

FINAL REPORT

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Climate Change in North East Victoria: Socioeconomic Resilience Plan

Report prepared for the North East Greenhouse Alliance

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Executive summary

Introduction

Dealing with natural climate variability is a part of life for communities of North East Victoria. Nevertheless, the prolonged drought experienced in North East Victoria in the 1990s and 2000s, accompanied by heatwaves and bushfires and followed more recently by floods, has come at considerable economic, social and environmental cost to the region. Thus the potential for greater climate variability in the future linked to global climate change – more frequent and / or severe droughts, more severe fire weather conditions, more intense rainfall and flooding – poses a challenge to the region's communities and industries that should not be ignored.

This report sets out a plan for building the resilience of industries and communities to climate change and variability. The resilience plan draws on an assessment of the vulnerability of industries and communities in North East Victoria to climate change and variability that is also presented in the report.

The report is the major output of Phase 1 of the project *Climate Change in North East Victoria: Socioeconomic Adaptation Planning*. The objective of Phase 1 is to develop a socioeconomic resilience action plan that will be used to identify initiatives that can be further developed through later phases.

Vulnerability assessment

North East Victoria is likely to be warmer in the future, with rainfall becoming less reliable and more extreme. These climate changes could result in a range of impacts – some positive, but many negative – to the region's natural and physical assets, as well as to major industries and infrastructure within the region. These impacts will, in turn, have indirect economic and social effects and implications for the delivery of local community services.

A commonly used framework for assessing the vulnerability of a regional community or economy to change is to consider vulnerability as a function of potential impacts and *adaptive capacity* of the community, with potential impacts being a function of *exposure* of the community to change and *sensitivity* of the community to the change. This framework is used as the basis for assessing the vulnerability of North East Victoria to climate change and variability.

Exposure

North East Victoria experiences a significant north-south gradation in average temperatures, with average annual daily temperatures ranging from about 12° C to 16° C in central and northern areas, but only around 6° C to 8° C in alpine areas. Noting this, it is the northern plains that are projected to have the greatest increases (in absolute terms) in the frequency of extreme high temperature days and heatwaves.

There is also a significant north-south gradation in average rainfall in the region with Benalla, Wangaratta and other areas in the north and north west of the region receiving, on average, only about 600 mm of rainfall annually and areas in the south, along the Great Divide, receiving up to 1800 mm. Given the north – south gradation in rainfall and temperatures (and associated evaporation), it is reasonable to characterise the northern plains areas of the region as being

generally more directly exposed to reduced water availability in the future than the higher rainfall south.

Paradoxically, because the areas to the north of the region tend to be low lying and subject to inundation, they are more exposed to intense rainfall events and associated flooding than the slopes in central and southern areas. Available projections point to likely increases in maximum rainfall intensities (of different durations) in many parts of the region in the future.

Climate change projections for the region also indicate that there will be an increase in the frequency of high and extreme fire risk days of up to 66% by 2050. Projections also point to an increase and in length of the fire season (extending into spring and autumn). Vegetation cover is a major factor contributing to bushfire exposure in the region, with Alpine Shire in particular having a large extent of bushfire prone areas.

Economic sensitivity and adaptive capacity

Climate change has the potential to have significant long-term effects on the economy of the North East Region, either directly through the exposure of key industries to changes, indirectly through the impacts of changes to those industries on the availability and cost of raw materials or through flow-on effects to the regional economy.

In general terms, LGAs and regions with diversified economies are likely to be less sensitive and have greater capacity to adapt to climate change and other changes. The economic diversity of the region has been assessed by measuring the distribution of employment across industry sectors. The assessment reveals that most LGAs in the region have reasonably diverse economies – in line with the diversity of regional Victoria as a whole. This would suggest that, in general terms, the local economies of the region are reasonably well placed to cope with ‘shocks’ in the future including those that could arise from climate change and variability. Towong would appear to be an exception to this general rule of thumb, having a relatively low level of economic compared with other parts of the region and Victoria.

Information on the reliance of regional economies on ‘climate dependent’ industries has also been compiled, with climate dependent industries being defined as:

- industries whose production processes/operations are tied directly to climate conditions (e.g. forestry, agriculture, snow-based tourism, water supply); and
- industries that are substantially reliant on inputs from the above listed industries to their production processes (e.g. food processing [agricultural produce], wood products manufacturing [forestry], pulp & paper [forestry, water], textiles [water]).

Industry data for the region reveals that Towong Shire and Alpine Shire are particularly reliant on climate dependent industries, although Indigo, Wangaratta and Benalla are also quite strongly reliant on these industries.

Social sensitivity and adaptive capacity

Climate change and variability has the potential to have significant long-term impacts on communities of the North East region. Evidence and data from Australian and international studies indicates that groups especially vulnerable to climate change, variability and extreme climate events such as floods, storms, bushfires and heat waves include:

- low income earners;
- infants and the elderly; and

- people with existing health conditions (including physical and mental health).

The *Index of Relative Socioeconomic Advantage and Disadvantage*, which captures information on levels of disadvantage and advantage, such as low or high income, occupation and education, has been assessed for LGAs in the region. Based on this assessment, the region as a whole would appear to have a moderate level of social advantage when compared to other parts of Victoria. However, care needs to be taken with comparing aggregated index values between different region and LGAs because:

1. the aggregate data for an LGA as a whole is likely to hide significant differences within the LGA; and
2. there are a wide range of variables included in the index construction.

Considering the first point, CCD level analysis for the region reveals that pockets of disadvantage exist in all LGAs, but that these pockets are most significant in Benalla and Wangaratta.

On the second point, a range of individual indicators having relevance to the sensitivity and adaptive capacity of communities to climate change and variability have been examined for the region. Data for these indicators reveals the following:

- Communities in larger urban centres in the North East region (e.g. Benalla, Corryong, Myrtleford and Wangaratta) tend, on average, to have lower economic resources than households in smaller townships and rural households.
- In most parts of the region, with the exception of Wodonga and the Alpine Resorts, there are relatively high proportions of elderly people (defined as people over 65 years of age).
- The region has relatively high levels of mental health concerns, especially in Benalla and Wangaratta, and the proportion of people reporting only fair or poor health is quite high in the larger centres of the region when compared to the Victorian average.
- The region overall has high levels of vehicle ownership, an important factor when considering levels of mobility. However, limited access to public transport as an alternative to motor vehicles is clearly a significant issue for most parts of the region, especially in the context of potential increases in the cost of fuel in the future.
- Communities with limited access to health and other community services, such as general practitioners, hospital beds, aged care places and pharmacies, are likely to have reduced capacity to adapt to climate variability and extremes. Indigo, Towong and Wodonga are below the averages for Victoria and the Hume region in terms of access to general practitioners. Most LGAs in the region are moderately well placed with regards to access to aged care services however.
- Arguably, households that have low average energy and water consumption are better placed to cope with increased energy and water prices that are projected to ensue over the coming years than households with high energy and water consumption. Household energy consumption in the region is close to or below the Victorian average, with Alpine Shire, Towong and Benalla having particularly low consumption. Factors explaining this trend are not clear though. Household water consumption across the region is also low to moderate when compared with other regions in Victoria. Again, factors explaining this trend are not clear.
- Strong community networks and social cohesiveness are important factors contributing to community resilience. Two indicators of strong community networks and social

cohesiveness are ‘levels of volunteerism’ and ‘access to support from family, friends and neighbours’. Data for the region shows that, generally speaking, the region performs quite well against both indicators, especially on levels of volunteerism.

Conclusions from the vulnerability assessment

At first glance, the economy and community of North East Victoria appear quite well placed to deal with the potential impacts of climate change and variability. The region’s economy is diverse and structurally sound. Communities in the region have moderate to high levels of income, education and other factors that contribute to social capacity. There are also strong community networks and levels of cohesiveness within the region.

Nevertheless, it is also clear that there are specific industries, groups and localities within the region that are vulnerable to climate variability and change. Further, climate variability and change will interact and build on established economic, social, demographic and policy pressures to increase the challenges that those industries and groups already face.

Survey and focus group discussions

A survey of community members and a series of focus groups discussions with industry representatives were undertaken for this project in November and December 2011. The purpose of the surveys and discussions were to gauge community and industry understanding of climate change, their views on how important they believe climate change and variability is for them and the region and whether, as householders and industries, they are actively preparing for climate-related events such as droughts, floods and bushfires. The methodology and results of the community surveys and industry focus groups discussions are detailed in separate documents attached to this report.

Community survey

An online survey was conducted across communities in North East Victoria, with an on-line, research only panel providing the main share of respondents to the survey. Survey questions and responses fall into three main categories:

1. climate change beliefs and level of concern;
2. climate change adaptation and mitigation actions by individuals/ households; and
3. the role of government and industry in assisting with/ implementing actions.

Respondents to the survey indicated a moderate level of concern about climate change, with 39 percent of respondents indicating that they are either fairly concerned (21 percent) or very concerned (18 percent) about the issue. This result is comparable to responses to a similar question posed in a national survey of Australian attitudes to climate change, undertaken in late 2010 by CSIRO. Of various climate-related events experienced recently, drought has caused the greatest level of concern and impact.

Survey respondents indicated a high take-up of low cost water efficiency measures such as improved garden watering practices (81 percent) and water efficient shower heads (69 percent), suggesting that there was strong community response to water restrictions and incentives implemented by governments and water authorities in the 2000s. Respondents also indicated that there has been relatively high take-up of low cost actions aimed at improving thermal comfort and reducing energy consumption in the home, such as draught proofing (51 percent).

On the other hand, survey responses indicate that there has been a quite low take-up of the more expensive water and energy efficiency options.

Importantly, a majority of respondents had **not** implemented measures designed to improve their preparation and response to climate extremes and hazards, such as bushfire plans (46 percent, yes) and Home Emergency Plans and Kits (~ 30 percent, yes) and other precautions to deal with storms, floods and bushfires (44 percent, yes). Low adoption of these actions came despite the fact that only a small percentage of respondents (~ 7 percent) agreed that implementing the actions would be difficult.

A significant majority of respondents agree that all levels of government (including local government) have important roles to play in responding to climate change. Those roles include ‘providing individuals with assistance to change behaviour’, ‘providing individuals with information on changing behaviour’ and ‘doing things that makes the community more resilient to future climate variability and change’.

Industry focus group discussions

Within the business community (those who participated in the focus group discussions) there appears to be a fairly strong level of understanding about climate change and the implications of climate change and variability (whether human induced or natural) for their businesses. To a significant extent this understanding reflects personal experience in dealing with climate extremes in the past.

Thus businesses have moved beyond the need for general information about climate change and variability to more specific and practical support to help them plan for, respond to and recover from climate extremes. Smaller businesses in the agricultural and tourism sectors in particular are seeking support of this nature.

Resilience plan

Building resilience and adaptive capacity

Resilience, as a concept, is closely related to both vulnerability and adaptive capacity. The essence of resilience in a community is its ability to utilise community resources to transform and respond to change in an adaptive way.

Recent studies suggest that the best way to build resilience of rural communities to climate change is to strengthen the stocks of assets, tangible and intangible, that are available to them in times of change.

Current industry and economic resilience building initiatives

Economic development is an important focus of all councils in North East Victoria, with the majority of councils having economic development strategies in place. These aim to strengthen the local economy by supporting local businesses, identifying business opportunities and attracting new businesses. Additionally, some councils have developed tourism strategies aimed at strengthening and diversifying the industry locally.

Skill and workforce development programs are largely administered by state or federal government agencies, in particular the Victorian Department of Business and Innovation (DBI) and the Department of Education, Employment and Workplace Relations (DEEWR). While climate change and climate variability do not play a major role in these initiatives, they foster

the resilience of local economies and industries, thereby improving the ability of industries and businesses to deal with the impacts of climate change and variability.

Numerous other programs and activities assist industries and individual businesses during times of change or hardship, such as climate extremes, strengthening their capacity to adapt to those extremes.

Current community resilience building initiatives

Councils in North East Victoria have also undertaken significant planning work in areas relevant to building community resilience.

- all councils have ‘healthy communities’ or ‘community wellbeing’ plans;
- a majority of councils have heatwave and drought response plans; and
- all councils have Municipal Emergency Management Plans, which incorporate recovery programs.

Other government, community and non-government initiatives provide general ‘ground level’ resilience building. Initiatives include regional partnerships and networks that build and strengthen resilience by improving regional service delivery, particularly to vulnerable groups. Programs of this nature help to foster the general resilience of communities to shocks, such as those associated with droughts, bushfires and floods, even though they do not specifically address climate change and variability.

Review of existing initiatives and identification of new actions

The process used to develop resilience building actions involved three main steps:

- a series of three resilience planning workshops held in the North East region in late November, 2011;
- follow-up community and stakeholder consultation sessions, conducted across the region in December, 2011; and
- further analysis including desktop review of established programs.

A number of principles underpin selection of the new actions. These include:

- proposed actions should add to and complement the economic and community resilience building programs that are already in place in the region;
- actions should have relevance to building social and economic resilience to climate change and variability;
- actions should be flexible, having the potential to be adjusted and scaled up or down to reflect changed circumstances or new information; and
- actions should have the potential to be applied at different scales - sector or community wide or scaled to target especially vulnerable localities, industries or segments of the community.

Building economic and community resilience

Potential new actions relevant to building economic and community resilience to climate change and variability are detailed in section 6 and section 7 of the main report. They include actions targeting the following areas:

- agriculture and forestry;
- manufacturing;
- tourism;
- community resilience to climate variability and extremes; and
- community resilience to droughts and reduced water availability.

The actions cover a range of areas including information and education, training, infrastructure, planning, program coordination and policy development.

While it might be desirable to implement all of the actions, resource constraints and competing priorities of NEGHA member councils and other organisations mean that it is necessary to prioritise the actions. Factors that should be considered when seeking to prioritise the actions are:

- Can the action be implemented in the short term?
- Can the action be driven locally (i.e. by a locally based council or other organisation)?
- Considering long term resilience building outcomes, how effective is the action likely to be?

Table ES.1 lists the actions from sections 6 and 7, providing a qualitative assessment of the actions against the above criteria. Actions rating best against the criteria are highlighted, noting that further consideration of the priorities would be desirable. It is recommended that agreed priority actions are given consideration for assessment in Phase 2 of the project, which is aimed at providing more detailed assessment and implementation of social and economic solutions.

Table ES.1: Potential industry and community resilience building actions (with priority actions highlighted for discussion purposes)

No.	Action	Can be implemented in short term?	Can be driven locally?	Effective LT contribution to resilience
Building industry resilience				
Agriculture				
1	Promote and improve outreach of established farm management and planning services	yes	yes	moderate
2	Training programs to encourage farm succession planning and good practice	?	in part	major
3	Research and trials into adaptive farm management practices	no	yes	major
4	Land bank	?	?	major
5	Sustainable land use strategy	no	yes	moderate
6	Long range regional weather forecast information	yes	no	minor

No.	Action	Can be implemented in short term?	Can be driven locally?	Effective LT contribution to resilience
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Manufacturing

7	Sustainability opportunities information and support package	yes	yes	major
8	Region wide audit of industries exposed to climate change	yes	yes	minor
9	Business continuity training program and toolkit - manufacturing	yes	yes	moderate
10	Industry sustainability network	yes	yes	minor

Tourism

11	Tourism business forward planning and crisis preparation	yes	yes	major
12	Business continuity training program and toolkit – tourism	yes	yes	moderate
13	Visitor extreme weather communications and travel plan	yes	in part	minor
14	Prescribed burns research, communications and ‘no-burn’ periods	in part	no	moderate

Building community resilience**Resilience to climate variability and extremes**

15	Coordinated approach to building community resilience	yes	yes	moderate
16	Community organisation support	yes	yes	minor
17	Community infrastructure priorities	yes	yes	major
18	Volunteer recruitment strategies, succession plans and skills banks	?	yes	moderate
19	Review of emergency management plans	?	yes	moderate
20	Community education on climate change and extremes	yes	yes	moderate
21	Resilience building and school education	no	no	moderate
22	Telecommunications and broadband	no	no	moderate

Resilience to droughts and reduced water availability

23	Enhancing water security in towns	no	yes	major
24	Ensure viability of priority open spaces	no	yes	moderate
25	Emergency water supplies for bushfire fighting	no	?	moderate
26	Food awareness and security education program	yes	yes	minor

1. Introduction

1.1 Project overview

Dealing with natural climate variability is a part of life for communities of North East Victoria, as it is for rural and regional communities across Australia. Nevertheless, the prolonged drought experienced in North East Victoria in the 1990s and 2000s, accompanied by heatwaves and bushfires, and followed more recently by floods, has come at considerable economic, social and environmental cost to the region. Thus the potential for greater climate variability in the future linked to global climate change – more frequent and / or severe droughts, more severe fire weather conditions, more intense rainfall and flooding – poses a challenge to the region's communities and industries that should not be ignored.

Recognising this, the North East Greenhouse Alliance (NEGHA)¹ has secured funding through the Australian Government's *Strengthening Basin Communities* program, Planning Component Round 2, to develop a regional climate change strategy focussing on socioeconomic adaptation planning. The project has been designed around three integrated phases, namely:

- Phase 1 – Climate change vulnerability assessment and resilience planning.
- Phase 2 – Socioeconomic studies.
- Phase 3 – Regional climate change strategy.

The project adds to earlier work by NEGHA, funded through the *Strengthening Basin Communities* program, Planning Component Round 1, which focussed on the potential impacts and risks of climate change to local councils in the region and their responses².

1.2 Scope of the resilience plan

This report is the main output of Phase 1 of the project. It builds on a *vulnerability assessment* report that was released earlier in Phase 1 and considers feedback received through industry and community consultations that were undertaken in early to mid-December, 2011. The resilience plan has two main parts:

1. A vulnerability assessment provides an analysis of the social and economic vulnerabilities of communities and industries in North East Victoria to climate variability and change including reduced water availability and increased rainfall variability. A series of indicators, which combined measure the sensitivity and adaptive capacity of industries and communities in the region to climate change, provide the main basis for the assessment. (see Box 1). Surveys designed to measure climate change understanding amongst the community and industries of North East Victoria provide additional information relevant to investigating the vulnerability of the region to climate change.

¹ The North East Greenhouse Alliance comprises the City of Wodonga, Rural City of Wangaratta, City of Benalla, and Alpine, Indigo and Towong Shires. It is working on this project in partnership with the Alpine Resorts of Mt Buller / Mt Stirling, Mt Hotham and Falls Creek, and the North East Catchment Management Authority (NECMA).

² See the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*, North East Greenhouse Alliance, October 2011.

2. The resilience plan sets out a range of actions designed to build the resilience of the regional economy and communities to climate change and variability. The plan takes into account vulnerable industries and communities identified in the first part of the report, as well as established local and regional measures that are aimed at building the resilience of communities and industries to ‘shocks’.

1.3 Report structure

This report is structured as follows:

- Section 2 outlines climate change projections for North East Victoria and potential impacts of those changes, focussing in particular on direct and indirect social and economic impacts.
- Section 3 provides a discussion of the vulnerability indicators and assesses interactions between different indicators to identify key vulnerability issues and localities for the region. It also provides an overview of results from community surveys and industry focus groups discussions.
- Section 4 provides a discussion of the concept of resilience and outlines the programs and policies that are already being implemented in the region to build community and industry resilience.
- Sections 5 and 6 detail potential actions for building the resilience of the regional economy and communities respectively to climate change and variability.
- Finally, section 7 sets out recommendations and next steps for Phases 2 and 3 of the project.

Box 1: Climate Change Vulnerability, Adaptive Capacity and Resilience – Some Important Concepts

The vulnerability of a community to climate changes (or other external ‘shocks’) can be understood in terms of the level of exposure to a change, the sensitivity of the community to the change and the community’s adaptive capacity (

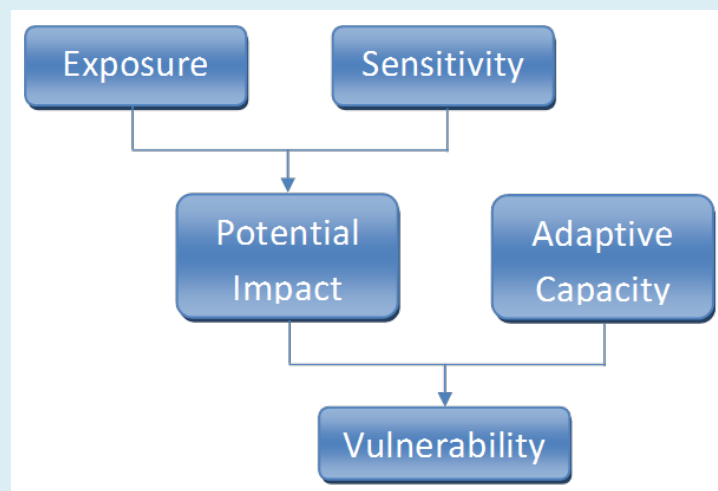
Figure 1), where:

- **Exposure** is the magnitude and nature of the change or related event. For communities in North East Victoria, exposure could be viewed in terms of the quantum of the reductions in the availability of water as a consequence of climate change or an increase in the magnitude or severity of climate extremes such as droughts, floods or bushfires.
- **Sensitivity** measures the responsiveness of a community or system to an exposure/change event. By definition, more sensitive systems are more responsive. Sensitivity will vary across communities and systems according to their characteristics. For instance, industries with greater dependence upon water will likely show a larger reaction (sensitivity) to reductions in available water (exposure) than those systems not as dependent upon water. Similarly, those communities with a high dependence on water sensitive industries will be more sensitive to a reduction in available water than those communities with a more diverse economic base.

Exposure and sensitivity together determine the magnitude of the potential impact associated with climate change.

- **Adaptive capacity** describes the ability of a community to modify or change its characteristics or behaviour to cope better with actual or anticipated impacts. For example, all other factors equal, a community with lower community stress and more financial resources may have greater adaptive capacity to deal with impacts than a community experiencing higher stress, and with less financial resources.

Figure 1: Components of vulnerability



Source: adapted from Schröter, 2004

Resilience is a concept that is closely related to both vulnerability and adaptive capacity. In environmental and social sciences literature resilience has been defined in three different ways - as recovery, as stability and as transformation. The essence of resilience in a community or a system is its ability to utilise community resources to transform and respond to change in an adaptive way.

2. Understanding climate change and its potential impacts in North East Victoria

2.1 Climate change projections

2.1.1 Global climate change

Since the late nineteenth century, average air temperatures at the earth's surface have increased by approximately 0.8°C. The warming has been detected in numerous independent temperature records over land, over sea and in ocean surface water. The Intergovernmental Panel on Climate Change (IPCC) concluded in its most recent assessment (IPCC 2007) that:

- it is very likely that greenhouse gas emissions generated by human activities caused most of the observed increase in globally averaged temperatures since the mid-20th century;
- temperature increases have also influenced the global hydrological cycle - precipitation in some regions of the world has increased significantly while more intense and longer droughts have been observed since the 1970s in other regions;
- an average global warming of 1.1 to 6.4 °C by 2090-99 relative to 1980-1999 temperatures can be expected;
- warming will be accompanied by increases in the amount of precipitation in high-latitude areas (very likely), while decreases are likely in most subtropical and warm temperate land regions;
- warming will also be accompanied by an increase in the frequency of extreme climate events – hot extremes, heat waves and heavy rainfall.

While there are uncertainties about global climate projections, including the magnitude of changes and regional and local impacts, it is important to note that the IPCC's conclusions are supported by the world's major science academies including the American Academy of Sciences, the Royal Society (UK) and the Australian Academy of Science.

2.1.2 Climate change projections for North East Victoria

Overview

North East Victoria is likely to be warmer in the future, with rainfall becoming less reliable and more extreme.

Table 1 summarises indicative changes to a range of climate variables for the region, drawing on projections from the CSIRO and the South East Australia Climate Initiative (SEACI) and assuming a high global emissions scenario³. Table 2 provides indicative changes to water balances in North East Victorian river basins. These indicative changes reflect results from range of hydrological studies undertaken for the region, with changes presented also based on a high global emissions scenario. The years provided (i.e. 2030 and 2070) in both tables should be

³ Global greenhouse gas emissions are currently tracking at the high end of emissions scenarios used in generating global and regional temperature change projections.

viewed as reference periods for the changes, rather than as specific points in time. The indicative changes are relative to averages for 1960 to 1990.

Table 1. Indicative changes to the climate of North East Victoria, based on high emissions scenario

Climate variable	Current ⁴	Indicative change		Comments
Average rainfall		2030	2070	Average annual rainfall could decrease by up to 28% by 2070 in the worst case. In the decade to 2007, the region's average rainfall was 12% below the 1961 to 1990 average.
Annual	1089 mm	- 3 %	- 10 %	
Spring	295 mm	- 7 %	- 19 %	
Summer	180 mm	uncertain	uncertain	
Autumn	249 mm	uncertain	uncertain	
Winter	367 mm	- 7 %	-15 %	
Runoff		2030	2070	Reductions in runoff are linked to a number of variables including reduced rainfall, higher evaporation and lower soil moisture.
Entire region		- 8 %	- 17 %	
Inflows to Murray system		- 20 %	- 40 %	
Rainfall intensity		2030	2070	Rainfall in the region is projected to become more variable, with fewer rainy days but rain falling in more intense bursts.
Annual rainfall intensity		+ 2 %	+ 10 %	
Maximum flood heights		+	+	
Flood return intervals (ARI)		+	+	
Fire weather		2020	2050	The length of the fire season is projected to increase also.
Number of high and extreme forest fire danger days	18	+ 4	+ 12	
Other		2030	2070	Average annual temperature could increase by up to 4 °C by 2070. Average annual temperatures in the last decade have warmed by 0.5 °C, reflecting increases in both daily maximum and minimum temperatures.
Average annual temperature	12.3	+ 1 °C	+ 3 °C	
Potential evaporation		+ 3%	+ 9%	
Solar radiation		+ 0.7 %	+ 2.2 %	

Sources: CSIRO 2006, 2008a, Beverly & Hocking 2010

⁴ Average 1961-1990, 'typical' location

Table 2. Indicative water balance changes, North East Victoria river basins

Climate variable	Indicative change ⁵		
	1995-2005	2030	2070
Kiewa basin			
Average rainfall	- 5 %	-3 to -6 %	-5 to -16 %
Runoff	- 3 %	-18 to -27 %	-25 to -48 %
Recharge	- 9 %	-6 to -12 %	-12 to -31 %
Streamflow	- 14 %	-4 to -11 %	-11 to -33 %
Mitta basin			
Average rainfall	- 5 %	-3 to -6 %	-6 to -17 %
Runoff	- 8 %	-25 to -36 %	-34 to -60 %
Recharge	- 13 %	-7 to -11 %	-15 to -39 %
Streamflow	- 16 %	-7 to -11 %	-15 to -43 %
Ovens basin			
Average rainfall	- 4 %	-1 to -4 %	-4 to -15 %
Runoff	- 0.3 %	-20 to -30 %	-28 to -50 %
Recharge	- 12 %	-5 to -13 %	-12 to -37 %
Streamflow	- 14 %	-1 to -10 %	-9 to -35 %
Upper Murray basin			
Average rainfall	- 2 %	-4 to -7 %	-6 to -16 %
Runoff	- 7 %	-30 to -42 %	-40 to -64 %
Recharge	- 11 %	-10 to -18 %	-18 to -42 %
Streamflow	- 10 %	-10 to -18 %	-18 to -45 %

Source: Beverly & Hocking 2010

Average rainfall projections indicate that the most likely change to 2030 will be a small decline (about 3 percent) in annual rainfall compared with the historic average, with most of the decline coming in winter and spring (about 7 percent). This trend is likely to intensify by 2070, with average annual rainfall decreasing by about 10 percent. Although the projections of changes to

⁵ Relative to 1957-2005 average

average rainfall seem relatively modest, relatively small reductions in rainfall can lead to more substantial reductions in runoff and water availability, as indicated by the data in Table 2.

Changes to extremes and variability

The data presented in Table 1 and Table 2 provides indicative changes to averages for a number of climate variables. While many of the projected changes appear to be relatively minor, small changes in averages have historically been linked to more significant changes to extremes and to variability. Temperature projections for North East Victoria, for example, suggest that the number of very hot days (35° C and 40° C) is likely to increase quite substantially in different locations in the region (see Table 3). Similarly, heavy rainfall intensity (99th percentile) is also likely to increase, while the number of rainy days is likely to decrease, particularly in winter and spring. These projections point to a trend of less frequent but more intense bursts of rainfall.

Table 3. Indicative changes to the climate extremes, North East Victoria

Climate variable	Indicative changes ⁶						Comments
	Alpine areas		Beechworth		Rutherglen		
	Current	2070	Current	2070	Current	2070	
Temperature extremes							The number and length of heatwaves are also projected to increase.
Frost days (<2°C)	114	61	49	17	81	40	
Days over 30°C	18	39	49	95	63	99	
Days over 35°C	2	9	9	28	17	41	
Days over 40°C	0	0	0	3	2	8	
Heavy rainfall intensity (99th percentile)							Increases of 70% + in summer, autumn and winter intensities and 35% + in spring intensities are feasible.
Annual	-	+14%	-	+9%	-	+10%	
Spring	-	-3%	-	+5%	-	+4%	
Summer	-	+11%	-	+9%	-	+11%	
Autumn	-	+6%	-	+4%	-	+6%	
Winter	-	+6%	-	+7%	-	+6%	
Number of rainy days							Decreases of 50% + in the number of rainy days annually are feasible.
Annual	93	-15%	81	-15%	71	-16%	
Spring	28	-28%	22	-32%	19	-33%	
Summer	18	-14%	12	-9%	11	-9%	
Autumn	20	-12%	18	-9%	15	-7%	
Winter	27	-22%	29	-28%	26	-30%	

Source CSIRO 2008a

⁶ High emissions scenario, mid-point projections.

Rainfall projections for South East Australia for also, indicate that there is likely to be increased rainfall variability (both season to season and year on year). These projections, combined with higher average and extreme temperatures, point to an increase in drought severity and possibly drought frequency for the region in the future. Specific projections relating to seasonality of runoff and frequency and duration of extreme dry and wet periods are not available for this study. As a general indication though, preliminary modelling undertaken by the project team for the entire lower Murray-Darling basin, drawing on scenarios presented in the CSIRO sustainable yields project, indicates that with a 19% reduction in average rainfall the frequency of ‘dry’ years (1st decile) could increase from 10% of years (based on the historical record) to about 26% of years.

Uncertainties

It is important to note that there are uncertainties associated with the climate change projections that provide the basis for the indicative changes presented in Table 1, Table 2 and Table 3. Uncertainties stem from inherent complexities of the climate system and regional hydrology, methods applied in different climate models and uncertainty about the future pathway of global greenhouse gas emissions. In general terms however, there is a quite high degree of certainty associated with temperature-related projections but less certainty associated with changes to average rainfall and associated changes to runoff and streamflow and to rainfall intensity.

2.1.3 Potential impacts of climate change

The climate changes outlined above could result in a range of impacts – some positive, but many negative – to the region’s natural and physical assets, as well as to major industries and infrastructure within the region. Impacts on these systems will, in turn, have indirect economic and social effects as well as implications for the delivery of local community services.

Table 4 provides an overview of the possible direct ‘physical’ impacts of climate change in the region, indicating the potential economic and social effects arising from those impacts. Some of these impacts will be felt quite uniformly throughout the region. Others however, will vary greatly from municipality to municipality and locality to locality depending on local physical and social characteristics.

Table 4. Potential impacts of climate change and variability in North East Victoria – social and economic dimensions

Sector/ service area	Climate changes and associated impacts	Social and economic dimensions
Community services		
Public health	<ul style="list-style-type: none"> Increased frequency and intensity of heatwaves Intense rainfall events (including following bushfires) transporting contaminants into waterways and drinking water supplies Increased intensity and frequency of extreme events (e.g. storms, floods, bushfires) Increased frequency or severity of droughts 	<ul style="list-style-type: none"> Heat stress (especially amongst elderly and infants) Increased incidence of food and water-borne diseases Stress and mental health issues
Emergency management (response)	<ul style="list-style-type: none"> Increased intensity and frequency of extreme events (e.g. storms, floods, bushfires) Increased frequency of code red days 	<ul style="list-style-type: none"> Public safety Refuges, places of last resort Isolation of vulnerable communities or individuals Loss of essential services (e.g. water, power, telecommunications, waste management)
Welfare services	<ul style="list-style-type: none"> Increased frequency or severity of droughts Increased intensity and frequency of extreme events (e.g. storms, floods, bushfires) 	<ul style="list-style-type: none"> Loss of income Loss of personal assets (uninsured or irreplaceable) Loss of habitable dwelling (temporary or long term) Increased insurance costs
Recreation	<ul style="list-style-type: none"> Increased frequency or severity of droughts Increased rainfall variability 	<ul style="list-style-type: none"> Degradation of sports fields and other public open spaces resulting in reduced availability or closure Limited water for swimming pools and other water based recreations
Public infrastructure & associated services	<ul style="list-style-type: none"> Increased intensity and frequency of extreme events (e.g. storms, floods, bushfires) Increased rainfall variability 	<ul style="list-style-type: none"> Increased damage to aged care, children's services, health facilities and other public infrastructure Restricted access to services

Sector/ service area	Climate changes and associated impacts	Social and economic dimensions
Economic development		
Agriculture & forestry	<ul style="list-style-type: none"> Increased rainfall variability and/ or frequency and intensity of droughts reduces long term yields and carrying capacity Increased frequency and intensity of extreme events (e.g. bushfires, floods, storms, heatwaves) impacts on short to medium term production Increased frequency and intensity of extreme events (e.g. bushfires, floods) disrupts transport to markets Increased farm input costs associated with carbon tax 	<ul style="list-style-type: none"> Long term viability of established broad acre agricultural industries Long term viability of established intensive agricultural industries Long term viability of native and plantation based forestry industries
Tourism	<ul style="list-style-type: none"> Increased average temperatures Reduced average precipitation Increased severity or frequency of droughts Increased severity or frequency of extreme weather events (floods, bushfires) Increased frequency of Code Red days 	<ul style="list-style-type: none"> Long term viability of snow-based tourism industries Long term viability of water-based tourism industries Risks to tourist safety Tourist movements restricted
Industry and townships	<ul style="list-style-type: none"> Increased rainfall variability and/ or frequency and intensity of droughts reduces water availability or increases water costs Increased frequency and intensity of extreme events (e.g. bushfires, floods, storms, heatwaves) impacts on short to medium term production Increased frequency and intensity of extreme events (e.g. bushfires, floods) disrupts supply or transport to markets Increased input costs associated with impacts of climate change on supply industries (e.g. agriculture) or carbon tax 	<ul style="list-style-type: none"> Long term viability manufacturing industries, especially water dependent industries Threats to viability of towns linked to decline in viability or shift in structure of industries Threat to viability of towns linked to limitations to future water supply

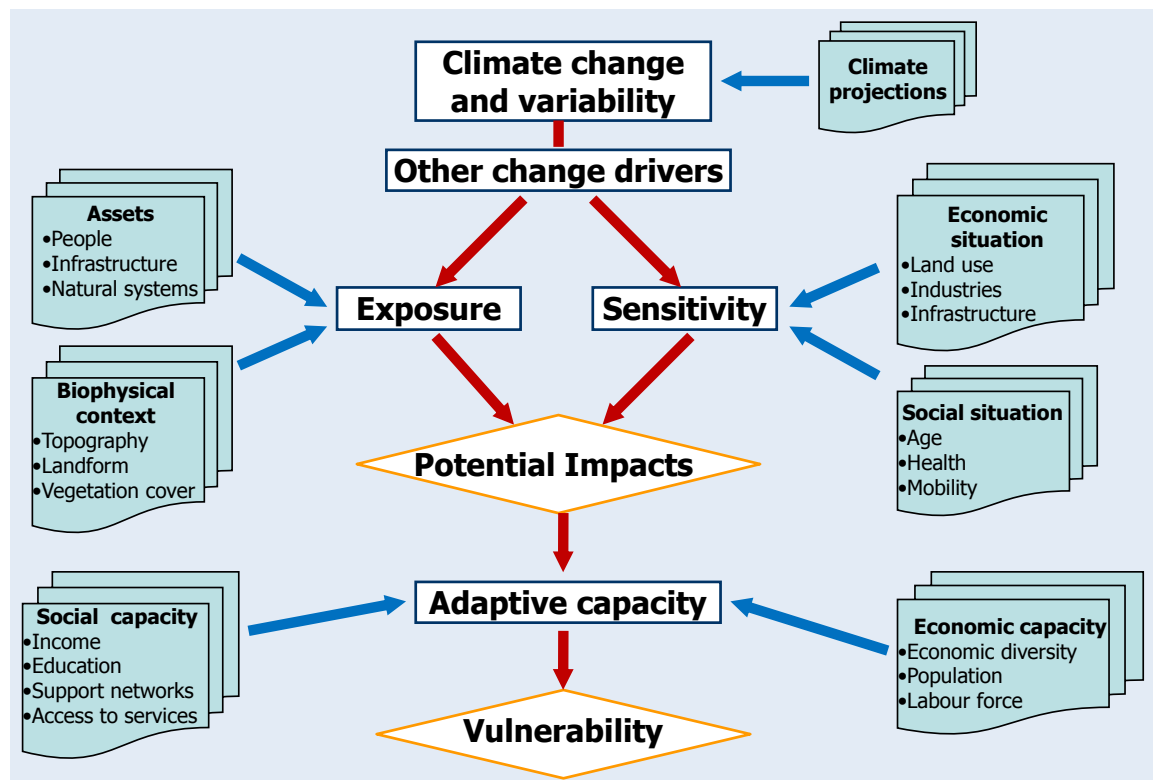
3. Vulnerability of North East Victoria to climate change

3.1 Assessment framework

As described in Box 1 and outlined further in Figure 2, a commonly used framework for assessing the vulnerability of a regional community or economy to climate change is to consider vulnerability as a function of potential (climate change) impacts and *adaptive capacity* of the community (Brooks et. al. 2005; Preston & Stafford Smith, 2009; Schröter, 2004), where adaptive capacity refers to the ability of a community or organisation to cope with actual or anticipated impacts of climate change.

Potential impacts are determined in turn by the *exposure* of the community to different climate change and variability and *sensitivity* of the community to the change - where exposure is the magnitude and nature of the climate change or related event and sensitivity is the responsiveness of a community or system to an exposure/change event. The greater the potential impact and the lower the adaptive capacity, the greater the vulnerability of a community will be.

Figure 2: Vulnerability assessment framework



Source: MJA after Schröter, 2004

The framework outlined above is used as the basis for assessing the vulnerability of North East Victoria to climate change and variability. The physical characteristics of the region, discussed in section 0, provide an understanding of the exposure of the region and its community to different aspects of climate change. A range of indicators are then used to define the sensitivity and adaptive capacity of the region to climate change⁷. In practice, it is often difficult to draw a distinction between the sensitivity of region or locality to climate change (i.e. its economic or social situation) and its adaptive capacity (i.e. its economic or social capital). For this reason, we consider sensitivity and adaptive capacity indicators together, first in terms of the region's economy (section 3.3) and then in terms of its community (section 3.4)⁸. A brief discussion of the ways in which indicators interact to identify key issues and localities is then provided in section 3.5.

It is important to note that the vulnerability of the community or economy to climate change and variability cannot and should not be divorced from their vulnerability to other drivers of change in the region – population growth and change, economic structural change, environmental change etc. Thus the sensitivity and adaptive capacity of the community or organisations to climate change will often (although not always) reflect their sensitivity and capacity to adapt to other changes. Another important point to note about vulnerability is that it is not a static concept – community members and businesses can move quickly from being resilient to vulnerable to change or vice versa depending on their individual circumstances. Recognising this, it is important to identify ways of improving resilience and adaptive capacity across the region's communities and industries. That is the focus of sections 5 to 8 of the report.

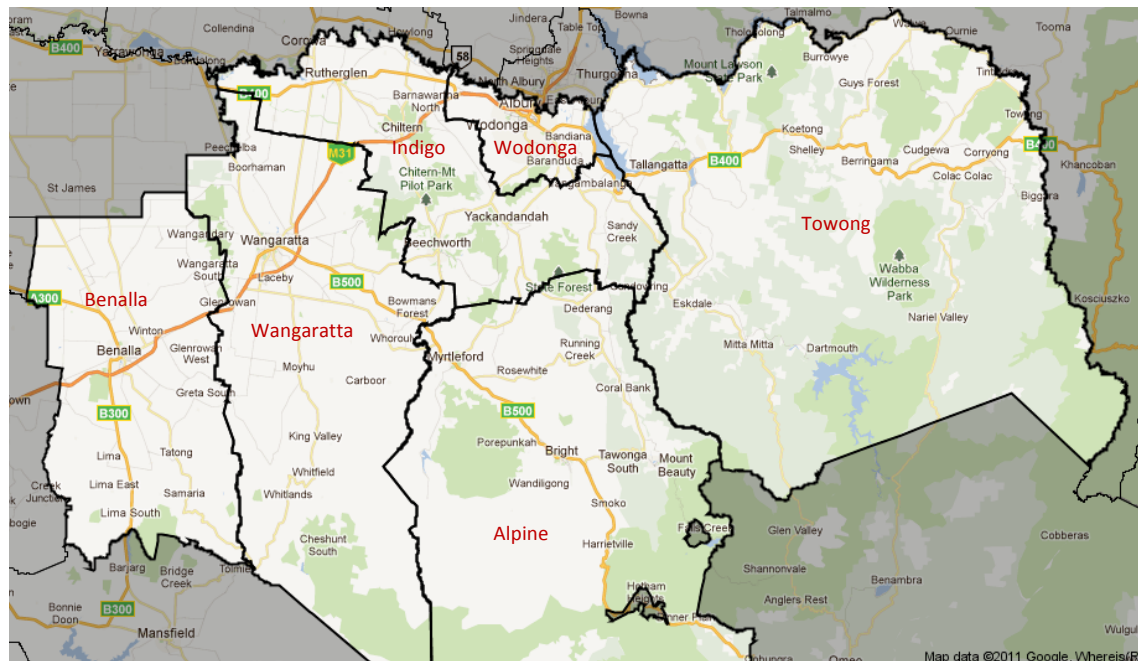
⁷ Indicator data are provided at the LGA and sub-LGA (Statistical Local Area – SLA) levels.

⁸ Appendix 1 contains a full list of indicators used in the assessment.

3.2 Physical characteristics of the region - exposure

The North East region of Victoria, as defined for this study, encompasses the local government areas of Alpine Shire, Benalla Rural City, Indigo Shire, Towong Shire, Rural City of Wangaratta and City of Wodonga (Figure 3). It also includes the Alpine Resorts of Falls Creek, Mt Hotham and Mt Buller/ Mt Stirling (not shown).

Figure 3: North East Victoria – study area



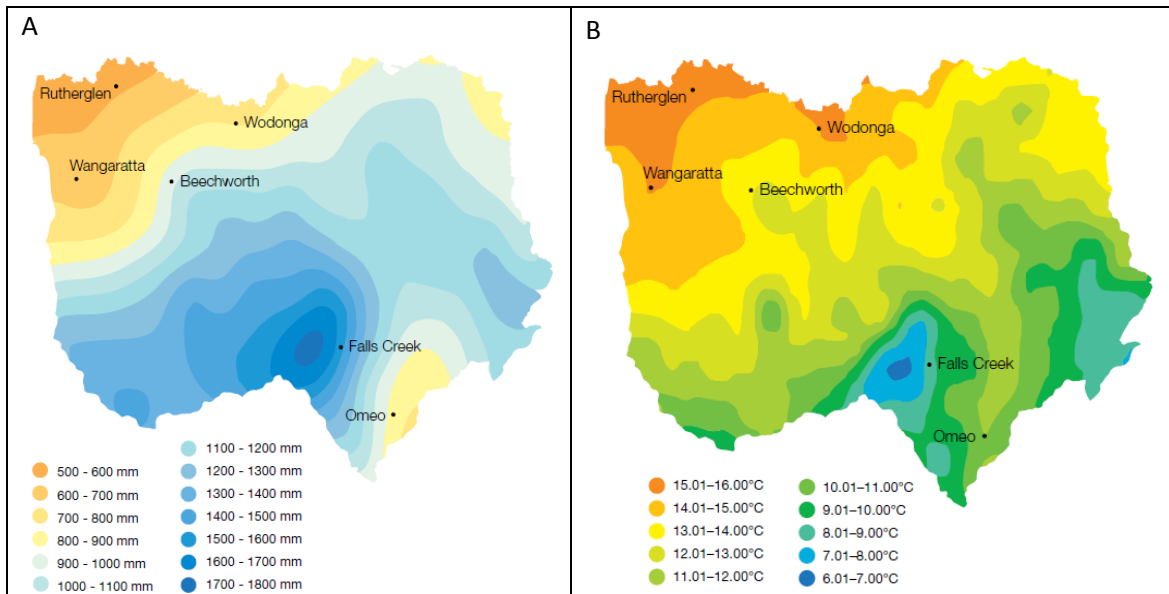
Source: Remplan Mapbuilder, based on Google Maps

Average and extreme temperatures

The climate of most of the region is temperate. Due to its geographic location on the northern slopes of the Great Dividing Range, the region experiences a significant north-south gradation in average temperatures (Figure 4), with average annual daily temperatures ranging from about 12° C to 16° C in central and northern areas, but only around 6° C to 8° C in alpine areas.

Similarly, daily mean summer temperatures range from a minimum of 11° C to a maximum of 19.5° C in the alpine areas, to a minimum of 14° C to a maximum of 31° C on the lower slopes and plains. Mean daily winter temperatures range from a minimum of -0.7° C to a maximum of 3.7° C in the alpine areas, to a minimum of 2° C to a maximum of 12° C on the plains.

Over the decade 1998 to 2007, average temperatures in North East Victoria were approximately 0.5°C warmer than the 30 year (1961 to 1990) average, with average daily maximum temperatures increasing by a greater amount than average daily minimum temperatures. The greatest increase in the average daily mean and maximum temperatures occurred in summer and spring (DSE, 2008). Warming has been greatest in alpine areas, which have warmed by an average of about 0.2°C per decade over the last 35 years.

Figure 4: Average annual rainfall (A) and daily temperatures (B), North East Victoria

Source: CSIRO, 2008

There has also been a statistically significant decrease in snow cover (depth and duration) in alpine areas over the past 50 years. The spring thaw has been occurring on average 2 days earlier each decade in that period and the frequency of 'big dumps' of snow has also decreased (Worboys and Good, 2011).

Despite recent trends in *average* temperatures, it is the northern plains that are projected to have the greatest increases (in absolute terms) in the frequency of extreme high temperature days and heatwaves. Projections for Rutherglen, for example, indicate that the number of days exceeding 40°C is likely to increase from an average of 2 per annum currently, to around 8 per annum (range of 5-15 days) in 2070 under the high emissions scenario (see Table 3). In human health terms this could be significant. A study into temperature thresholds for heat related deaths in regional Victoria for example, has found that in Wodonga there is a notable increase in mortality when the maximum temperature exceeds 40°C (16 episodes). This trend towards greater mortality continues as temperatures increase to 42°C or more (Loughnan et al. 2008).

Average annual rainfall and water availability

There is also a significant north-south gradation in average rainfall in the region with Benalla, Wangaratta and other areas in the far north and north-west of the region receiving, on average, only about 550 to 700 mm of rainfall annually and central and southern areas, along the Great Divide, receiving between 1000 and 1800 mm (Figure 4). As outlined in Table 1 and Table 2, average rainfall is projected to decline by around 10% in the major river basins of the region (range - 5% to -15%), with most of the decline likely to occur in winter and spring.

Rainfall projections for the region are not yet at a sufficiently high resolution to pinpoint significant local differences in rainfall, runoff and water availability. Given the north-south gradation in rainfall and temperatures (and associated evaporation) though, it is reasonable to characterise the northern plains areas of the region as being generally more directly exposed to reduced water availability in the future than the higher rainfall south.

Extreme rainfall and flooding

Paradoxically, because the areas to the north of the region tend to be low lying and subject to inundation, they are also more exposed to intense rainfall events and associated flooding than the slopes in central and southern areas. High magnitudes of rainfall over short-time periods have contributed to major flooding in the past, both riverine and flash flooding, in a number of lower catchments and drainage areas in the region. Significant urban and commercial areas in the rural cities of Wangaratta and Benalla, for example, are already exposed to 1 in 100 year flooding.

Detailed regional projections are not yet available for changes to maximum rainfall intensities at different durations (e.g. 2 hour, 8 hour, 24 hour, 48 hour). Available projections however, indicate likely increases in maximum intensities of longer duration events (e.g. 24 hour) in many parts of the region (Abbs & Rafter, 2008), as well as significant increases in short duration events (see Table 3). These projections point to increases in the annual exceedance probabilities (AEP) of given flood magnitudes. Probable maximum flood (PMF) and 1 in 100 year flood levels are also likely to increase at given locations in the region, exposing greater numbers of people and businesses to the direct impacts of flooding in the future and increasing the frequency of exposure for communities who are already exposed.

Bushfires

Many parts of North East Victoria have been affected by major bushfires in recent history including in 2003 (Great Divide fires), 2006-07 (Victorian Alps fires) and 2009 (Black Saturday).

Climate change projections for the region indicate that there will be an increase in the frequency of high and extreme fire risk days of up to 66% by 2050. Projections also point to increase and in length of the fire season (extending into spring and autumn).

It is important to note that a range of factors (not just fire weather conditions) contribute to the ignition and spread of bushfire across a landscape and the risks that they pose to communities. The major factor contributing to bushfire exposure is vegetation cover. Council planning schemes and accompanying overlays (i.e. Wildfire Management Overlays [WMO] or Bushfire Management Overlays [BMO]) have been identified by the Country Fire Authority (CFA) using information about the density and extent of vegetation, with scrub, woodlands and forests that are greater than 5 hectares in extent and having a canopy cover of greater than 30% being considered high bushfire risk areas and therefore being subject to a BMO/WMO (CFA, 2010).

All LGAs in the region have areas that are subject to a BMO, with Alpine Shire in particular having very substantial BMO areas. The most hazardous bushfire areas (in terms of human impacts), tend to occur around the fringes of development where significant human communities and infrastructure are present, but where there is also significant native and modified vegetation to fuel the fires. Towns in the region that are regarded as being in high bushfire risk areas and are covered by township protection plans include: Bogong Village, Dederang, Bright-Wandiligong, Porepunkah and Tawonga (Alpine Shire); Stanley and Yackandandah (Indigo Shire); Dartmouth and Mitta Mitta (Towong Shire); Baranduda (City of Wodonga); and Whitfield-Cheshunt (Rural City of Wangaratta).

3.3 Economic sensitivity and adaptive capacity

3.3.1 Overview

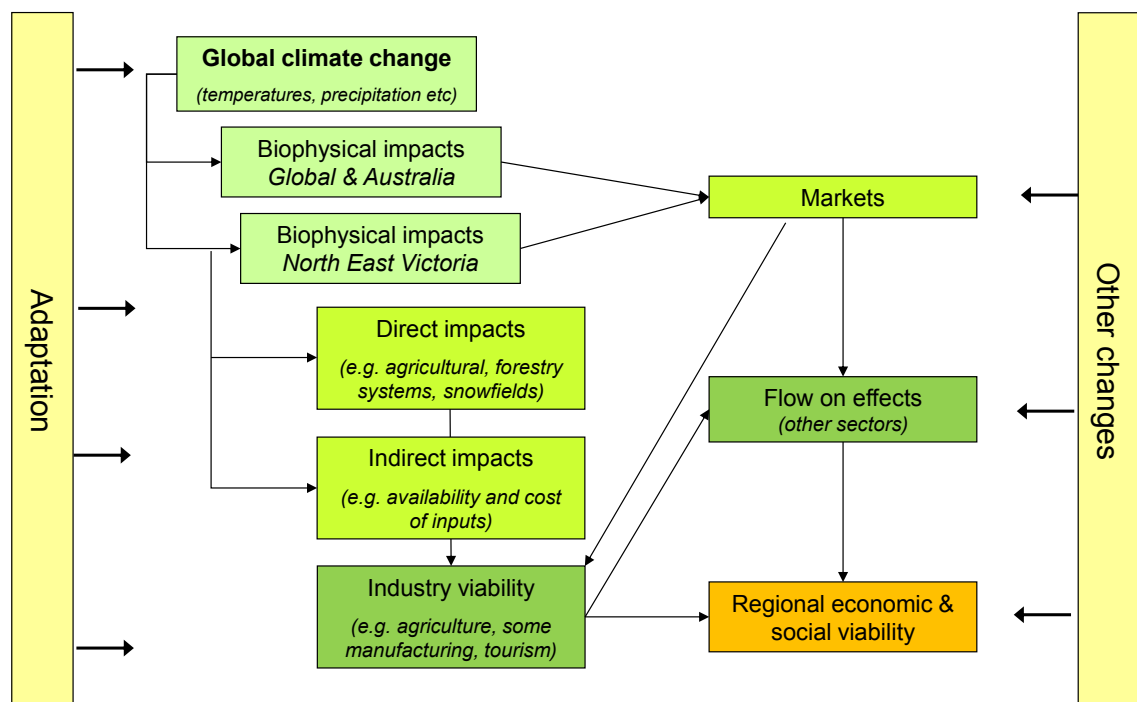
Climate change has the potential to have significant long-term effects on the economy of the North East Region, either directly through the exposure of key industries to changes, indirectly through the impacts of changes to those industries on the availability and cost of raw materials or through flow-on effects to the regional economy (Figure 5).

Water supply and primary industries (agriculture and forestry) are the most sensitive industries to the direct impacts of climate change. The vitality of the agricultural and forestry industries are particularly dependent on rainfall and impacted by changes in temperatures, soil moisture conditions, and the increasing frequency and severity of extreme weather events (CSIRO, 2008b).

Climate changes will also have indirect effects on other industries. Manufacturing industries responsible for the processing of agriculture and forest products, such as food processing, beverage manufacturing, wood processing and pulp & paper, could be affected by availability and prices of primary inputs for example. These industries also tend to be heavily dependent on water and could be impacted by a shortage of water (and associated rises in water prices). Similarly, the viability of tourism may also be affected by climate change impacting on major attractions in the region, such as the snowfields, wineries (water availability and bushfires), waterways and nature and scenic based tourism (bushfires and floods). In addition, extreme events, such as intense rainfall, flooding or bushfires, can cause disruptions to many businesses. Transport, communications and construction are especially susceptible in this regards.

A decline in viability of directly and indirectly effected industries will inevitably have flow-on effects to other businesses. All effects direct, indirect and flow-on will in turn impact on the region's economy and society.

Figure 5: Potential impacts of climate change on economy of North East Victoria



Source: MJA

The extent of impacts however, will ultimately depend on the adaptive capacity of regional industries and communities and how that capacity is used to adapt to the impact of climate change.

In this section we assess the sensitivity and adaptive capacity of the economy of the North East region to the impacts of climate change, considering a range of indicators and examining differences between LGAs and (in some cases) areas within LGAs. In undertaking this assessment, the interaction of climate change with other drivers of change (e.g. demographic change) is considered.

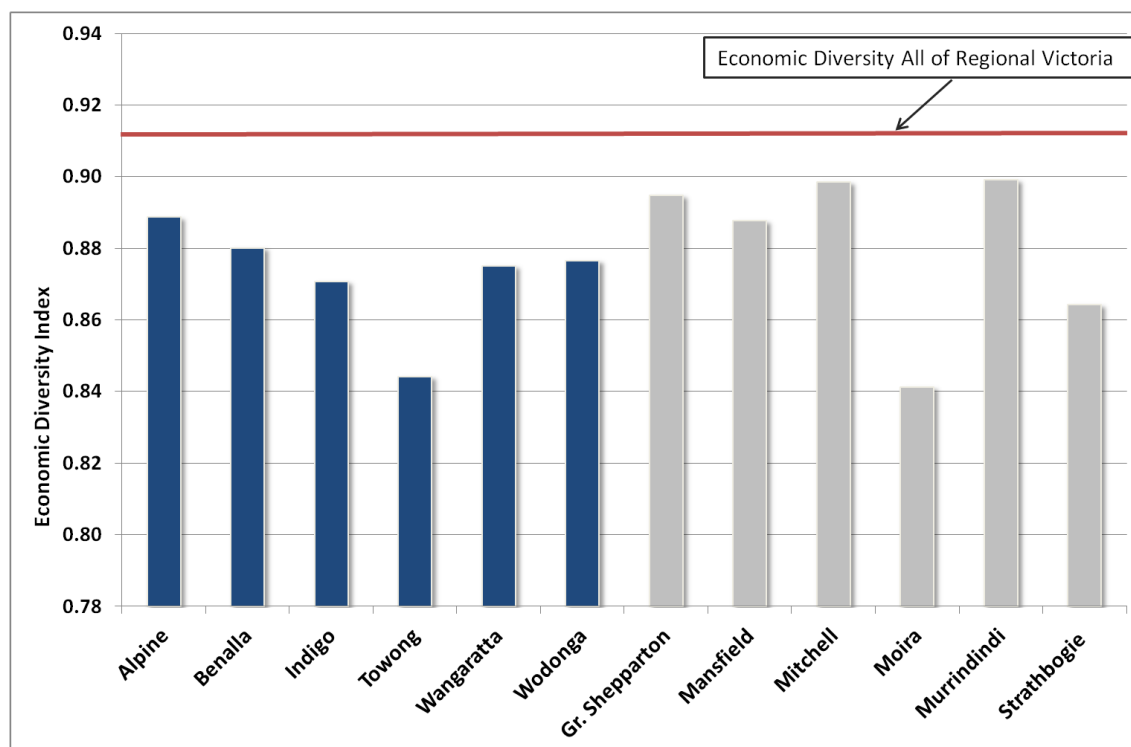
3.3.2 Economic diversity

In general terms, LGAs and regions with diversified economies are likely to be less sensitive and have greater capacity to adapt to climate change and other changes (ABARE/BRS 2010; Brooks et. al. 2005; MJA 2010). This capacity reflects their ability to diversify out of the risk or innovate to absorb impacts and changes. Above a minimum population, as system diversity increases so does the ability of a system to absorb and transition through shocks.

The economic diversity of the region has been assessed using the Shannon-Wiener index of diversity⁹. In this case, the index has been used to measure the distribution of employment across industry sectors within each LGA. 19 sectors were used in line with 'industry of employment' data available from the 2006 Census, which list how many people are employed in each employment sector.

The Economic Diversity Indexes for the region are presented, with the index value for the whole of regional Victoria provided as a basis for comparison (Figure 6). In most of the region's LGAs the diversity index is a little below the index of 0.91 for regional Victoria as well as for the whole of Victoria (0.92) but is in line with diversity values for many individual LGAs in both regional and metropolitan Victoria. This would suggest that, in general terms, the local economies of the region are reasonably well placed to cope with 'shocks' in the future including those that could arise from climate change and variability. Towong would appear to be an exception to this general rule of thumb having an economic diversity index of just 0.84, suggesting that its economy is dependent on a more limited range of industries than other LGAs in the region, a conclusion that is confirmed by analysis in the following section.

⁹ The Shannon-Wiener index was originally developed through the discipline of information systems theory to measure the order (disorder) observed within a particular system. It has been widely applied since in the field of ecology to measure species richness, as well as entropy in thermodynamics and economic concentration. The index measures a combination of 'variety' and 'balance' of industry employment. The index value ranges from 0 to 1. A region with an index of 0 would rely entirely on one industry for its employment.

Figure 6: Economic Diversity Index, North East Victorian LGAs, 2006

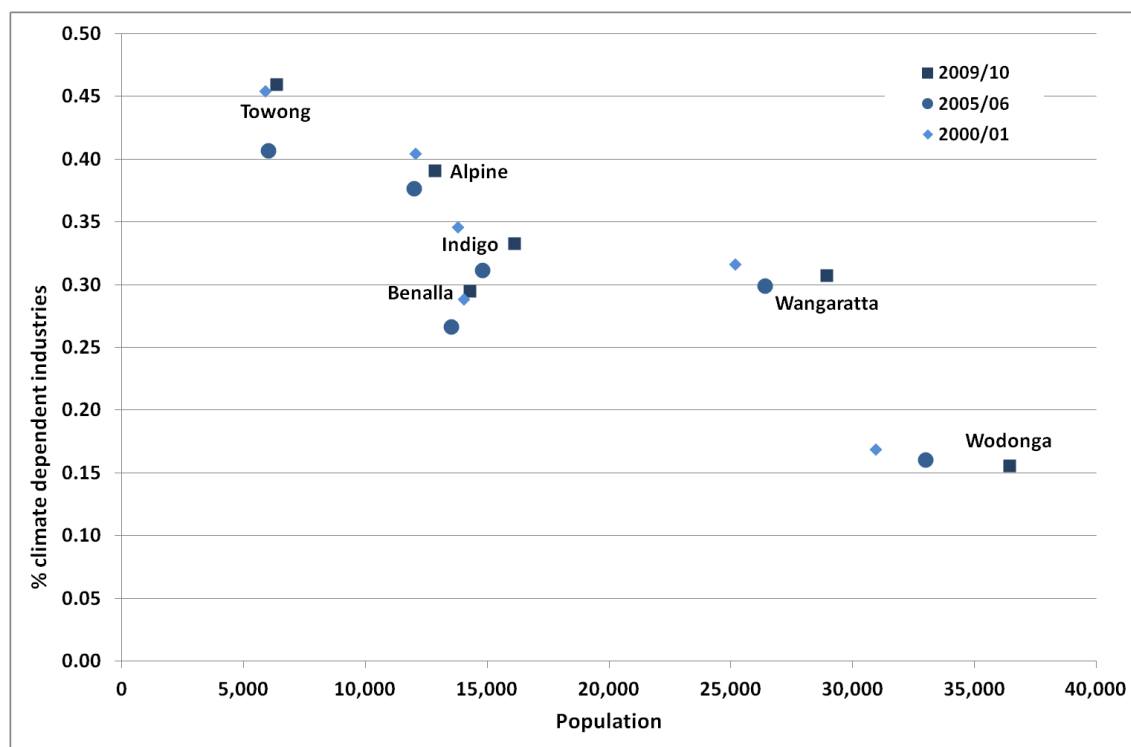
Source: MJA Analysis based on ABS Census 2006

3.3.3 Reliance on climate dependent industries

The economic diversity index provides a sound overall indication of the sensitivity of regional economies to future change but does not necessarily tell us much about the sensitivity of those economies to climate change and variability. To that end, information on the reliance of regional economies to ‘climate dependent’ industries has been compiled, where climate dependent industries are defined as:

- industries whose production processes/operations are tied directly to climate conditions (e.g. forestry, agriculture, snow-based tourism, water supply); and
- industries that are substantially reliant on inputs from the above listed industries to their production processes (e.g. food processing [agricultural produce], wood products manufacturing [forestry], pulp & paper [forestry, water], textiles [water]).

Climate dependent industry data for the region (Figure 7 and Table 5) reveals that Towong Shire and Alpine Shire are particularly reliant on climate dependent industries, although Indigo, Wangaratta and Benalla are also quite strongly reliant on these industries. Only Wodonga has a low reliance these industries when compared with the average for regional Victoria (~ 26%) and even Melbourne (~16%).

Figure 7: Climate dependent industries and population size in 2000, 2005 and 2010

Source: NIEIR, 2011; ABS Census 2006

The proportion of climate dependent industries (based on employment) declined for all LGAs in 2005, but increased again in 2010, with the exception of Wodonga (Figure 7). There is also a clear trend with regard to population size and climate dependency of industry. Smaller communities in the region appear to rely more on climate dependent industries than the larger population LGAs, such as Wodonga. This situation is consistent with Australian and international trends. The United States Department of Agriculture Economics Research Service (USGER) (Keller, 2000) and the Australian Bureau of Transport (Houghton, 1997) have both found that economies of smaller communities are more likely to be dependent on a single sector – agriculture in the case of the smaller population LGAs in North East Victoria. Larger communities, on the other hand, are more likely to have diverse economies, their economies not being structured around one industry or sector. USBER research suggests diverse economies typically begin to appear when the population of a municipality's major town grows above 10,000 people, becoming statistically significant when the town's population is greater than 25,000 persons (Keller, 2000). In Australia, the Bureau of Transport has found communities are less resilient and more likely to be dependent on a single sector when they have a population of less than 15,000 people (Houghton, 1997).

A detailed breakdown of climate dependent industries (Table 5) shows that all LGAs except Wodonga rely to a large extent on agriculture for employment. Towong is particularly reliant on this sector with over 35 percent of its residents being employed in the agricultural sector (Table 5, green highlight). As well as being reliant on agriculture, Alpine Shire is also reliant on the tourism industry, with accommodation and food and beverage services account for more than 13 percent of employment there (orange highlight). Indigo and Wangaratta also have quite significant food processing (yellow highlight) and textile industries (blue highlight) respectively, although both industries have shown a noticeable decline over the past decade, probably linked to international market pressures.

Table 5: Employment in climate dependent industries, North East Victoria (% of total employment)

LGA	Agriculture, Forestry and Fishing			Tourism related				Manufacturing					Total climate dependent industries
	Agriculture & Aquaculture	Forestry & Logging	AFF Support Services	Accommodation	Food & Beverage Services	Arts & Heritage	Sports & Recreation	Food Product Manufacturing	Beverage & Tobacco Products	Textile, Leather, Clothing & Footwear	Wood Product Manufacturing	Pulp, Paper & Paper Products	
2000													
Alpine	14.9	1.0	0.5	9.0	6.0	0.5	1.0	1.4	1.3	0.7	5.6	0.0	41.9
Benalla	14.0	0.3	0.8	1.7	4.3	0.2	1.2	1.3	0.2	2.9	3.4	0.0	30.2
Indigo	14.7	0.2	0.7	2.3	4.2	0.4	0.4	9.1	1.9	0.6	0.7	0.2	35.4
Towong	34.9	0.8	0.8	2.1	3.3	0.2	0.4	2.3	0.0	0.2	0.8	0.3	46.0
Wangaratta	12.2	0.3	0.3	1.3	5.4	0.2	0.7	2.4	2.0	5.9	1.8	0.0	32.5
Wodonga	1.8	0.1	0.2	1.2	5.6	0.2	0.9	5.3	0.2	1.2	0.4	0.9	18.0
2005													
Alpine	11.5	1.2	0.6	8.2	6.9	0.8	0.9	1.6	1.7	0.6	5.3	0.0	39.4
Benalla	11.4	0.4	0.8	1.1	4.7	0.2	1.1	1.6	0.2	3.0	3.5	0.0	27.9
Indigo	11.7	0.1	0.7	2.1	4.9	0.5	0.3	8.0	1.9	0.4	0.9	0.3	31.9
Towong	28.7	0.7	0.7	1.7	4.1	0.2	0.2	3.0	0.0	0.3	1.2	0.3	41.0
Wangaratta	9.9	0.3	0.5	1.2	5.9	0.2	0.8	2.6	2.2	5.3	2.0	0.0	30.9
Wodonga	1.2	0.1	0.2	1.1	5.4	0.1	0.7	5.5	0.2	0.8	0.5	1.2	16.8
2010													
Alpine	16.3	1.4	0.8	7.1	6.5	0.5	0.9	1.4	1.4	0.5	3.6	0.0	40.5
Benalla	16.3	0.4	1.0	0.9	4.8	0.2	1.1	1.4	0.2	2.0	2.3	0.0	30.7
Indigo	16.6	0.2	0.8	1.7	4.7	0.4	0.3	6.5	1.5	0.2	0.7	0.3	33.9
Towong	35.6	0.7	0.9	1.2	3.7	0.2	0.2	2.6	0.1	0.2	0.8	0.1	46.4
Wangaratta	14.1	0.3	0.8	1.0	5.5	0.1	0.8	2.3	1.8	3.5	1.4	0.0	31.6
Wodonga	1.6	0.1	0.3	1.0	5.5	0.1	0.7	5.0	0.1	0.4	0.4	1.1	16.3

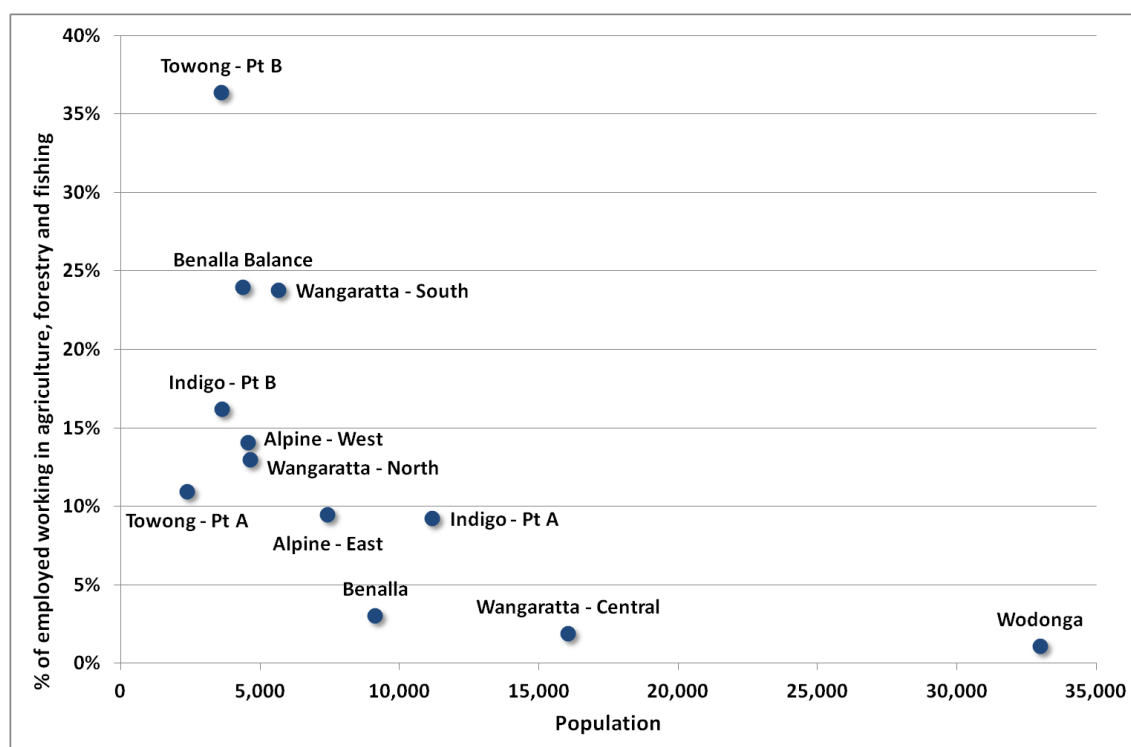
Source: MJA Analysis, based on NIEIR YourPlace database

Below we examine some of the climate dependent industries – agriculture, tourism and manufacturing – more fully. In addition, we briefly analyse the construction industry, which is somewhat exposed to weather events.

Agriculture

As noted, agriculture is a major industry for most LGAs of the region. In 2010, the agriculture and aquaculture sector provided between 14 and 36 percent of employment for all LGAs, except Wodonga (Table 5). The United States Department of Agriculture Economics Research Service classifies agriculture dependent communities as those with either 15 percent or more of economic production value and/or employed residents worked in farm sector occupations. USBER finds that farming dependent communities are more likely to be smaller communities, generally with populations totalling less than 10,000 people. These research findings are reflected in the North East region, with a decreasing proportion of residents being employed in the agricultural sector as the population increases (Figure 8).

Figure 8: Employment in Agriculture and Forestry by population size, by Statistical Local Area¹⁰



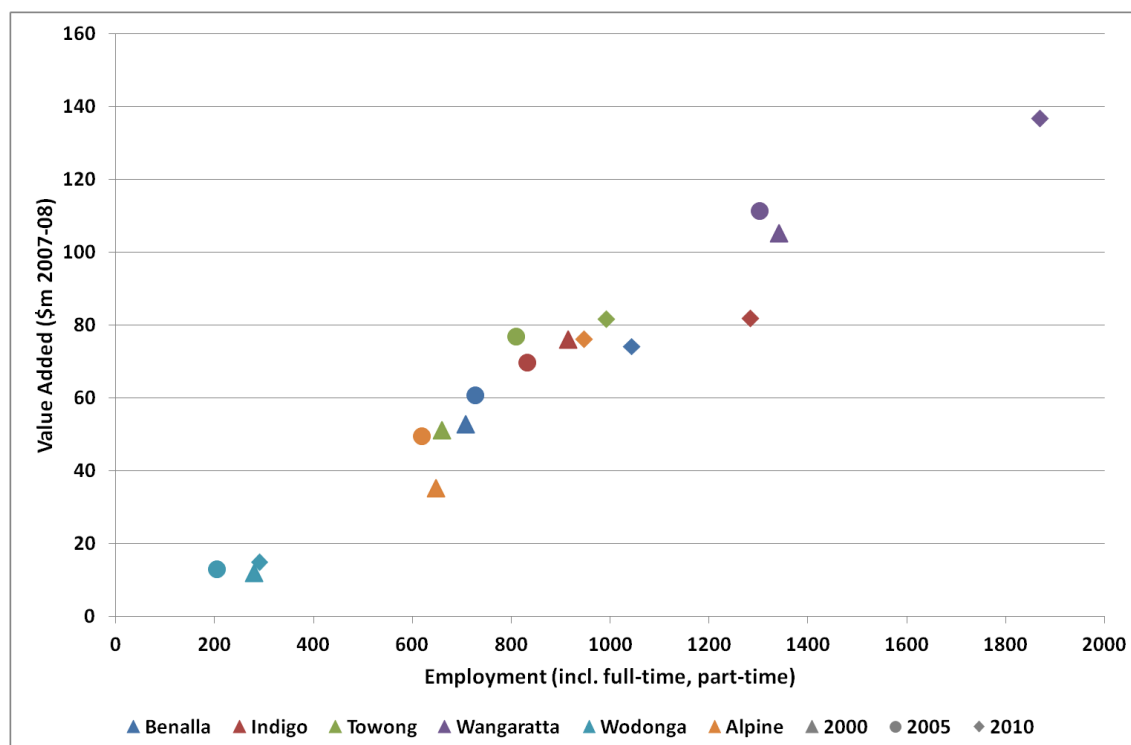
Source: ABS Census 2006

¹⁰ Statistical Local Area (SLA) is the smallest level of geography contained in the Australian Standard Geographical Classification. All LGAs in North East Victoria contain two SLAs, with the exception of Wodonga which has only one and Wangaratta which has three. Maps of SLAs can be found on the ABS website (<http://www.abs.gov.au/websitedbs/censushome.nsf/home/data>)

Figure 9 highlights the primacy of agriculture to the economies of most LGAs (except Wodonga), in terms of both value added and employment. To a significant extent, other businesses within the region are dependent on agriculture, being integrated within the agricultural value chain by providing inputs and using outputs of agricultural activities.

It is noteworthy, that all LGAs show increases in employment and value added between 2005 and 2010, which suggests that the agricultural sector made a good recovery after the prolonged drought. It is also possible that farmers in the North East region have adapted and are somewhat resilient to climate change impacts.

Figure 9: Value Added and full-time employment in agriculture, by LGA



Source: MJA Analysis, based on NIEIR YourPlace database

Note: all dollar values are real 2007-08 dollars

Agriculture is responsible for substantial share of economic output of most LGAs in North East Victoria. In 2006, the total gross value of agricultural production amounted to \$65.5 million to \$107.5 million for LGAs with a high dependence on agriculture (Table 6). A large proportion of this value is created by livestock in all LGAs, with the exception of Alpine, which derives more than half of its agricultural production value from cropping. On a per capita basis, the value of agricultural production in these LGAs is substantially greater than for the state as a whole. It is also greater than many other agriculturally dependent LGAs in Victoria, although comparable to the neighbouring region of Goulburn. Towong had an exceptionally high value of agricultural production in 2006 at \$13,000 per capita.

The agricultural sector faces a wide range of risks and potential impacts from climate change including;

- direct risks to yields or productivity associated with an altered climate regime;
- increased loss or damage to stock and crops associated with an climate related extremes (e.g. droughts, floods, bushfires, heatwaves); and

- indirect risks associated with increased costs of farm inputs and/or changing market conditions.

Considering these types of risks, analysis by Broadleaf and MJA suggests that Victorian agricultural sector facing the greatest level of risk from climate change is irrigated agriculture – linked to water security issues (Broadleaf & MJA, 2007). On this point, it is important to note that none of the six North East Victoria LGAs has a high proportion of irrigated agricultural land. The area irrigated as percentage of all agricultural land is less than 5 percent for any of the LGAs and therefore below the Victorian average. By comparison, 18% of agricultural land in the Goulburn region is irrigated. The low reliance on irrigated agriculture however, does not mean that the region’s agricultural sector is not immune from a wide range of impacts from climate change in the future - direct and indirect.

Table 6: Regional agricultural production statistics, North East Victoria LGAs, Goulburn and Victoria, 2006

Measure	Alpine		Benalla		Indigo		Towong	
Gross value of agricultural production	(\$m)	(\$'000 per capita)	(\$m)	(\$'000 per capita)	(\$m)	(\$'000 per capita)	(\$m)	(\$'000 per capita)
Crops	39.6	3.3	21.9	1.6	23.1	1.6	5.9	1.0
Livestock	13.7	1.1	34.4	2.5	24.7	1.7	41.1	6.8
Livestock slaughtering	13.0	1.1	11.3	0.8	17.6	1.2	30.9	5.1
Total	66.3	5.5	67.5	5.0	65.5	4.4	77.9	13.0
Area under production	(ha)	(ha per capita)	(ha)	(ha per capita)	(ha)	(ha per capita)	(ha)	(ha per capita)
Cereals for grain	32	2.7	16,743	1,237.5	10,056	678.5	158	26.3
Vegetables for human consumption	24	2.0	12	0.9	4	0.3	0	0.1
Orchard trees (including nuts)	807	67.2	182	13.4	492	33.2	18	3.0
All fruit (excluding grapes)	825	68.7	182	13.4	499	33.7	20	3.4
Non-cereal broadacre crops	1,025	85.4	4,360	322.3	2,175	146.7	110	18.3
Total	70,786	5,898.3	136,829	10,113.8	113,059	7,628.3	170,360	28,360.3
Livestock	(no)	(no per capita)	(no)	(no per capita)	(no)	(no per capita)	(no)	(no per capita)
Sheep and lambs	3,023	0.3	249,681	18.5	101,388	6.8	67,363	11.2
Milk cattle (excluding house cows)	10,476	0.9	5,094	0.4	13,585	0.9	24,179	4.0
Meat cattle	37,128	3.1	59,939	4.4	54,675	3.7	119,545	19.9
Water use	(ha)	(ha per capita)	(ha)	(ha per capita)	(ha)	(ha per capita)	(ha)	(ha per capita)
Area irrigated ('000 ha)	3	0.2	3	0.2	3	0.2	3	0.2
Area irrigated as % of agricultural land	4.2%		2.2%		2.7%		1.8%	

Measure	Wangaratta		Wodonga		Goulburn		Victoria
Gross value of agricultural production	(\$m)	(\$'000 per capita)	(\$m)	(\$'000 per capita)	(\$'000 per capita)	(\$'000 per capita)	(\$'000 per capita)
Crops	39.1	1.5	0.9	0.0	1.5	3.3	0.8
Livestock	48.6	1.8	7.6	0.2	3.2	1.8	0.5
Livestock slaughtering	19.8	0.8	1.2	0.0	0.9	3.1	0.5
Total	107.5	4.1	9.7	0.3	5.7	8.3	1.8
Area under production	(ha)	(ha per capita)	(ha)	(ha per capita)	(ha per capita)	(ha per capita)	(ha per capita)
Cereals for grain	6,176	234.0	36	1.1	1.09	0.89	0.48
Vegetables for human consumption	49	1.9	1	0.0	0.00	0.02	0.01
Orchard trees (including nuts)	442	16.7	8	0.2	0.01	0.07	0.01
All fruit (excluding grapes)	501	19.0	9	0.3	0.01	0.07	0.01
Non-cereal broadacre crops	1,266	48.0	0	0.0	0.32	0.17	0.11
Total	168,078	6,368.0	25,455	771.7	14.5	7.7	2.4
Livestock	(no)	(no per capita)	(no)	(no per capita)	(no per capita)	(no per capita)	(no per capita)
Sheep and lambs	130,569	4.9	20,121	0.6	30.54	9.97	3.49
Milk cattle (excluding house cows)	14,773	0.6	510	0.0	0.18	2.24	0.34
Meat cattle	107,365	4.1	19,627	0.6	5.38	2.14	0.52
Water use	(ha)	(ha per capita)	(ha)	(ha per capita)			
Area irrigated ('000 ha)	6	0.5	0	0.0			
Area irrigated as % of agricultural land	3.6%		0.0%		1.8%	18.0%	5.3%

Source: ABS 2010, National Regional Profile, 2005-2006 for Strathbogie, South Goulburn, Goulburn and Victoria

Note: South Goulburn includes Benalla, Mansfield, Strathbogie and Mt Buller and Mt Stirling Alpine Resorts

Goulburn includes Benalla, Campaspe, Greater Shepparton, Mansfield, Mitchell, Moira, Murrindindi, Strathbogie as well as Mt Buller, Mt Stirling and Lake Mountain Alpine Resorts

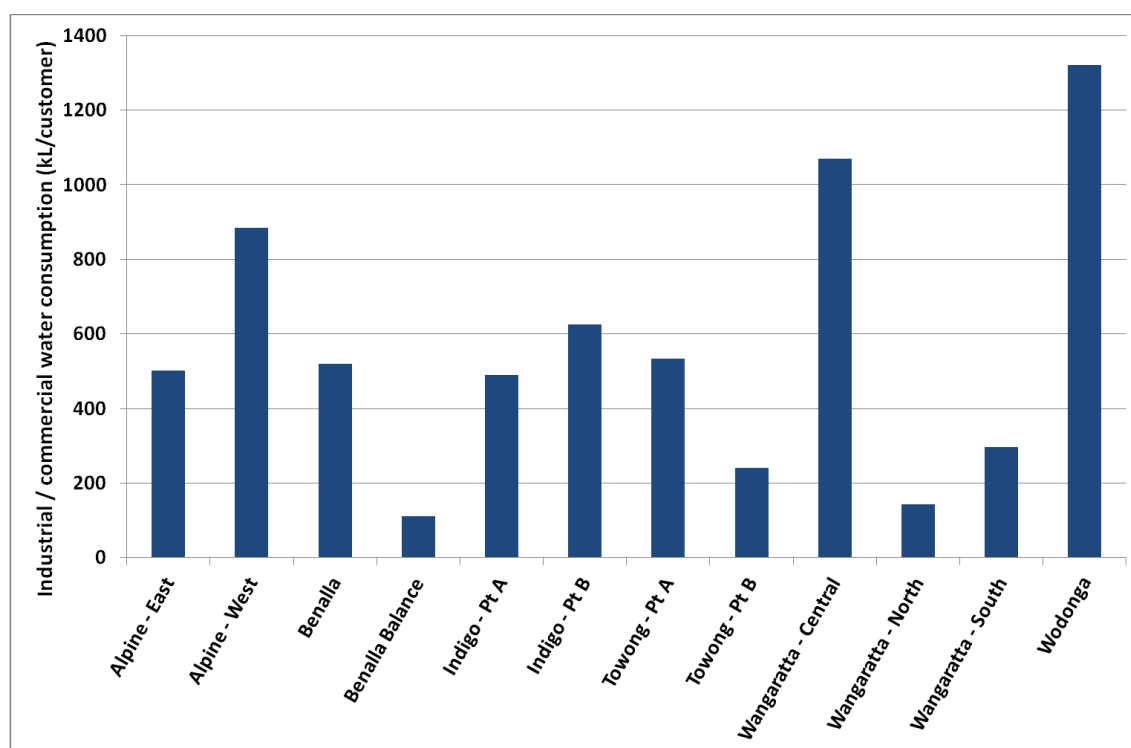
Manufacturing

Climate dependent manufacturing is an important sub-sector in the region, generating an estimated 9 percent of the region's total output (value added) in 2010, although this has fallen from about 15 percent in 2000.

Major manufacturing industries in the region classified as climate dependent include food processing (e.g. Uncle Tobys (Nestle), Mars Australia and Vitasoy), textile manufacturing (e.g. Bruck Group and Australian Country Spinners) and wood product manufacturing (incl. Alpine MDF and Carter Holt Harvey Woodproducts). All of the industries listed above are major water users and are therefore sensitive to reduced water availability. Furthermore, they are sensitive to indirect impacts, such as higher costs or availability of raw material inputs from primary industries.

Major industrial water users are located primarily in Wodonga and Wangaratta, but are also located in Indigo and Alpine Shires (Figure 10).

Figure 10: Average industrial and commercial water consumption, 2010-11

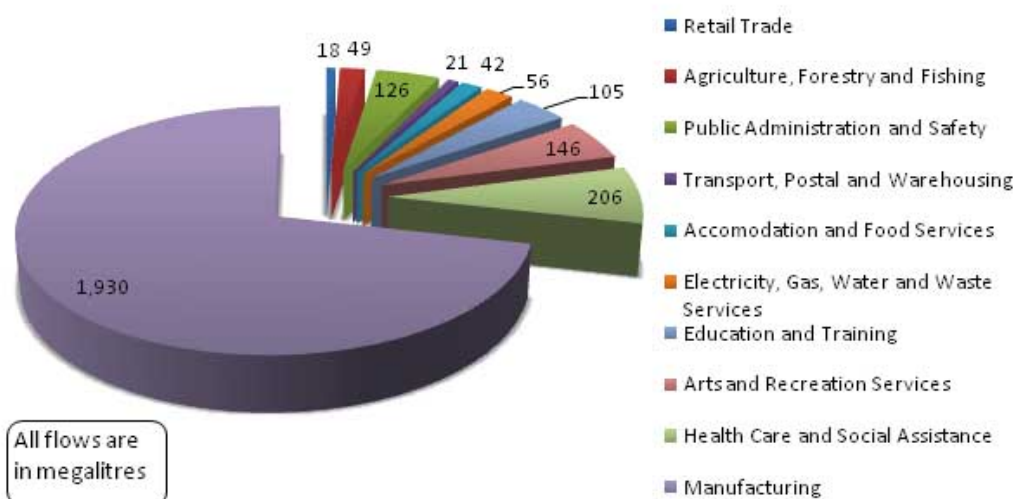


Source: NEW, 2011

In 2006-07 the Victorian Government implemented the initiative *Water Management Action Plans* (WaterMAPs), which aims at improving the water efficiency of major water using commercial, industrial and institutional customers. The program is mandatory for all non-residential water customers with a consumption of more than 10 ML of water per year and requires them to develop WaterMAPs. Over the last 5 years, non-residential customers accounted for approximately 37 to 38 percent of the total reticulated water consumption in the region. In 2008-09, 56 customers – with 12 of these being manufacturing businesses – were over the 10 ML per year threshold. These 56 customers accounted for over half of the usage

within the non-residential sector, with the consumption of the WaterMAP customers amounting to 2,699 ML. Of this amount, over two-thirds were consumed by the manufacturing WaterMAP customers (Figure 11).

Figure 11: Breakdown of consumption for North East Water WaterMAP customers, 2008-09



Source: North East Water (available at <http://www.nerwa.vic.gov.au/customer/200911167131.htm>)

Through the WaterMAP and other programs, it is apparent that manufacturing and other WaterMAP customers have been quite proactive in reducing their water consumption, thereby reducing their sensitivity to reduced water availability. North East Water reports that 44 major customers participated in the WaterMAP program in 2010-11 (NEW, 2011). Of these 44 customers, nine consumed between 50 ML and 200ML per year and two consumed between 300 ML and 500 ML per year. Nine of these are climate dependent manufacturing industries based in the study area (Table 7). In 2010-11, the 44 WaterMAP customers achieved water savings of 9.1 percent, slightly below the reduction target of 10 percent. Even so, over the five year period since the program was implemented in 2006-07, WaterMAP customers have achieved savings of more than 35 percent (1.2 GL).

Table 7: Highest water consumers amongst WaterMAP customers located in the North East Region

Name of customer
Wodonga Rendering Pty Ltd
Bruck Australia Ltd
Vitasoy Australia Products
Mars Australia Pty Ltd
Alpine MDF Industries P/L
Carter Holt Harvey Wood Products Aust Ltd
Nestle Australia Ltd
Australian Country Spinners
Mackay Casings Pty Ltd

Source: North East Water, 2011

Tourism

Tourism is an important regional sector, generating significant employment for the region - ranging from 5 percent in Towong (low) to almost 14 percent in Alpine (see Table 5). The value of output (value added) from tourism is somewhat less though, being in the order of 4 percent across the region.

Considering industry structure, the study area includes much of the 'Victorian High Country' campaign region, as classified by Tourism Victoria, as well as the 'Murray East' sub-region. Tourism in the study areas falls into a number of broad categories including:

- alpine/ snow based tourism;
- eco and adventure tourism;
- food and wine;
- history and heritage; and
- general touring.

To a lesser or greater degree, all of these categories are sensitive to climate change and variability, with the first three categories quite clearly so.

The Alpine Resorts Falls Creek, Mt Hotham, Mt Buller and Mt Stirling are a major part of the tourism industry in North East Victoria. Although they are small communities, they generate significant seasonal employment opportunities for residents in surrounding LGAs and contribute to the gross regional product of the region, Alpine Shire in particular. A report on the *Economic Significance of the Australian Alpine Resorts* (NIEIR, 2006) found that in 2005 the winter resorts of Falls Creek and Mt Hotham generated an additional \$106 million in gross regional product for the Alpine Shire, which represents 20 percent of its gross product.

Alpine/ snow based tourism is clearly far from the dominant category of tourism to the region however, as evidenced by survey data presented in 'Victoria's High Country Market Profile', which shows that in 2010 only 13% of overnight visitor respondents nominated snow sports as an activity that they engaged in (Tourism Victoria, 2011). Further evidence that the other categories of tourism are also important to the industry in the region is provided by information that on seasonality of tourism, which reveals a very even spread of visitors to the region (based on % of domestic overnight domestic visitors) across the four seasons (Tourism Victoria, 2011).

The impact of climate change and variability on the long term viability of the industry in the region is unclear at this stage. There is strong evidence to indicate that visitation rates to the alpine resorts are low during 'poor' snow seasons compared with 'good' snow seasons (ARCC, 2011; NIEIR, 2006). However there is insufficient evidence over time to indicate whether the long term trend of declining snow depth and duration (Worboys and Good, 2011) is having an impact on long term visitation rates. There is no clear trend in visitation rates to alpine resorts over the last ten years for example (ARCC, 2011). Similarly, although there is some colloquial evidence to suggest that visitation rates to the region have dropped off significantly immediately following major climate-related disasters (e.g. fires 2003, 2006-07, 2009; floods 2010) annual visitor numbers to the region (overnight and day trip) have remained fairly constant over the past 10 years.

A note on the construction sector

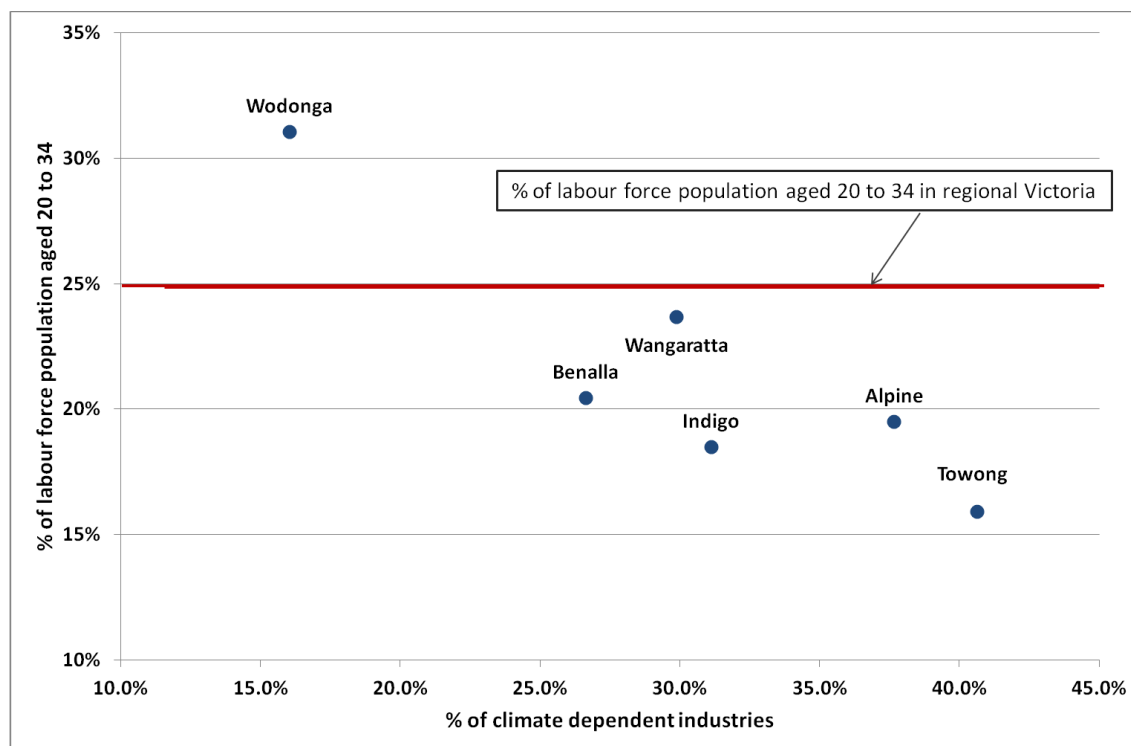
The region's construction industry provides for approximately 8 percent of employment and more than 7 percent of value added. As such, it is an important sector for the region. While weather can significantly influence activity in the sector in the short term (e.g. disruptions due to prolonged and/ or intense rainfall and heatwaves), these disruptions tend not to have a lasting effect on the industry, with other factors such as the overall level of regional economic activity and growth being much more important to the long term viability of the sector¹¹.

3.3.4 Workforce

Another factor to consider when examining the sensitivity and adaptive capacity of the economy of the North East region is workforce demographics and structure. In general terms, older workforces tend to have lower participation rates, sometimes lower productivity and are less flexible in the face of change (Abhayaratna, and Lattimore 2006).

Overall, the workforce in North East Victoria is relatively old, with the proportion of younger workforce participants (20-34) being low in all of the region's LGAs relative to the rest of Victoria, with the exception of Wodonga (Figure 12). Furthermore, there is appears to be a link between workforce age, population size and the reliance on climate dependent industries. This situation raises questions about the adaptability of the region's workforce to climate change and other changes and shocks in the future, compounding the vulnerability of industries that are climate dependent.

Figure 12: Workforce aged 20-34 and climate dependent industries, 2005-06



Source: ABS Census 2006; NIEIR YourPlace database

¹¹ This view was confirmed during focus groups discussions with industry representatives in December 2011 (see report *Qualitative Research: Industry Attitudes to Climate Change/Variability*, GPS Research).

3.4 Social sensitivity and adaptive capacity

3.4.1 Overview

Climate change and variability has the potential to have significant long-term impacts on communities of the North East region, separate from any flow-on effects that could result from impacts on the region's economy and industries. Evidence and data from Australian and international studies (Brooks et al. 2006; Dwyer et al. 2004) indicates that groups especially vulnerable to climate change, variability and extreme climate events such as floods, storms, bushfires and heat waves include:

- low income earners;
- infants and the elderly; and
- people with existing health conditions (including physical and mental health).

The vulnerability of these groups stems from:

- limited capacity to prepare for impacts due to lack of resources or an inability to access or effectively utilise relevant information;
- difficulty in responding to particular impacts, due to physical incapacity, lack of mobility or lack of resources; and/or
- problems with recovering from impacts, again due to lack of resources or to the absence of effective social networks.

In this section we assess the sensitivity and adaptive capacity of communities in the North East region to the impacts of climate change, considering a range of indicators and examining differences between LGAs and areas within LGAs.

3.4.2 Index of Relative Advantage and Disadvantage

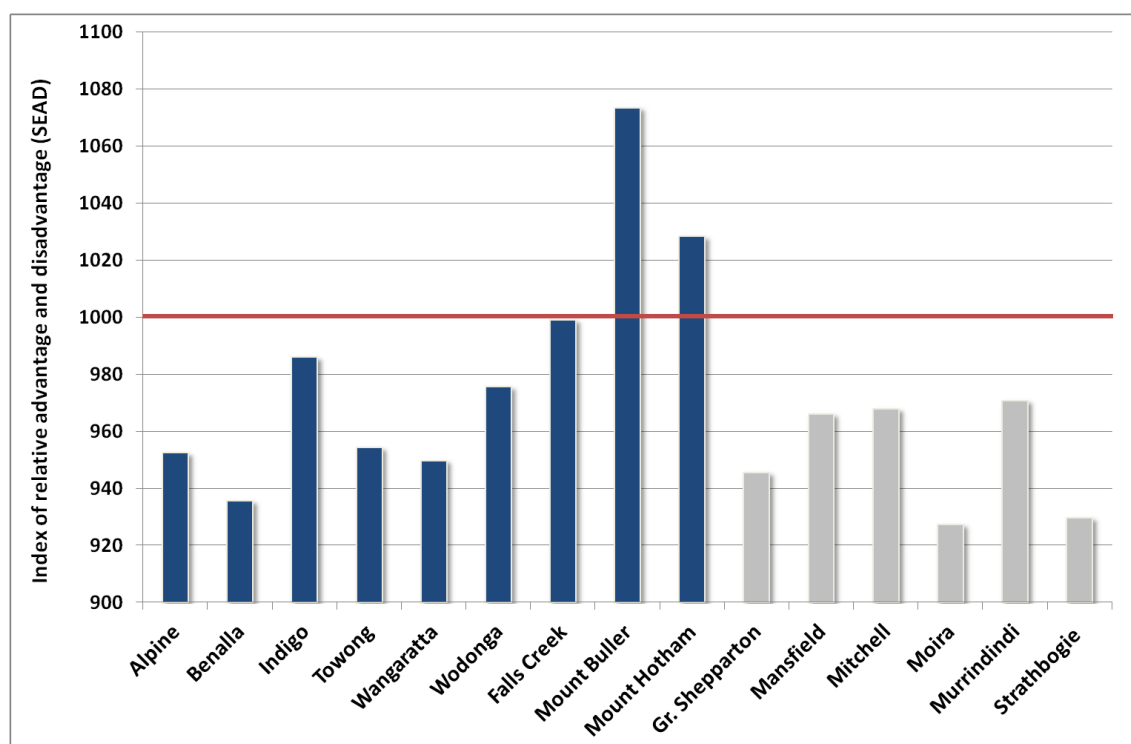
Four Socio-Economic Indexes for Areas (SEIFA) have been constructed by the Australian Bureau of Statistics, from the 2006 Census of Population and Housing data. These indexes allow comparison of the social and economic conditions across Australia, with each index focusing on different aspects of socioeconomic status. One of these is the *Index of Relative Socioeconomic Advantage and Disadvantage*, which contains indicators of disadvantage and advantage, such as low or high income, occupation and education. A high index score suggests a relative lack of disadvantage and greater advantage, whereas a low score indicates relatively greater disadvantage and a lack of advantage¹². For example, a high score implies many households with high incomes and/or many people in skilled occupations, as well as few households with low incomes and/or few people in unskilled occupations.

All LGAs within the North East region are within one standard deviation (i.e. within the range of 900 to 1100) of the Australian Average of the *Index of Relative Socioeconomic Advantage and Disadvantage* (Figure 13). Approximately two-thirds of the census collection districts (CCD) and the population of Australia lie within this range. As such, the region as a whole would appear to have a moderate level of social advantage when compared to other parts of Australia and Victoria.

¹² SEIFA index values are derived from multiple-weighted variables, with the reference value for the whole of Australia set to 1,000. Lower values indicate lower socioeconomic status.

The region's high dependency on agriculture for employment and wealth creation may be reflected in the lower than Australian average scores. However, there is no evidence of a strong correlation between a low score and a high dominance of agriculture. For example, Indigo Shire has a relatively high score, compared to the other 5 LGAs (excluding the Alpine Resorts), whereas Benalla and Alpine Shire, LGAs with less agricultural activity compared with Indigo Shire, have lower scores.

Figure 13: Index of Relative Socioeconomic Advantage and Disadvantage, North East region (blue) and adjoining LGAs (grey)



Source: ABS SEIFA 2006

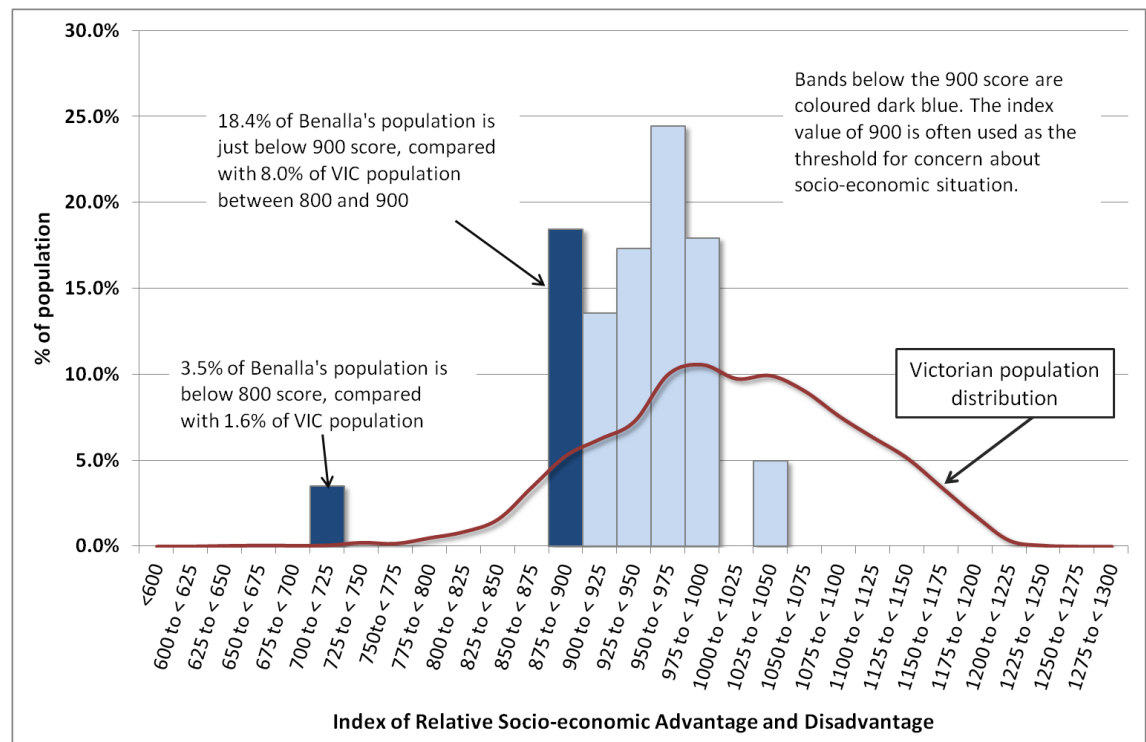
However, care needs to be taken with comparing aggregated index values between different region and LGAs because:

1. the aggregate data for an LGA as a whole is likely to hide significant differences within the LGA; and
2. there are a wide range of variables included in the index construction (see Appendix) - two LGAs might have similar Indexes of Relative Advantage and Disadvantage but for very different reasons.

Considering the first point, it is possible to disaggregate the index data to census collection district (CCD) level in order to identify pockets of advantage or disadvantage within LGAs in the region. This CCD level analysis for the region reveals that pockets of disadvantage exist in all LGAs, but that these pockets are most significant in Benalla and Wangaratta (Figure 14, Figure 15). In Benalla, about 3.5 percent of its population live in localities with an index value of 700 to 725. Similarly, 1.7 percent of Wangaratta's population live in localities with an index value of 750 to 775. This places these groups amongst the 1.5 percent of the Victorian population with the highest social disadvantage.

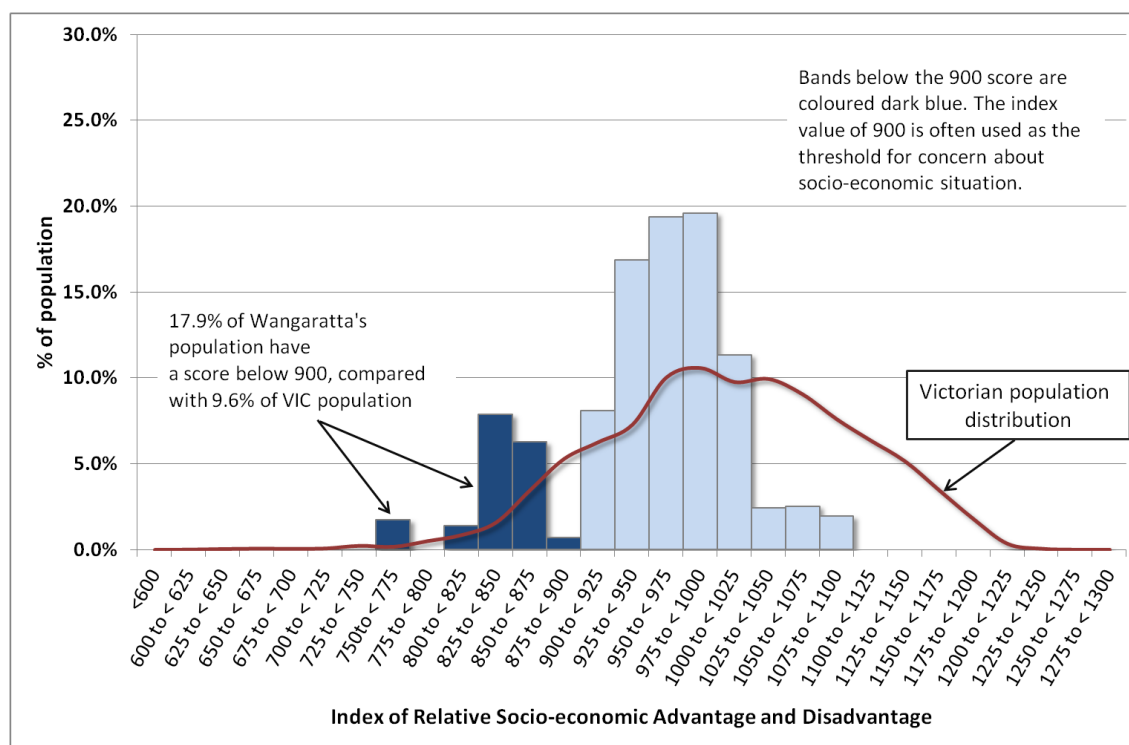
On the second point is it useful to examine a wider range of individual indicators to gain a clearer picture not only of the factors contributing to social advantage and disadvantage within the region but factors which contribute to other aspects of sensitivity and adaptive capacity to climate change and variability. A range of indicators are examined in the following sections.

Figure 14: Benalla Index of Social Advantage and Disadvantage - percentage distribution of residents across CCD values (Australian distribution in red)



Source: ABS SEIFA, 2006

Figure 15: Wangaratta Index of Social Advantage and Disadvantage - percentage distribution of residents across CCD scores (Australian distribution in red)



Source: ABS SEIFA, 2006

3.4.3 Economic capacity of households

The *Index of Economic Resources* was used to examine households' access to economic and financial resources and the associated ability to participate in society. This index includes 15 variables, such as: household income, housing expenditures (e.g. rent, mortgage repayments) and wealth (e.g. home ownership). That is, a high score suggests that households in this area have greater access to economic resources, with a larger number of households owning property and earning high income, and a low number of household earning low income or being unemployed. On average, households with a higher score have more financial and economic resources available.

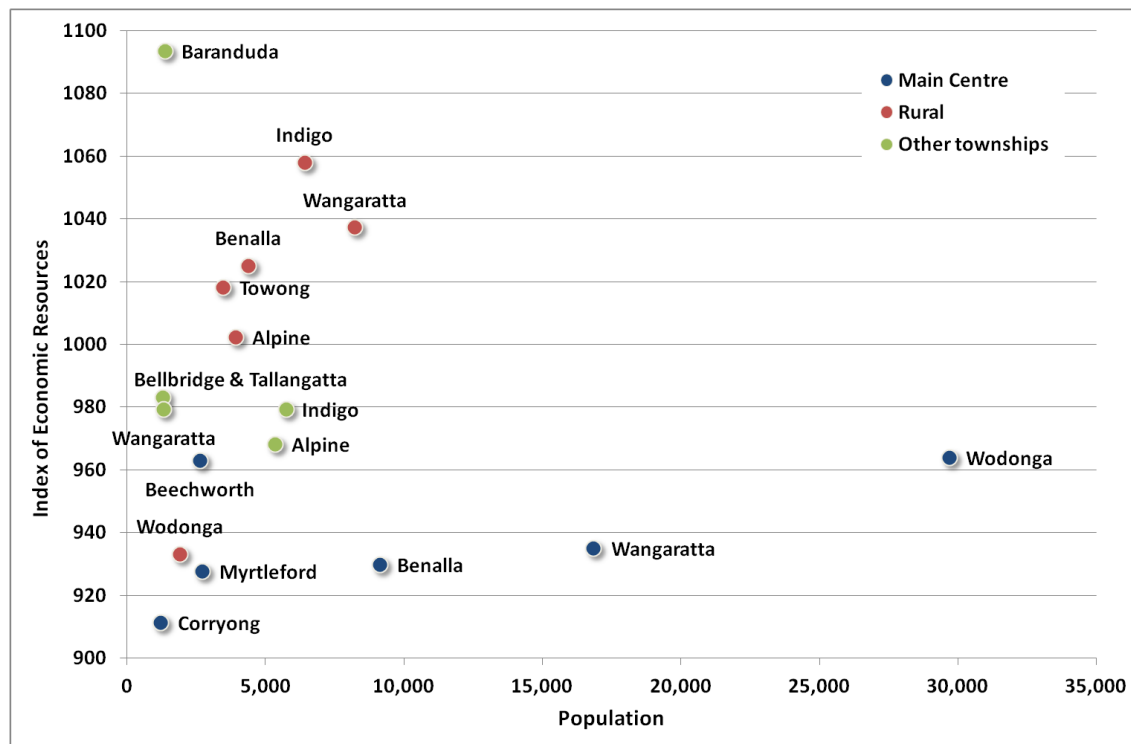
Households with a higher financial capacity tend to be less sensitive to climate variability and extremes as they are able to both prepare for impacts (e.g. improvement of housing quality) and recover from impacts (Brooks et al. 2006; Dwyer et al. 2004). The Australian average is again 1000, with a standard deviation of 100.

The analysis shows that communities in larger urban centres in the North East region (e.g. Benalla, Corryong, Myrtleford, Wangaratta) tend, on average, to have lower economic resources than households in smaller townships and rural households. That is, larger centres have more households with lower income and housing stress, and fewer households with high income or home ownership. For example, the proportions of dwellings rented from the government housing authority and households receiving rent assistance are higher in larger centres of Benalla, Wangaratta and Wodonga.

By contrast, some smaller townships and rural communities have better access to economic resources, with the rural areas of Indigo and Wangaratta and the township of Baranduda (part of

the Rural City of Wodonga) having relatively strong economic capacity. For example, rural areas have a lower unemployment rate and greater proportion of home ownership.

Figure 16: Index of Economic Resources



Source: ABS SEIFA 2006

Note: Other townships in Alpine and Indigo Shire and the Rural City of Wangaratta include:

Alpine: Bright, Mount Beauty, Dinner Plain, Harrietville, Porepunkah, Tawonga and Wandiligong;

Indigo: Barnawartha, Kiewa, Tangambalanga and Yackandandah

Wangaratta: Eldorado, Glenrowan, Milawa, Moyhu and Oxley

It is worth noting that the financial capacity of individuals will differ significantly for males and females. On average, women earn less and have lower superannuation fund balances than men (WHGNE 2011). In addition, 60 percent of low income earners (less than \$400 gross income per week) within the region are women (DoH 2010). In particular, single mothers and elderly women living alone will have limited financial capacity to prepare for and recover from climate change impacts.

3.4.4 Age

Data for the North East Region indicates that in most parts of the region, with the exception of Wodonga and the Alpine Resorts, there are relatively high proportions of elderly people (defined as people over 65 years of age). The proportions of elderly people in Towong, Alpine and Benalla are significantly above the regional Victoria and Melbourne averages (see Figure 17).

Elderly people are particularly sensitive to some of the health risks associated with climate variability and extremes, notably heat related mortality and morbidity (McMichael et al. 2003; Ibrahim & McInnes, 2008; Victorian Department of Human Services 2006). It is notable too

that this group (along with children and people with prior medical conditions) were disproportionately represented in fatalities arising from the Black Saturday bushfires (Handmer et al., 2010). The elderly tend also to have diminished personal mobility and are often on relatively low incomes.

Women generally account for a larger proportion of the elderly due to a longer life expectancy (DoH 2010), with associated health and mobility constraints. Across Victoria, 56 percent of the population aged 65 and over, and 63 percent of the population aged 80 and over are women. The percentage of women amongst the elderly is similar in the study region (ABS Census 2006). In addition, almost 75 percent of the elderly aged 75 and over and living alone are women, who most likely have a lower financial capacity to adapt to climate change impacts (DoH 2010) (see also section 3.4.3).

Young children and infants may also be sensitive to temperature extremes and heatwaves due to less developed thermoregulation. Demographic data for the region indicates that the number of young children (< 5 years) in the region is in line with or slightly below the Victorian average in most areas, although pockets in the major urban centres have higher concentrations of young children.

Figure 17: Proportion of persons aged 65 and over, North East Victoria



Source: ABS Census 2006

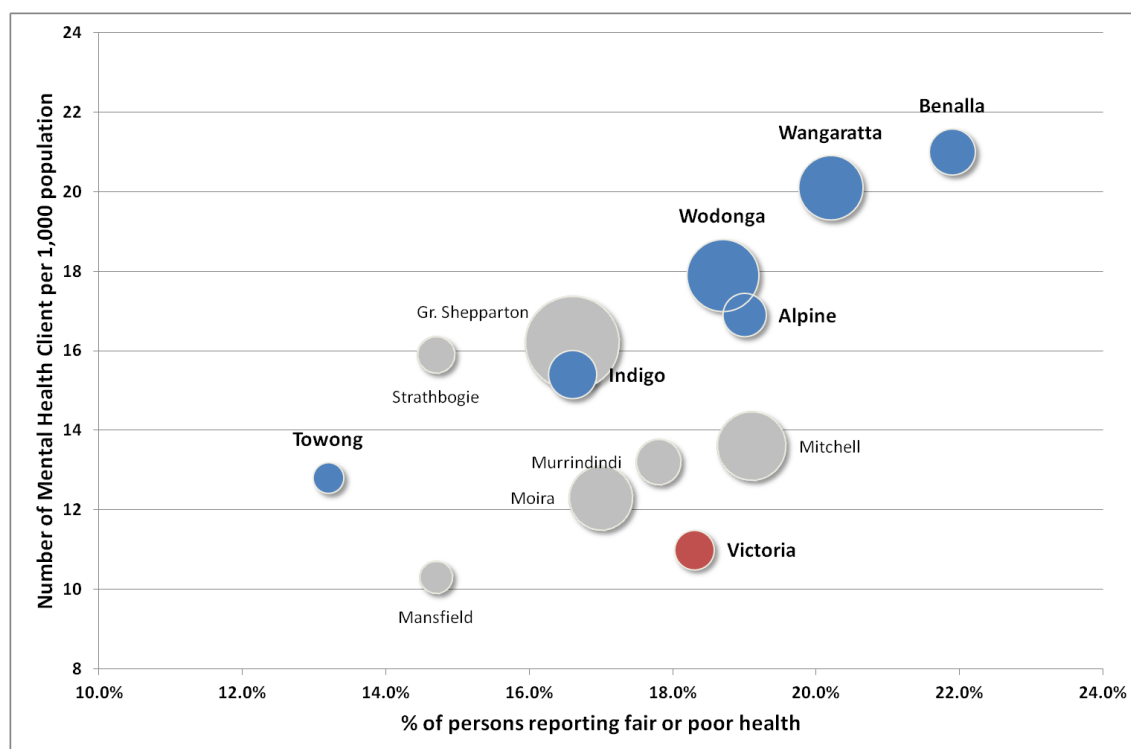
3.4.5 Health and wellbeing

Climate change impacts and extreme events also place additional stress on people with existing health conditions, both physical and mental.

The region has relatively high levels of mental health concern in all LGAs (Figure 18). In Benalla and Wangaratta in particular, the number of registered mental health clients¹³ per 1,000 population is high, almost twice the Victorian average. In addition, the proportion of people reporting only fair or poor health as part of the Victorian Population Health Survey in 2008 is quite high in parts of North East Victoria, especially in the larger population centres, when compared to the Victorian average and with other population centres in adjoining regions.

Interestingly, the two LGAs with the highest proportions of registered mental health clients and persons reporting fair or poor health are also the two LGAs with pockets of high socio-economic disadvantage (see section 3.4.2). However, there is no strong correlation between a high number of persons with an existing health condition and a low Index of Socio-Economic Advantage and Disadvantage.

Figure 18: Percentage of people reporting only fair or poor health and mental health clients



Source: Department of Health, 2010

Note: Bubble size indicates population size, except for Victoria

In addition, it is worth noting the gender dimensions of existing health conditions. A well-documented example is gender differences in mental health. Generally, men suffer from higher rates of “externalising” disorders, such as aggression, while women are more vulnerable to “internalising” disorders, such as depression, anxiety and psychological distress (WHIN 2011).

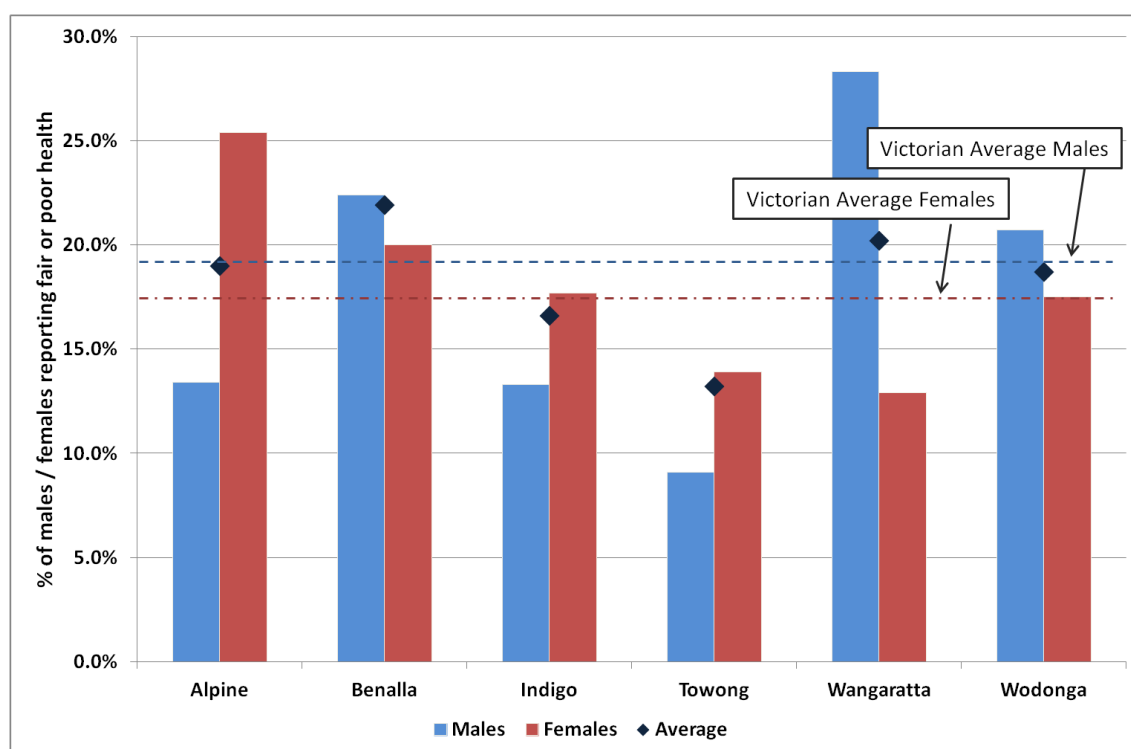
¹³ “When a referral is made to a public mental health service, a clinician will determine the most appropriate service response. If the referral is accepted for further service delivery or intervention, the client is registered on the Victorian public mental health client information management system.” Source: Department of Health, 2010

Across Victoria, the percentages of males and females reporting only fair or poor health are relatively similar. A slightly higher proportion of males (19.2 percent) than females (17.5 percent) reports existing health conditions (Figure 19).

In LGAs with larger centres, i.e. Wodonga, Wangaratta and Benalla, the percentage of males with existing health conditions is greater than the Victorian average for males. The gap between males and females reporting fair or poor health is also larger than for Victoria. In particular, Wangaratta shows a very high percentage of males reporting fair or poor health (28.3 percent).

By contrast, the percentage of women reporting fair or poor health is significantly greater than men's in more rural LGAs, i.e. Alpine, Indigo and Towong. However, the percentages of males and females reporting existing health conditions in these LGAs are lower (or at a similar level) than the Victorian averages, with the exception of Alpine. The percentage of females living in the Alpine Shire and reporting fair or poor health is markedly high at 25.4 percent.

Figure 19: Percentages of males and females reporting only fair or poor health



Source: Department of Health, 2010

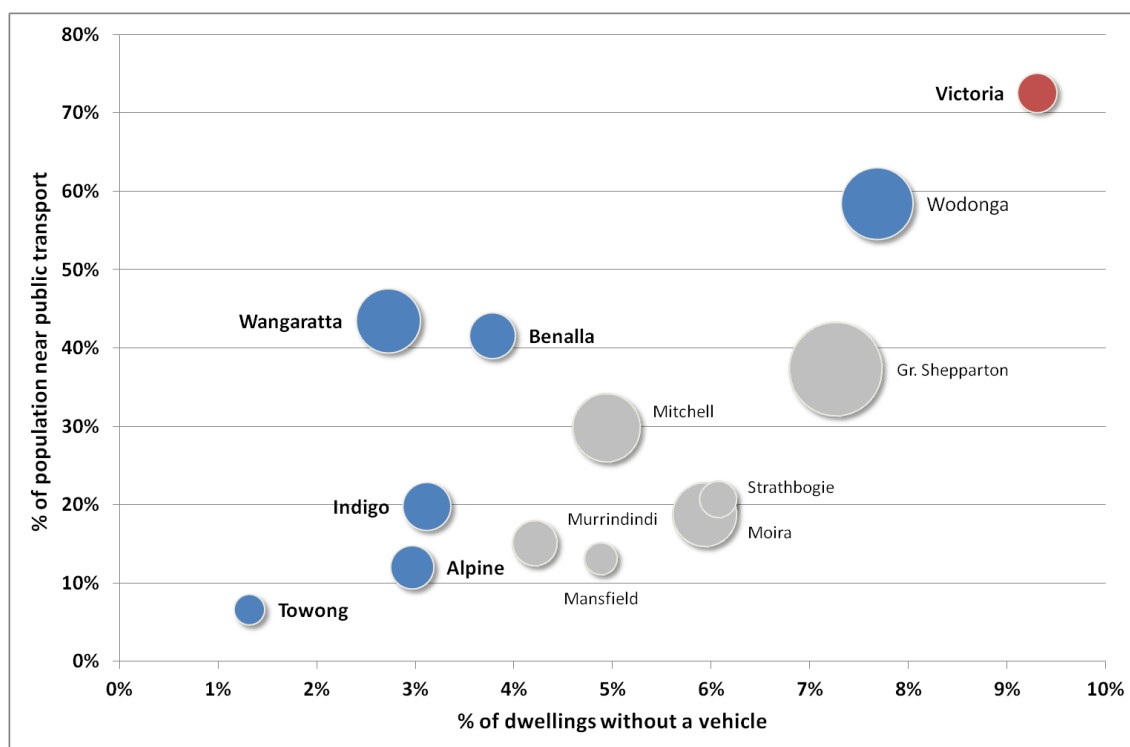
3.4.6 Mobility and transport services

Mobility is also a factor that could affect sensitivity and capacity to adapt to climate variability and extremes. In addition to personal mobility (linked to age and health factors described earlier), mobility of community members can be influenced by their access to public transport or a motor vehicle. An examination of data vehicle ownership data and public transport access data for Australia shows that, unsurprisingly, there is a strong negative correlation between the two – i.e. in areas where there is good access to public transport there tends to be lower car ownership.

On the whole this is true of the North East region, with only a small to moderate proportion of the population of the region being near public transport¹⁴ (with public transport access being greatest in the urban centres) but a correspondingly high to very high motor vehicle ownership rate (with ownership being highest in the smaller, more remote communities (e.g. Towong) (Figure 20). Considering overall transport access therefore, the region seems to be reasonably well placed, certainly when compared with adjoining LGAs, some of which have limited access to public transport **and** a significant proportion of households that do not own a vehicle (e.g. Strathbogie, Mansfield).

On the other hand, limited access to public transport as an alternative to motor vehicles is clearly a significant issue for most parts of the region (with the possible exception of Wodonga), especially in the context of potential increases in the cost of fuel in the future.

Figure 20: Indicators of mobility: dwellings with no motor vehicle and access to public transport



Source: ABS Census 2006, Department of Health 2010

Note: Bubble size indicates population size, except for Victoria

3.4.7 Health and aged care services

Communities with limited access to health and other community services, such as general practitioners, hospital beds¹⁵, aged care places and pharmacies, are likely to have reduced capacity to adapt to climate variability and extremes. Their capacity to prepare for or recover from climate extremes (e.g. heatwaves) is diminished.

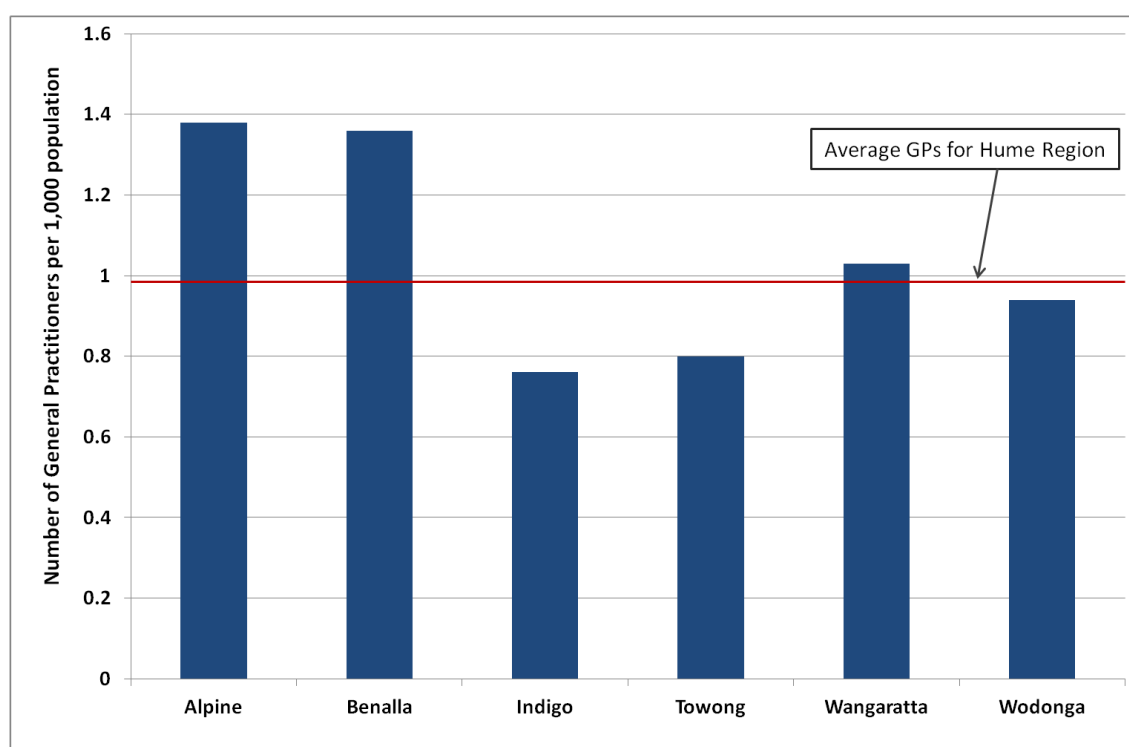
¹⁴ Near public transport is defined as living within 400 metres of a bus and/or tram stop and/or 800 metres of a train station. Source: Department of Health, 2010.

¹⁵ Consistent, region wide data on access to hospitals and hospital beds was not available for this study.

Alpine, Benalla and Wangaratta are reasonably well placed in terms of access to general practitioners, having a higher proportion of general practitioners than the averages for both the Hume region (0.99 GPs/ 1000 population) and Victoria (1.03) (Figure 21). Indigo, Towong and Wodonga are below the Victorian and Hume region averages however, significantly so in the case of Indigo and Towong.

However, this data provides an incomplete picture of access to health services in the region. Wangaratta, for example, has access to both public and private hospitals and specialist services, which are not readily accessible in other parts of the region. On the other hand, regional health care service specialists consulted for this project indicate that the number of GPs in the region providing bulk billing is low, especially in Benalla, and that this limits access for low income groups to medical services.¹⁶

Figure 21: Access to health services (General Practitioners)



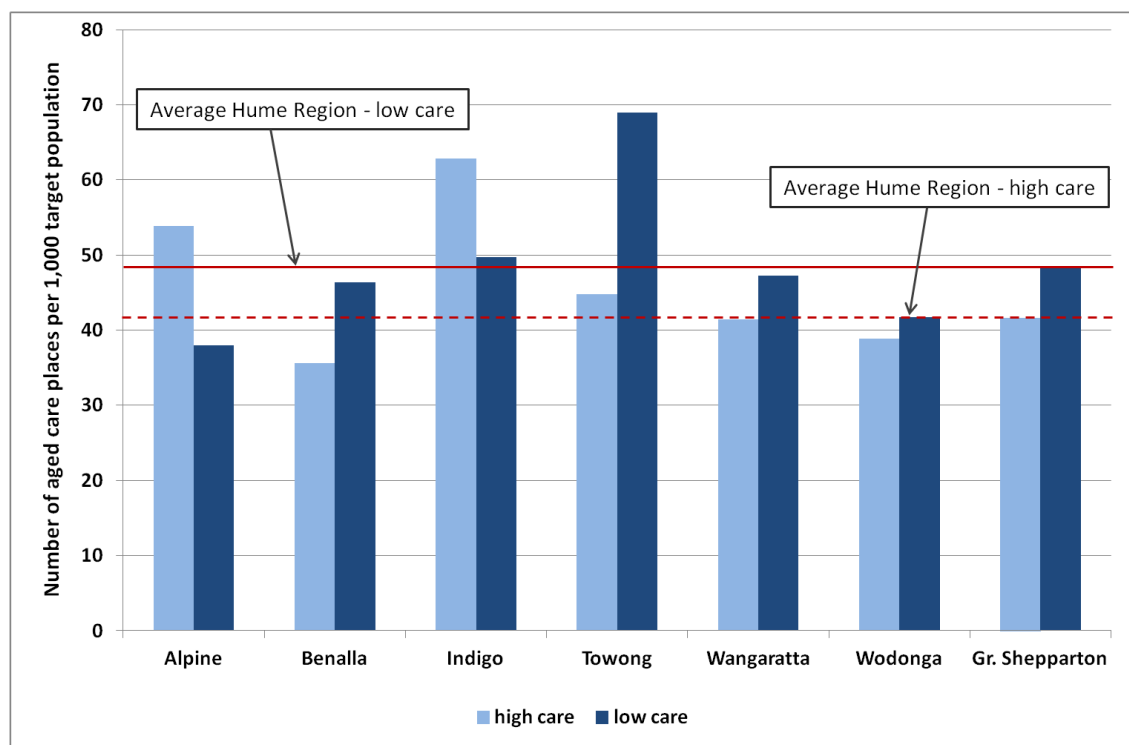
Source: Department of Health, 2010

Available data suggests that most LGAs in the region are moderately well placed with regards to access to aged care services. Larger centres, i.e. Benalla, Wangaratta and Wodonga, are below or close to the Hume region and Victorian averages for high care (41.3 and 41.6 places per 1,000 target population respectively) and low care (46.0 and 48.5 places per 1,000 target population respectively). All other LGAs are above or close to the Hume Region average (Figure 21).

Alpine Shire falls below the Hume region average for low care places, but has significantly more high care places than the average. Both Indigo and Towong Shires are above average for both high and low care places¹⁷.

¹⁶ At the time of writing, detailed data was not available to fully substantiate this case.

¹⁷ Data for Alpine, Indigo and Towong Shires has been questioned by reviewers though, with suggestions that there is high demand elsewhere for aged care places from residents of these Shires.

Figure 22: Access to aged care services

Source: Department of Health, 2010

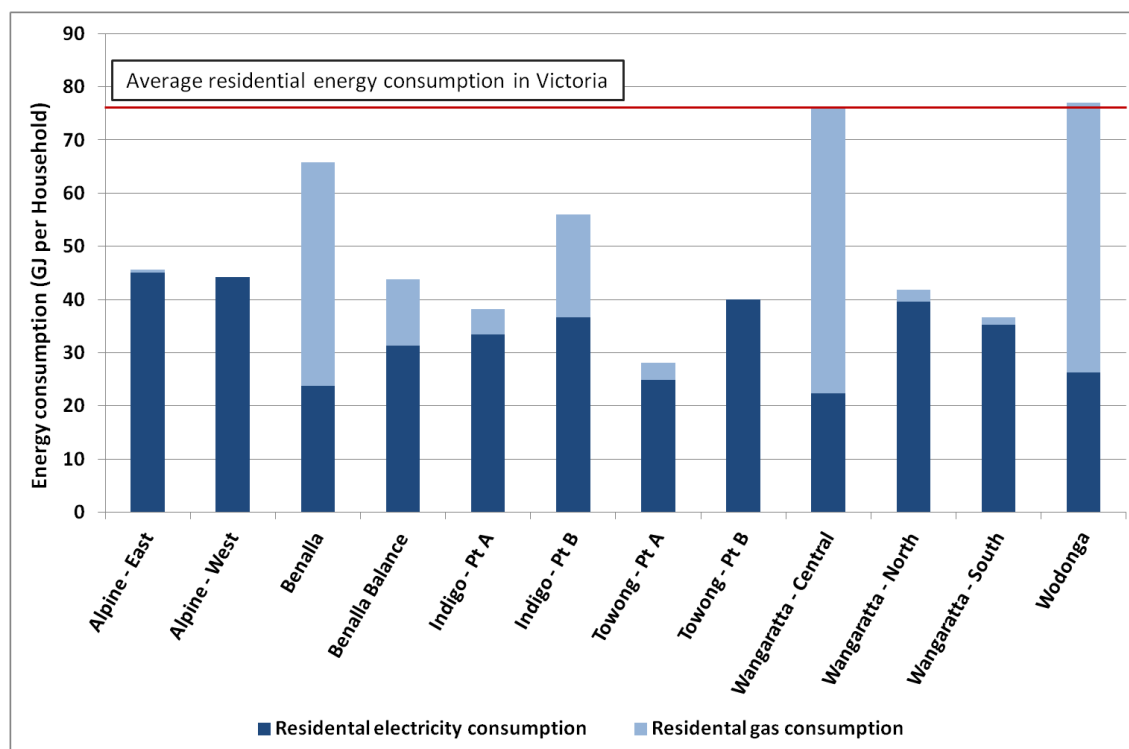
Note: target population is defined as persons aged 70 and over

3.4.8 Household energy and water consumption

Household energy and water consumption are important indicators of the capacity of households to adapt to future climate change and variability. Arguably, households that have low average energy and water consumption are better placed to cope with increased energy and water prices that are projected to ensue over the coming years (in part linked to climate change and climate change response) than households with high energy and water consumption. Low energy and water consuming households may also be better placed to deal with energy and water demand and supply fluctuations that could also become more pronounced in the future¹⁸.

Household energy consumption in the region is close to or below the Victorian average. Alpine Shire, Towong and Benalla have particularly low energy consumption (Figure 23).

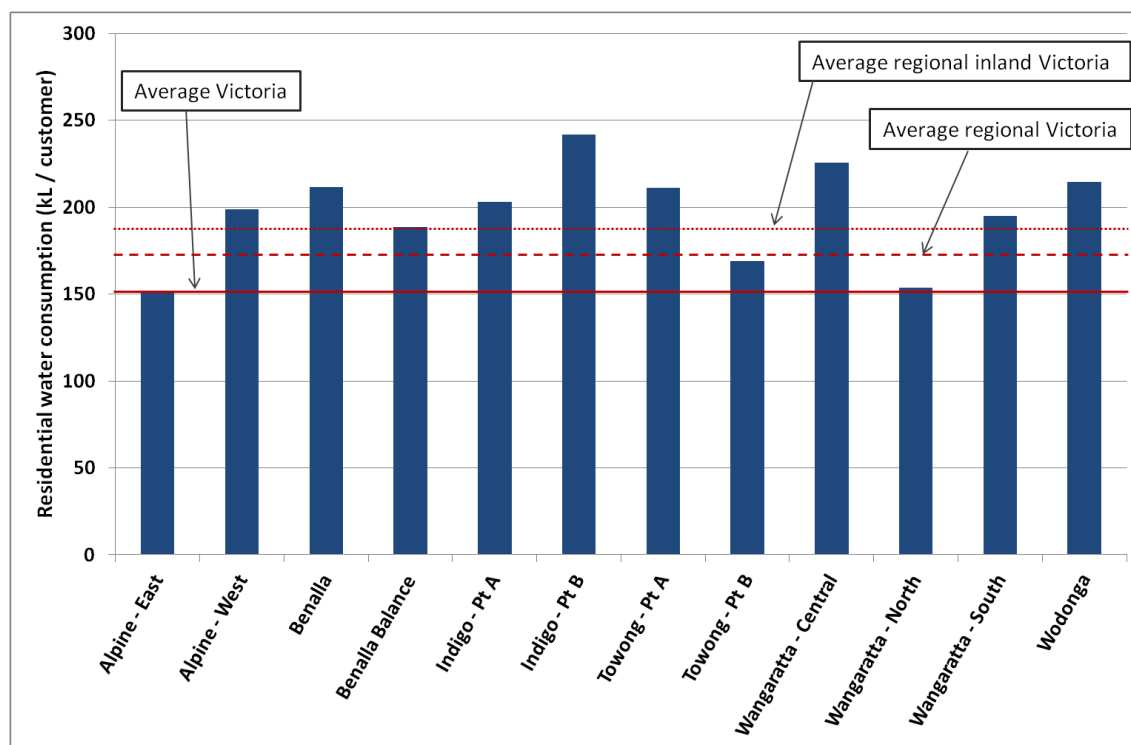
¹⁸ There are a number of potential alternative indicators relating to thermal comfort and sustainability including house design and orientation and adaptation of alternative water and energy technologies. Comprehensive region wide data on these variables was not available to the study however.

Figure 23: Residential Energy consumption, 2006

Source: DSE, 2011

Factors explaining this trend are not clear though. High gas consumption in Wangaratta central, Wodonga and Benalla central can be explained by access to reticulated gas. Much of this gas is likely to be used for heating, especially in winter. By contrast areas not connected to reticulated gas, such as most parts of Alpine and Towong Shires, Wangaratta South and North and significant parts of Indigo Shire, are more likely to use heating sources that are not included in household energy consumption data (e.g. solid fuel heaters and open fire places). On the other hand it is apparent that households in some parts of the region have particularly low energy consumption, even allowing for lack of access to reticulated gas (e.g. Towong, Indigo south and Wangaratta south). Factors examined include average household size and income, but data for the region does not appear to show any significant correlation between these factors and energy consumption. Other potential factors include house design and orientation and adoption or other energy efficiency measures. Regional data is not available for those factors however.

Household water consumption in the region also ranges from low to moderate levels when compared with other regions in Victoria (Figure 24). Water consumption is particularly low in parts of Alpine and Towong Shires and Benalla are especially low. Again, factors explaining this trend are not clear but could include: local climate conditions; the level of nature of water restrictions that were in place at the time of data collection; other water savings initiatives that have been implemented in North East Victoria and other parts of Victoria; and household size. Further research that is beyond the scope of this study is required to determine the importance of these factors.

Figure 24: Residential water consumption, North East Victoria and other regional centres 2009-10

Source: North East Water 2011; NWC 2011

Another vulnerable group is households not connected to reticulated water supply, relying on tank or bore water. These households are particularly at risk of low water availability due to extended dry periods and droughts.

Assuming that each residential connection corresponds to a private dwelling¹⁹, about two-thirds of households in Alpine and Indigo Shires and Wangaratta and almost all households in Wodonga are connected to reticulated water supply, whereas only half of the households in Towong Shire are connected.

3.4.9 Community networks and cohesiveness

The Department of Planning and Community Development, Victoria (Pope & Zhang 2011) identifies four overarching characteristics of ‘strong communities’:

- assets – economic resources, natural resources, human resources;
- local area amenity - “pleasantness”, proximity to shops/facilities, quality infrastructure;
- strong governance – strong leadership and decision-making; and
- networks – community participation, inclusion of all population groups.

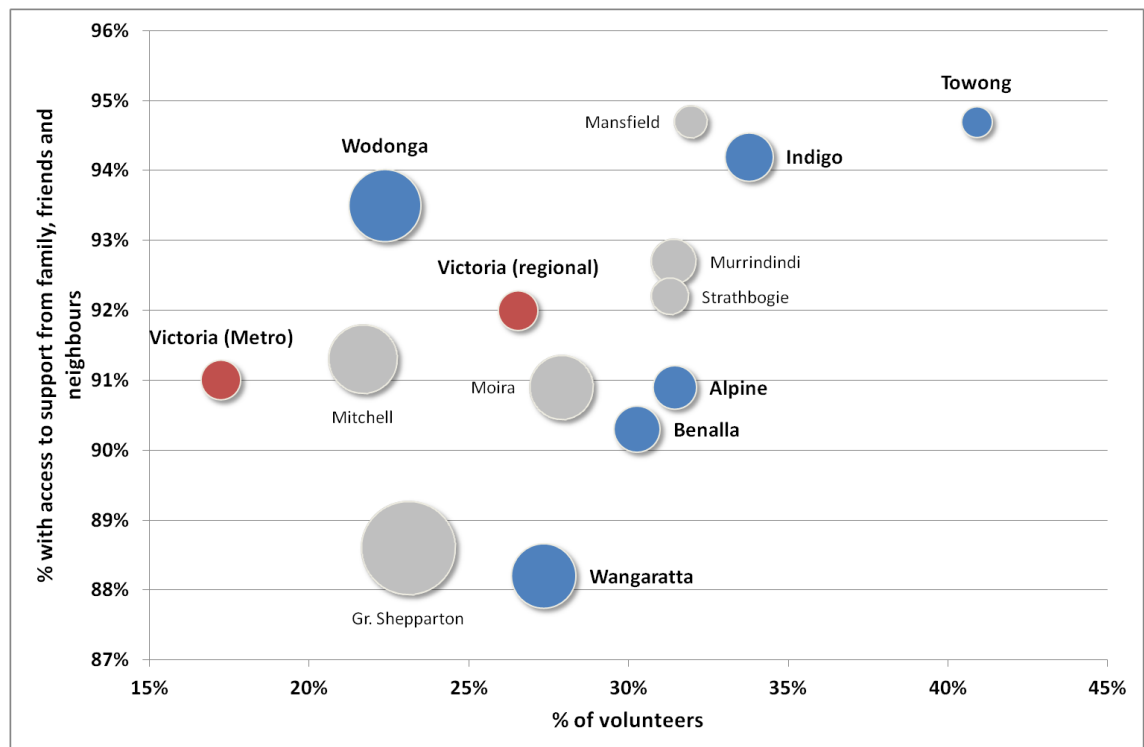
One of these characteristics that has not been addressed through earlier indicators and is particularly relevant to the capacity of communities to adapt to climate variability and change is building strong networks. Two indicators relevant to building strong community networks and cohesiveness are ‘levels of volunteerism’ and ‘access to support from family, friends and neighbours’. Data for the region shows that generally speaking the region performs strongly

¹⁹ Including occupied and unoccupied private dwellings

against both indicators, especially on levels of volunteerism. The smaller shires, Towong and Indigo, rate particularly well against both indicators. Communities in Wangaratta however, have relatively low levels of access to support.

The rate of volunteers in Victoria has increased over the last 15 years (ABS 2007 and 2011), which would suggest that the study region also experienced an upward trend. However, data on an LGA level was not available, except for 2006.

Figure 25: Levels of volunteerism and access to support, 2008



Source: DPCD, 2010, ABS Census 2006

3.5 Vulnerability assessment, some general conclusions

At first glance, the economy and community of North East Victoria appear quite well placed to deal with the potential impacts of climate change and variability. The region's economy is diverse and structurally sound. On the whole, communities in the region have moderate to high levels of income, education and other factors that contribute to social capacity. There are also strong community networks and levels of cohesiveness within the region.

Nevertheless, it is also clear that there are specific industries, groups and localities within the region that are vulnerable to climate variability and change (Table 8). Further, climate variability and change will interact and build on established economic, social, demographic and policy pressures to increase the challenges that those industries and groups already face.

Considering these combined pressures, building resilience of the economy and community of North East Victoria to climate change and variability will be best focussed on the following areas:

- The agricultural sector across the region, but especially in Towong.
- The tourism sector, especially in Alpine Shire.
- Food processing & beverages, pulp & paper, wood products and textile manufacturing industries, especially in Wangaratta and Indigo Shire.
- Communities vulnerable to climate extremes (heatwaves, bushfires, floods and storms), with a particular emphasis on:
 - the elderly;
 - people with pre-existing health concerns;
 - households on low incomes; and
 - isolated communities (either geographically or lacking access to support networks).

All LGAs in the region have pockets where there are significant proportions of people in one or more of these categories. Benalla has significant proportions of people in most of these categories. Wangaratta, Alpine and Towong have significant proportions of people in a number of these categories.

Table 8: Qualitative assessment of relative vulnerability*‡ of economies and communities in North East Victoria to climate variability and change, considering a range indicators

Factors contributing to vulnerability	Alpine	Benalla	Indigo	Towong	Wangaratta	Wodonga
Economic						
Agriculture dependence	*‡	*‡	*‡	*‡	*‡	
Tourism dependence	*‡		*		*	
Manufacturing (selected) dependence	‡	‡	*‡		*‡	‡
Industrial water consumption	* (West)				*‡ (Central)	*‡
Workforce age	*‡	*‡	*‡	*‡	‡	
Social						
Socioeconomic disadvantage	‡	*‡	‡	‡	*‡	‡
Proportion of population >65	*‡	*‡		*‡	‡	
Pre-existing health concerns	* (women)	*‡ (women & men)			*‡ (men)	‡ (men)
Mental health concerns	‡	*‡	‡	‡	*‡	‡
Limited access to health services	*	*	*‡	*‡	*	*‡
Limited access to aged care	‡ (low care)	*‡			‡	*‡
Limited access to public transport	*‡	*	*‡	*‡	*	*
Limited access to support networks	*‡	*‡			*‡	

* indicates above (below - access to support and to services, workforce age) average for North East region;

‡ indicates above (below) averages for regional Victoria and/ or Victoria

4. Survey and focus group discussions

A survey of community members and a series of focus groups discussions with industry representatives were undertaken for this project in November and December 2011. The purpose of the surveys and discussions were to gauge community and industry understanding of climate change, their views on how important they believe climate change and variability is for them and the region and whether, as householders and industries, they are actively preparing for climate-related events such as droughts, floods and bushfires.

The methodology and results of the community surveys and industry focus groups discussions are detailed in separate documents attached to this report. Following is an overview of the key findings of the two exercises which, along with the vulnerability assessment, provide context for the resilience plan.

4.1 Community survey

4.1.1 Survey overview

An online survey was conducted across communities in North East Victoria, with an on-line, research only panel providing the main share of respondents²⁰. Panel membership was quite representative, with panel members being drawn from towns, semi-rural areas and farms in similar proportions to their geographic and age distributions in the general community²¹. To boost survey numbers, the survey was also open to the general public in those communities. The survey was conducted between 27 October and 20 December, with the total sample being 134 respondents.

4.1.2 Summary of results²²

The survey questions fall into three main categories:

4. climate change beliefs and level of concern;
5. climate change adaptation and mitigation actions by individuals/ households; and
6. the role of local government, other levels of government and industry in assisting with/ implementing actions.

²⁰ The use of an online panel in preference to a telephone poll was for two main reasons. First, the large number and detail of some questions would have made telephone polling problematic. Second, telephone polling was prohibitively expensive.

The panel was drawn from MyOpinions, which is a nationwide panel used solely for market research, defined as a 'pure market research online access panel'. This means that panellists are not combined for different types of usage and, in turn, the occurrence of any negative survey effect is prevented. No direct marketing is allowed or conducted. MyOpinions is accredited to ISO 20252 and ISO 26362. Furthermore, regular internal reviews of its processes are conducted in order to ensure that MyOpinions continues to comply with the industry standards and policies set by Association of Market and Social Research Organisations (AMSRO) and the essential organisation for encouraging, advancing and elevating market research worldwide (ESOMAR).

²¹ There was an over representation of females to males in the sample however (60/40), and income levels in the sample group were higher than for the general population.

²² See attached report, *Topline Report to NEGHA: Household Survey*, GPS Research, December 2011.

A summary of the results is provided below under these three categories. The small sample size means that the results need to be treated with care, although as noted in the discussion of the first category of questions, survey results closely correspond to responses provided to similar questions in an Australia wide survey conducted for the CSIRO (Leviston & Walker 2011), providing a level of confidence in the reliability of the results.

Climate change beliefs

Respondents to the NEGHA survey indicated a moderate level of concern about climate change. In response to Question 13 - *From what you know or have heard in the media about climate variability and change, how concerned are you?* – 39 percent of respondents indicated that they are either fairly concerned (21 percent) or very concerned (18 percent) about the issue, with 34 percent indicating that they are either not concerned about the issue or only a little concerned and 23 percent being ‘neutral’. This result is comparable to responses to a similar question posed in a national survey of Australian attitudes to climate change, undertaken in late 2010 by CSIRO (Leviston & Walker 2011). Responses to other questions in the NEGHA survey indicate concern about climate change stems more from impacts on the family’s financial situation than on health and wellbeing.

Of various climate-related events experienced recently, drought has caused the greatest level of concern and impact, with 19 percent of respondents indicating that drought had had a major or very significant impact on their household in the past five years, greater than for bushfires (14 percent), heatwaves (12 percent), storms (10 percent) and floods (8 percent).

Responding to Question 17 – *Do you believe climate change is natural and caused by human actions?* – there was a fairly even split between those who believe that change is mainly or entirely caused by human actions (32%), those who believe that it is mainly or entirely caused by natural processes (27%) and those who believe that it is partly natural and partly human actions (34%). Again, this result is comparable to responses to a similar question posed in the national CSIRO survey (Leviston & Walker 2011).

Climate change adaptation and mitigation actions

Questions on climate change adaptation and mitigation actions fall into two sub-categories:

- questions on personal/household actions taken that could improve their ability to respond and adapt to climate variability and change; and
- questions on personal/household actions taken to mitigate their greenhouse gas emissions²³.

Adaptation actions

In response to Question 29 – *Have you done or are you already doing any of the following options?* - respondents indicated high take-up of low cost water efficiency measures such as improved garden watering practices (81 percent, yes) and water efficient shower heads (69 percent, yes). This suggests that there was strong community response to water restrictions and incentives implemented by governments and water authorities in the 2000s. Respondents also indicated that there has been relatively high take-up of low cost actions aimed at improving

²³ In the context of this project, which is focussed on climate change adaptation and resilience planning, climate change mitigation actions are less relevant than adaptation actions and the underlying factors driving those actions. Nevertheless, responses to questions relating to actions taken to mitigate greenhouse gas emissions provide a useful point of comparison to responses relating to climate change adaptation.

thermal comfort and reducing energy consumption in the home, such as draught proofing (51 percent, yes), although less so than the water efficiency actions. Survey responses however, indicate that there has been quite low take-up of the more expensive water and energy options, such as rainwater tanks (34 percent, yes) and improved window efficiency (21 percent, yes). Cost was clearly identified as the major barrier to the take-up of these options (Question 31).

Importantly, a majority of respondents had **not** implemented measures designed to improve their preparation and response to climate extremes and hazards, such as bushfire plans (46 percent, yes) and Home Emergency Plans and Kits (~ 30 percent, yes) and other precautions to deal with storms, floods and bushfires (44 percent, yes). Low adoption of these actions came despite the fact that only a small percentage of respondents (~ 7 percent) agreed that implementing the actions would be difficult (Question 30). In the case of bushfire survival plans, the major reasons given for not implementing a plan were 'not in a bushfire area' (26 percent) or 'not needed' (23 percent), although 'lack of information' (15 percent), 'lack of time' (10 percent), 'haven't got around to it' (6 percent) or 'no particular reason' (15 percent) were also reasons given. Similarly, the major reasons given for not implementing a Home Emergency Plan were 'not needed' (20 percent), 'lack of information' (11 percent), 'lack of time' (11 percent), 'haven't got around to it' (17 percent) or 'no particular reason' (17 percent).

Another key finding from survey Question 29 – *Have you done or are you already doing any of the following options?* - is that only 35 percent of respondents had ensured that their home a contents insurance covers climate related events. 'Cost' of the insurance (36 percent) was the major reason given for this situation, although other significant factors given include 'not needed' (19 percent), 'I'll take the risk' (8 percent), 'insurance company will not insure' (7 percent) and 'don't trust supplier/ insurance company' (7 percent).

Mitigation actions

In response to Question 26 – *Have you done or are you already doing any of the following (mitigation) options?* - respondents claim to have implemented many of the low cost options that are available to them: 'use lights less efficiently' (93 percent, yes); 'switched to efficient lighting' (87 percent, yes); and 'use your car less' (57 percent, yes). Other options have much lower take-up rates however: 'buy a fuel-efficient car' (37 percent, yes); 'car pool and car share' (17 percent, yes); 'use public transport' (16 percent, yes); 'installed solar hot water' (16 percent, yes); 'installed solar power' (16 percent, yes); 'get a home energy audit' (11 percent, yes) and 'purchased carbon offsets' (9 percent, yes). Efficient lighting options had been taken up because they were easy and cheap to implement (Question 27). Other options had not been taken up wither because they were costly (solar hot water, gas hot water, solar power, greenpower), were not practical (public transport, car pooling, cycling) or because not enough was known about them (home energy audit, carbon offsets).

For the most part, respondents indicated that they would not be willing to pay any extra money (49 percent) or only relatively small amounts of extra money (\$10-20 per month – 26 percent) to fund initiatives (mitigation or adaptation) to help address climate change.

Role of government and industry

A significant majority of respondents agree that all levels of government (Federal, State, Local) have important roles to play in responding to climate change (Questions 32 and 33). Those roles include 'providing individuals with assistance to change behaviour', 'providing individuals with information on changing behaviour' and 'doing things that makes the

community more resilient to future climate variability and change'. Respondents agree that local authorities have responsibility for taking action on climate change (29 percent strongly agree, 46 percent agree), albeit slightly less responsibility than other levels of government (e.g. federal government 40 percent strongly agree, 39 percent agree) and industry (44 percent strongly agree, 36 percent agree) (Question 35).

4.1.3 Implications for resilience planning

Bearing in mind the relatively small sample size, responses to the survey indicate that there is a lack of consensus within North East Victorian communities as to the level of threat posed by climate change and variability to them and their families. The diversity of views on this closely match the range of views on whether climate change is human caused or is natural.

It could be argued that this uncertainty is not especially important in the context of resilience planning – it is important for individuals and communities to be prepared for change regardless of the causes. On the other hand, the survey results indicated that there is substantial scope, even a need to improve the community's ability to plan for, respond to and recover from climate extremes, i.e. improve their resilience to these extremes. Perception about the causes of climate change and variability could influence it preparedness to engage in additional programs aimed at enhancing resilience.

4.2 Industry focus group discussions

4.2.1 Discussions overview

Two focus groups of business owners and people making decisions about businesses were selected from North-Eastern Victoria. The groups were located in the City of Wodonga and the City of Wangaratta and were held on Tuesday 6 and Wednesday 7 December 2012.

Approximately 25 people participated from the following industries²⁴:

- alpine tourism;
- other tourism (including wine tourism and eco-tourism);
- construction/building;
- horticulture & viticulture; and
- grazing/ cropping.

The discussions focused on the following main areas:

- understanding of climate change and variability and potential impact on industries;
- industries' planning and preparation for climate change and variability; and
- the role of government.

²⁴ Manufacturing industries representatives were invited and registered for the workshops but were unable to attend.

4.2.2 Summary of discussions²⁵

Understanding of climate change and variability

Participants were aware of climate change and variability and the majority felt that it would have some impact on their business. Not all the participants said that they believed climate change to be true however.

Participants seem to understand the specific issues that they had to deal with relating to weather extremes and bushfires and were aware that climate extremes would have an impact on their business. However, they were unsure as to the certainty of these weather extremes reoccurring in the future.

Planning and preparation

Many of the businesses were trying to tackle the consequences of these extremes but in a relatively ad hoc manner - not based on any long term strategy. One of the key difficulties that businesses felt they faced, especially those in the tourism and agriculture sectors, is trying to predict the future with any certainty, given climate variability. Thus they were not sure if or how they could plan for heatwaves, floods, droughts or bushfires. A few of the smaller businesses, especially in the tourism sector, indicated that they had changed their operations to cater for extreme weather events. In one case this meant taking riding trails in different areas. In another case, the tour guide had alternative places to take his customers fishing if some rivers were flooded.

Cost appeared to be the primary reason preventing businesses, especially the smaller businesses, from doing more.

It seemed that the larger businesses were adopting a more strategic approach to the issue by broadening their products or services so that they were less reliant on a single income source. These larger businesses were concentrated in the agric-tourism sector.

Role of government

The participants all felt that they had access to significant amounts of information about climate change and variability and were not looking for more. The internet was mentioned as an excellent source of information that allowed for as little or as much as they needed.

In relation to supporting the businesses, a number of small and medium enterprises indicated that offering climate change and variability support sessions, even for half a day, may assist them to put risk management strategies in place.

4.2.3 Implications for resilience planning

Within the business community (those who participated in the focus group discussions) there appears to be a fairly strong level of understanding about the climate change issue and the implications of climate change and variability (whether human induced or natural) for their businesses. To a significant extent this understanding reflects personal experience in dealing with climate extremes in the past.

²⁵ This is an edited version of the discussion contained in the attached report, *Qualitative Research: Industry Attitudes to Climate Change/Variability*, GPS Research, December 2011.

Thus businesses have moved beyond the need for general information about climate change and variability to more specific and practical support to help them plan for, respond to and recover from climate extremes. Smaller businesses in the agricultural and tourism sectors in particular²⁶ are seeking support of this nature. Strategic, financial and business continuity planning would be welcome first steps. Representatives of the construction industry indicated a lower level of concern about the impacts of climate change and variability.

²⁶ Information from a workshop held with representatives of the manufacturing sector indicates that some businesses in that sector would also benefit from this support.

5. Resilience planning

5.1 Building resilience and adaptive capacity

As discussed in Box 1, resilience as a concept is closely related to both vulnerability and adaptive capacity. The essence of resilience in a community is its ability to utilise community resources to transform and respond to change in an adaptive way. In environmental and social sciences literature resilience has been defined in three different ways - as recovery, as stability and as transformation.

Brooks (2003) suggests that the essence of resilience (in a community or a system) is its ability to utilise community resources to transform and respond to change in an adaptive way. A resilient community is able to employ its resources and its adaptive capacities in a proactive and pre-emptive way, whereas a less resilient community may only be able to take action after the change has had an impact (or not at all). A resilient community has the flexibility and creativity to develop and embrace new and alternative ways of doing things. This is the notion of resilience as transformation and is particularly relevant to climate change impacts that may involve a permanent or semi-permanent change in state – for example a permanent a reduction in water availability.

For the purposes of this project, which involves building the resilience of communities to a range of potential climate change impacts to social and economic systems, the ‘recovery’ and ‘stability’ definitions are also relevant. Thus a resilient community is also able to employ its resources and its adaptive capacities to improve its ability to recover after extreme climate events such as floods or bushfires.

Recent studies suggest that the best way to build resilience of rural communities to climate change is to strengthen the stocks of assets, tangible and intangible, that are available to a community in times of change – the ‘five capitals’ approach (Figure 26 - Nelson et al. 2007).

Figure 26: The five capitals

Human Capital	The skills, health and education of individuals that contribute to the productivity of labour and economic value
Social Capital	Reciprocal claims on others by virtue of social relationships, the social bonds that facilitate cooperative action and the social bridging
Natural Capital	The productivity of natural resources, such as water and land, and actions to sustain their productivity into the future
Physical Capital	Capital items produced by economic activity from other types of capital that can include infrastructure and equipment
Financial Capital	The level, variability and diversity of income sources, and access to other financial resources (credit and savings) that contribute to wealth

Households and communities with greater diversity and stocks of the five capitals are likely to be more resilient and have greater adaptive capacity to deal with climate change, variability and related events such as droughts, floods and bushfires. These communities have more resources to draw on, and greater flexibility to substitute between different livelihood strategies in times of stress. In seeking to build resilience through strengthening these capitals, balance is important, as a range of capitals are often necessary to effectively make use of others.

5.2 Current initiatives

The following two sections outline programs and activities already in place in North East Victoria, which seek to or have the effect of building and strengthening economic and community resilience. The focus is on programs that have a local government role, although some programs being coordinated by state government departments, agencies and non-government organisations are also identified and discussed.

5.2.1 Industry and economic resilience building in North East Victoria

Economic development is an important focus of all councils in North East Victoria. The majority of councils have economic development strategies in place. These aim to strengthen the local economy by supporting local businesses, identifying business opportunities and attracting new businesses. Additionally, some councils have developed tourism strategies aimed at strengthening and diversifying the industry at the LGA level.

Skill and workforce development programs are largely administered by state or federal government agencies, in particular the Victorian Department of Business and Innovation (DBI) and the Department of Education, Employment and Workplace Relations (DEEWR). In addition, Industry Skill Councils provide industry skill development programs, such as *Sustainability Skills* for the manufacturing industry.

While climate change and climate variability do not play a major role in economic development strategies and skill development programs, these initiatives foster the resilience of local economies and industries, thereby improving the ability of industries and businesses to deal with climate change and climate variability impacts.

Numerous other programs and activities, implemented at the local, regional or national levels, assist industries and individual businesses during times of change or hardship (such as climate extremes) and strengthen their capacity to adapt to those hardships. Examples include:

- rural financial counselling services that improve financial self reliance and business planning;
- water and energy efficiency and/or greenhouse gas emissions reduction programs;
- information and education on business continuity planning; and
- informal networks and groups, facilitating knowledge transfer.

Most of these programs consider climate change and variability to some extent, in particular programs for the agricultural and (nature) tourism sectors, sectors that are most directly impacted by climate change and extreme events (droughts, bushfires, floods, etc.).

Table 9: Overview of relevant economic and industry resilience building initiatives currently in place in North East Victoria

Program/ initiative	Objectives / comments	Responsible organisation(s)	Climate change and variability considered?
Economic resilience			
Municipal economic development strategies	<ul style="list-style-type: none"> Assist businesses to consider their business risks and identify opportunities. 	<ul style="list-style-type: none"> City of Wodonga Rural City of Wangaratta Benalla Rural City Alpine Shire (in development) 	No
Tourism strategies: <ul style="list-style-type: none"> Alpine Region Strategic Tourism Plan Towong Tourism Strategy 2010-2013 Wangaratta Tourism Industry Strategic Plan 	<ul style="list-style-type: none"> Identify and facilitate development of tourism opportunities. 	<ul style="list-style-type: none"> Alpine Shire Towong Shire Rural City of Wangaratta 	Yes, in part
Tourism Boards	<ul style="list-style-type: none"> Regional tourism committee responsible for development and marketing of regional tourism in Victoria's High Country (including Alpine Shire, Indigo Shire and Rural City of Wangaratta). 	<ul style="list-style-type: none"> North East Victoria Tourism Board (covering Alpine Shire, Benalla Rural City, Indigo Shire, Towong Shire, Rural City of Wangaratta, and Alpine Resorts Mount Buller, Mount Hotham, Falls Creek) Murray Regional Tourism Board (covering City of Wodonga) 	No
Business and industry initiatives (ad hoc)	<ul style="list-style-type: none"> Diversification of inputs (e.g. alternative woods / softwood). Sourcing inputs from different areas / region (e.g. vineyards, orchards in other regions). 	<ul style="list-style-type: none"> Local businesses 	Yes, in part

Program/ initiative	Objectives / comments	Responsible organisation(s)	Climate change and variability considered?
Training and workforce development			
North East Industry Workforce Development Strategy (Stage 2)	<ul style="list-style-type: none"> Implementation of priority actions identified in Stage 1. Focus is on construction, manufacturing and aged care industries in Wangaratta and Wodonga. 	<ul style="list-style-type: none"> Rural City of Wangaratta City of Wodonga 	No
Hume Workforce Development Network	<ul style="list-style-type: none"> Aims to address workforce needs across the region, building upon the success of the North East Industry Workforce Development Strategy (see above). Will provide advice and assist with the delivery of key workforce development projects Completion of workforce templates in each local government area. 	<ul style="list-style-type: none"> Department of Planning and Community Development North East Local Government Network Funded by RDV and Workforce Victoria 	No
Employment and training programs including: <ul style="list-style-type: none"> Green Corps Sustainability Skills (Manufacturing) General employment and training assistance 	<ul style="list-style-type: none"> Work experience activities. Training, skill development and enhancement. Career advice. 	<ul style="list-style-type: none"> Jobs Services Australia (Department of Education, Employment and Workplace Relations) Industry Skill Councils (e.g. Manufacturing Skills Australia) Not for profit (e.g. GVGT Australia) 	Yes, in part
National VET Sector Sustainability Policy and Action Plan	<ul style="list-style-type: none"> Provides a national framework for the vocational education and training sector to support the development of sustainability skills. 	<ul style="list-style-type: none"> Department of Education, Employment and Workplace Relations 	Yes, in part
National Workforce Development Fund	<ul style="list-style-type: none"> Supports training and workforce development in areas of current and future skills needs. Provides funding to support the training of established and new workers. 	<ul style="list-style-type: none"> Department of Education, Employment and Workplace Relations 	No

Program/ initiative	Objectives / comments	Responsible organisation(s)	Climate change and variability considered?
Skills for Growth	<ul style="list-style-type: none"> Small and medium-sized businesses are supported in: <ul style="list-style-type: none"> - identifying business objectives and priorities; - assessing the skill needs; - establishing a customised workforce training and development plan; and - placing staff into accredited training. 	<ul style="list-style-type: none"> Business Victoria (Department of Business and Innovation) 	No
Experience Plus	<ul style="list-style-type: none"> Targets job seekers and workers aged 45 and over, as well as their employers. 	<ul style="list-style-type: none"> Department of Education, Employment and Workplace Relations 	No
Business capacity building			
Rural Financial Counselling Service (RFCS)	<ul style="list-style-type: none"> Free and impartial support and referral information to help clients to manage the challenges of industry change and adjustment, and improve financial self reliance and business planning. Advice on succession planning for farmers. 	<ul style="list-style-type: none"> Goulburn, Murray, Hume Agcare (GMH Agcare) 	Yes, in part
Farm Management Deposits Scheme	<ul style="list-style-type: none"> A risk management tool that encourages farmers to set aside pre tax income in good years for use in low-income years for better management of fluctuations in income due to climate variability and market changes. Provides tax benefits, with tax not payable on the income until the financial year it is withdrawn. 	<ul style="list-style-type: none"> DAFF ATO 	Yes, in part
Share Farming Arrangements (ad hoc)	<ul style="list-style-type: none"> Land owner and share farmer provide different, but complementary, resources and utilise synergies. Sharing of labour input, risks, responsibilities, skills and control. 	<ul style="list-style-type: none"> Landowners and farmers Information and advice provided by VFF (in particular Dairy Group) and Dairy Australia 	No
RegenAG	<ul style="list-style-type: none"> Committed to regenerating Australian farms, soils, communities and on-farm livelihoods. Provides access to skills and information on innovative and effective regenerative agricultural activities covering a wide range of fields. 	<ul style="list-style-type: none"> RegenAG 	Yes, in part

Program/ initiative	Objectives / comments	Responsible organisation(s)	Climate change and variability considered?
Water and Energy Efficiency Programs / Carbon Reduction Programs (e.g. Grow Me The Money)	<ul style="list-style-type: none"> Information, education and advice for (small and medium sized) businesses on water and energy efficiency, and the reduction of their carbon footprint. 	<ul style="list-style-type: none"> VECCI; EPA Victoria Municipal Association of Victoria (MAV), Sustainability Victoria, and Carbon Compass 	Yes, in part
Continuity / contingency planning for businesses	<ul style="list-style-type: none"> Workshops to help local businesses prevent, prepare, respond and recover from a disaster or other event significantly impacting on their business. 	<ul style="list-style-type: none"> Indigo Shire 	Yes, in part
<ul style="list-style-type: none"> Open for Business (Guide to crisis management for tourism business); Crisis Essentials Guide; and Crisis Communications Handbook 	<ul style="list-style-type: none"> Provides information and advice for tourism businesses on how to prepare for, respond to and recover from a crisis event. The communication handbook also provides advice on restoring visitor confidence. 	<ul style="list-style-type: none"> Tourism Victoria 	Yes, in part
Earth Check Sustainable Communities	<ul style="list-style-type: none"> Advice on environmental sustainability, destination management and marketing, economic development, regional planning and strategic planning for tourism. 	<ul style="list-style-type: none"> Earth Check (environmental management and tourism consultancy firm) 	Yes
Industry associations, networks and groups (various)	<ul style="list-style-type: none"> Networking. Information and knowledge sharing. 	<ul style="list-style-type: none"> Victorian Farmers Federation Tourism Alliance Victoria Rural Business Women Landcare North East 	Yes, in part

5.2.2 Community resilience building in North East Victoria

Councils in North East Victoria have also undertaken significant planning work in areas relevant to building community resilience:

- all councils have ‘healthy communities’ or ‘community wellbeing’ plans;
- a majority of councils have heatwave and drought response plans; and
- all councils have Municipal Emergency Management Plans (incorporating recovery programs).

The heatwave plans specifically recognise potential impacts of climate change and variability on health and infrastructure and set out actions for their mitigation.

Councils are required to develop community wellbeing plans by the State Government. The wellbeing plans outline measures and actions to address a range of existing and potential issues - not necessarily climate change impacts - and improve community health.

Other government, community and non-government initiatives provide ‘ground level’ resilience building. These include partnerships and networks, such as the Rural Women’s Network, that build and strengthen resilience by providing a platform for the transfer of knowledge and a sense of belonging. Other programs, such as Primary Care Partnerships and the Community Resilience Committee (Alpine Shire), build and strengthen resilience by improving regional planning and / or service delivery. Programs of this nature help to foster the general resilience of communities to shocks, such as those associated with droughts, bushfires and floods, even though they may not specifically address climate change and variability.

A comprehensive framework is currently in place for emergency management in North East Victoria, covering the planning, prevention, response, recovery and support arrangement for emergencies and natural disasters (e.g. including bushfires and floods) in each municipality. Extreme events, such as floods and bushfires, will also affect any visitors to the region. Emergency management procedures seek to ensure the safety of visitors as well as residents. Tourism services providers, such as visitor information centres and accommodation providers, provide information for tourists and visitors in case of code red days and/or emergencies.

Table 10: Overview of relevant community resilience building initiatives currently in place in North East Victoria²⁷

Program/ initiative	Objectives / comments	Responsible organisation(s)	Climate change and variability considered?
Community resilience building			
Alpine Community Resilience Committee	<ul style="list-style-type: none"> Build and strengthen preparedness to assist in emergency. Community resilience building. Establish and strengthen partnerships and networks. 	Alpine Shire	Yes, in part
Relationships Australia	<ul style="list-style-type: none"> Provide relationship support services for individuals, families and communities. 	Relationships Australia (not-for-profit organisation)	No
Rural women's network	<ul style="list-style-type: none"> Network to strengthen communities, enabling and empowering women. 	Department of Human Services	No
Health and wellbeing			
Healthy community plans / community wellbeing plans	<ul style="list-style-type: none"> Required by State Government under the Public Health and Wellbeing Act 2008. Objectives include: <ul style="list-style-type: none"> “to plan in advance to make informed decisions around social, economic or physical environments that directly affect the health and wellbeing of all communities” (Towong); and “to strengthen communities and support individuals to be resilient when faced with the challenges of economics and climate change” (Wangaratta). 	<ul style="list-style-type: none"> Alpine Shire Benalla Rural City Indigo Shire Towong Shire Rural City of Wangaratta City of Wodonga 	Yes, in part
Heat wave plans	<ul style="list-style-type: none"> Recognise potential climate change impacts on health and infrastructure. Support local communities to adapt to heatwave conditions taking account of local conditions and resources. 	<ul style="list-style-type: none"> Alpine Shire Benalla Rural City Indigo Shire Towong Shire Rural City of Wangaratta City of Wodonga 	Yes
Hume Health	<ul style="list-style-type: none"> Information and links to health and lifestyle services in the Hume region (includes links on drought and bushfire). 	Hume Health	Yes, in part

²⁷ Note, general health and community services and planning for the region are not included (i.e. services through Department of Health (Hume Region), Department of Human Services (e.g. Ovens & King & Upper Hume Community Health Services), Department of Planning & Community Development, Australian Government Department of Health & Ageing).

Program/ initiative	Objectives / comments	Responsible organisation(s)	Climate change and variability considered?
Primary Care Partnerships	<ul style="list-style-type: none"> Voluntary alliances of primary care health agencies working together to improve health service planning, information and delivery across the North East region. 	<ul style="list-style-type: none"> Lower Hume Primary Care Partnership Central Hume Primary Care Partnership Upper Hume Primary Care Partnership 	No
Women's Health Goulburn North East	<ul style="list-style-type: none"> Promotes the health and wellbeing of women. Improves the delivery of health and community services for women. 	<ul style="list-style-type: none"> Funded by DHS's Community and Women's Health Program 	Yes, in part
Men's Community Reference Group	<ul style="list-style-type: none"> Planning and implementation of men's health and wellbeing initiatives in the region. 	<ul style="list-style-type: none"> Upper Hume Primary Care Partnership 	No
Mental health support organisations	<ul style="list-style-type: none"> Provides first point of contact and referral services. Information and support for mental health patients, and families and friends. Awareness raising. 	<ul style="list-style-type: none"> Various NGOs <ul style="list-style-type: none"> Beyond Blue Lifeline Black Dog Institute 	No
Emergency management and drought response			
Municipal emergency management plans and committees	<ul style="list-style-type: none"> Regional emergency response planning committees are in place to managing emergencies at the regional level. Municipal Emergency Management (Planning) Committees (MEMCs) oversee the preparation of Municipal Emergency Management Plans (MEMPlans), which cover the management, prevention, response, recovery and support arrangement for emergencies in each municipality. 	<ul style="list-style-type: none"> Municipal Emergency Management (Planning) Committees (MEMCs) including: <ul style="list-style-type: none"> Councils CFA SES Victoria Police DSE DoH 	Yes, in part

Program/ initiative	Objectives / comments	Responsible organisation(s)	Climate change and variability considered?
Municipal fire management plans and committees	<ul style="list-style-type: none"> Municipal Fire Management Planning Committees (MFMPs) develop the municipal fire prevention plan and township protection plans, designate Council Neighbourhood Safer Places (also known as Places of Last Resort), develop protocols for notification of code red days; and co-ordinate provision of water for fire fighting. The Victorian Fire Risk Register (VFRR) prioritises localities and assets for protection during wildfires in the region. 	<ul style="list-style-type: none"> Municipal Fire Management Planning Committees (MFMPs) including Councils, CFA and DSE. 	Yes, in part
Emergency information provision (visitors and tourists)	<ul style="list-style-type: none"> Provide information for tourists and visitors in case of code red days and/or emergencies. 	<ul style="list-style-type: none"> MEMCs Visitor Information Centre Media outlets 	Yes, in part
Drought strategies and activities	<ul style="list-style-type: none"> Manage the social impacts of the drought. Provide information and education. Arrange community meetings to encourage knowledge transfer and strengthening community connectedness. Maintain security of drinking and stock water to rural residents and farms. Maintain security of water supply for fire fighting. Provide rate concessions for drought affected residents. 	<ul style="list-style-type: none"> All LGAs in collaboration with other agencies (e.g. CFA, water authorities) 	Yes, in part
State Emergency Relief and Recovery Plan	<ul style="list-style-type: none"> Provides guidelines, plans and resources for emergency relief and recovery. Informs a standard approach to emergency relief in Victoria (through the Emergency Relief Handbook). 	<ul style="list-style-type: none"> DHS, supported by the Red Cross 	No

5.3 Review of initiatives and identification of new actions

5.3.1 Review process

The process used to develop resilience building actions, which are detailed in the following sections of the report (section 6 and section 7) involved three main steps. These are discussed below.

Step 1 – resilience planning workshops

A series of three workshops was held in the North East region at Wodonga, Wangaratta and Bright, in late November 2011. Approximately 45 people with an interest in economic development, community services and community development participated in the workshops over the three days. The participants came from NEGHA member councils, state government agencies, business and industry associations and community organisations.

The focus of the workshops was on identifying initiatives that will build resilience of industries or communities in the region to climate change and variability.

Outputs from the workshops were included in a preliminary list of actions for building resilience of industries and communities to climate variability and change, outlined in the Context Paper.

Step 2 – follow-up consultations

Community and stakeholder consultation sessions were conducted across the region in the first and second weeks of December, 2011. Discussions at the sessions focussed on the Context paper, inviting feedback on both the vulnerability assessment and the preliminary list of actions.

Step 3 – further analysis and review

Following the workshops and consultations, a more detailed consideration of potential new actions was undertaken considering:

- further review of established programs;
- actions recommended at the workshops and consultation sessions;
- outcomes of the vulnerability assessment;
- results of the community surveys and industry focus group discussions;
- relevant actions outlined in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*; and
- actions proposed and/or being initiated elsewhere in Australia.

5.3.2 Principles underpinning new actions

A number of principles underpin selection of the new actions proposed in Sections 6 and 7 of the report. These are described below.

Complementary

First proposed actions should add to and complement the economic and community resilience building programs that are already in place in the region. Thus, as described in section 5.3.1, a key step in the process of identifying new actions, was first to identify and review relevant established programs and initiatives and use the review as a basis for considering new programs and initiatives based on identified gaps.

Relevant

Proposed actions should have relevance to building social and economic resilience to climate change and variability. That is, actions should:

- reduce the exposure of vulnerable industries or communities to climate variability and change;
- reduce their sensitivity to climate variability and change; or
- increase their capacity to adapt to climate variability and change.

Adaptive

Actions should be consistent with the principle of adaptive management. That is, they should be flexible, having the potential to be adjusted and scaled up or down to reflect changed circumstances or new information.

Ideally, actions should also have benefits beyond building resilience to climate change and variability – that is, they build resilience of industries and communities to change in general.

Scalable

Actions should have the potential to be applied at different scales - sector or community wide or scaled to target especially vulnerable localities, industries or segments of the community.

6. Building economic and industry resilience

Potential new actions relevant to building economic and industry resilience to climate change and variability are described in this section. Actions are listed under the three main sectors identified in section 3.3 as being most vulnerable to climate change and variability: agriculture & forestry; tourism and ‘climate dependent’ manufacturing.

6.1 Agriculture and forestry

6.1.1 Current situation

Farmers in North East Victoria – like other Australian farmers – are well versed in managing natural climate variability and changing market conditions. Climate change however, is likely to exacerbate both climate and market variability for the agricultural sector, presenting new and significant challenges. The recent drought and other pressures confronting the farm sector in the region provide lessons on building resilience to climate change and variability and the need to develop approaches that go beyond traditional responses such as drought relief. Identified needs include the following.

- Improved short to medium term farm decision making and planning, including financial planning and management.
- Long term succession planning, to ensure that viable farms and farming areas are maintained into the future.
- Improved farmer access to information on alternative farming models and methods, especially methods that will enhance adaptability and flexibility of farms in the face of increased climate variability.
- Accessible and plain language information on:
 - i) the implications of climate change for the agricultural sector in the north east region; and
 - ii) long range weather forecasts.
- Improved land-use planning at the regional level to ensure protection of the region’s most viable and productive agricultural land.

6.1.2 Potential actions

Promote and improve outreach of established farm management and planning services

Action

Non-profit organisations, such as Goulburn Murray Hume Ag Care, provide specialist advice to farmers in areas such as financial counselling, business planning and succession planning. Provision of advice is often only taken up by farmers once they are in dire financial circumstances, following referral from other service providers and banks. There is a need to extend the early take-up of business and financial planning services through improved outreach and multi-media marketing of those services. This will require additional funding. NEGHA member councils should consider liaising with relevant service providers to identify and seek funding for improved outreach and multi-media marketing of the services.

Responsibility

NEGHA member councils liaising with relevant service providers (e.g. Goulburn Murray Hume Ag Care)

Target group

Farmers across the region

Training programs to encourage farm succession planning and good practice**Action**

‘Hands-on’ farm sector training programs should be encouraged through TAFE, the Department of Education and Early Childhood Development (DEECD) and / or Adult Community and Further Education (ACFE) organisations.

- One program would seek to nurture younger members of established farming families and encourage them to continue farming in the longer term. This program could be implemented through the Victorian Certificate of Applied Learning (VCAL) or TAFE.
- Another program would aim to provide one-on-one skills to first time farmers on basic farm management and methods, as a means of ensuring that viable farm land that has changed ownership is used productively and sustainably in the future. The program could build on information packs that are currently provided by DPI. It would be community based and focussed on knowledge sharing, drawing on the expertise of regionally-based leaders in their respective fields. As such, it could be appropriate to implement the program through a regionally based ACFE organisation (e.g. Albury-Wodonga Community College, The Centre for Continuing Education).

Responsibility

Regional education organisations, including TAFE, DEECD and ACFE. NEGHA member councils could play a facilitation role by promoting these programs with the educational organisations.

Target group

Farmers across the region, especially younger members of farming families and new/first time farmers.

Research and trials into adaptive farm management practices

Funding for research and trials into adaptive farm practices should be sought. There is anecdotal evidence that farm businesses across the North East region, in a variety of industries (including vineyards, grazing and broad acre cropping), are already adopting innovative and sustainable practices that are:

- improving the businesses’ capacity to adapt to climate variability and change; and/or
- reducing net carbon output.

Information on these practices could be compiled into a series of case studies and be used as a basis for seeking further funding for regional trials that demonstrate best practice in these areas. The Australian Government’s Carbon Farming Futures program represents a possible source of funding for this initiative.

Responsibility

The Department of Primary Industries (DPI), working with Landcare groups and/or the North East Catchment Management Authority (NECMA) and Goulburn Broken Catchment Management Authority (GBCMA). NEGHA member councils could play a facilitation role by promoting the action with these organisations.

Target group

Farmers in the region adopting innovative practices

Land bank

Action

A 'land bank' to harmonise the needs of existing land owners with potential new farmers and young farmers, through leasing and share farming arrangements, should be considered for the region. The land bank would aim to:

- encourage young people and new farmers into farming by reducing their need to purchase land, entailing substantial capital outlays;
- provide an income to older farmers and retirees reducing the need to sell their land;
- enable established farmers to extend their operations without having to purchase more land; and
- encourage the retention of prime agricultural land for farming.

Responsibility

Rural Finance could be a suitable body to facilitate and administer the program. NEGHA member councils would need to approach that organisation to discuss the feasibility of a trial program for the region.

Target group

Farmers across the region

Sustainable land use strategy

Action

A sustainable land use strategy should be produced for the region to promote sustainable, productive and resilient rural areas including through the protection of prime agricultural land at a viable scale. The strategy should also seek to ensure that agriculture, forestry and residential/rural residential developments effectively co-exist. Objectives of the strategy would be reflected in council planning schemes.

The sustainable land use strategy could be supported by a Regionally Significant Agricultural Lands Map that identifies agricultural land in the region that has high productive capacity but is potentially vulnerable to climate change and other pressures.

Responsibility

Councils working with the Department of Planning and Community Development (DPCD) and DPI would produce the strategy.

Target group

Regional agricultural sector

Long range regional weather forecast information**Action**

Extend long range weather forecast information provided by the Bureau of Meteorology to ensure that is provided at a regional scale, is presented in a user friendly format and is available through a range of sources in addition to the Web, for example, using mail outs.

Responsibility

Bureau of Meteorology (BoM). NEGHA member councils would need to approach BoM to discuss the feasibility of a trial information program being adopted for the region.

Target group

Farmers across the region

6.2 Manufacturing

6.2.1 Current situation

As noted in section 3.3.3, manufacturing industries in the North East region have been quite proactive in reducing their water consumption in response to the recent drought, with North East Water's WaterMAP customers having achieved water savings of more than 35 percent over the five years to 2010-11. This has reduced their sensitivity to reduced water availability in the future. Some advances are also being made in achieving waste and energy savings. Nevertheless, there is still significant scope to increase the resilience of regionally based climate dependent manufacturing industries to climate change and variability. The following gaps and shortcomings with the current situation have been identified.

- There are a range of programs, assistance and grant schemes to encourage firms to identify and implement water, waste and energy savings. Many of these have low take-up rates due to:
 - lack of awareness about the financial and other benefits of implementing the programs;
 - lack of capacity within firms to implement identified opportunities and/ or a lack of seed funding; or
 - lack of coordination between firms and industries (e.g. finding markets for waste products derived from water and waste management initiatives).
- A need for improved workforce training – new and innovative methods and processes.
- A need for improved business planning, especially to deal with the impacts of floods, bushfires and Code Red days on staff availability and resource inputs.

6.2.2 Proposed actions

Sustainability opportunities information and support package

Action

Consider developing an information and support package on water, energy, waste and cost savings. The package would target manufacturing firms in the region, providing firms with information and support on:

- available technologies, systems and processes for reducing water and energy consumption and waste, with case studies provided of industry leaders/ early adopters who have successfully and cost-effectively reduced water and energy consumption and waste;
- audits and other support that can be utilised to identify water, energy and waste reduction opportunities;
- sustainability training programs provided by government (e.g. 'Sustainability Skills' through Manufacturing Skills Australia); and
- available government assistance and grants programs that can be accessed to assist firms implement more sustainable practices and reduce their water and energy consumption and waste.

The aims of the package would be to increase the awareness and ultimately take-up of sustainability programs and opportunities, as well as improving coordination between the

different programs. The information component of the strategy would require a range of approaches including active marketing, case studies, fact sheets (e.g. return on investment calculators), forums, industry outreach and promotion through industry groups and chambers of commerce.

Responsibility

NEGHA member councils, working with regional industry groups, North East Water (NEW) and the Victorian Environment Protection Authority (EPA)

Target group

‘Climate dependent’ manufacturing businesses in the region

Region wide audit of industries exposed to climate change²⁸

Action

A high level audit of manufacturing industries in the North East region should be undertaken to assess which industries have the greatest level of exposure to climate change, variability and response in terms of energy and water consumption, other resource inputs and markets. The audit would consider the impacts of reduced water availability, increased rainfall variability and climate extremes and carbon pricing on:

- costs and availability of water and energy;
- the supply chain to manufacturers dependent on agricultural and forestry inputs; and
- other indirect impacts, such as disruptions to transport.

Responsibility

NEGHA member councils, working with regional industry groups, North East Water (NEW) and EPA Victoria

Target group

‘Climate dependent’ manufacturing businesses in the region

Business continuity training program and toolkit - manufacturing²⁹

Action

Consider developing a business continuity training program and toolkit for manufacturing businesses in the region. The program would train businesses on how to produce business continuity plans and to consider and address disruptions to business associated with the direct impacts of climate change and variability (bushfires, floods, storms, Code Red days), impacts on staff availability, and disruptions to supplies and/or markets.

Training should be consistent with Australian Standards and best practice on business continuity management as set out in:

- The Business Continuity Management Handbook HB 221-2004); and

²⁸ Note, this action in part reflects Actions G3 and N2 in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*.

²⁹ Note, this action reflects Action G2 in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*.

- A practitioner's guide to business continuity management (HB 293-2006).

Funding for the program could be sought from Regional Development Australia or another relevant federal or state government agency.

Responsibility

Councils working with chambers of commerce, the Australian Industry Group and local TAFE Institutes or universities

Target group

Manufacturing businesses in the region, especially small to medium businesses

Industry sustainability network

Action

A regional network of industries implementing or interested in implementing sustainability practices (e.g. water, waste and energy reduction initiatives) should be considered. The network would provide a point of connection between different businesses and industries in the region and conduit for the sharing of information on sustainability practices.

Once fully established, the network could also be used as means of promoting the region as a hub for sustainable industry practice and attracting new industries engaging in sustainable practices to the region.

The network would be set up on an opt-in basis.

Responsibility

One or more established industry organisations (e.g. chambers of commerce) would provide suitable host organisations for the network and are important to promoting its development. NEGHA member councils could play an initial facilitation role however.

Target group

Businesses and industries involved or interested in sustainability practices.

6.3 Tourism

6.3.1 Current situation

The tourism industry in North East Victoria has been working actively to increase the resilience of the sector to downturns and crises, many of which can be linked to climate extremes such as bushfires, floods and droughts. Crisis preparation training program is being implemented through the North East Regional Tourism Board (NERTB) and Tourism Victoria and the region has established a tourism crisis response committee. Nevertheless, recent droughts, floods and other climate extremes impacting the region in recent years point to the need for continued efforts to build resilience of the tourism sector to climate change and variability, especially in the following areas:

- improved communications to tourists and operators about how to respond in the event of a natural disaster and also when Code Red days are declared;
- improved forward planning and preparation by tourism operators to downturns and crises (especially those associated with natural disasters and climate variability);
- tourism sector disaster recovery;
- sector wide strategic planning to reduce seasonal fluctuations in tourism;
- minimising the impacts of fuel reduction burns on the tourism sector;
- water security for agri-tourism.

6.3.2 Proposed actions

Tourism business forward planning and crisis preparation

Action

A role should be established within the NERTB to provide ongoing mentoring and support to tourism businesses. The focus of the role would be to:

- educate and mentor tourism businesses on forward planning and crisis preparation;
- provide leadership, be a point of contact and advocacy for tourism businesses in times of crisis; and
- seek funding to develop support programs.

The role would be ongoing and build on the crisis preparation training program that is currently in place.

Business continuity training program and toolkit – tourism

Action

As per the business continuity training program and toolkit – manufacturing (see section 6.2.2). The program would be extended to include tourism businesses.

Responsibility

Councils working with the NERTB

Target group

Tourism businesses in the region

Visitor extreme weather communications and travel plan³⁰

Action

A communications and travel plan should be developed with the aim of educating and providing timely and accurate information to tourists and other visitors about the risks of extreme weather events, how to act should these events occur and where they should/ should not travel. The communications plan should also provide information to tourists on what to do in the event of Code Red days.

Responsibility

Councils (through MEMCs), working with the emergency response group of NEVRTB, local tourism associations, BoM, Parks Victoria, emergency management organisations (SES, CFA, police) and broadcasters (e.g. local radio and TV stations)

Target group

Tourists and visitors to the region, tourism operators

Prescribed burns research, communications and 'no-burn' periods

Action

A number of actions to reduce the impact of prescribed burns on the tourism sector (and also the agricultural sector) are proposed including:

- set aside 'no burn' times in peak visitation times (e.g. Easter, long weekends);
- develop improved public communications on why, when and how prescribed burns are undertaken and ensure that forward schedules of fuel reduction burns, developed by DSE and Parks Victoria, are effectively communicated to local communities; and
- support improved research and monitoring of prescribed burns by DSE, consistent with recommendations of the 2009 Victorian Bushfires Royal Commission.

Additional actions on water security and telecommunications that are relevant to tourism are discussed in the following section on community resilience.

Responsibility

DSE and Parks Victoria working with the NERTB

Target group

Tourism and agricultural businesses impacted by prescribed burns

³⁰ Note, this action in part reflects Action H1 in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*.

7. Building community resilience

7.1 Building resilience to climate variability and extremes

7.1.1 Current situation

It is clear that a huge range of programs and initiatives are already in place, regionally and within individual LGAs, which have the effect of building resilience within the community to external and internal pressures and ‘shocks’. Some of the programs and initiatives are implemented or coordinated through councils, state government agencies. Many others are implemented through community organisations and networks. Some of these initiatives are focussed on areas directly relevant to climate change:

- Municipal Emergency Management Plans and associated emergency preparation and response programs and resources;
- disaster recovery funding and programs; and
- heat wave strategies.

Other programs and initiatives are focussed more broadly on building community resilience (e.g. healthy community and community wellbeing strategies) or working with vulnerable groups in the community such as the elderly, younger people, families under financial stress and people with pre-existing health concerns.

Further efforts to build resilience within the community to climate change and variability should not duplicate current programs and initiatives and should draw on existing organisations and networks. Future effort needs to focus on improving regional coordination and program coordination and strengthening existing programs and initiatives, for example by:

- extending their reach;
- ensuring that particularly vulnerable groups are targeted through relevant programs and plans;
- ensuring that the design and implementation of relevant programs and plans involves inputs from a diverse range of community members; and
- building the capacity and diversity of staff and volunteers resources.

7.1.2 Proposed actions

Community resilience committees

Action

Councils have an important coordinating role to play in fostering wellbeing and building resilience within local communities. Through local Emergency Management Committees, they already play this role in the area of emergency response, coordinating the work of relevant agencies and volunteer organisations. This approach could be extended to resilience planning through the establishment of community resilience committees in each of the region’s local government areas. The committees would have a particular focus on:

- coordinating programs and initiatives relevant to community preparedness for and recovery from natural disasters and other climate extremes, as well as long term structural pressures facing local communities and economies;
- network and partnership building between relevant agencies and community organisations on these issues;
- ‘mapping’ of community programs and initiatives that build local community and resilience and organisations responsible for their delivery;
- establishing and coordinating registers of vulnerable groups;
- coordinating local and regional information sharing; and
- identifying gaps in programs and program delivery.

The Alpine Community Resilience Committee, which is already operating successfully, provides a possible model for these committees.

Responsibility

NEGHA member councils, working with local agencies and community organisations

Target group

Whole of community

Community organisation support

Action

Councils could recognise the value of established and emerging community organisations in building community resilience by providing those organisations with in-kind support. Support could be provided in the form of:

- assistance with grant writing;
- infrastructure provision (e.g. accommodation); and
- secretarial, accounting and legal support.

Responsibility

NEGHA member councils (potentially through the proposed community resilience committees)

Target group

Local community organisations

Community infrastructure priorities

Action

Councils should consider developing a priority list and schedule of public infrastructure that will contribute to building resilience of local communities to climate change and variability and provide a demonstration of good practice to the community. The priority list would also aim to identify interdependencies between infrastructures, including assets that have the potential to be impacted by interconnected or auxiliary assets that are managed by other agencies.

The priority list should include details on:

- the type of infrastructure and how it will build resilience;

- preliminary cost estimates;
- responsibility (council, agency or other) for initiating the infrastructure;
- interconnections / interdependencies with other infrastructure; and
- potential funding sources.

Responsibility

NEGHA member councils (possibly through the proposed community resilience committees)

Target group

Community wide

Volunteer recruitment strategies, succession plans and skills banks

Action

As discussed in section 3.4.9, the level of volunteerism is generally strong across the region relative to other regions in Victoria. Nevertheless, maintaining a strong volunteer base is an ongoing problem for many community organisations, especially in the face of increasing barriers to volunteerism (e.g. legal liability issues, increasing workforce participations rates).

Councils, potentially working through the proposed community resilience committees, could consider developing volunteer recruitment strategies and succession plans for their LGAs. The strategies could include establishment of local community ‘skills banks’ to provide information on volunteers and volunteer skills available to community organisations.

The succession planning would entail developing a program for engaging youth and young adults in volunteer organisations. The program would require creative ideas and need to actively target secondary schools, tertiary institutes and TAFEs in volunteer recruitment. It would be coordinated across a range of volunteer organisations.

Responsibility

NEGHA member councils

Target group

Whole of community, especially younger community members

Review of emergency management plans

Action

Municipal Emergency Management Committees should consider conducting a review of their Municipal Emergency Management Plan (MEMP) and sub-plans with the aim of identifying limitations with the MEMP and providing recommendations and tools to improve the capacity of councils and emergency service agencies to manage projected increases in extreme events from an emergency response perspective, particularly projected increases in the coincident occurrence of extreme events, such as floods and bushfires.

The review should also:

- consider the ability of key service providers to continue to deliver key community services during and after extreme events;

- seek to integrate all hazard and risk planning not currently part of the MEMP (e.g. heatwave plans); and
- ensure that especially vulnerable groups are addressed in the plan, for example through the inclusion of ‘vulnerable’ or ‘at risk’ group registers.

Responsibility

NEGHA member councils working with regional emergency service agencies

Target group

Whole of community, especially vulnerable groups

Community education on climate change and extremes³¹

Action

Councils should consider developing a coordinated regional education program to ensure that the community is properly informed about the risks of climate change and variability to the region and that community members are better prepared to deal with the impacts of climate extremes such as floods and bushfires. The program could include information on:

- potential regional impacts of climate change;
- associated risks to households and the community;
- the concept of climate change adaptation;
- adaptation responses being developed by councils and agencies; and
- how householders and community members can improve their own resilience to climate extremes.

A key objective of the program would be to improve household and community ownership / responsibility for emergency response and build capacity to reduce their short term dependence on mainstream services and the need for evacuation. As such, the program should seek to build on existing community awareness and preparation programs, such as FloodSafe and Fire Ready, and would target key vulnerable groups in the community.

Various options should be explored for disseminating the information including the online Clearing House recommended in Action 1.2.6 of the Hume Strategy.

Responsibility

NEGHA member councils working with regional emergency services agencies

Target group

Whole of community, especially vulnerable groups

³¹ Note, this action in part reflects Action M2 in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*.

Resilience building and school education

Action

Schools play a crucial role in local areas as community hubs. Integrating resilience building programs in the school curriculums would help to reinforce resilience building at the community level. Any schools program would need to be targeted at an appropriate year level, be integrated with other programs and policies of schools (e.g. emergency management plans), actively engage students and encourage them to take up roles and responsibilities within the broader community.

Responsibility

DEECD

Target group

School students

Telecommunications and broadband

Action

Reliable telecommunications has been identified as critical to effective emergency preparation and response for local communities and businesses. Reliable broadband will also generate significant opportunities for enhancing communications and community capacity during emergencies.

Municipal Emergency Management Committees could consider identifying a priority list of network coverage 'black spots' and lobbying Telstra and telecommunications authorities to rectify them.

Responsibility

Municipal Emergency Management Committees

Target group

Telecommunications agencies and authorities

7.2 Building community resilience to droughts and reduced water availability³²

7.2.1 Current situation

As in other parts of south east Australia, the prolonged drought in North East Victoria from 1997 to 2010, highlighted the vulnerability of the region to a future with increased rainfall variability and increased severity of droughts. Water security risks came to the fore in the drought, during which record low inflows to water storages such as Lake Hume were recorded. North East Water (NEW) responded to the threats with a range of measures designed to increase water security for urban areas and towns. These included development of a Water Supply and Demand (WSDS) and a Permanent Water Saving Plan. Some councils in the region also developed drought response strategies. Notwithstanding these plans and strategies and the drought breaking rains of the past 12 months, water security remains a long term concern for many towns in the region, especially (but not exclusively) towns dependent on unregulated systems for their water supplies. Concern stems from a number of factors including:

- lack of water security as a barrier to future residential growth and growth in key local industries such as tourism;
- the impact of droughts and water restrictions on local amenity and wellbeing; and
- water availability for bushfire fighting.

Another water-related issue that has been raised by participants involved in the process of developing this plan is food security. Although food shortages are unlikely ever to be a community wide issue in the region or Australia more broadly - even under the worst case climate change scenarios - water security and reliability are important in the context of global food security, Australia's role as a food exporter and the future cost of food. Indirectly, this has important implications for food consumers in the region.

7.2.2 Proposed actions

Enhancing water security in towns³³

Action

North East Water (NEW), working with councils and community advisory committees should develop a regionally prioritised schedule for the enhancement of water supply in towns and other areas, especially those supplied from unregulated systems or where security of supply has been a major problem in the recent past and is likely to be in the longer term given climate change projections.

NEW should then investigate water supply and demand options to increase diversity and sustainability of water supply to priority areas considering cost-effectiveness, feasibility and environmental and social impacts.

³² Note, issues relating to resilience of the agricultural sector in the face of reduce water availability are discussed in section 6.2.1.

³³ Note, this action in part reflects Action A2 in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*.

Responsibility

North East Water (NEW), working with councils and community (water) advisory committees

Target group

Towns vulnerable to long term water security

Ensure viability of priority open spaces³⁴

Action

Councils should review their open space plans (or other information identifying community requirements in relation to playing fields and open space), with a view to rationalising and prioritising parks, gardens and playing fields to manage in times of low water availability. Criteria for prioritising parks would need to be developed (e.g. gardens valued highly by the community, utilisation rates, economic benefits) and incorporated into relevant plans.

Councils, working with NEW, should then investigate medium to long term actions to ensure ongoing viability of priority parks, gardens and playing fields including:

- recycled water;
- water capture and storage opportunities such as wetlands, tanks and (underground) water storages;
- increased efficiency of irrigation;
- planting strategies to more drought/salt tolerant species;
- alternative, all weather surfaces.

Councils, working co-operatively with each other and with NEW, should actively pursue funding for priority projects through established Commonwealth and State funding programs.

Responsibility

NEGHA member councils working with NEW

Target group

Whole of community

Emergency water supplies for bushfire fighting³⁵

Action

- i. Municipal Fire Management Planning Committees (MFMPs) should review fire management plans for municipalities in North East Victoria, and associated components of the Victorian Fire Risk Register, to ensure that availability of suitable water supplies for fire suppression in periods of low water availability, especially in proximity to towns covered by township protection plans.

³⁴ Note, this action in part reflects Action I1 in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*.

³⁵ Note, this action reflects Action J3 in the report *Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan*.

- ii. MFMPCs, working with NEW, should also identify existing or potential new water supply sources that could be quarantined for bushfire fighting during the fire season, where gaps have been identified through part i) of this action.
- iii. MFMPCs should seek funding through the FARSS³⁶ for construction of new supplies identified in part ii).
- iv. They should also consider lobbying the state government to provide for an increase in the state/local government funding ratio for water-related capital works under the FARSS.

Responsibility

Municipal Fire Management Planning Committees

Target group

Communities in high risk bushfire areas, especially in towns covered by township protection plans

Food awareness and security education program

Action

Building on a range of initiatives that have already been initiated in the region (e.g. Albury-Wodonga food share, community gardens), councils working with Department of Primary Industries (DPI), community organisations, should establish a region wide program to educate consumers about Australian agriculture from a global perspective including:

- where our food comes from;
- how it is produced;
- the benefits of sourcing locally produced food;
- options for sourcing locally grown food; and
- food sharing.

Responsibility

NEGHA member councils working with DPI and community organisations

Target group

Whole of community

³⁶ The Fire Access Road Subsidy Scheme (FARSS) is administered by CFA and is a State Government funded subsidy scheme. Subsidies are available for Municipalities for the construction and maintenance of fire access roads or construction of static water supplies.

8. Conclusions

Climate change and variability poses significant social and economic challenges to North East Victoria. While communities and industries have shown considerable resilience to natural disasters and other ‘shocks’, such as droughts, floods and bushfires, these events have caused considerable hardship in the past. It is important therefore, that practical and achievable measures are implemented to prepare communities and industries for these events in the future, especially given the potential for climate extremes to increase in frequency and/ or magnitude under given climate change projections.

Vulnerability assessment provided in Section 3 of the report indicates that there are industries, localities and sections of the community who warrant particular attention when considering actions for building economic and social resilience. Results of community surveys and industry focus group discussions (Section 4) further reinforce the importance of resilience building in the region. Although many programs and initiatives are in place already, which have the effect of building economic and social resilience to climate change and variability, it is apparent that there are still gaps and deficiencies (Section 5).

Sections 6 and 7 outline a substantial number of actions that have the potential to address those gaps and further build the resilience of communities and industries in North East Victoria to climate change and variability. The actions cover a range of areas including information and education, training, infrastructure, planning, program coordination and policy development.

While it might be desirable to implement all of the actions, resource constraints and competing priorities of NEGHA member councils and other organisations mean that it is necessary to prioritise the actions. Looking forward to Phase 2 of the project, factors that should be considered when seeking to prioritise the actions are:

- Can the action be implemented in the short term (within 1 to 2 years)?³⁷
- Can the action be driven/implemented at the local level (i.e. by a locally based council or other organisation)?
- Considering long term resilience building outcomes, how effective is the action likely to be?

Table 11 lists the actions from sections 6 and 7, providing a qualitative assessment of the actions against the above criteria. Actions rating best against the criteria are highlighted, noting that further consideration of the priorities would be desirable. It is recommended that agreed priority actions are given consideration for assessment in Phase 2 of the project, which is aimed at providing more detailed assessment and implementation of social and economic solutions.

³⁷ This distinguishes an ‘action’ from ‘outputs’ and ‘outcomes’.

Table 11: Potential industry and community resilience building actions (with priority actions highlighted for discussion purposes)

No.	Action	Can be implemented in short term?	Can be driven locally?	Effective LT contribution to resilience
Building industry resilience				
<i>Agriculture</i>				
1	Promote and improve outreach of established farm management and planning services	yes	yes	moderate
2	Training programs to encourage farm succession planning and good practice	?	in part	major
3	Research and trials into adaptive farm management practices	no	yes	major
4	Land bank	?	?	major
5	Sustainable land use strategy	no	yes	moderate
6	Long range regional weather forecast information	yes	no	minor
<i>Manufacturing</i>				
7	Sustainability opportunities information and support package	yes	yes	major
8	Region wide audit of industries exposed to climate change	yes	yes	minor
9	Business continuity training program and toolkit - manufacturing	yes	yes	moderate
10	Industry sustainability network	yes	yes	minor
<i>Tourism</i>				
11	Tourism business forward planning and crisis preparation	yes	yes	major
12	Business continuity training program and toolkit – tourism	yes	yes	moderate
13	Visitor extreme weather communications and travel plan	yes	in part	minor
14	Prescribed burns research, communications and ‘no-burn’ periods	in part	no	moderate
Building community resilience				
<i>Resilience to climate variability and extremes</i>				
15	Coordinated approach to building community resilience	yes	yes	moderate
16	Community organisation support	yes	yes	minor
17	Community infrastructure priorities	yes	yes	major

No.	Action	Can be implemented in short term?	Can be driven locally?	Effective LT contribution to resilience
18	Volunteer recruitment strategies, succession plans and skills banks	?	yes	moderate
19	Review of emergency management plans	?	yes	moderate
20	Community education on climate change and extremes	yes	yes	moderate
21	Resilience building and school education	no	no	moderate
22	Telecommunications and broadband	no	no	moderate

Resilience to droughts and reduced water availability

23	Enhancing water security in towns	no	yes	major
24	Ensure viability of priority open spaces	no	yes	moderate
25	Emergency water supplies for bushfire fighting	no	?	moderate
26	Food awareness and security education program	yes	yes	minor

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Appendix: Vulnerability indicators

The indicators used in this assessment, either individually or as a basis for aggregated indices, are listed below. They have been listed classified under three broad categories:

- ‘economic’;
- ‘social’; and
- ‘infrastructure & services’.

Category	Descriptor	Indicators	Data sources
Economic	<i>Economic diversity</i>	Distribution of employment across industry sectors (Shannon-Wiener index)	ABS
	<i>Climate dependent industries³⁸</i>	% of jobs in accommodation, agriculture & forestry, beverage % tobacco products, food & beverage services, food product manufacturing, forestry & logging, Pulp & paper, Textiles, clothing & footwear, wood produce manufacturing	ABS Census; NIEIR YourPlace
		sales and/or value added from above industries as % of total sales and/or value added	NIEIR YourPlace
	<i>Labour force mobility</i>	% of working age population aged 20-34 Employment by industry and age	ABS census ABS census
Social	<i>Community-wide sensitivity and adaptive capacity</i>	Index of relative advantage and disadvantage (includes information on income levels, occupation and education)	ABS
	<i>Sensitivity to climate extremes</i>	% of people aged 65 years and over	ABS census
		% of people aged 4 years and under	ABS census
		% of people with a core activity need for assistance	ABS census
		% reporting fair or poor health status	DoH
		Registered mental health clients per 1,000 population	DoH
		% of lone person households	ABS census
	<i>Financial capacity</i>	% of households below median Victorian and/or Australian weekly household income	ABS census
		Unemployment rate	ABS census
	<i>Education</i>	% of People aged > 24, who have a no qualification	ABS census

³⁸ Note, data for the construction and transport industries were also assessed but was not included in the report.

		% of People aged > 24, who have a bachelor degree, graduate diploma or post-graduate degree	ABS census
		% of People Aged > 24, with highest qualification level between certificate and advanced diploma	ABS census
	<i>Support networks</i>	% of persons aged 15 and over, who help as volunteer	ABS census
		% of people with access to support from family / friends / neighbours	DPCD
	<i>Capacity to upgrade / improve housing</i>	% rented, % being purchased or fully owned	ABS census
		% of people renting from government housing authority	Social Health Atlas
		% rental stress	Social Health Atlas
		% mortgage stress	Social Health Atlas
Infrastructure & services	<i>Mobility</i>	Number of vehicles per household	ABS census
		Number of dwellings without vehicle	Social health Atlas
		% of population near public transport	DoH
	<i>Water consumption</i>	Industry water consumption	North East Water
		Residential water consumption	North East Water, National Water Commission
	<i>Energy consumption</i>	Residential energy consumption	DSE
	<i>Accessibility of health and other services</i>	Access to pharmacies	PhARIA
		General Practitioners per 1,000 population	DoH
		Aged care places (high and low care) per 1,000 target population	DoH
		Social workers, psychologists, psychiatrists per 1,000 population	Social Health Atlas