modifications to farm management deposit scheme – use as form of self-funded insurance.
- Research into food production in local communities.
- Opportunities to utilise 'out of season' rainfall for crop production, pastures.
- Insurance impacts – multi peril crop insurance too many payouts – risk too high. Either mandatory or underwritten by government.

Farm Diversification

- Feed supplements for livestock – Biochar use ties into energy industry. Provides benefit back to producers (payment for plant feed source and biochar). Cold pressed canola meal – benefits from reduced animal emissions. Bull kelp supplement provides similar benefits. Money in carbon.
- New industry – potential return to localised markets, shorter supply chains – reduced freight costs.
- Bulk commodity approach – difficult to continue this approach in competition with products not produced to same standards or requirements.
- Industry diversification – development of niche industries and products, reduces declining population densities.

Main barriers

- Market disincentives to adaptation are challenging strategic actors (eg. Farmers for Climate Action 2018).
- Regulatory and policy frameworks that discourage innovation.
- The commitment to 'continuous improvement' is uneven across the sector when it needs to be universal.
- Lack of informed government forward projections.

- Lack of stimulus that can be relied on for long-term change and commercial investment.
- Steep reduction in agriculture department extension staff numbers and research centres.
- Lack of practical and proven models for agriculture under climate change.
- Lack of development of a bioeconomy to provide a market for agricultural biomass (residues).
- Lack of enough experienced consultants, contractors, and suppliers/installers of advanced systems.
- Financial system that values carbon - rewards sequestration, costs 'users'. Emissions Reduction Fund is too onerous. Needs a simpler system, less administrative burden. ASX underwrite carbon credits through the Emissions Reduction Fund. Could be delegated to accountants for example. Voluntary system of credits as well – eg. farm forestry group does the prelim audit.
- Tax on carbon emitters. Investors need confidence in long term arrangements to achieve long term changes.
- Political representation for the agricultural sector demonstrates a reluctance to include climate adaptation in policy. Lack of bipartisan policy at state and federal level.

Appendix 4:

Impacts on the Grampians economy

What is the current situation?

What effects is a changing climate having on the Grampians Region economy?

Access to affordable energy sources is an emerging issue in the Grampians Region. A number of businesses are leading on the development and installation of renewable energy technologies at their headquarters. Microgrids and minigrids are meeting local industry energy demands. Trials of renewable energy sources across the Region have been ongoing for a number of years and are attracting a higher profile here. More projects are in development.

Businesses are seeking cost reductions, and it is becoming apparent that adapting to climate change impacts can reduce financial imposts. This is particularly the case with industries dependent on the land, where low rainfall in recent years is now requiring changes to business practices. It is becoming recognised that adapting to climate change impacts is a cost-effective solution.

Local industry continues to demonstrate it can quickly pivot to changing and unpredictable circumstances.

In addition to the private sector actions being undertaken, there are a range of community-led and government-supported projects that are helping communities adapt to a changing climate.

Research projects underway across the Region are helping the business community understand the broader impacts of climate change, and have and will help provide adaptive solutions.

A number of these innovations, projects, and research activities have been and are being undertaken in partnership.

What actions, innovative or otherwise, are currently underway within the Grampians Region (or beyond) to help the Regional economy adapt to a changing climate?

The following is a list of innovative activities in the area of climate change adaptation that have already been delivered:

- Data sovereignty project with Federation and La Trobe Universities for agricultural systems.
- Hepburn Wind co-locating a 7.4 megawatt solar farm and 10 megawatt hours battery storage at their existing windfarm.
- The Hepburn Wind-operated community fund/bank co-funded an upgrade to the Hepburn Recreation Reserve 'place of last resort', which has seen solar and battery storage installed that will provide power to the site: power is often the first outage during a fire.
- The Smythesdale landfill harvests greenhouse gas, which creates energy and goes back into the grid.
- Gekko Systems is trialling a modularised, containerised biodigester system at [Trigg Farm](#) near Ballan.

- A biodigester has been installed at Berrybank Farm's intensive piggery for some decades, converting the farm's significant waste by-products into energy.
- Skipton and Beaufort Hospitals have installed straw-fired and woodchip-fired boilers.
- Central Goldfields Shire Council's Carisbrook Landfill is producing compost from food and garden organic waste.
- JBD Industrial Park, near Bacchus Marsh, is home to a number of businesses operating in the reclaimed energy and waste sector, and the Park itself also houses a working cattle farm.
- Meredith Dairy has a waste-to-energy biodigester facility.
- Gekko Systems has a waste-to-energy biodigester facility.
- The Grains Innovation Centre in Horsham recently celebrated its 50-year anniversary. Offering a world-class research facility delivering regional, national and international benefits in regional development and science and innovation, the GIC is a partnership of government, academia and industry.

- The wine industry is already replacing unsuitable plants with later-ripening varieties that ripen at approximately the same time as the original plants so as to maintain quality.
- The redevelopment of Wail Nursery has improved the utilisation of bush foods and native foods for a variety of areas across broadacre cropping.
- The Dja Dja Wurrung (Bendigo) have been undertaking research with La Trobe and Federation Universities looking at Kangaroo grass for flour in baking.
- During the drought, agriculture showed a significant growth in the uptake of zero till or minimum till.
- Longerenong Agricultural College partners with agricultural businesses across the region to deliver adaptive research programs and bright minds for tomorrow's agriculture.
- Artisan Agriculture Project is a Hepburn Shire Council project telling the story of 'Paddock to Plate', activating business/ tourism opportunities.

There are also a significant number of projects already in development:

- A planning permit has been issued in Golden Plains Shire for the installation of a biodigester to convert chicken waste to fertiliser.
- McCain is building a 'behind-the-meter' solar farm on their own site to fuel production.
- Gekko Systems is working with McCain on installing a biodigester.
- Biodigesters are being investigated at a small and modular, single building (eg. residential; hospitality business) scale.
- Local and State government organisations continue taking up funding of rooftop solar installations and general energy efficiency improvements at publicly owned buildings.
- Buninyong Bank is developing a shared meter in the business district and also backs the Newstead microgrid project.
- A community-led microgrid for business and residential properties in Trentham is in development.

- Natimuk Community Energy is a cross-sectoral partnership project that will install front-of-meter photovoltaic power generation equal in capacity to the electricity consumption of the town.
- Agricultural trials in the Wimmera, assessing impacts of extreme temperatures on wheat crops in northwestern Victoria, identifying regional economic impacts and adaptation opportunities.
- Wail Nursery provides significant research opportunities, with meaningful engagement and recognition of Indigenous knowledge at its heart.
- GNET is developing a partnership with smaller businesses to generate a critical mass for the purchase, long-term, of power generated from renewable sources.

The business industry tells us that the following ideas could be applied to the Grampians region:

- Commercialisation of the grain industry to encourage improved systems connections, for example connecting brewers and bakers, should be further explored. A 50 hectare site in the northern plains near St. Arnaud and a further two sites near Smeaton are being considered.
- Industrial and commercial businesses are the key producers feeding energy back into the grid.
- Mine shafts and public buildings (especially schools) could provide solar-pumped hydro.
- Encouraging the development of agroforestry as providing a sustainable and renewable industry source.
- Biodiversity community has State Wide Integrated Flora and Fauna Teams (SWIFFT) to run quarterly forums to share research, information, projects, etc. There should be an equivalent forum to share early research for agriculture sector and possibly other sectors around climate adaptation.

- Encouragement of bulk purchasing of electricity by companies or cooperatives.
- Encouraging mosaic farming as a viable economic and environmental alternative to traditional farming practices.
- Educate, support and provide incentives for the farming sector to prioritise privileging preservation of local biodiversity with farming practices.
- Develop relationships with CSIRO. Some real opportunities with research and better use of native plants and legumes in grazing systems; huge opportunity in this part of the world.
- Hepburn Shire is a leading local government authority in the region in terms of promoting zero carbon emissions.
- Natural resources like state forests, national parks and natural reserves could offer respite from increased temperatures if there is not the risk of fire.

What does an optimally adapted Grampians Region economy look like, and what are the barriers to get there?

It is evident from the conversations with the Grampians Region business community that a 'circular economy' as a business model is sustainable, achievable, and desirable. But what does this look like for our Region, and how do we get there?

A circular economy

There is an intersection between business and community that is coming to the fore in the Grampians Region. The 'triple bottom line' is now a reality for businesses looking to ensure their sustainability. Practical opportunities on this path to the circular economy model include:

- Maximisation of renewable energy sources (e.g. [Gekkos](#)).
- Renewable energy sources co-located with industry (e.g. [McCain](#)).
- Natural gas through biomass treatment (e.g. [Berrybank Farm](#)).
- On-site recycled wastewater (e.g. [QWM Water](#)).
- Improved and a greater diversity of water-efficient food production systems.
- Re-use of already-used materials to manufacture new products (e.g. [Replas](#)).
- Use of commercial and residential food and garden waste ('FOGO') for compost and biogas production.

Partnership and leadership

An emphasis on the value of partnerships in delivering an adapted economy must be made. To date, a significant number of the innovations in climate change adaptation have been achieved through a partnership model. One example of such a project is the development of a biodigester in partnership between Gekko Systems and McCain in Ballarat. Other partnerships have been cross-sectoral: Beaufort and Skipton Hospitals with support of local Councils have installed straw-fired and wood-fired boilers. Hepburn Z-NET is a community partnership working to make the Hepburn Shire the first zero-net emission local government area in Australia; from the partnership arose another high-profile project in the Grampians Region, the Hepburn Windfarm, which is entirely community-owned.

It is evident that business and the community is leading on adaptation, with the role of government minimised to one of facilitative support rather than leadership.

Also evident from conversations with the Region's business community is the need for government to act. Particular expectation is placed at the feet of the State government, with the following areas identified as needing urgent attention:

- The vulnerability of the power infrastructure to increased temperatures.
- Inadequate transport infrastructure. Currently, road and rail transport is impractical or financially unviable for a number of projects associated with creating waste from energy.
- Sustainable living and working outcomes. New buildings and public places could be mandated to be carbon-neutral.
- An 'electricity price guarantee'. The lack of certainty for businesses makes purchasing power difficult. Decentralising the grid and forming power partnerships to encourage greater take up of purchase-power agreements is essential.

Appendix 5:

Water working group

Water use in Western Victoria already offers strong illustrations of adaptation in response to a changing climate. Since the 1990s, in general terms, rainfall across most of the State has been significantly lower than the longer-term historic averages. Strategic water infrastructure (such as the Wimmera Mallee Pipeline), sourcing alternative water supplies (eg. recycled water) and measures to reduce individual consumption have enabled regional communities to keep their meters ticking with less reliance on household-level water restrictions. Understanding that we can make less water go further is a core value for the Climate Adaptation Strategy.

ADAPTATION PLANS AND ACTIONS ALREADY UNDERWAY	LEAD AGENCY
Integrated Water Management forums	Water corporations and catchment management authorities
Pilot Water Sector Adaptation Action Plan	DELWP
Victorian Rural Drainage Strategy	DELWP
Catchment-based climate adaptation strategies	Catchment Management Authorities across Victoria
Pipeline projects	Water corporations
Development of Integrated Water Management Strategies – formation of Integrated Water Working Groups	Catchment Management Authorities
Environmental water releases – new sources of water. biodiversity/recreation benefits	
Western Irrigation Network – Use of treated wastewater to provide climate resistant irrigation water.	Western Water
Treated waste-water supplementing groundwater supplies for non-potable applications – Ballarat, Horsham, Edenhope	Regional Water Authorities
Rehabilitating previously drained wetland sites.	Various land managers
Stormwater reuse systems replacing alternate supplies. Eg. water for recreation ovals - Horsham Warracknabeal, Ballarat. Lake Wendouree receives an additional 1.9 GL on average per year from stormwater harvesting replacing supply from Gong Gong Reservoir.	Various local governments
Use of mining process water for rehabilitation purposes.	Iluka Resources
Pilot Water Sector Adaptation Action Plan	DELWP
Victorian Rural Drainage Strategy	DELWP
Regional catchment and waterway strategies	Catchment management authorities
NRM plans for climate change	Catchment management authorities
Stormwater reuse for recreational watering	Local governments
Western Sustainable Water Strategy	DELWP

Leading opportunities

Utilising Alternative Water Sources

- Increased use of recycled water or alternative supplies (eg. stormwater) to replace potable or surface water (eg replacing sources of water for irrigation) . Scope within integrated water management groups to identify additional projects.
- Utilising alternative water sources to provide green spaces in dry communities. This is important for mental wellbeing of rural residences and helps with passive cooling.
- Increased utilisation of treated groundwater (eg. desalinisation) to supplement water supplies.
- Early involvement of water authorities in precinct planning to maximise integrated water management opportunities.
- Expansion of the water grid into the Grampians region assists community and environmental adaptation.

Protecting and Enhancing Water Quality

- Improve water quality to reduce the frequency and intensity of Blue-green Algal outbreaks. Reduced water quality threatens our water supplies.
- Protecting catchment and water resources to maintain recreational water access. Minimise the loss of amenity resulting from restrictions on waterway use resulting from water quality degradation.
- Protect water quality from impacts of built environment and nutrient inflows.
- Consideration of water and adaptation in planning schemes. Reduce water requirements/consumption associated with new developments.
- Roof water harvesting as alternate water supply.

Infrastructure Improvements for Water Savings

- Infrastructure upgrades for water efficiency gains (eg. channel/storage decommissioning, water pipelines).
- Water grid infrastructure provides increased flexibility and savings resulting from more efficient storage management.

Achieving Multiple Benefits from Water Resource Management

- Greater emphasis on the link between biodiversity and water resource management (in water, at site, in and around watercourses, lakes, etc). Wildlife refuges on waterways to help wildlife survive drought. Wimmera CMA has examined the feasibility of the strategic watering of deep holes of dry watercourses and improving water quality in weir pools.
- Use of consumptive water transfers to increase water quality in creeks and rivers. (Already happening in the Wimmera- multiple values from the same bit of water). The [Northern Region Sustainable Water Strategy](#) details the principle of using consumptive water to provide social and environmental benefits as it is transferred (see page 140).
- Use of treatment plant buffer zones to enhance specific habitat requirements.

Reconnect Communities to Water for Cultural, Economic, Customary and Spiritual purposes.

- Recognise and manage water resources for traditional owner values. Incorporate traditional owners in water resource decision making.
- Use of indigenous water science – benefits of a more holistic view of water management under climate change.
- Engage DELWP Water and Catchments regarding regional opportunities associated with the Aboriginal Water Program.

Sharing Water Resource Management Knowledge

- Greater sharing of information between Integrated Water Management Forums- projects, ideas, and lessons learned etc.

Main barriers

- The ability to balance the needs of all users in the future and ensure that we can provide adequate water resources for the environment and recreation (not just consumptive users) under scarcer water supplies.
- More regular reviews of water strategies to incorporate climate change effects.
- Wimmera has only recreational entitlement.
- Population growth (particularly in the Central Highlands) and land use changes will place more demand on our water resources.
- More emphasis on climate change in decision making. Level of uncertainty around consequences and impacts leads to inaction. Often insufficient level of confidence in the data to support concrete action.
- Availability of resources to undertake climate adaptation works. Priority given to water supply 'core' business. Water authorities are in the business of selling water – guides their priorities.
- Farm Dams harvesting surface water – current permit system doesn't effectively regulate non-commercial storages.
- Increased frequency of wildfires is likely to reduce catchment water yields and water supply quality.

Appendix 6:

Documents reviewed

As well as those referenced, these documents and resources were reviewed in developing this Strategy.

- [ACTIVATE: Eight psychological strategies to tackle climate change](#)
- [Biodiversity 2037](#)
- [City of Ballarat Food Strategy 2019-2022](#)
- [Climate Change Act 2017 \(Vic\)](#)
- [Cool It](#)
- [Corangamite Natural Resource Management Plan for Climate Change](#)
- [Corangamite Regional Floodplain Strategy 2018-2028](#)
- [Corangamite Waterway Strategy 2014-2022](#)
- [Decarbonisation Futures](#)

- [Future Landscapes](#)
- [Glenelg Hopkins CMA Climate Change Strategy 2016-2023](#)
- [Grampians New Energy Taskforce Grampians Regional Roadmap to Net Zero Emissions](#)
- [Heat Health Plan for Victoria](#)
- [Inquiry into Tackling Climate Change in Victorian Communities](#)
- [Pilot Water Sector Adaptation Action Plan](#)
- [State Emergency Management Plan](#)
- [Strong, Innovative, Sustainable: A new strategy for agriculture in Victoria](#)
- [Tackling climate change and its impacts on health through municipal public health and wellbeing planning: Guidance for local government, 2020](#)

- [Victorian Emergency Management Reform White Paper](#)
- [Victorian Public Health and Wellbeing Plan 2019-2023](#)
- [Victorian Rural Drainage Strategy](#)
- [Victorian Traditional Owner Cultural Fire Strategy](#)
- [Victoria's Climate Science Report 2019](#)
- [Western Sustainable Water Strategy](#)
- [Wimmera Floodplain Management Strategy](#)
- [Wimmera Waterway Strategy 2014-2022](#)

Appendix 7:

Stakeholders consulted

Regional Climate Adaptation Groups

Central Highlands

Miranda Adams
Department of Families,
Fairness and Housing

Tara Ash
Central Highlands Water

Dr Tamara Boyd
INtrinsic SCOPE

David Collins
Golden Plains Shire Council

Barbara Curzon-Siggers
Hepburn Z-NET

Cherie Draper
Community member

Dr Peter Gell (Co-Chair)
Federation University

Bob Hartmann
Friends of Canadian Corridor

Justin Horne
Moorabool Shire Council

Taryn Lane
Coalition for Community Energy

Andrew Lang
Farm Forest Growers Victoria

Rob Law (resigned)
Central Victorian Greenhouse Alliance

Karen Marsh
Department of Families,
Fairness and Housing

Jason McGregor
Central Highlands Water

Dr Adam Miller
Deakin University

Dominic Murphy
Hepburn Shire Council/Meredith Dairy

Dr Tony Rickards (Co-Chair) (resigned)
Community member

Ed Riley
Pyrenees Shire Council

Pat Russell (resigned)
Central Highlands Water

Wimmera Southern Mallee

Tony Baker
Wimmera Catchment Management
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Authority

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Horsham Rural City Council

Steven Hobbs
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Gil Hopkins
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Barengi Gadjin Land Council

Daryl Scherger (resigned)
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Chris Sounness
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Yarrook Farms

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Farm Forest Growers Victoria

Dominic Murphy
Meredith Dairy

Richard Murphy
Glenelg Hopkins Catchment
Management Authority

Bernadette Northeast
Glenelg Hopkins Catchment
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Behaviour change and community cohesion

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Biodiversity

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Victorian Bioenergy Network

Heat

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