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What would a climate-adapted settlement look like in 2030? A case study of Inverloch and Sandy Point

Final Report

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WHAT WOULD A CLIMATE-ADAPTED SETTLEMENT LOOK LIKE IN 2030?

A case study of Inverloch and Sandy Point

Monash University

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Disclaimer

The views expressed herein are not necessarily the views of the Commonwealth or NCCARF, and neither the Commonwealth nor NCCARF accept responsibility for information or advice contained herein.

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ABSTRACT

The issue considered by this research report revolves around the broad themes or questions such as: what are we adapting to?; who or what adapts?; and, how does adaptation occur? The challenge that these questions create is that the concept of an adapted settlement encompasses both 'visual' and 'process' dimensions. Therefore, there is a need to understand how the settlement will decide what it wants to look like in a climate adapted world, and how the settlement is going to achieve this successful adaptation response by (and beyond) 2030. Essentially, adaptation is not something that achieves an endpoint, but is ongoing and responsive to the various impacts that must be adapted to. Thus, there is a need for flexibility, and for adaptive capacity to be initiated and able to continue to change and evolve as required now and into the future.

To explore the research questions, a mixed methods approach was undertaken. The work was divided into four parts, each with different methodology emphasis. These parts and methodologies were:

Research part	Research methodology
Exploration of trends	Exploratory research (Stebbins 2001); Literature review; Surveys; Web feedback; Workshops; Focus Groups; Case studies
Community consultations	
Interstate workshops	
Achieving adapted settlements	Triangulation (Hamlyn 1971); Grounded theory that builds a model based on a real world situation (Glaser and Strauss 1999); Economic modelling

These parts represented different research approaches, both qualitative and quantitative in form, most of which could be understood as exploratory in nature. Exploratory research is a method of research in the social sciences that seeks better understanding of the issues at hand when there is not a lot of knowledge around the subject (Stebbins 2001). For the present research, the methodology was strengthened through the process of triangulation, where data was obtained from a number of data sources (Hamlyn 1971). For example, data was acquired from both community consultation and interviews with key community leaders. The findings from the Victorian case studies were then compared with the data from the interstate workshops.

This research found that commonalities were found in all locations. The adaptation process was only at an early stage in each location, and was being undertaken in an environment of considerable uncertainty. While engagement with the local communities was taking place, there was a common need for a structure to assist adaptation decision-making. Such a structure would enable community decisions to be included in adaptation action and would allow for better communication and integration between the community and various levels of government. This structure would help to promote the sharing of ideas and experiences to achieve the best possible pathways to adaptation. Common principles which could be shared with other similar Australian settlements generally related to the process to assist adaptation, as each local adaptation outcome will be largely place-specific. Drawing on the Inverloch community consultation, a visual representation of what the community expressed in relation to adaptation is presented. Applying knowledge gained in the research process, the research team provided a framework of adaptation tasks that would fit with the proposed governance decision-making structure. Further examination of the timing of the task of adapting infrastructure was undertaken, using an established economic micro simulation model and regional data bases.

EXECUTIVE SUMMARY

The issue considered by this research report revolves around the broad themes or questions such as: what are we adapting to; who or what adapts; and, how does adaptation occur? It provides an examination of what a climate-adapted Australian settlement would look like in 2030. A climate-adapted settlement is considered in terms of physical structure, as well as the processes that will assist in reaching adaptation and maintaining adaptation further through the century. While even the process of adaptation will evolve and change over time, this research looks at what is happening now, the settlement features and trends, and the forces facilitating and inhibiting the successful process of adaptation. The research examines adaptation at the local level, particularly the community response, local government and, to a lesser extent, how state government can facilitate adaption. Adaptation was viewed broadly, encompassing social, environmental and economic issues.

The objectives of the research are:

- What are/will be the challenges outside climate change faced by these case study settlements which will impact on adaptation, as the context in which climate change decisions will need to be made?
- What climate changes will be present in each of these settlements in 2030 and what trends will be in place for 2050 or 2070 (where this is available)?
- What is the community's vision of a climate-adapted settlement, what sort of settlement does the community want and how can wellbeing be maximised for all residents?
- How can this preferred settlement be achieved? Who makes what decisions about adaptation and where does responsibility lie?
    - What characteristics of a community will tend to facilitate or militate against successful adaptation?
    - When is the right time to make decisions in relation to the various areas and issues?
    - Where does local responsibility begin and end?
- What are the commonalities and differences of issues between the case study sites and can experiences be drawn from the interstate workshops?
- What are the principles which can be generalised from this research to small urban settlements throughout Australia?
- What have the research team learned about the adaptation tasks needed for Inverloch and Sandy Point to be adapted in 2030? What would be the economic, social and environmental impacts of an extreme event on Inverloch and Sandy Point?

To explore the research questions, a mixed methods approach was undertaken. The work was divided into four parts, each with different methodology emphasis. These parts and methodologies were:

Research part	Research methodology
Exploration of trends	Exploratory research (Stebbins 2001); Literature review; Surveys; Web feedback; Workshops; Focus Groups; Case studies
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These parts represented different research approaches, both qualitative and quantitative in form, most of which could be understood as exploratory in nature.

Exploratory research is a method of research in the social sciences that seeks better understanding of the issues at hand when there is not a lot of knowledge around the subject (Stebbins 2001). For the present research, the methodology was strengthened through the process of triangulation, where data was obtained from a number of data sources (Hamlyn 1971).

Two small Victorian settlements, Inverloch and Sandy Point, were used as case studies to examine the present situation and trends in the community, as well as the projections in relation to climate change, by 2030 and beyond. A community consultation was held in each settlement, using a Grounded theory methodology, to understand the views and issues important to the local community. Data was also acquired from interviews with key community leaders. The project also sought to understand how other parts of Australia are managing the adaptation process, whether issues revealed in the two case study sites are similar to those found in other states, and whether broad principles can be drawn. Hence, workshops were organised in South Australia, Tasmania and Western Australia, and roundtable discussions were held to share findings about the adaptation process. Further examination of the timing of the task of adapting infrastructure was undertaken, using an established economic micro simulation model and regional data bases.

The findings to the objectives listed above can be summarised as follows. The research found that there were a number of dominating trends in Inverloch and Sandy Point which will influence adaptation. These trends included population growth and accompanying housing developments which were felt to be placing the form and experience of the settlement at risk. They also included issues relating to an ageing population, pockets of disadvantage and financial stress in Inverloch and an economy significantly based in tourism. Neither the communities nor the individuals consulted were able to form a vision of what an adapted settlement would look like in 2030. The participants viewed the adaptation process as more short term and incremental, dealing with issues around quality of life as they presented, rather than moving towards a defined longer-term outcome.

The community consultations raised the issue that the adaption decision-making process, in terms of when to adapt and who makes the decisions, is unclear. Indeed, where the community wished to make a decision, there was not a transparent process to instigate this decision. In many situations, the Inverloch community felt disempowered as they believed that often their views were overlooked, whereas the Sandy Point community became more active and forceful to achieve their goals. Those who were consulted in both settlements were keen to participate in their local adaptation process.

The absence of a vision or an adaptation outcome was also reported in the interstate workshops. Indeed, little attention has been given to what comprehensive adaptation entails, the majority of attention being given to the issue of sea level rises. While some states were developing scenarios of possible outcomes as a means of understanding adaptation choices, the choices were based more on values of what was important now, rather than a direction or vision of what could be. Many other issues did not feature, such as: the impact on business and the local economy and the specific impact on various groups in the community (such as those already experiencing social exclusion). Maintaining biodiversity and ecosystem services and the responsibilities around this was particularly over-looked. Similarly, local responsibility for places/characteristics of national importance, such as migratory bird habitats, was not on the local agenda in the case study sites, nor in the communities discussed in the interstate workshops.

The research found that all sites were in the early stages of the adaptation process and in a learning phase. While all sites were approaching adaptation slightly differently, there were commonalities in many of the issues they were facing. The importance of consulting with the community was understood, but there was a lot of uncertainty around this, particularly around decision-making, the take-up of community ideas and legal liability, as well as the size of the adaptation task and lack of resources (information and funds). The workshop in Tasmania reported an absence of a structure to instigate adaptation decisions at the community and local and state government levels. The Western Australia workshops reported the development of a governance structure in one region and the South Australia workshop reported the use of a pre-existing structure to manage the adaptation process across the state, although this was reported as not yet fully engaging local communities.

This report recommends improvement in the process of decision-making with the community. A governance structure is proposed that coordinates, enables, promotes and finances a large part of the adaptation process. This structure would facilitate a bottom–up and top–down process of decision-making. Such a structure would identify and address gaps, enable access to the adaptation knowledge and experience of others, and facilitate both the process and evaluation of knowledge development. The findings from this research suggest that adequate resourcing is critical to a good adaptation outcome but is not currently in place.The group would have its own office and resourced administrative support as well as a secure operational budget. This group was named during the Inverloch community consultation, as ‘The Voice of Inverloch’.

The adaptation role for local government in all sites was presented as being very large, and often unsupported and confusing, especially in relation to the considerable volume of information they were receiving, not necessarily in a useful form. There was great uncertainty about decision-making expressed by the community, in the personal consultations and in the interstate workshops. This was also felt to be a barrier for action at the state government level. It was unclear who should be making the adaptation decisions: whether they should be made at the community level or by government. However, the communities were commonly viewed as strong and resourceful, especially by many of those in the individual consultations.

The research team examined two aspects of the adaptation task ahead. Tasks for adaptation and suggestions about the distribution of decisions among individuals/households, local organisations, council, regional organisations and state government, were offered as a possible framework to understand the adaptation process. In the second piece of work, infrastructure costs were modelled for two extreme events: water inundation in Inverloch, and fire at Sandy Point. Three adaptation options modelled were: adaptation investments and no insurance; no adaptation and insurance by households and local government; and no adaptation and no insurance. Interestingly, the findings again depended heavily on value judgements and local decisions about the relative importance of the present versus future generations and the spread of costs over time, as well as among those impacted and not impacted by the extreme event. Tentative conclusions found that in Sandy Point the no investment and no insurance option cost more than if adaptation had occurred. In Inverloch, the case for deferment of adaptation could be argued if future savings were to be used for present abatement costs. However, a decision made on a case by case basis is preferable, one which takes values and the psychological impact of an extreme event into account and which also factors in the loss of ecosystem services, especially in a tourist or lifestyle-based economy.

1. INTRODUCTION, AIMS AND OBJECTIVES

1.1 Overview

This project provides an examination of what a climate-adapted Australian settlement would look like in 2030. What is the adaption to; who or what adapts; how does adaptation occur; and, how do we monitor and evaluate adaptation action to determine if it is successful? The project broadens the scope of this question beyond the narrow base that has been considered to date. For example, Leitch and Inman (2012) note that, until very recently, there have been few studies of perceptions of sea level rise either in Australia or internationally. Perceptions of sea level rise determine how people make decisions about both 'chronic' and 'crisis' coastal issues, including protection of property and preparedness for coastal natural disasters. The project moves the focus away from major urban areas, which have been the target of recent thinking, to regional and rural Australia, to begin to understand the adaptation process for smaller settlements. The project considers many of the risks and challenges associated with climate change, such as understanding the 'everyday adjustments' that people and local communities will need to make to better cope with climate change and the type of challenges faced in an extreme event. This issue is explored through a critical examination of two case study sites within the Gippsland region of Victoria: Sandy Point in the South Gippsland Shire and Inverloch in the Bass Coast Shire.

The concept of an adapted settlement encompasses a visual idea and a process idea; therefore, there is a need to understand how the settlement wants to look and how the settlement is going to achieve a successful adaptation response. The task of this project is to understand what adaptation success would look like in an Australian coastal settlement in 2030. However, the research team notes that the changes likely to be experienced as a result of the climate change already set in train (by the amount of CO_2(e) emitted to date) will extend well beyond this 17-year timeframe. Indeed, the major changes are likely to occur later in the century. Essentially, adaptation is not something that achieves an endpoint, but is ongoing and responsive to the various impacts that must be adapted to. Thus, there is a need for flexibility, and for adaptive capacity to be able to continue to change and evolve as required over the next 100 years and beyond.

What a climate-adapted settlement would look like in 2030 is considered in terms of physical structure and the more hidden processes that will assist in reaching this point and maintaining adaptation further through the century. While even the process of adaptation will evolve and change over time, this research looks at what is happening now, the settlement features and trends, and the forces facilitating and inhibiting the successful process of adaptation.

There is no simple answer to these questions, as the influencing forces are complex, interrelated and nonlinear, and operate in feedback loops. System thinking is required, encompassing reflective thinking and no one set approach, and assumptions must be queried. Holistic thinking is necessary and boundaries must be defined so that appropriate action can be taken. There is a need to understand the trigger points and the positive and negative feedback loops (Ison 2010). The final appearance of a climate-adapted settlement will depend on many factors, including a vision of the future, the impact of climate change, who makes the decisions and at what point, and the nature and extent of other trends, including the external drivers. This will also be impacted by the present state of the community and the interface between how uncertainty is treated and risk understood.

While the two case study settlements present particular sets of economic, social and ecological challenges, they are not unique in facing new challenges associated with climate change. Therefore, the project's findings should be relevant to other similar settlements across Australia. These settlements will be used as a comparative case study with a view to generalising the findings for a national approach. The settlements were chosen as they were able to represent different characteristics to enable researchers to understand the relative importance of local variations to the form of the settlement in 2030 and the extent of broad principles which can be elicited and generalised regardless of varying local attributes.

Research on adaptation in Australia has largely concentrated on what needs to be done to adapt, with responsibility mainly being given to local government (e.g. Department of Climate Change and Energy Efficiency 2010; Pradhan and Shrestha 2012). There is a lot of work on scenarios and the choices that need to be made (e.g. Wiseman et al. 2011).There is very little work on how these choices are being made, and who is making value judgements and the highly complex decisions regarding responses and priorities. Adaptation tends to be viewed as a separate 'add-on issue' rather than an issue which needs to be embedded in all parts of society and the economy, and integrated with the other social, economic and environmental trends that are taking place. There are present changes in population sizes and structure, concerns about the manufacturing and agricultural sector in Victoria, and a significant trend of species collapse, for example. Thus, adaptation needs to take place in a dynamic setting and in the context of other evolving issues. There are knowledge gaps about what adaptation is occurring on the ground, what people understand about the need to adapt to climate change and the conditions that assist or hinder adaptation.

The project aims to develop place-based understanding of local and regional adaptation responses within the broader context of regional and national adaptation strategies. Differences in terms of socioeconomic and biophysical contexts will have a significant impact on each settlement's vulnerability; that is, the character, magnitude and rate of climate change and the sensitivity and the capacity to adapt (Parry et al. 2007). Townships and their surrounds within this region are already exposed to extreme climate events, including coastal and inland flooding, bushfires, extreme temperatures and drought (Brooke and Hennessy 2005). Moreover, demographic shifts in this region have led to increased pressures on local infrastructure, which will only be exacerbated by climate change (Harvey et al. 2004). Local councils and communities are well placed to determine needs and vulnerabilities as well as the most appropriate adaptation measures, and to ensure these are effectively integrated with local and regional programs and strategies (Marsden, Jacob Associates et al. 2006).

The project objective, as outlined, is to better understand what has been described as a 'wicked problem' (Conklin 2005). This refers to a problem that is difficult to resolve because of complex interdependencies, where solving one issue may reveal others, often knowledge is not complete or may be contradictory, and the situation may change. Usually, many stakeholders are involved and resolution may depend, not so much on more or better governance but on new forms and systems of governance. Past ways of operating will not necessarily assist in solving new challenges, as the new challenges overlaid with climate change present issues very different from the past.

The project seeks to understand how other parts of Australia are managing the adaptation process and if issues revealed in the two case study sites are similar to those found in other states. Hence, workshops were organised in South Australia, Tasmania and Western Australia, where roundtable discussions were held to share findings about the adaptation process. This was undertaken to determine whether universal or general principles may be formed for facilitating the adaptation process

and achieving the best form of adaptation possible, or whether the adaptation process is very different according to location.

The project team endeavoured to understand further the reality of the task ahead for Inverloch and Sandy Point, drawing on knowledge gained about the settlements and the research team's expertise. Also considered was how an extreme event might impact on the two case study communities, in particular, the economic and social impacts and the effect on the structural environment. This work illustrates the reality of an extreme event and the sort of decisions that have to be faced to adapt to this possibility in the best possible way. This work used a well-established economic model to examine the local and wider impacts of a severe flood at Inverloch and a severe fire at Sandy Point.

The research team was formed as a microcosm, reflecting the sort of integrated work needed to produce successful adaptation. A multi-discipline, multi-sector project team worked together to successfully complete the project.

1.2 Research aims and objectives

As noted above, there is a large literature on adaptation. This can be contrasted to observational and anecdotal evidence that there is not a lot of adaptation taking place on the ground. This project intends to shed light on whether this is so in practice at the local level, and why. It explores the issue of just what is being aimed for in adaptation and what outcomes are desired. Indeed, consideration of the characteristics of a climate-adapted (or climate-adapting) settlement includes the questions first raised by Smit and colleagues in 2000:

- What is the adaption to?
- Who or what adapts?
- How does adaptation occur?
- How do we monitor and evaluate adaptation action to determine if it is successful?

In the context of little observable adaptation occurring in small Australian settlements, some additional questions might be asked in order to better understand what is happening now and to provide some thoughts on what should be happening to achieve successful adaptation.

The aim of this project is to shed light on what a climate-adapted settlement would look like in 2030. This question is considered in the context of an integrated approach to environmental, social and economic issues and the current situational challenges of the case study settlements. The question also incorporates consideration of what needs to be done to achieve this vision of a climate-adapted settlement. As noted above, the question is taken as considering an 'adapting' settlement as adaptation is an ongoing process rather than a single endpoint.

To successfully address this question, there are a number of component objectives or question to which answers need to be sought. These are:

1. What are/will be the challenges outside climate change faced by these case study settlements which will impact on adaptation? as the context in which climate change decisions will need to be made?

2. What climate changes will be present in each of these settlements in 2030 and what trends will be in place for 2050 or 2070 (where this is available)?
3. What is the community's vision of a climate-adapted settlement, what sort of settlement does the community want and how can wellbeing be maximised for all residents?
4. How can this preferred settlement be achieved? Who makes what decisions about adaptation and where does responsibility lie?
    a. What characteristics of a community will tend to facilitate or militate against successful adaptation?
    b. When is the right time to make decisions in relation to the various areas and issues?
    c. Where does local responsibility begin and end?
5. What are the commonalities and differences of issues between the case study sites and can experiences be drawn from the interstate workshops?
6. What are the principles which can be generalised from this research to small urban settlements throughout Australia?
7. What have the research team learned about the adaptation tasks needed for Inverloch and Sandy Point to be adapted in 2030? What would be the economic, social and environmental impacts of an extreme event on Inverloch and Sandy Point?

1.3 Location of case study settlements

The maps in Figure 1.1 locate the two case study settlements examined in this project. Inverloch is located on the coast, 160 km from Melbourne. The township adjoins Anderson Inlet, a shallow marine estuary at the mouth of the Tarwin River. Sandy Point is located approximately 200 km from Melbourne on the coast 40 km south of Leongatha, on the western side of the approaches to Wilsons Promontory. Sandy Point lies between Waratah Bay and the marine estuary of Shallow Inlet. An aerial view of Inverloch and Sandy Point is shown in Figures 1.2 and 1.3.

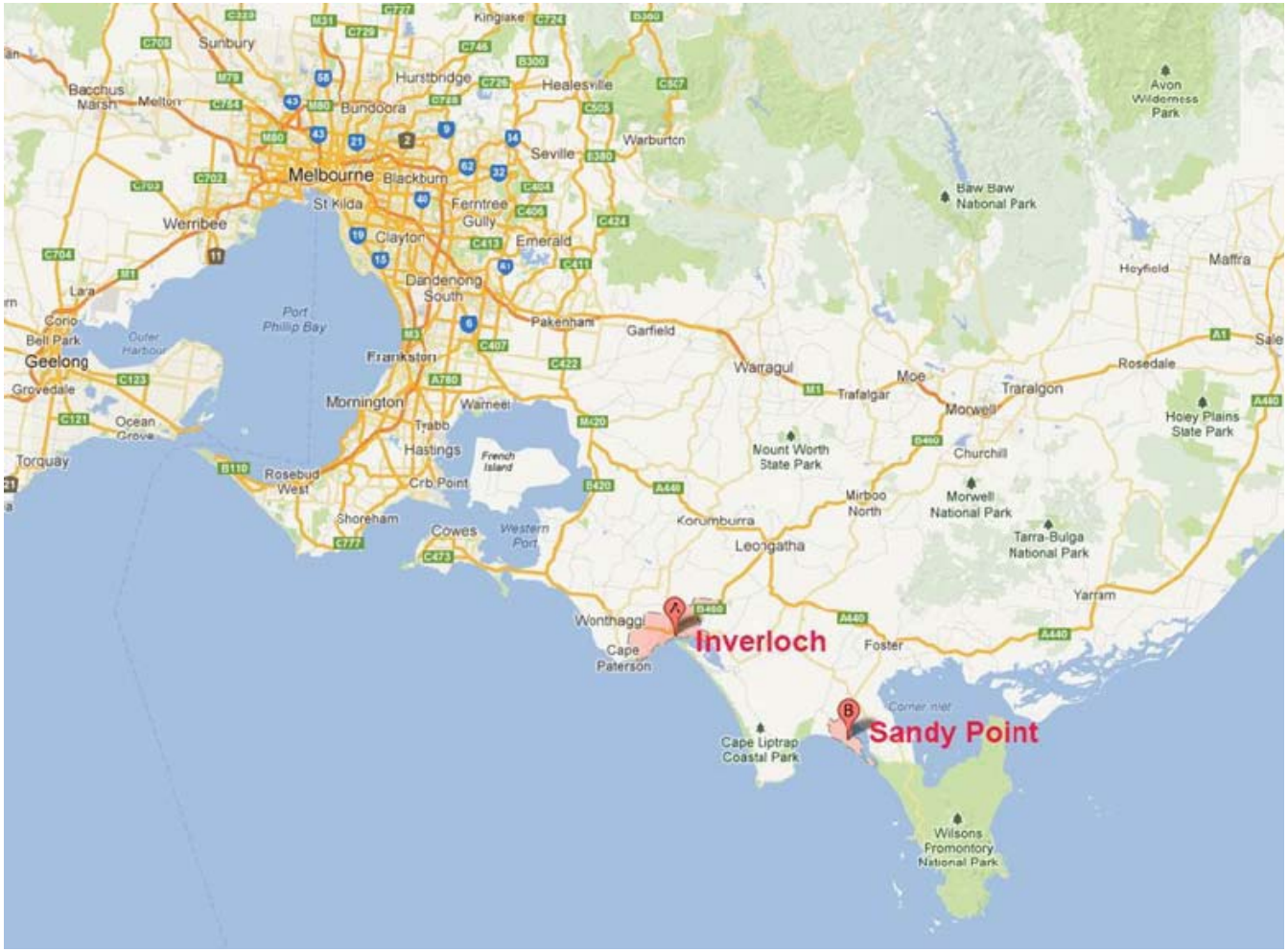

Figure 1.1: Location of two settlements in Gippsland and location of Gippsland in Victoria (Source: Google Earth)

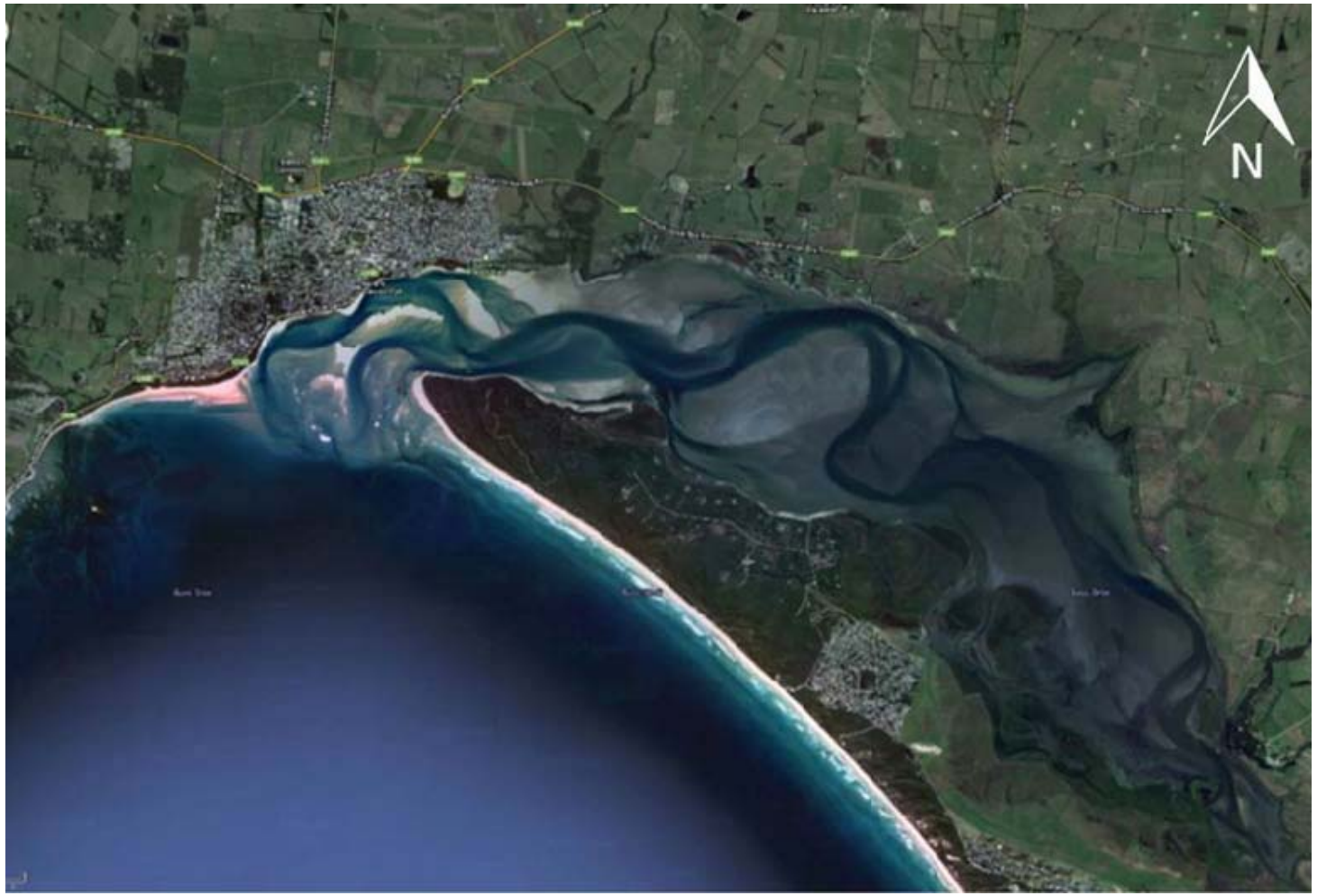

Figure 1.2: Areal view of Inverloch and surrounds (Source: Google Earth)

Figure 1.3: Areal view of Sandy Point and surrounds (Source: Google Earth)

2. RESEARCH ACTIVITIES AND METHODS

2.1 Approach

In seeking to determine what a climate-adapted settlement would look like in 2030, this research considered this vision from a local perspective. The project endeavoured to understand not only how the settlements would appear visually, but the process to achieve this state of adaptation. Thus, the research explored issues such as how successfully this challenge was being met locally by the community, how social, economic and environmental climate change trends were being integrated for successful adaptation, whether these findings were similar to experiences elsewhere in Australia and the challenge of an impact of an extreme event to achieving successful adaptation.

To explore the research questions outlined in Chapter 1, a mixed methods approach was undertaken. The work is divided into four parts, each with a different methodology. These parts are: exploration of trends; community consultations; interstate workshops; and the task to achieve adapted settlements. These parts represent different research approaches, both qualitative and quantitative in form, most of which could be understood as exploratory in nature. Exploratory research is a method of research in the social sciences that seeks better understanding of the issues at hand when there is not a lot of knowledge around the subject (Stebbins 2001). For the present research, the methodology was strengthened through the process of triangulation, where data was obtained from a number of data sources (Hamlyn 1971). For example, data was acquired from both community consultation and interviews with key community leaders. The findings from the Victorian case studies were compared with the data from the interstate workshops.

The aim of qualitative research is to understand and represent the experiences and perspective of people as they encounter, engage and live through situations (Elliott et al. 1999). The central purpose is to enrich understanding rather than verify earlier conclusions or theory. Quality principles were applied to this research in order to maximise the quality of the work. For example, the researchers made it clear to the research participants who they were, the purpose of the research and their desire to understand their point of view, and offered opportunities for comments and feedback throughout the course of the project. This provides creditability checks. A website was established and the location advertised where the project team and materials produced were accessible. Feedback was encouraged, and was received. The summary of the findings of the community consultations were made available and transcripts of the workshops sent to the interstate participants. Similarly, it is made clear to the reader of this report who the research participants were and the voices of the participants are often given. The verification of data from a couple of sources supported the research findings and the findings were coherent and made sense to readers.

Results reported in Parts 2 and 3 of the report used a grounded research method of qualitative research. Grounded theory was first developed by Strauss and Glasser in the 1960s and is a frequently used methodology in qualitative research. Grounded theory is seen as ‘a powerful methodology’ when the aim is to build a theory or a model that is based on a real world situation (Glasser and Strauss 1999). A strength of grounded theory is that is reveals how people think, how they act in a certain context, why they act this way and the consequences of the actions (Kinnunen and Simon 2013). The method seeks to unravel the ‘elements of experience’, to enable the researcher to understand the nature and meaning of an experience of a particular group of people in a particular setting (Moustakas, 1994, p. 4). Thus, the research

seeks to explore an issue rather than entering the research with a preconceived hypothesis. Moustakas provides an overview of the grounded research process, drawing on Packer and Addison (1989), where grounded researchers:

- question gaps in the data, seeking information on what influences and directs the people and situation being studied;
- follow an open process of research rather than a fixed method;
- recognise the importance of context and social structure; and
- undertake an inductive process, where theory grows out of the data.

The project methodology also drew on a case study design that has the aim of bringing out the details from the viewpoint of the participants by using multiple sources of data (Tellis 1997). The case study does not rely on sampling research, but, rather, follows a holistic approach where participants are maximised, given the research time and resources (Yin 1993). This research used the case study design to explain complex causal links in real-life interventions and to describe the real-life context in which the intervention has occurred (Yin 1993; Verschuren 2003). The sources of data used in this case study research were: documentation (used to understand trends that impact on the communities), interviews, direct observation, participant observation (used in the consultations) and quantitative data (such as in the population trends for the communities) (Yin 1994). The latter is viewed as a legitimate component of the case study method, where appropriate (Verschuren 2003).

Monash University Human Research Ethics Committee gave ethics approval for the conduct of this research (approval number CF12/1655 – 2012000894).

2.2 Parts of the Research

2.2.1 Part 1: Understanding the trends

Part 1 addresses two research questions:

1. What are/will be the challenges outside climate change faced by these case study settlements, which will influence the adaptation process. as the context in which climate change decisions will need to be made?
2. What climate changes will be present in each of these settlements in 2030 and what trends will be in place in 2050 or 2070?

The first question was addressed through an exploration of the available documentation and other resources, including brief consultation with people within the communities, as well as analysis, which synthesised the material using an expert in the particular field. Information was gained about past and future trends relating to the following domains: regional economic base (agriculture, industry, tourism and services); income distribution; population trends (size and structure); education; housing and land-use planning; infrastructure (transport, services); environmental health and challenges, including biodiversity and ecosystem services; population wellbeing, health and equity; sense of community, environmental amenity, social capital, participation, social inclusion; cultural and historical issues; and governance and political engagement.

Details of this work were compiled in: *Discussion Paper 1: The Present Environmental, Social and Economic Situation and Trends in Inverloch and Sandy Point and Surrounds*; in complementary reports, *Uptake of Renewable Energy in Bass Coast and*

South Gippsland Shires and *An Ecosystem Services Approach to Climate Change Adaptation: Case-studies of Inverloch and Sandy Point*, *Victoria*; *Sandy Point Profile – People 2006, 2011 & 2031*; and in *Inverloch Profile – People 2006, 2011 & 2031*. This material was made available on the project website.

The second research question was addressed by two leading climate scientists. Projected climate changes were ascertained for south-eastern Victoria, drawing on the work completed by the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO) and the *Intergovernmental Panel on Climate Change* (*IPCC*). This included projections of the impact of a changing climate on temperature (day/night, land/sea and increase in the number of hot and cold days); rainfall changes (seasonality, location, volume and severity of downpour); rise in sea level; ocean acidification; weather extremes; and evaporation rates. Again, this information was placed on the project website.

2.2.2 Part 2: Community consultations

Part 2 of the research address the following two research questions:

- What is the community's vision of a climate-adapted settlement, what sort of settlement does the community want and how can wellbeing be maximised for all residents?
- How can this preferred settlement be achieved? Who makes what decisions about adaptation and where does responsibility lie?

These issues are explored in case studies of two settlements in Victoria, Sandy Point and Inverloch. These localities were chosen to reflect both the points of comparison and differentiation. This comparison enabled the researchers to understand the relative importance of local variations to the form of the settlement in 2030, and the extent of broad adaptation principles that can be elicited regardless of varying local attributes. Although small, Sandy Point was chosen as it is likely to represent approximately 800 small towns around Australia with permanent populations of between 200 and 500 people. These are not necessarily located on the coast, but similar issues will be faced by other tourist destinations, such as communities associated with national parks and alpine areas. These small communities face many challenges arising from climate change, often as an extra complication imposed on existing difficulties associated with rural decline, isolation and an ageing population, particularly if they are favoured as retirement destinations.

Like many similar small townships, the appeal of Sandy Point is in its proximity to a natural environment. The populations of both Sandy Point and Inverloch substantially increase over the peak tourist season. There may be a question as to the viability of these small towns with the added stress of climate change. Also of concern is the impact on the tourism industry. The projected higher temperatures will place such small towns at increased risk of wildfire. The biodiversity value of such areas is high. The choices between fire protection measures and the desire to maintain as much of the bush environment as possible will impact on the appearance of these towns by 2030. Inverloch is a larger settlement with a much closer travelling distance to the large urban centre of Melbourne.

These issues were addressed through community consultations held at Inverloch and Sandy Point. As the first consultation was planned in Inverloch, initially an attempt was made to attract a wide diversity of participants by sending an invitation from the local shire council, with names randomly selected from the electoral role. This was

supplemented by invitations through community welfare groups in order to also include those residents in rental properties who might not be on the electoral role. It was hoped this consultation would interest both permanent and non-permanent residents of Inverloch. However, the response was very low, so an alternative method of invitation was used for both community consultations. It was recognised that the timing of mid-winter for the consultations was not ideal, as those with holiday homes in the settlements were not likely to be in residence. This is not unusual in quantitative research, with researchers typically having to select their samples from the accessible population rather than from the target population (Johnson and Christensen 2004).

In the alternative engagement approach, the conferences were widely advertised through the disbursement of posters and brochures around the town, in local cafes, the supermarket, and estate agents. Advertisements were placed in the local papers, and notification was made by the local shire councils, including a notice on their web pages. Notices were placed on Facebook pages, although not many were available in these two settlements. Some letter boxing was done. Approximately 400 personal email invitations were sent out to individuals and to all known community groups. The community groups were asked to spread the invitation through their membership. On expression of interest, people were sent an information page about the consultation and a summary about local climate change impacts.

During the community consultations, more information was given to the participants on the consequential impacts of climate change on the economy, on people and on the environment. The impacts were described in the context of the background conditions and trends impacting the two settlements. Participants then took part in large and small group discussions. The consultations with the community lasted from 10am to 3pm, on a Saturday, with a provided lunch break. The Inverloch consultation was attended by 43 participants, plus 10 people from the research team. The Sandy Point consultation had 18 local residents attend, two people from local and state government and five members of the research team.

These community consultations were complimented by 24 individual consultations with community leaders and those in local decision-making capacity. This number of conversations was seen as broadly representing the range of expressed views. They lasted between 20 minutes and 1 hour and were conducted by telephone or face-to-face. The individual conversations were targeted at community leaders, many of whom were employed in local government but who were asked to respond giving their personal view on the issues. While there was a broad structure to the information being sought and some prompt questions for the interviewers, individuals were also invited to comment on issues they saw as relevant.

2.2.3 Part 3: Interstate workshops

Part 3 examined the following research questions:

- What are the commonalities and differences of issues between the case study sites and what experiences can be drawn from the interstate workshops?
- What principles can be generalised from this research to small urban settlements throughout Australia?

These questions were explored in workshops held in Western Australia (WA), Tasmania and South Australia (SA). The WA workshop was held at the Shire Offices of Mandurah, a major developing regional location 72 km south of Perth, WA (Figure 2.1).

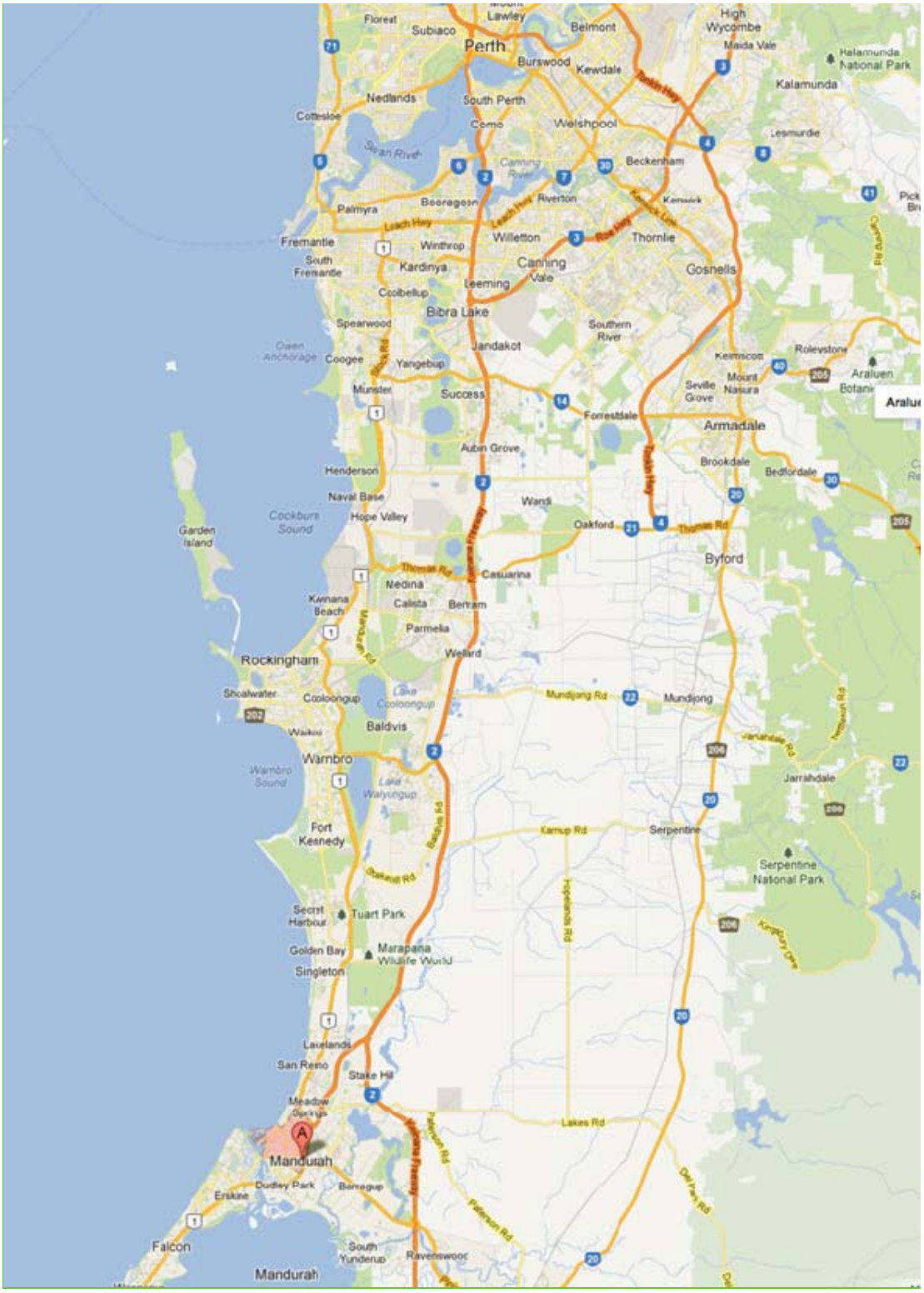

Figure 2.1: Location of Mandurah in relation to Perth, WA (Source: Google Maps)

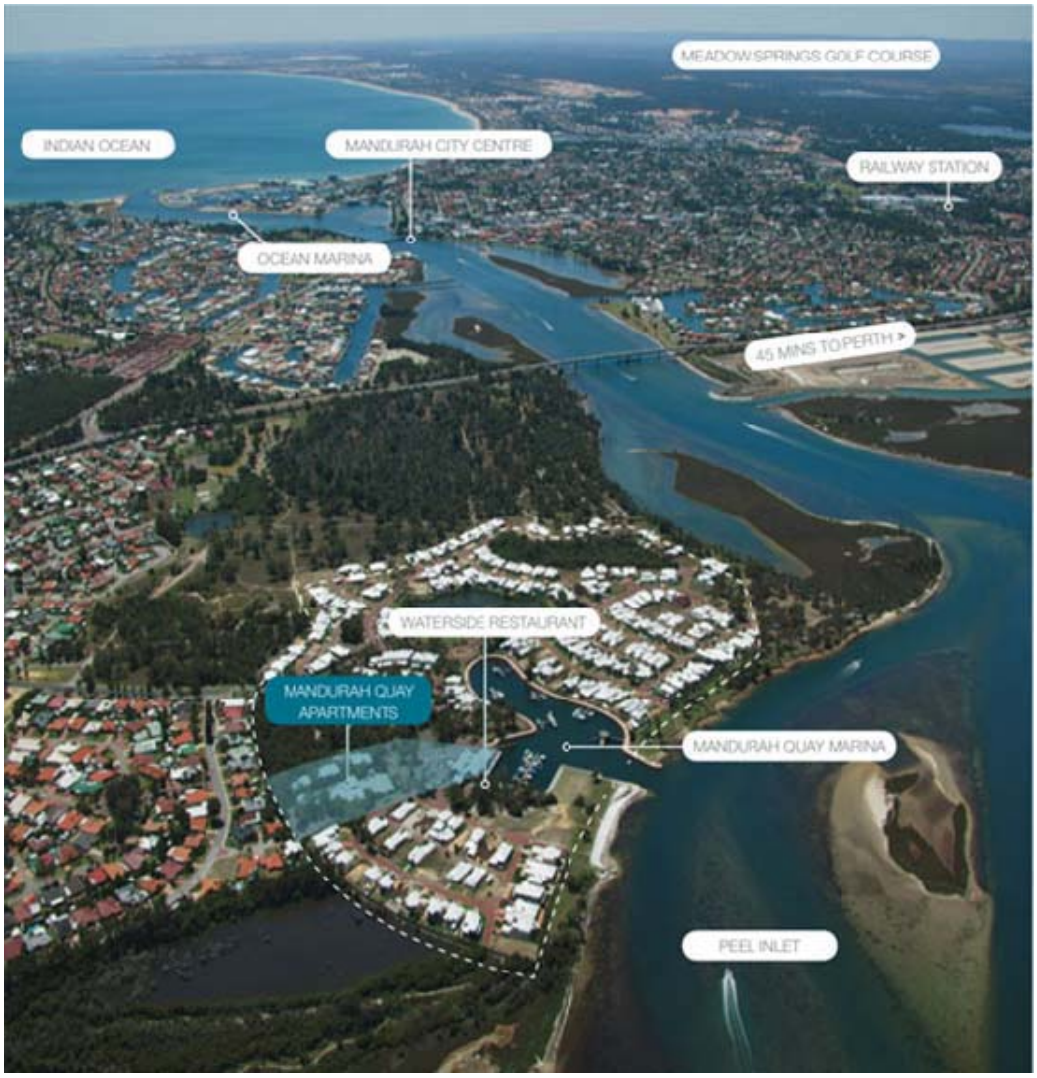

Figure 2.2: The settlement of Mandurah (Source: Google Maps)

Although Mandurah is larger than the Victorian settlements, it was chosen because the local council had been very active in adaptation over the past few years. In contrast, the project team was told that the smaller settlements in WA had not yet begun the adaptation process. Located along an estuary and once a fishing village, Mandurah has a population of 74,000. The local council is of the view that this population may double by 2030. It is a tourist town as well as a 'sea-change' area for retirees, located on the side of an inland sea and estuary systems. The centre of the town has recently undergone revitalisation, and there are significant urban developments, including a canal-based housing development on the coast. Thus, although considerably bigger than Inverloch and Sandy Point, Mandurah contains some similar features and trends to these settlements (Figure 2.2). The Tasmanian workshop was held at the Office of Premier and Cabinet, Hobart, Tasmania. The workshop in SA was held at the Department of Environment, Water and Natural Resources, Adelaide, South Australia, the department that oversees adaptation.

A key liaison person in each state who had a central state role in adaptation was invited to facilitate the workshops, to advise the research team on workshop locations and to recommend who should attend. Formal invitations were sent out by the research team and almost all people accepted the invitation, with the exception of representatives from not-for-profit community-based organisations. This was despite an offer to cover attendance costs. While the workshops were restricted to 20 attendees to facilitate discussion, they involved wide representation from government, local government, consultants and academics.

The workshop in WA comprised three senior state government staff, six staff from local government, one academic from Curtin University and five members of the project team. The Tasmanian workshop comprised: seven people from the Department of Premier and Cabinet, which oversees adaptation; two people were from the Tasmanian Planning Commission; two people were consultants to government; one person was from the Local Government Association of Tasmania; one person was from local government; and two people were from the University of Tasmania. The workshop in South Australia included four staff from the Department of Environment, Water and Natural Resources, two people who had regional responsibility for climate change, and a person from the University of SA. Four or five representatives from the research team were present at each of the workshops, comprising a mix of state government, local government, academic researchers and consultants, as well as a Gippsland community group.

The research team produced a background report for the interstate workshops to inform them of the project team's findings up to the time of the workshops. The workshops lasted approximately 4 hours and were chaired by members of the research team. The workshops had the aim of understanding the hosts' experiences of the local process of adaptation, and during the workshops the following was discussed:

- a vision of an adapted settlement in 2030;
- the local process of adaptation and the similarities and differences to that found in the Victorian case studies, particularly in relation to the role of the community in decision-making;
- the national implications of the research and where the interface lies between national principles and local features and attributes; and
- issues that the workshop host would like to raise.

The information from the workshops was digitally recorded and professionally transcribed for a theme-based analysis.

2.2.4 Analysis of data from the community consultations and the workshops

There is no 'right way' of undertaking data analysis for qualitative research and grounded theory methodology (Kinnunen and Simon 2013). This provides for strengths in that the researcher can adapt his or her approach to best interrogate the data, but disadvantages in that analysis takes time and reporting space, and readers may be unfamiliar with the method. The research team decided not to electronically record the community consultations as there was a risk that this would inhibit the expression of personal views, so manual recording of key points was undertaken by appointed scribes (Joyce 2011). The identity of those involved in the group and individual discussions has been kept confidential. This has a disadvantage in that narrative voices do not come through as strongly in the community consultation findings in

comparison to the workshops. The decision was made to allow the voices to come through in the reporting of the results of the workshops, so representation of the participants' views is visible.

Analysis in this research was undertaken through the selection of categories of information that emerge from the data via systematic categorisation and interpretation (DiGangi et al. 2011). The researchers drew on the detailed personal note-taking and notes from the scribes appointed for the large and small group discussions, in each of the community consultations. The community consultation findings were sent to all participants for verification and amendment where needed. Transcriptions of recorded information and researcher notes were drawn on for analysis of the workshop data. The data was organised to display themes, patterns, connections and omissions, also noting the other data around the topic to further understand the participant's position (DiGangi et al. 2011; Chenail 2012). There is a requirement for the researchers to be conscious of their own preconceptions in this work so as not to bias the findings. Quotations were selected to illustrate the themes and to allow the reader to gain greater understanding of the chosen theme and, where possible, the spoken voice.

Knowledge generated this way should not be used for generalisation to the population, in this case all residents of Inverloch and Sandy Point; rather, the findings apply to the particular group, location and context of those who attended the community consultations (Onwuegbuzie and Leech 2010). The findings and subsequent theories need to be tested more formally in new research. In the shorter term, ongoing contact by some research team members is continuing to take place in Inverloch to further develop the research findings.

2.2.5 Part 4: The task of achieving adapted settlements and Part 5: Economic modelling

Given the intense work done in the two case study areas of Inverloch and Sandy Point, and the expertise of the research project team members, some professional opinions from team members were provided to illustrate the adaptation task ahead of these settlements. This work offers further insight into the research questions:

- What is the community's vision of a climate-adapted settlement, what sort of settlement does the community want and how can wellbeing be maximised for all residents?
- How can this preferred settlement be achieved? Who makes what decisions about adaptation and where does responsibility lie?

The work comprised:

1. A visual presentation of the vision of Inverloch as an adapting settlement, as expressed by the participants at the community consultation and interpreted by the researchers. A representation of Inverloch and surrounds and a view of the central town area were compiled.
2. A matrix of tasks needed to be undertaken to realise an adapting settlement by 2030, including who should undertake these tasks. This was compiled drawing on many sources: climate change challenges as defined in Part 1 of the research, knowledge and expertise of the local area and knowledge from a review of the literature.

3. Modelling which looks at what the impact would be of a major extreme event on the two settlements.

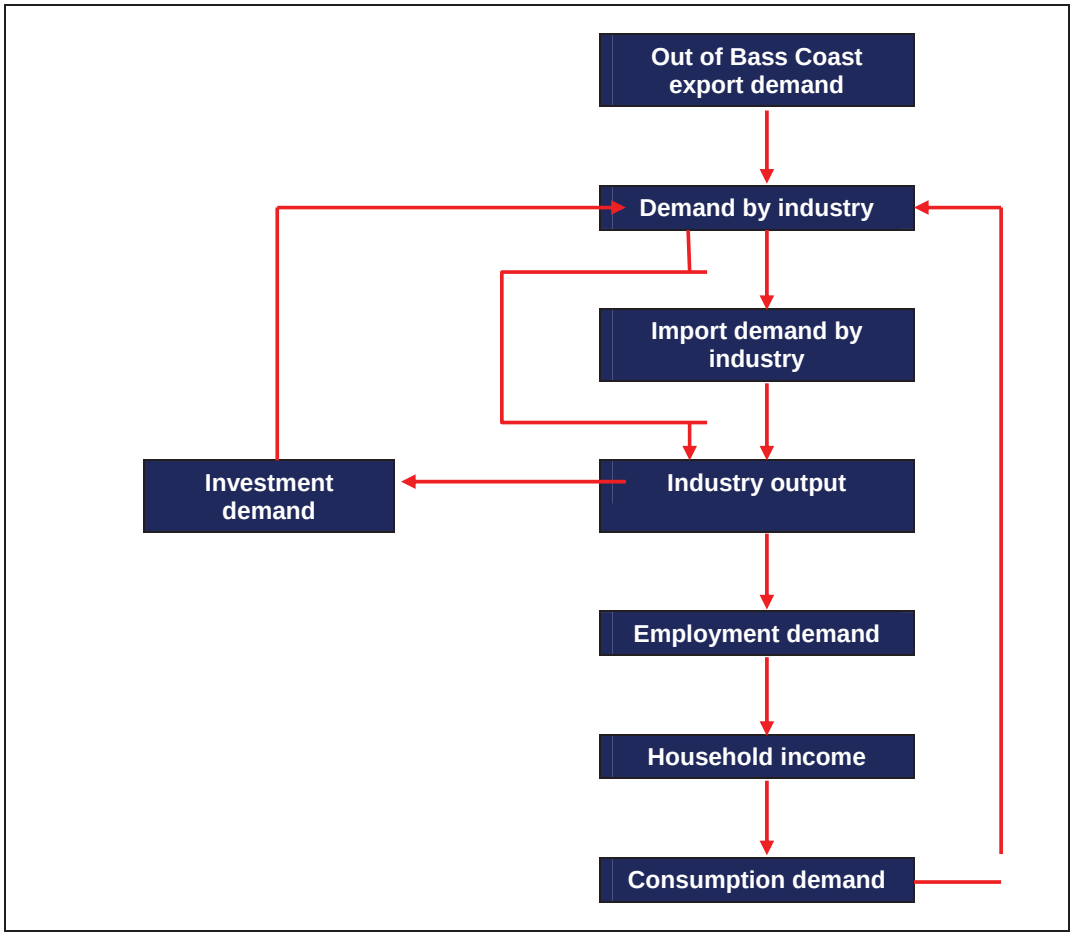

Figure 2.3: The modelling framework for Inverloch and surrounds

This impact of a severe event (flooding in Inverloch and fire in Sandy Point) was examined using an econometric model developed by the National Institute of Economic and Industry Research (NIEIR). Details of the NIEIR model are provided in Appendix 1. In brief, the modelling framework is a standard dynamic input–output model for the Bass Coast Local Government Area economy. There are 49 industries in the model. There is a household income formation segment and consumer demand and investment formation equations. The model is used in conjunction with the Monte Carlo simulation to calculate the probability density function outcome for key indicators, such as gross regional product and employment.

3. CONTEXTUALISED LITERATURE AND THEORY

3.1 Approach to the literature

As outlined in the methodology, this research adopts a mixed method approach, encompassing both quantitative and qualitative techniques. This chapter provides a literature review that establishes the context for the research work. There is some controversy regarding the role of theory when applying the grounded theory approach (Glaser 1998; Dunne 2011). In brief, the divergent views relate to whether a full literature review should be completed prior to the data collection phase, or whether it should take place, as appropriate, throughout the course of the research. This research takes a middle ground, where an early review is undertaken of the research question, and the subsequent findings, as they evolve, are discussed in the context of the literature. As the qualitative research is exploring the nature and meaning of an experience of a particular group of people in a particular setting, the most relevant literature may not actually be known prior to the data collection. Thus, the Discussion section of this report also draws on theory and perspectives from the literature as it relates to the emergent research findings, in order to build knowledge in the field (Stern 2007).

3.2 Adaptation to climate change

3.2.1 Climate change

Pearce and Le Page (2008) point out the difficulty in predicting climate change in the shorter term. According to Pearce and Le Page, since the 1960s, 90% of the excess heat due to greenhouse gases has gone into the oceans and they believe that the sea temperature has a dominating impact on weather. However, longer-term trends of steady warming have been shown to be correct. There is a strong trend of warming in the ocean, which in the longer run means warming in the atmosphere. With an average temperature rise of 0.8°C, which has occurred over the past 130 years, and an Australian temperature rise if 0.9°C since 2010, unchecked greenhouse gases are likely to warm the Earth (on average) by more than 4°C by the end of the century (Climate Scientists Australia 2011; Karoly et al. 2013). It is now recognised that some degree of global warming is inevitable. Even if the production of all emissions stopped immediately, the amounts of greenhouse gases already in the atmosphere would raise global temperatures by an additional 2°C by 2100 (Schmit 2009). The severe consequences of this will affect the viability of many plant and animal species, with impacts on agriculture, human health and wellbeing, infrastructure and, indeed, all parts of society.

Australia has just experienced its hottest summer recorded, to accompany the statistic that six of the hottest ten summers have occurred in the past decade (Hannam 2013a). There has been a significant increase in the frequency of days over 35°C and hot nights over the past 50 years (CSIRO & Bureau of Meteorology 2012, referred to in Karoly et al. 2013). Victoria has also experienced its driest summer in almost 30 years, approximately 30% below average (Hannam 2013b). This is on top of a trend of a 10 to 20% reduction in rainfall during late autumn/winter and a reduced frequency of very wet years (SEACI 2010, referred to in Karoly et al. 2013).

3.2.2 Adaptation

It is common to define the responses to climate change as mitigation (i.e. reducing greenhouse gas emissions) and adaptation (i.e. learning to live with the environmental changes that will occur due to climate change). The more successful the mitigation, the less demanding the adaptation task will be. However, the failure to adequately address climate change and the continual rise in emissions has led to a need to adapt now and in the future, whatever the future success of mitigation. It is argued that the separation between mitigation and adaptation is somewhat artificial (for example, Kane and Shogren 2000). Indeed, the ability to reduce greenhouse gas emissions must be the first step in the process of good adaptation.

Adger et al. (2005, p. 78) define adaptation as:

> *An adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities.*

This definition is consistent with that adopted by the Intergovernmental Panel on Climate Change (IPCC 2007a), but has some shortcomings. An alternative definition, put forward by Moser and Ekstrom (2010, p. 1), is:

> *Adaptation involves changes in social-ecological systems in response to actual and expected impacts of climate change in the context of interacting non-climatic changes. Adaptation strategies and actions can range from short-term coping to longer-term, deeper transformations, aim to meet more than climate change goals alone, and may or may not succeed in moderating harm or exploiting beneficial opportunities.*

Moser and Ekstrom note that their definition differs from the IPCC's in a couple of respects:

- It does not implicitly assume that adaptation strategies will be effective. Moser and Ekstrom point out that whether harm is moderated and beneficial opportunities are exploited are contingent on many factors, not just on the adaptive action itself. Some adaptive actions may turn out to be maladaptive later on.
- It recognises that adaptation must consider, but may not be justified, by climate change alone and may be initiated or undertaken in the context of non-climatic windows of opportunity (e.g. land use plan updates, infrastructure replacement and renovating a building).

The focus of this project is also on social–ecological systems; hence, the Moser and Ekstrom definition appears to be the most appropriate for this research. The revised definition was also supported by the *Commonwealth Scientific and Industrial Research Organisation* (*CSIRO*) Climate Adaptation Flagship in its 2011 submission to the Productivity Commission inquiry that is seeking to identify barriers to effective climate change.

Adaptation can involve both building adaptive capacity in individuals, groups and organisations, and implementing adaptation decisions through actions by individuals, groups, organisations and governments. Adaptation is not something that is thought about separately to other decisions, but is an integral part of all planning, policy and

actions throughout society. Thus, all environmental, social and economic decisions need to be embedded in the context of both mitigation and adaptation, and decisions in all these areas have significant outcome implications for these climate change responses.

The previous economics commissioner of the UK's Sustainable Development Commission has a vision of human flourishing, which will necessitate 'ending the folly of separating economy from society and environment' (Jackson 2009, p. 83). Human flourishing will also require such actions as greater investment in public infrastructure, sustainable technologies and ecological maintenance and protection. Jackson notes that simply telling people to reduce their consumption and live more sustainably, for example, by insulating their homes, driving less and putting on a jumper, will not work. There is a need to change the perverse forces that drive people to consumerism in the form of status competition and also provide opportunities for people to participate in meaningful ways, to contribute creatively to the life of society.

The embeddedness of actions creates difficulties for change (Miller 2005). Thus some actions which have become automatic are less amenable to behavioural change. The way we act and how we use technology becomes invisible, and we are not commonly aware of how they determine our behaviour (Derrick 2013). What may be adaptive for one person may result in adverse consequences for others, or short-term adaptation may leave longer-term problems. Thus, effectiveness, efficiency, equity and legitimacy considerations are essential (Adger et al. 2005). Such considerations involve value judgements and choices to be made.

The ability to adapt entails the need for new ways of thinking, entailing reflection on the society that we want in the future and prepare for a move from business as usual to sustainable business. This involves overcoming many barriers and current thinking paradigms that are based on the dominance of economic and business models, individualised self-interest, competiveness and, in recent decades, rampant consumerism (Rifkin 2011). Moving to an environmentally-sustainable model will have co-benefits for society as research is increasingly demonstrating that beyond a certain point, economic acquisition does not increase wellbeing or happiness (Eckersley 2004). Yet, despite this growing knowledge, most 'developed' countries operate on the premise that more assets are better.

Adger and colleagues (2005) talk of three steps in adaptation: reducing the sensitivity of the system to climate change (e.g. putting in water tanks to ensure adequate fresh water is available), altering the exposure to climate change (such as build a sea wall to reduce/prevent inundation) and increasing the resilience of the system to climate change (improving wellbeing and available resources and support recovery from hazards). Smit and colleagues (2010) discuss retreat. This refers to moving to safer terrain and to 'abandoning' and 'relocating' existing settlements (Malcolm 2010). Discussions of the role of land use (or spatial) planning also stress that an important initial step is to 'avoid' (e.g. keep new development out of areas that are likely to be at risk).

The process of adaptation is complex, there being many pathways, many players and interdependent systems, choices and outcomes. The need to adapt may be a direct result of climate change, or it may occur due to other second and higher-order impacts as a result of climate change or adaptation measures themselves (Stanley, in press). Thus, there is a need to adapt to the following:

1. Direct impacts from climate change:
    - Those impacts that can be predicted, such as a rise in temperature.

- Those where it is known that there is a chance the event will occur, but there is little warning about when and where and how severe the event will be in the sense of both impact and how long the event will continue. An example of this might be a severe storm.

2. Indirect, second or higher-order impacts:
   - Indirect impacts may occur because of a direct impact. When Cyclone Larry destroyed bananas worth $300 million in Queensland, it resulted not only in storm damage, but caused the price of bananas to rise and left up to 4,000 people out of work (*Sydney Morning Herald* 2006).
   - Indirect impacts may arise from government policy to reduce greenhouse gas emissions, such as a carbon price, which, in turn, raises the price of goods to consumers.

Direct effects may occur along a range of predictability and may occur immediately or over a longer period of time. Thus, there may be a need to respond to an immediate unpredictable event, such as fire. In contrast, there may be time to prepare for a more predictable outcome, such as longer-term water shortages in south-east Australia. Of course, as in the latter scenario, while an event may be more predictable, details may be less clear when a longer time span is involved (Stanley, in press).

When large transitions are planned, managed and executed within extended timeframes, societies and economies have a better chance of coping (Malcolm 2010, p. 9). Adaptation may be reactive or anticipatory, autonomous or planned. Adaptation actions can also take technological, economic, legal or institutional forms (Smit et al. 2000), as well as involve engineering or planning responses. The extent of adaptation can vary, ranging from:

- Business as usual; that is, responding to changes in an incremental fashion, as they manifest.
- 'No regrets'; that is, taking actions that will result in a range of other benefits, either to solve existing problems (such as erosion) or address the likely impacts of other social or economic forces (such as the effects of rising energy prices and reducing availability). This could be described as a transitional approach.
- Active adaptation, or a transformational strategy, that will seek to anticipate major changes and position the communities to minimise impacts and take advantage of opportunities (Biggs et al. 2011).

3.3 The process of adaptation

3.3.1 Adaptation at the local level

Communities are at the forefront of government policies on environmental sustainability and climate change adaptation, particularly those centring on climate change science. While large sectors of the public are knowledgeable about climate change science they may feel ambivalent, and often conflicted, about the need to engage in pro-sustainable or climate change adaptation practices. At the same time, it is well-recognised that the response to climate change requires social and cultural change, as well as scientific solutions. Scientific leaders now frequently call for a 'culture change' in our environmental positioning. Many authors believe we are in a critical historical moment,

with the scientific evidence for anthropogenic climate change having been broadly accepted (Storch and Flöser 1999; Hardy 2003; Ehlers and Krafft 2006).

Academic interest in adaptation is extensive, covering a wide range of topics: non-human species, the events to which adaptation is necessary, and the choices that need to be made. There are a lot of instructions regarding how adaptation should be carried out and what needs to take place. However, it is very difficult to find literature on what adaptation is actually taking place, who is doing this adapting and what is assisting and inhibiting this adaptation. Ultimately, the adaptation has to occur 'on the ground', undertaken by people, households, communities and other organisations.

This topic appears to be largely unexplored. Ager and Barnett (2009), among others, recognise that action by people is the critical component of adaptation that has to take place. Components of this fundamental issue relate to ideas of feasibility, cost and the distribution of the burden of this task (equity), to which could be added issues such as opportunity (Ager and Barnett 2009). While there is a gradual increase in adaptation, Web and Beh (2013) note that there is not yet systemic change and little movement from assessment to action. Web and Beh conclude that there is a need for support, good products and services to assist the adaptation process. What is required are good adaptation principles, an understanding of end-user needs and products that support adaptation, such as knowledge portals, access to adaptation products, and a national coordinating capability to deliver core products, and to develop relationships and shared activities.

In 2009, Ager and Barnett wrote a brief commentary on their four concerns about adaptation to climate change in relation to the ability to adapt, which still rings true. Their first concern relates to the scale and interconnectedness of adaptation impacted by the risk of 'significant surprises', such as an extreme event (p. 2800). The implication of this is that there will have to be a major turnaround in policy, planning and behaviour, an issue that is yet to pervade adaptation thinking. The authors note that (p. 2801):

> *There is a need for careful thought about the ways in which potential transitions of sectors and places to reduce vulnerability should be conceived of, initiated, and managed.*

The second of their concerns relates to the fact that adaptive capacity will not necessarily translate into action. The authors provide an example of the difficulties local government faces in implementing the Victorian Coastal Strategy recommending a policy of planning of sea levels of not less than 0.8 m by 2100, including possible legal liabilities. They suggest that this may be progressively revised, probably not accounting for the fact that the present Victorian Government has revised this downwards. Their third concern relates to the sustainability of present adaptation responses, such as the carbon emissions of the Wonthaggi Water Desalination Plant in Melbourne. The authors note that moral hazard issues are not well addressed in relation to issues of public subsidies, insurance and compensatory mechanisms.

The fourth issue of concern relates to the metrics used to determine the goals and success of adaptation. They note that the social context of adaptation needs to be considered, as communities value things differently, and a 'successful' policy may not be viewed as such by a local community. This is especially so when adaptation impacts on cultures and lifestyles and people face losses of things that they care about, not just material losses where most of the activity undertaken by governments and planners concentrates. The authors note that adaptation may threaten 'values and strongly held conviction concerning place and identity' (p. 2004).

Osbahr and colleagues (2010) investigate a related issue, looking at what leads to 'successful' adaptation in three agricultural settlements in South Africa. They note that both formal and informal networks and institutions are critical for successful adaptation. Structured formal communication channels assist in bonding networks. They found that place-based adaptation was important, as was flexibility to adapt to climate risks. However, resource-constrained communities face adaptation limits.

3.3.2 Visioning an adapted settlement

Regulatory planning approaches that simply focus on land use change have been criticised for not taking into consideration the impacts such change have on local citizens and communities, and the potentially severe effect on quality of life (Gleeson and Low 2000; Cuthill 2004). In terms of climate change impacts, researchers have made recommendations on enhancing adaptive capacity, yet, as Smith and colleagues (2010) point out, decision-makers remain focused on adaptation plans and strategies. They argue that what is needed is also a way to enhance the knowledge base of decision-makers and this means multiple perspectives are necessary. One of the conclusions made from Smith and colleague's study (p. 11) is that research is:

> *needed at the local scale in particular – especially because of context-specific influences on adaptive capacity perceived to be operating at that*.

Hence, climate change adaptation processes require active engagement at institutional, governmental and community levels. One key aspect of such engagement is the inclusion of all stakeholder voices in decision-making processes, and, in order to be successful, local communities need to participate in adaptation decisions and processes. This requires establishing a community vision relevant to local stakeholder groups.

In general, the goal of community visioning processes is to facilitate, with the creation of 'a common vision and plan for a desired community' (Ayres 2012, p. 16), a means to include a broad range of stakeholders in planning decisions. This vision takes into consideration a balance between a healthy society, the environment and the economy, and provides guidance for future planning and action (Cuthill 2004). Such an approach is advantageous as it can provide 'a degree of mutual understanding and even ownership among the stakeholders' (Healey 1998, p. 14). Successful visioning can help to ensure shared leadership between elected officials and community members, collaborative and consensus building processes that actively engage citizens, the creation of a commonly-held community vision, and attention to the critical aspects of the implementation of such processes (Ayres et al. 1990; Cuthill 2004; Ayres 2012). The visioning exercise empowers the community in a bottom-up exercise, where in reality control will be dependent on factors such as abilities, issues, time and resources available (Morse 1996). The exercise must find a balance between personal and common interest. The success of a visioning exercise depends on valid and reliable information, the use of a multi-disciplinary project team and good communication (Cuthill 2004).

3.3.3 Community decision-making

Once the vision has been established, the community has the task of decision-making to facilitate reaching that vision. The process of mitigation and adaptation involves making decisions in all areas of life, at the right time, and maximising the benefits and minimising the costs (DEFRA 2009). Public policy is formed as a government response to improve a situation or to solve a problem for a group or groups of people (Dunn 2008). The benefits and costs are sometimes considered to assist in this decision-

making. However, there is always a normative aspect to the decision that involves choices around desired outcomes, the preferred means to achieve these outcomes and the competing values and trade-offs. These choices are rarely made transparent or documented and public preference is usually not given much weight in relation to the decisions being made.

Boon and colleagues (2012) argue that a resilient community demonstrates preparedness: the ability to recognise, evaluate and address emerging issues. They state that (p. 23):

> *Characteristics of community competence include collective action and decision making, problem solving skills, creativity, and empowerment, all of which are based on collaboration and individuals' characteristics and resilience*.

Also necessary is good communication regarding climate change science, said to be a complex process as those doing the communicating assume that decision-makers process information analytically, whereas people are more likely to rely on experiential processing systems (Veron-Kidd et al. 2012). This is in the context of climate change, which is commonly incremental, and, therefore, may not be clearly experienced, and uncertain in that the occurrence of events is not definitively predictable.

Making decisions under uncertainty may require recognition that decision-making will be ongoing in the context where ideas of permanence, stability and absolute options are not present. To counteract this, Zambrano-Barragán (2013) argues the need for a number of conditions. Importantly, again, good information is highlighted, as well as incentives, resources and skill development. This also provides an environment where autonomous adaptation may occur. She also stresses the importance of the establishment of participatory, inclusive decision-making processes, where a bottom-up approach allows for the identification of local priorities. Partnerships with local government and regional government are important, to implement and test the decisions.

Returning to information and research, research and information are key elements of any decision-making process, especially when decisions are to be made under uncertainty (Zambrano-Barragán 2013). To enhance decision-making in relation to adaptation in Australia, Barnett and colleagues (2011, p. 5) (see also Thom et al. 2010) argue that:

> *research is needed that advances understanding of: (1) the vulnerability and adaptive capacity of individuals, communities, businesses and industries; (2) the barriers and limits to adaptation; (3) the governance and institutional arrangements necessary to ensure that adaptation is as effective, efficient and equitable as possible*.

Decision-making must take place in the context of all variables (social, environmental and economic). In addition, climate change adaptation might be place-sensitive in environmental *and* social terms, and decision-makers must recognise that the two dimensions are inextricably interwoven. These issues are further considered in the following section.

3.4 The social and environmental interface

3.4.1 The nature of this interface

An adaptive or adapting settlement will be one that has adapted across all economic, social and environmental systems. An ecosystem services approach has been adopted for a number of studies examining the impacts of climate change (e.g. Kareiva et al. 2011; Daly-Hassen et al. 2012). In general, the approach is to examine the impact of climate change on a range of specified ecosystem services and the potential of that impact to change human wellbeing. In other words, how will climate change impact biophysical and human systems in a way that influences the availability of ecosystem services, and what are the likely consequences for human wellbeing and the choices that need to be made?

In general, the starting point for an ecosystem services assessment is the Millennium Ecosystem Assessment (MA 2005) conceptual framework illustrated in Figure 3.1. The MA framework shows the linkages between ecosystem services and human wellbeing.

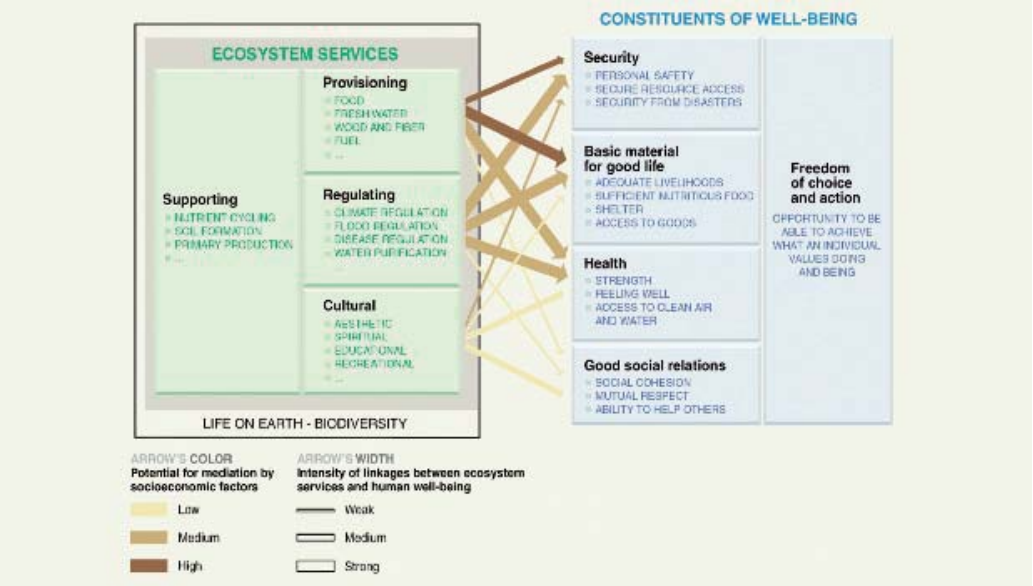

Figure 3.1: Linkages between ecosystem services and human wellbeing

Source: Wittmer and Gundimeda (2012)

Ash et al. (2010) emphasise the need to consider both the 'process and the product' in any ecosystem assessment; stakeholders need to be fully engaged in the process design. This is because ecosystem assessments involve choices between services based on values held by the individuals making those decisions. Lack of stakeholder ownership of the process will diminish the legitimacy of the assessment with its intended audience. A brief overview of the two sides of the story for adaptation, environment and wellbeing, is given below.

3.4.2 Environmental adaptation

Australia's Biodiversity Conservation Strategy 2010–2030 lists the main threats to biodiversity as: habitat loss, degradation and fragmentation, invasive species, unsustainable use and management of natural resources, changes to the aquatic

environment and water flows, changing fire regimes and climate change (NRMMC 2010).

Direct pressure from climatic changes is adding to the existing strain on biological systems due to threats such as habitat loss, invasive pest species and resource exploitation (Wilson et al. 2005; Driscoll et al. 2011). It is likely that interactions between these existing threats and threats due to climate change will further accelerate the current biodiversity crisis, which is clearly demonstrated by continuing loss of species, despite a global commitment in 2002 to reverse this trend (Butchart et al. 2010; Mace et al. 2010; CBD 2010; Larsen et al. 2011).

All people, even those in the most developed societies, rely directly or indirectly on biodiversity for food, fibre, fuel and medicines (Mace et al. 2010) and on healthy ecosystems that will continue to function and support ecosystem services, even in the face of rapid environmental change. The preservation of ecosystem services in all parts of the world is highly dependent on the conservation of biodiversity (Larsen et al. 2011). Biodiversity also matters for ethical and aesthetic reasons. The richness and diversity of nature are intrinsically valued by people everywhere (Mace et al. 2010). The current global loss of biodiversity is likely to continue unless we are able to address and reverse the processes causing it (CBD 2010), including the effects of climate change.

Evidence for changes in phenology (bud burst, flowering, breaking hibernation, migrating, breeding and egg laying) (Crick et al. 1997; Crick and Sparks 1999; Inouye et al. 2000; Winkler et al. 2002; Cotton 2003), asynchronies in phenology for predator–prey and insect-plant systems (Stenseth and Mysterud 2002), elevational or latitudinal range shifts (Thomas and Lennon 1999; Wilson et al. 2005; Hitch and Leberg 2007; Popy et al. 2010; Virkkala and Rajasarkka 2011) and population declines (Warren et al. 2001; Saether et al. 2004; Lindström et al. 2010) is linked to changes in climate, now well documented globally. The response of human communities as they seek to mitigate and react to climate change themselves may result in further pressure on biological communities, for example as land use changes exacerbate habitat losses (van Rensburg et al. 2004; Schrag et al. 2009).

In summary, the effects of climate change on biodiversity and ecosystems, and, therefore, on ecosystem services, are difficult to predict. However, changes in climate parameters, such as rainfall and temperature, are likely to affect species in terms of (Chambers et al. 2005):

- changes in distribution (both latitudinal and altitudinal);
- changed movement patterns;
- changes in abundance of species, including local extinctions‘
- changed phenology; and/or
- indirect impacts (e.g. changed distributions of one species affecting that of another).

Each of these pressures interacts with existing threats, such as habitat fragmentation, and are likely to be exacerbated by increasing pressures on biodiversity as human populations take actions to adapt to climate change. In the absence of a better understanding of the effects of climate on biodiversity and ecosystems, management of the climate-related threats is largely linked to activities that are designed to increase the resilience of our ecosystems.

> *Resilience describes an ecosystem's capacity to adapt to changes and disturbances while maintaining the same basic function, structure and interactions* (NRMMC 2010, p. 8).

The protection, restoration and enhancement of remnant native vegetation communities; and increasing connectivity of ecosystems across the landscape are considered appropriate actions to take in order to increase resilience (NRMMC 2010). Therefore, maintaining existing parks and reserves is a key strategy, but improving connectivity outside reserves is of particular importance.

3.4.3 Human wellbeing

How wellbeing is understood and defined varies considerably, both over time and between theorists. In social policy, wellbeing encompasses ideas of reducing distress, want and disease (Manderson 2005, p. 2), the meeting of fundamental needs (Maslow 1943, Nussbaum 2005), notions of fulfilment ('self-satisfaction, contentment, personal fulfilment and existential calm', Manderson 2005, p. 4), the building of happiness (Layard 2005) and 'capabilities' (Sen 1992). Sen (1987) argues that a person's wellbeing should be based on the capacity to do, which may be unequal between people. He argues that functional capabilities are needed, such as the ability to live to old age, to engage in economic transactions, or to participate in political activities. The notion of wellbeing also includes ideas around values. Nussbaum (2005) believes that the state's role is to enable people to make choices about how to enhance their own wellbeing. There is a need to address:

> *persistent inequalities and disadvantages… through a principled commitment to affirmative action, to getting all citizens above the threshold on all the major capabilities* (Nussbaum 2005, p. 43).

Understanding social cohesion is important to the processes of a climate-adapting community, and how communities adequately respond to issues of social and ecological resilience, socio-cultural and environmental sustainability, and community wellbeing (see also Bourdieu 1984; Field 2008):

> *Social cohesion involves building shared values and communities of interpretation, reducing disparities in wealth and income, and generally enabling people to have a sense that they are engaged in a common enterprise, facing shared challenges, and that they are members of the same community* (Maxwell 1996, p. 13).

How societies are organised, and the values they hold, must be more carefully examined for, as Adger and colleagues (2009, p. 338) note, 'values translate into action because they frame how societies develop rules and institutions to govern risk, and to manage social change and the allocation of scarce resources' (see also O'Riordan and Jordan 1999; Norton 2003; Edwards et al. 2011). In this context, climate change adaptation takes on issues of social justice, as the impacts of climate change fall disproportionately on people and communities already suffering social and economic disadvantage (Mendelsohn et al. 2006; Stern 2006; Heltberg et al. 2009).

3.5 Understanding place in the context of adaptation

The project has a place-based approach to understanding the local process of adaptation. Discussions about what place is invariably focus on notions of spatial location, of inhabiting particular bounded spaces that are (perhaps) easily located on a map. Yet, this view neglects the complex ways in which a place is experienced,

understood and constituted. As Massey points out, the concept of place arises out of particular moments of intersecting relations, 'nets of which have over time been constructed, laid down, interacted with one another, decayed and renewed' (1994, p. 120). Therefore, collapsing ideas of a place onto its cartographic representation obscures the numerous ways in which human and non-human entities create multiple and varied sets of relations that then give that place meaning. Understanding place means taking into consideration not just the material forms that are present (both of the environment and those constructed by human activity), but also the immaterial and ephemeral aspects of place; that is, the ideas we hold about place, the values we attribute to it, and our emotional attachments.

Further to this, the particularity of a place arises 'not by placing boundaries around it and defining its identity through counterposition to the other which lies beyond, but precisely (in part) through the specificity of the mix of links and interconnections *to* that 'beyond'' (Massey 1994, p. 5). This is significant in better understanding the dynamics inherent in the coastal towns examined in this study. These coastal towns are sites for those who wish to (and are financially able to) have access to these idyllic locations, either as weekend/holiday residences or who relocate and downsize (see also Dowling 2004; Burnley and Murphy 2004; Connell and McManus 2011). However, this affluent in-migration raises many complex issues. Increased house prices may push out those no longer able to compete on the housing market. The strong connection new residents continue to have with their metropolitan lives (they often continue to commute between the city and the coast, but also in transplanting elements of 'city' culture) can challenge notions of how we belong in and to place. In these situations, one response is to advocate a rather narrow and conservative view of who 'belongs'.

Such downsizing, and sea-changes and tree-changes also point to changes in the *Zeitgeist*. Many commentators have noted that in the West generally there has been a sense of loss of meaningful community. Some, such as Sennett (2006), argue that the new global economy has meant less certainty and increased anxiety, leading to a much more fragmented sense of identity. In response to this sense of fragmentation and disconnection there has been a shift to ways that create greater emotional attachment, ways that reconnect us and remake our ties of belonging, which draw on romanticised and nostalgic views of these rural/coastal regions. This, too, plays a dynamic part in these coastal communities, as some battle to save 'their place', while addressing lack (of housing, infrastructure and services), while others celebrate the marking out of 'our' coastal home places.

There is messiness in the processes of place and community formation and, consequently, belonging, not least because of the heterogeneous sets of social relations that construct these shared senses of identification and belonging. What we find, then, in these places is a complex spatiality of both presence and absence, where identity, place and belonging are difficult to isolate and are, instead, interwoven and overlapping. The 'big picture' concerns we have with climate change adaptation need to begin with acknowledging the immediacy of our relationships and the significance of such personal and social dynamics that, nonetheless, extend beyond that of location.

4. RESULTS AND OUTPUTS: PART 1, UNDERSTANDING THE TRENDS

This section presents the findings on the first two research questions: What are/will be the challenges outside climate change faced by these case study settlements as the context in which climate change decisions will need to be made? What climate changes will be present in each of these settlements in 2030 and what trends will be in place in 2050 or 2070 (according to available data)?

4.1 Non-climate trends

This section presents an overview of the present economic, social, environmental and governance arrangements in each of the settlements and any capacity issues (facilitating and inhibiting factors) external to climate change. More details and maps can be found in *Discussion Paper 1: The Present Environmental, Social and Economic Situation and Trends in Inverloch and Sandy Point and Surrounds (2012), An Ecosystem Services Approach to Climate Change Adaptation: Case-studies of Inverloch and Sandy Point, Victoria* (2012), *Uptake of Renewable Energy in Bass Coast and South Gippsland Shires (2012), Inverloch Profile – People 2006, 2011 & 2031*, and *Sandy Point Profile – People 2006, 2011 & 2031*. These reports can be found at http://www.monash.edu.au/research/sustainabilityinstitute/programs/cities/gcc.html.

4.1.1 Gippsland region

Gippsland's economy relies on natural resources and strong population growth in the areas closer to Melbourne (see Department of Business and Innovation 2010). Gippsland's oil, gas, coal, water catchment, agricultural produce and nature-based tourism industries drive not only the region's economy but also that of Victoria. A projected population growth of 20% over the next 15 years also means a growth in demand for goods and services and residential and industrial space, and necessitates improved infrastructure. It is a Federal and state government priority to address Gippsland's ability to capitalise on opportunities around such things as a low carbon economy transition plan, post-secondary education, sustainable development and technologies, and health and wellbeing outcomes. The movement of different sectors of the population into and out of this region is also significant, with an inflow of low income households (especially retirees), which is increasing the strain on local government services, and an outflow of young people major metropolitan areas (NIEIR 2003–2004).These strategic drivers also mean increased pressure on the liveability and sustainability in the region.

The Gunai/Kurnai and the Boonwurrung Aboriginal peoples have a strong traditional association with the South Gippsland coast.

General Health Status

Based on a range of indicators, people who live in Gippsland are less healthy than people who live in Melbourne or many other parts of Victoria (Victorian Department of Health 2010). Cancer, cardiovascular disease, neurological and sense disorders, mental disorders and chronic respiratory diseases are the leading causes of disease burden in the Gippsland region.

Environment

Large areas of remnant native vegetation lie along the coast, with coastal scrub and grasslands from Anderson Inlet to Cape Liptrap. Coastal parks and reserves in the

area constitute the largest continuous marine protected area in the central Victorian bioregion. There are good populations of native fish in many waterways. The Tarwin is listed as an important river for the threatened Australian Grayling and is considered necessary for long-term survival of the species. Remnant blackfish are of important social value to the region. Bunurong Catchment waterways are valued for micro invertebrate communities and significant threatened flora and fauna. Anderson Inlet and Shallow Inlet are listed as wetlands of national importance. Both provide habitat for migratory water birds, native fish and other species. Birdlife International lists Shallow Inlet and Anderson Inlet as Important Bird Areas. Shallow Inlet was declared a Marine and Coastal Park in 1986. Anderson Inlet is one of only four locations in Victoria where mangroves have been found to occur (Ross 2000). Many small spring-fed remnant swamps in the Tarwin region are important to biodiversity in the region. The region is home to 20 known threatened flora species and 57 known threatened fauna species.

4.1.2 Bass Coast Shire

Since 2007 the rate of population growth in the Shire has exceeded 3% a year, reaching 3.7% a year from 2010 to 2012 (preliminary estimate, not taken from Census). This is roughly double the average rate in Gippsland as a whole. The share of the population aged 55 and over has now reached 40%, a figure similar to the New South Wales (NSW) South Coast, the region with the highest older age population in the country. This can be compared with 34% of the population 55 years and over in Gippsland as a whole. The share of the population in the other age groups is, again, comparable with the NSW South Coast: 21% aged less than 20 (NSW South Coast has 23%); 9% aged 20–29; and 29% aged 30–54 (NSW South Coast has 28%). As the proportion aged 55 and over has increased, the proportion aged less than 20 has fallen. The proportion aged 30–54 has also declined but the proportion aged 20–29 has been reasonably constant.

Population growth has been accompanied by an increase in average household size from 2.7 persons in 2007 to 3.1 in 2012. For comparison, average household size in Gippsland remained constant at 2.8 persons over this period, similar to the NSW South Coast. The increase in household size was not due to an increase in the proportion of children in the population and indicates that there may have been an increase in the proportion of older multiple-person households, including group households of workers employed in the construction of the desalination plant.

The workforce has grown a little more rapidly than the population, thus increasing as a proportion of the population. However, the proportion of the population in the workforce, 47%, is still well below that in Gippsland as a whole, where the rate is 56%. In the NSW South Coast the proportion is 50%, which is not so different from Bass Coast. The major reason for the low workforce proportion would be the high proportion of retirees.

According to the Commonwealth Department of Education, Employment and Workplace, the unemployment rate is 5.5% of the workforce, the same as for Gippsland as a whole. However, when this figure is adjusted for excess take-up of disability support pensions by persons of workforce age, the rate in Bass Coast increases to 7.7% (and to 10.6% for Gippsland). For all these measures, the rates for NSW South Coast are higher; for example, the *National Institute of Economic and Industry Research* (NIEIR) adjusted unemployment rate (which takes into account some hidden unemployment, such as changes in trends of those moving to an invalid pension) for the NSW South Coast is 15%. Bass Coast, therefore, has lower unemployment than would be expected from the age structure of its population.

At 14.1%, social security take-up among the working-age population is also lower than in Gippsland as a whole (15.7%) and in the NSW South Coast (19.4%). However, the proportion of the population of working age not in employment is high, 34%, or 42% if adjusted to a full-time-equivalent basis, both numbers being higher than those for Gippsland as a whole or the NSW South Coast. Bass Coast, accordingly, appears to be distinguished by an unusually high proportion of the population aged 16–64 who are neither employed nor receiving social security. There are two likely reasons for this:

- a higher than average proportion of spouses who are not receiving work incomes and are ineligible for social security because their spouse has earned a certain level of income; and
- a higher than average proportion of households dependent on property incomes and/or on running down assets.

In accordance with these patterns, wages and salaries per capita are low, even in comparison with the NSW South Coast. Social security benefits are similarly low. However, business income per capita is higher than in the NSW South Coast (although less than in Gippsland as a whole). This would be partly due to the greater importance of farming in Bass Coast compared to the NSW South Coast. Property income is also on the high side. On a per capita basis, it is 1.07 times the average for Gippsland and for the NSW South Coast. This property income is balanced by a relatively high level of interest paid, 1.4 times the average per household in Gippsland and the NSW South Coast. As a result, disposable income per household is low, 83% of the Gippsland average and just below the NSW South Coast average. However, in real terms, disposable income per household has been increasing, having risen by nearly 70% since 2001, a greater increase than for Gippsland (57%) and the NSW South Coast (48%).

The aggregate household-sector balance sheet for Bass Coast compares with Gippsland and the NSW South Coast as follows:

- The value of property and unincorporated business per household is high: 2.2 times the Gippsland average and twice the NSW South Coast average.
- The value of financial assets is above the comparator regions, but not significantly: 1.3 times the Gippsland average and 1.1 times the NSW South Coast average.
- Related doubtless to the high value of property assets, the value of household liabilities is also high: 1.5 times both the Gippsland and NSW South Coast averages.

As a result, the household debt service ratio, at 24%, is among the highest in the country, as is the household debt to gross income ratio of 1.86. It would appear that many households in the Shire could easily be in financial difficulty should interest rates rise or incomes fall. It is also likely that many households struggle to finance home maintenance, let alone pay for items to deal with problems such as unexpected storm damage.

Bass Coast Shire is not self-contained. Outbound commuter traffic, mainly in the direction of Melbourne, exceeds inbound and the work income of residents exceeds work income generated within the Shire by approximately 10%. Some 11% of residents in Bass Coast are employed in Melbourne City (Birrell and Rapson 2012). If road connections are improved, more commuters could be attracted to Bass Coast Shire as Melbourne expands into its south-east corridor, thus opening up job opportunities

closer to the Shire. Average hours worked per employed person have been declining and, at 26 hours, are below the average in both Gippsland as a whole and the NSW South Coast, as well as substantially below the level in Bass Coast in 1992 (33 hours). Similar but less marked declines have occurred in Gippsland and in the NSW South Coast. The decline in average hours of 23% since 1992 has been compensated for by an increase in real terms of 29% in the average rate of pay.

The pattern of employment by industry is similar to Gippsland as a whole, with one outstanding exception: 26% of employed persons in Bass Coast work in construction in comparison with 11% in Gippsland. The proportion working in accommodation and food services is also above the Gippsland average, while the proportion working in agriculture is lower. A construction boom began in the Shire in the mid-2000s, with the proportion of the workforce employed in construction moving from 15% then to the current 26%. A small part of this boom is due to the preparation and supply of construction materials for activities in Greater Melbourne, but the largest part is due to the construction of the desalination plant at Wonthaggi. A noticeable decline in construction activity is expected when the construction of the plant is complete.

Before the commencement of construction of the desalination plant, residential construction accounted for the bulk of construction activity in the Shire. This was proceeding steadily, reflecting several factors:

- an increase in long-distance commuting to Melbourne or, more likely, to the employment areas around Dandenong;
- retirement and pre-retirement demand by households who harvest the capital gains on their home in Melbourne and move to lower-cost houses in the Shire, coupled with more traditional holiday-home demand; and
- government and finance-sector policies that have encouraged borrowing for dwelling purchase.

In future, these drivers are likely to diminish in strength, due to the following:

- increasing petrol prices will discourage long-distance commuting, although improved telecommunications may counter this trend;
- the scope for retirement migration depends on the disparity between suburban and Shire house prices and there is no guarantee that the incentive to retirement migration will remain as strong as it is at present; and
- government and finance-sector encouragement of borrowing for home purchase is running up against the wall of high household indebtedness.

After a peak in 2011, residential new construction declined in 2012. This could be a portent of further declines to come.

When asked if there had been any times in the previous 12 months when they had run out of food and could not afford to buy more, 9.4% of persons living in Bass Coast stated that they had experienced food insecurity, and 6.7% in South Gippsland, compared with the Victorian State average of 6% (Community Indicators Victoria, 2007).

Inverloch

Inverloch is a seaside village located in the Shire of Bass Coast on the Bass Highway 27 km south of Leongatha. Inverloch does not fit neatly into the typology of Australian coastal amenity communities (Gurran et al. 2005). It is perhaps most closely aligned to

a coastal lifestyle destination, which are predominantly tourism and leisure communities (Gurran et al. 2006).

Inverloch has a permanent population of 4,959, housing 17% of the residents of the Shire (ABS 2011). In 2011, only 52% of the 3,823 dwellings in the town were occupied. It had a slightly older population than Bass Coast as a whole: 43% aged 55 and over as against 39% for the Shire. In 2011, the median age for Inverloch was 49 years, compared with 46 for Bass Coast Shire as a whole and 37 for Australia. The economic base of Inverloch is largely in the service, education and construction industries.

In 2011, the average household income in Bass Coast was around $1,150 a week, with a similar figure in Sandy Point and a noticeably higher figure in Inverloch: a little over $1,500 a week. These household incomes are compounded from average personal incomes of around $670 a week in Bass Coast as a whole, around $720 a week in Sandy Point and around $780 a week in Inverloch (these are averages for persons nominating a positive income and exclude non-response and nil or negative incomes). It is noticeable that average personal incomes for Inverloch residents are 20–25% above average personal incomes for the Shire as a whole for income-earners in all age groups from 15 to 54 years, but fall back to near equality in the retirement age groups. Sandy Point, by contrast, reported average incomes similar to Bass Coast in general for people of workforce age, but appears to have some relatively high-income retirees. Inverloch is a reasonably salubrious part of the Shire but is not on a par with Cowes, for example. However, it might be both more affordable and more accessible for people employed outside the Shire.

The proportion of individuals aged 15 years and over with nil or negative incomes was around 6% in each area, concentrated among teenagers (especially in Sandy Point, where doubtless there is very little work available), with a secondary peak in the 55–64-year age group. This peak would doubtless consist mainly of already-retired spouses. In Bass Coast as a whole, 28% of households reported that they made mortgage payments and a further 26% paid rent, leaving 46% as owners. The debt burden (reported in the State of the Regions report 2010 (NIEIR 2010) would, therefore, seem to be concentrated on a limited proportion of households. The proportion of owners in Inverloch was a little higher than the Bass Coast Shire average, and noticeably higher in Sandy Point (69%). The proportion of renters in Inverloch was similar to the Shire average, but the proportion of mortgagees was less.

The combined effect of the elevated housing demand generated by workers on the nearby desalination plant project and second-home buyers has been to raise the median price for a house to $450,000 in 2011: equivalent to the median in the tourist mecca of Phillip Island and considerably higher than that in nearby Cape Patterson to the west (*The Age*, 24 March 2012). The average mortgage in Bass Coast as a whole was approximately $345 a week, with the average in Inverloch higher at around $400 a week. Similarly, average rents in Bass Coast as a whole were $255 a week and $325 a week in Inverloch. It is not possible to relate these outgoings to the incomes of the households making the payments, although the higher payments in Inverloch tally with the higher household incomes there. The credit burden is likely to be particularly heavy for a minority of households: perhaps around 15% in both Bass Coast as a whole and in Inverloch.

By 2031 Inverloch will have 1,500 additional residents, fewer children (as a percentage of the population), more people 65 years and over, and a slight reduction in the proportion of single-person households.

Urban structure

Clause 21.10 of the Municipal Strategic Statement Bass Coast contains a vision for Inverloch (Stanley 2012). This is a consolidated and sustainable coastal village that optimises the existing natural assets and character, and services the lifestyle and recreational needs of residents and visitors. The Inverloch Design Framework does not seek to amend this vision. The strategy seeks to articulate this vision at its various levels through the consideration of thematic issues across the study area. Based on the above vision, the overarching objectives of the Inverloch Design Framework are to:

- manage growth within an established town boundary;
- provide housing diversity that is responsive to the changing demographic of permanent residents, and the housing and accommodation needs of the non-permanent residents;
- direct residential growth to key areas at the edge of town, and provide opportunities for consolidation and infill proximate to the town centre;
- enable the restructuring of the town centre to improve circulation and pedestrian priority;
- support the provision of convenience shops in designated areas to meet the convenience needs of local residents within a short walk from home;
- support ongoing local job opportunities through the protection of the industrial area;
- support the provision of recreation at Thomsons Oval and the main Recreation Reserve to meet the ongoing needs of users; and
- provide a mix of tourist accommodation opportunities, including camping and caravans.

The settlement patterns have traditionally focused on areas proximate to the foreshore and town centre. Over time, settlement has extended north and west. The Bass Coast Planning Scheme has established a Settlement Hierarchy, which seeks to set out the strategic directions and development opportunities in the Shire. This is consistent with the definitions for Inverloch contained within the Victorian Coastal Strategy. Within this strategy, there is moderate spatial growth capacity, some of which will be beyond the existing urban zoned land, with infill within defined settlement boundaries.

Central to the vision for the Inverloch Design Framework is the maintenance of the natural and coastal character of town. This character will be protected through the proposed design response that seeks to:

- minimise visual impact of urban development on the significant environmental qualities of Inverloch, including the foreshore and Screw Creek Reserve;
- manage built form and design in terms of height, density and architectural quality;
- enhance the town centre through improved design, structure and circulation for pedestrians and vehicles;
- enhance streetscapes, building on the strong coastal landscaping that frames the residential setting;
- maintain an informal and relaxed pedestrian environment through the provision of non-urban streets (no kerb and channel) (however, providing footpaths on key streets to enhance walking and cycling); and
- improve overall links to town and the foreshore via a network walking trails.

The character zones are shown in Figure 4.1, with representations of the character.

Inverloch is supplied with both a reticulated water supply and sewerage. Anecdotal evidence of flooding in and around the commercial centre, and beyond the northern boundary of the village suggest that the existing drainage infrastructure is inadequate and in need of further investigation to determine whether improvements are required to manage stormwater discharge.

Environment and ecosystem services

The landforms around Anderson Inlet are dominated by sand. On the western side of Anderson Inlet and in front of the township of Inverloch, the foredune is made up of alluvial deposits. The eastern side, around Point Smythe, is classified as coastal dunes. The backshore profile and intertidal slope is quite flat. The western side of Anderson Inlet is defined by dune-capped cliff and sandy foredunes. Fourteen ecological vegetation classes (EVCs) (there being approximately 300 in Victoria) are represented in the Inverloch study area. Six of the fourteen EVCs are considered either Endangered or Vulnerable. One species present in the Inverloch study area, the Coast Bitter Bush (*Adriana quadripartita*), is listed as Vulnerable in Victoria. It is not presently endangered but is likely to become so soon. Several species present in the Inverloch study area are listed as Rare in Victoria. The Coast Stackhousia (*Stackhousia spathulata*), which is found in the Inverloch study area, is suspected to be threatened but present distribution information does not allow a proper assessment.

None of the mammal species recorded in the Inverloch study area are of conservation concern in Victoria. However, bird species are a different story. Five bird species recorded in the Inverloch study area are classified as Critically Endangered or Endangered in Victoria. Critically Endangered are the Intermediate Egret and the Orange-bellied Parrot. (also Critically Endangered nationally). Endangered birds are: the Little Egret, the Great Knot and the Terek Sandpiper. Ten bird species present in the Inverloch study area are considered Vulnerable in Victoria. The Leathery Turtle, recorded in the study area, is considered Critically Endangered in Victoria and is listed nationally as Vulnerable. Six frog species are known to occur in the Inverloch study area, including the Southern Toadlet, which is listed as Vulnerable in Victoria.

The social and economic significance of the embayments relate to the significant recreational value for bird watching, walking, fishing, boating and swimming (Zavadil and Ferguson 2010) Anderson Inlet alone is estimated to attract 30,000 visitors a day during peak season for sailing, water skiing, surfing, windsurfing and kite surfing. There is conflict between natural assets and development around the embayment of Anderson Inlet. The location of shorebird habitat can be seen in Figure 4.2.

Figure 4.1: Character zones of Inverloch

Source: Project Team, 2012, Discussion Paper 1

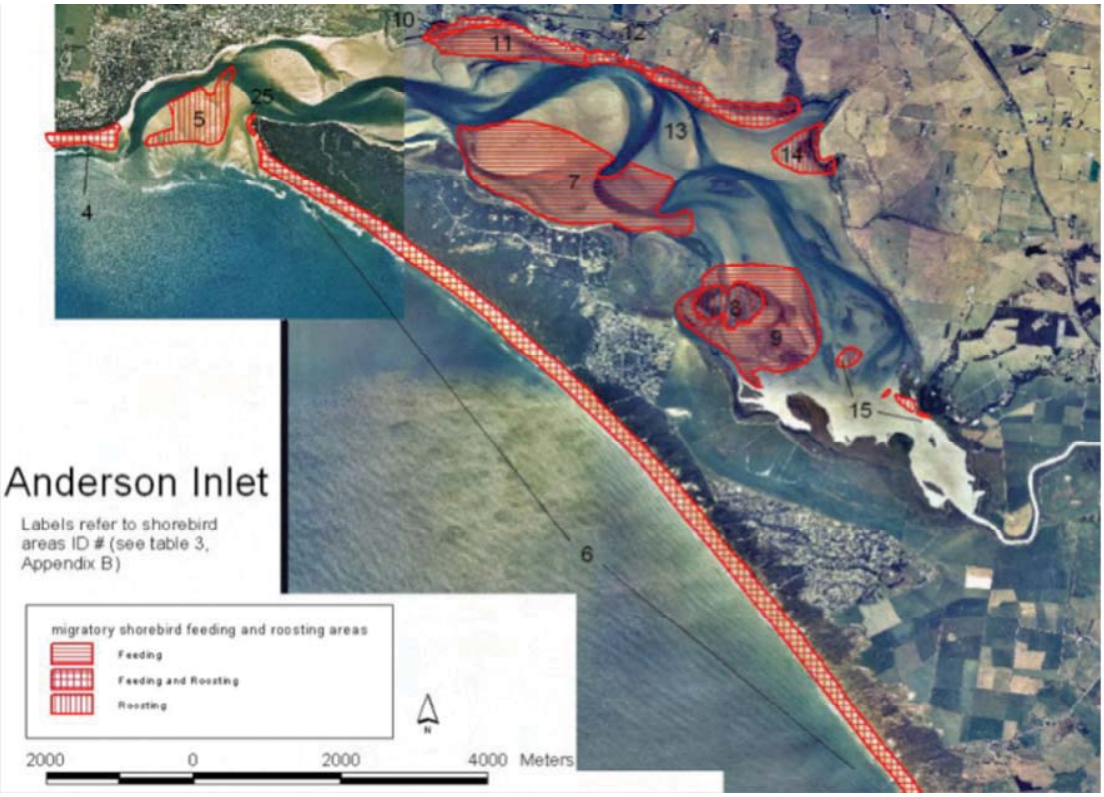

Figure 4.2: Anderson Inlet shorebird habitat

Source: Project Team, 2012, Discussion Paper 1

4.1.3 South Gippsland Shire

The Shire of South Gippsland has a long coastline, divided into three parts:

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- a swathe of sandy beaches facing Bass Strait and backed by sand dunes or low hills;
- the foreshore of the Wilson's Promontory National Park, comprising a succession of rocky headlands and sandy beaches; and
- the foreshore of Corner Inlet, which, while sandy, is sheltered from open water.

The first part of this coastline includes six small seaside settlements:

- Venus Bay;
- Tarwin Lower (not strictly a beach settlement, but near the beach and which may common characteristics);
- Cape Liptrap;
- Walkerville;
- Waratah Bay; and
- Sandy Point.

The beach settlement of Tidal River differs from these in that it lies within a National Park, while settlements along the shore of Corner Inlet are different again because they

lack real beaches. The settlements are perhaps best seen as an eastward extension of the row of beach settlements in Bass Coast Shire, but further from Melbourne.

The permanent resident population of Sandy Point at the 2011 Census was 198, 0.7% of the population of the Shire. Even adding the string of settlements from Venus Bay to Sandy Point together, the total population would be less than 5% of the population of the Shire, which, unusually for a Local Government Area with such a long coastline, is concentrated inland. This means that it cannot be presumed that data for the Shire as a whole tells us anything about the coastal settlements, let alone about Sandy Point. Indeed, there is every indication that Sandy Point has very little economic or social connection to the Shire at large. The data available at present is, therefore, restricted to the first release of 2011 Census data.

Sandy Point

Sandy Point is located 40 km south of Leongatha in the South Gippsland Shire and 5 minutes from Shallow Inlet, with Wilson's Promontory National Park to the east. Sandy Point was developed as a small holiday coastal hamlet in the 1950s and has remained a popular destination for surfing, fishing and boating. There is a surf club, a tennis court, a local hall, a caravan park and a shopping strip, with a cafe/restaurant, a general store and mini golf facilities. The main approach to the settlement is along Sandy Point Road, which links Telopea Drive and Beach Parade with the commercial centre. The route into the centre of the village is not direct as it winds along quiet streets bordered by roadside vegetation. This low-key entry contributes to the calm and relaxed atmosphere within the surrounding coastal landscape.

The permanent population of Sandy Point was officially 198 in 2011 (ABS 2011), although is likely to be slightly higher than this. Of these residents, 47% are aged 55 and over, and there is a noticeable lack of residents aged in their 20s. Of the 63 households in Sandy Point, 11 homes were rented, 9 were mortgaged and the remaining 43 were fully-owned. Being primarily a holiday destination, the population greatly expands to many thousands of people over the holiday season, accommodated in approximately 602 buildings and also in camping-type accommodation. Based on the proportion of the Surf Lifesaving members, approximately two-thirds of the holiday residents are from Melbourne and approximately one-third from Foster and the Latrobe Valley. Sandy Point is likely to represent many such small towns around Australia, there being approximately 600 such towns with a permanent population between 200 and 500, some of which are tourist destinations.

The distance between Sandy Point and Melbourne means that it is less likely than Inverloch to have occasional visitors and those who do travel that far are more likely to pass by to Wilson's Promontory. The single road in and out means that people do not pass through, but come to Sandy Point only as their intended destination.

Housing stock in Sandy Point is generally low key in terms of design and built form. Traditional small cottages and kit houses have formed the basis of the character of the current housing stock in the settlement since the 1960s.This, combined with the fact that the visual character of the town is dominated by native tea-trees, is key to the formation of the relaxed character of the settlement. Recent trends are showing that dwelling stock has evolved from typical single-storey dwellings to multi-level buildings, including a mix of two-storey and three-storey dwellings that have been designed to take full advantage of the views of the coastline.

Average household income in Sandy Point was around $1,150 a week, compounded from average personal incomes of around $720 a week (these are averages for persons nominating a positive income and exclude non-response and nil or negative

incomes). Sandy Point reported average incomes similar to Bass Coast Shire for people of workforce age. Unfortunately, the first round of 2011 data does not give the industry or place of employment of Sandy Point's workforce, but it is likely that there is a combination of outbound commuting (which may be daily, part-week or week-on–week-off) and locally based employment, including local retailing and services, but also perhaps IT-based. It is probable that a proportion of employed persons worked in construction and dwelling maintenance, either in the settlement or at other locations within driving distance. These jobs would be vulnerable to the buoyancy of the local construction market, just as tourism jobs during the summer would be vulnerable to the state of the Victorian coastal tourism market. Sandy Point seems to have some relatively high-income retirees and, hence, less dependence on social security for retirement income than is common in areas with elderly populations. The proportion of individuals aged 15 and over with nil or negative incomes was around 6%, concentrated among teenagers (doubtless there is very little work available for teenagers in Sandy Point in winter), with a secondary peak in the 55-64 year age group. This peak would doubtless consist mainly of already-retired spouses.

The geography of Sandy Point means that is has some of the qualities of an island community, bounded on one side by the primary dune and the ocean, and on the other by the inlet, with only one road in and out across land, which is only a metre or so above the current one in 100 years flood/storm surge level. Sandy Point has an existing sea wall on the inlet (built in the 1920s and '30s), which protects it from a 20-cm sea level rise on top of a one in 100 years flood/storm surge. There is very limited land available for expansion of the town above potential flood levels. Sandy Point's permanent economic base is much more limited than Inverloch's. Sandy Point does not have reticulated water or sewerage.

By 2031, the coastal district of the South Gippsland Shire, which includes Sandy Point, is expected to have fewer children as a percentage of the population, more people over 60 years of ages and more than one and two person households. Council is expecting population growth of approximately 2% per annum, including more non-resident owners 'transitioning' to living in Sandy Point by spending more time there and keeping in touch with Melbourne jobs/businesses through the Internet, for example.

Urban structure and planning

Local policies that relate to coastal planning and development include The South Gippsland Coastal Development Plan 2004, which is a strategic Planning framework for the future development of towns along the coast. Also relevant are parts of the Local Planning Policy Framework in the South Gippsland Planning Scheme. Some key features of this strategic planning document include:

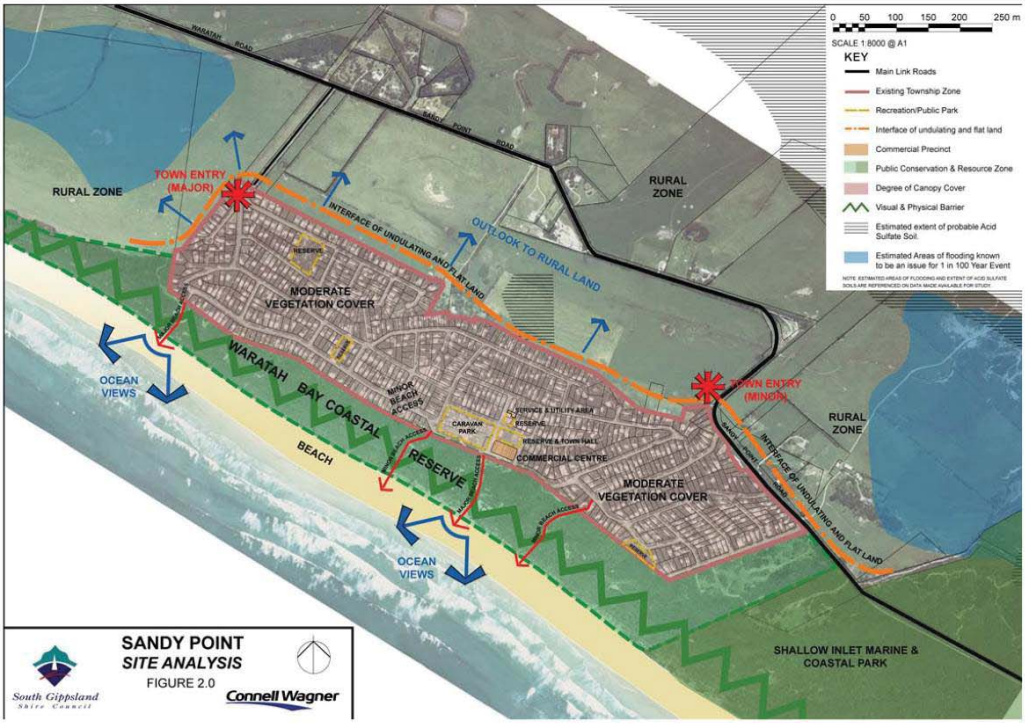
- any growth to be concentrated in towns, not strip development; and
- to promote compact or consolidated growth and the development of eco towns with sustainability principles.

The Local Planning Policy Framework includes clauses where the council aims to ensure that sustainable land use and development can occur. It highlights areas within the shire, particularly coastal areas facing increasing environmental pressure from residential development.

There are three overlays that apply to Sandy Point:

- Environmental Significance overlay 3, which applies to the entire village and surrounding area;

- Environmental Significance overlay 5, which applies to areas susceptible to erosion by minimising land disturbance and vegetation loss; and
- Land Subject to Inundation Overlay, to prevent inappropriate development in flood-prone areas and to protect the water quality of nearby waterways.



COMMERCIAL CENTRE

RESIDENTIAL MIX OF NEW AND OLD DEVELOPMENT

Figure 4.3: The character of Sandy Point

Source: Project Team, 2012, Discussion Paper 1

Environment

The open coast and entrance to Shallow Inlet consist of sandy coastal dunes. The intertidal slope is flat and Sandy Point beach is highly exposed to wave energy. The east side of the entrance to Shallow Inlet has low exposure to wave energy. The Sandy Point settlement is located behind and partially within the coastal dune complex. The foredunes at the Waratah Bay beach are composed of fine, well-sorted, wind-blown sand that is held together by Marram Grass, with a wave-built berm of coarse shelly

sand underneath. Shallow Inlet is coastal embayment, with a narrow single-crested dune, which suggests there is not a lot of sand here protecting the inlet. The wave direction in this location is west, which contributes to the westward movement of sand. If the sand was to move west, the entrance to the Inlet may increase.

There are three overlays that apply to Sandy Point:

- Environmental Significance Overlay Schedule 3 – Coastal Areas (ESO3). This applies to the entire village and surrounding area with objectives relating to the protection of the coast to retain important environmental features.
- Environmental Significance Overlay Schedule 5 – Areas Susceptible to Erosion (ESO5).
- Land Subject to Inundation Overlay. The purpose of this overlay is to prevent inappropriate development in flood-prone areas, and also to protect the water quality of nearby waterways.

Thirteen (of approximately 300 in Victoria) EVCs are represented in the Sandy Point study area. Seven of the thirteen EVCs in the Sandy Point study area are considered either Endangered or Vulnerable in the Bioregion and a further three are noted as Depleted. The Coast Bitter Bush (*Adriana quadripartita*), listed as Vulnerable in Victoria, is found in Sandy Point. Four species present in the Sandy Point study area are listed as Rare in Victoria. The Water Parsnip (*Berula erecta*), which is found in the Sandy Point study area, is suspected to be threatened but present distribution information does not allow a proper assessment.

The White-footed Dunnart is the only mammal recorded in the Sandy Point study area that is of conservation significance. Native mammals present in the Sandy Point study area include marsupials, such as the Black Wallaby, the Koala, the Common Wombat, the Common Ringtail Possum and the Common Brushtail Possum. Monotremes, the Platypus and the Short-beaked Echidna, are present. Aquatic mammals, such as the Bottlenose Dolphin and the Long-finned Pilot Whale, have been recorded as present.

Three bird species recorded in the Sandy Point study area are Endangered in Victoria: the Little Egret, the Fairy Tern and the Gull-billed Tern. Four bird species present in the Sandy Point study area are considered Vulnerable in Victoria: the Hooded Plover, the Little Tern, the Eastern Great Egret and the White-bellied Sea Eagle. Six bird species are considered Vulnerable in the Sandy Point study area. Both the Inverloch and Sandy Point study areas have several feeding and/or roosting areas, which are important to migratory wading birds. Figure 4.4 shows the Shorebird habitat at Sandy Point.

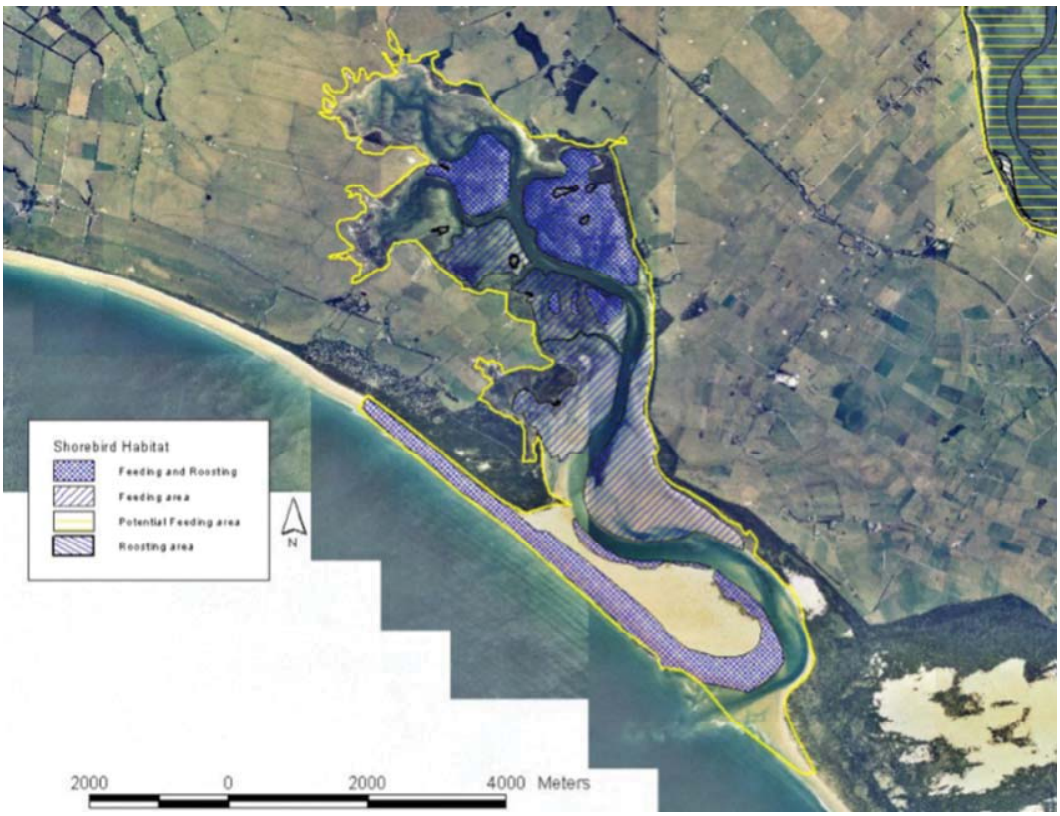


Figure 4.4: Sandy Point shorebird habitat

Source Project Team 2012, Discussion Paper 1

4.2 Climate projections

The information in this section is taken from the report *Climate Futures for the South East Australian Coast*, written by Griggs et al. (2012). The section is structured around climatic variables of importance for adaptation. Where appropriate and where information is available, changes in both average and extreme values of the climatic variable are considered. Each variable includes both the observed change in the variable up to the present and projected changes for the future. For observed change, the 1970–2011 trends are used (compared to the longer-term averages in the variable, which, for most Australian records, go back to 1900 or 1910). The last four decades encompass most of the observed trends that have been influenced by anthropogenic climate change.

The projections of future climate trends are based on a set of trajectories of future greenhouse gas emissions known as the Special Report on Emissions Scenarios (SRES) scenarios (as they were developed in the Intergovernmental Panel on Climate Change (IPCC) (2000) Special Report on Emission Scenarios; see Figure 4.5). Results presented in this report use the B1 scenario to represent low future emissions, the A1B scenario to represent medium future emissions, and either the A2 or A1FI scenarios to represent high future emissions.

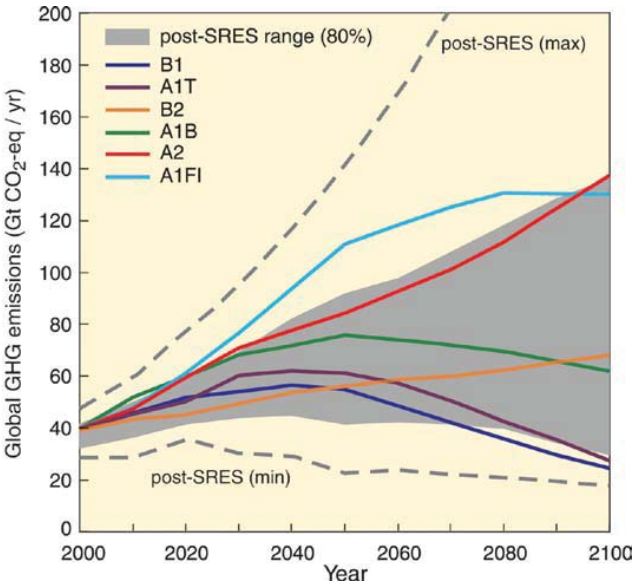


Figure 4.5: Special Report on Emissions Scenarios (SRES) scenarios for future greenhouse gas emissions (coloured lines)

Source: IPCC (2007a), Figure 3.1

For projections of future trends for 2030 and 2070 are used. Unless otherwise specified, the projections have the following characteristics: (i) the baseline is the average of the variable during the 1980–1999 period and is referred to as the '1990 baseline'; (ii) the 2030 projections are an average of the 2020–2039 period; (iii) the 2070 projections are an average of the 2060–2079 period; (iv) three projections are given for each time period, representing low, medium and high emission scenarios; and (v) a number of climate models are used for each projection (for a given time period and emission scenario), with the results presented as percentiles (10th, 50th and 90th). Also included are some climate-related risks that are very important for adaptation but that depend on combinations or aggregations of climatic variables rather than on changes in single variables, such as coastal flooding and bushfires.

There is often a tension between the desire for climate futures information at fine spatial and temporal scales and the reliability of the projections at the desired scales.

This tension is manifest in several features of this section:

- There is more confidence in projections of temperature change than of rainfall change.
- More can be said about projected change at large spatial scales than at local or small regional scales.
- In general, we have more confidence in projected changes in average values than we do in changes in extremes.
- Projections of future change in climatic variables are only meaningful at temporal scales of two decades or more. Shorter timescales are increasingly dominated by modes of natural variability than by the longer-term underlying trends.

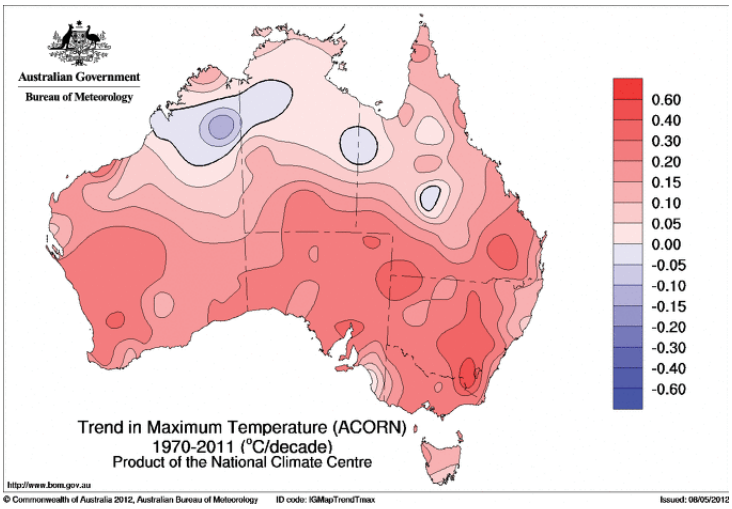
The following information is based on the most up-to-date science available as of May 2012.

4.2.1 Surface air temperature

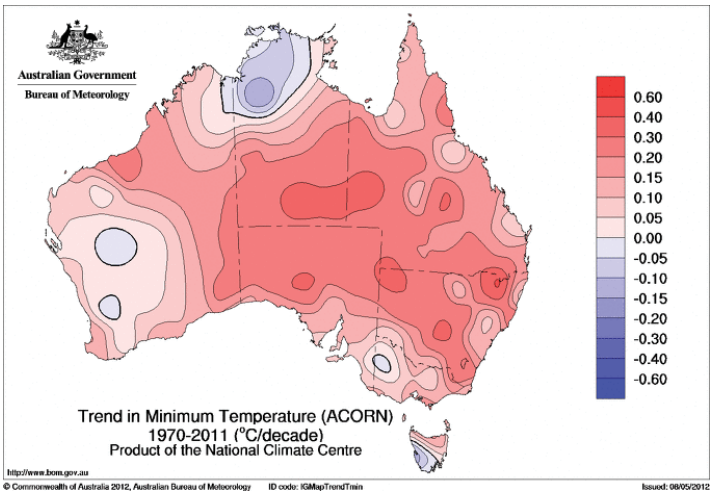
Observed trends: average surface air temperature

There has been a warming trend of between 0.15 and 0.3°C every 10 years in maximum temperature over the past 40 years for the south-east Australian coast, with a warming of 0.2 to 0.3°C every 10 years for the Gippsland coast study area (Figure 4.6a). There has been a warming trend of between 0.1 and 0.3°C every 10 years in minimum temperature over the last 40 years for the south-east Australian coast (Figure 4.6b), with a warming of 0.1 to 0.2°C for the Gippsland coast study area. There has been an observed increase in mean (average of the daily maximum and minimum temperature) temperature of 0.1 to 0.3°C every 10 years over the past 40 years for the south-east Australian coast (Figure 4.6c), with the majority of the area warming between 0.1 to 0.2°C every 10 years.

(a) Maximum temperature



(b) Minimum temperature



(c) Mean temperature

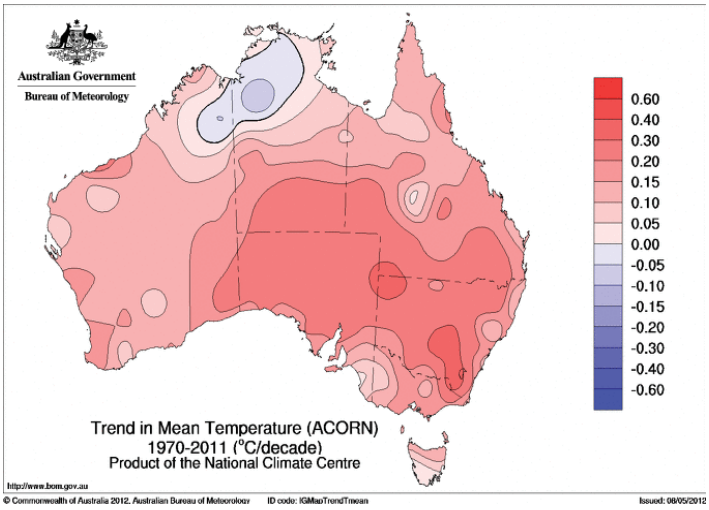


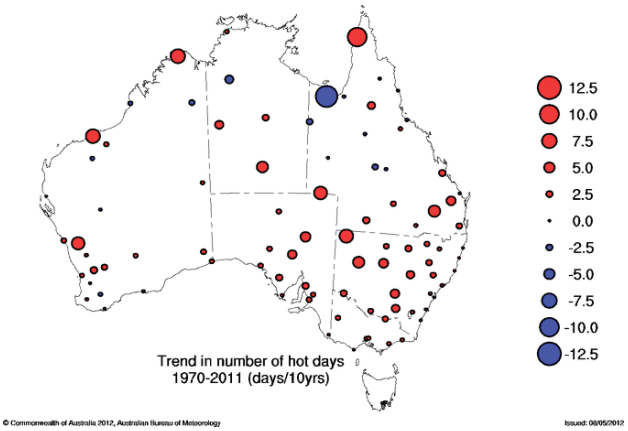
Figure 4.6 (a) (b) and (c): Trends in temperatures over Australia over the period 1970 to 2011
Source: Bureau of Meteorology: www.bom.gov.au/climate/change/acorn-sat/.

Observed trends: hot days

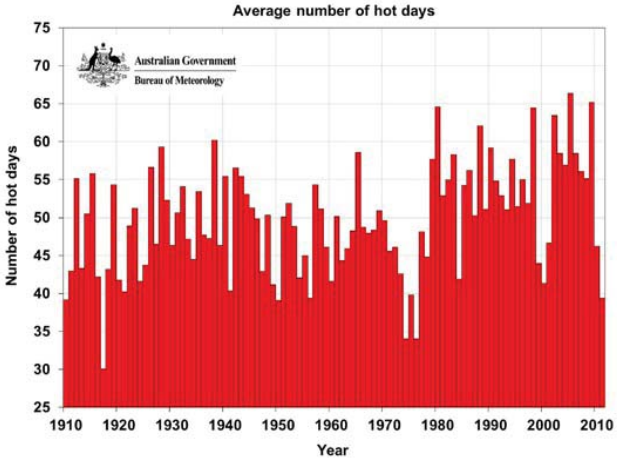
As can be seen from Figure 4.7(a), most sites in Gippsland show an increase in the number of hot days (above 35°C) of 2.5 days every 10 years. Inland, there has been a larger increase in the number of hot and very hot (greater than 40°C, not shown) days in south-east Australia. However, as can be seen from Figure 4.7b for the whole of Australia, any trend is superimposed on a high degree of year-to-year variability.

There have been increases in the maximum temperature of the hottest day of between 0.2 and 0.8°C every 10 years over the past 40 years for the south-east Australia coast (Figure 4.7c), with the exception of a couple of stations, which show little change or a slight decrease. Although there is limited data, the few observations from the south-east Australia coast indicate that there have also been increases in the duration of warm spells of approximately 2.5–5 days every 10 years (Figure 4.7d).

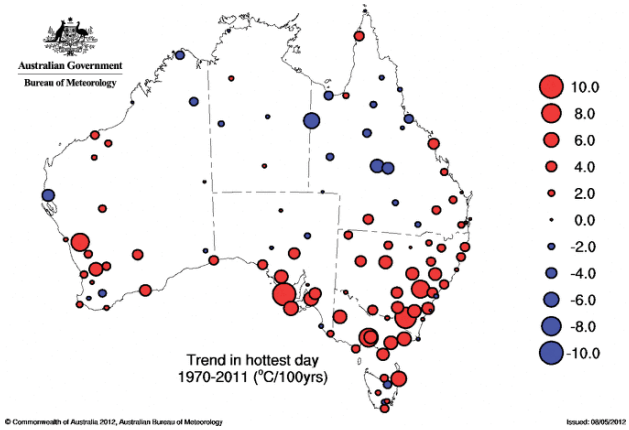
(a) Number of hot days: Trends in the number of days over 35°C (in days per decade) over the period 1970 to 2011



(b) Annual number of hot days over 35°C: Australian average



(c) Trends in the temperature of the hottest day recorded each year over the period 1970 to 2011



(d) Trends over the period 1970–2011 in the number of days each year (in days per decade) that occur during warm spells; that is, during a period of at least 4 consecutive days when daily maximum temperature is greater than a threshold based on the 90th percentile for the period 1961–1990

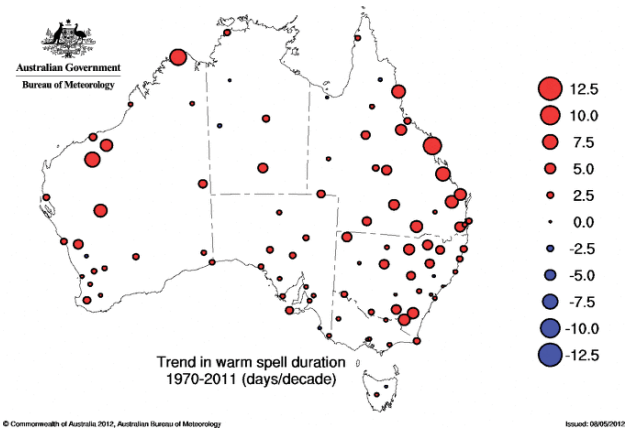


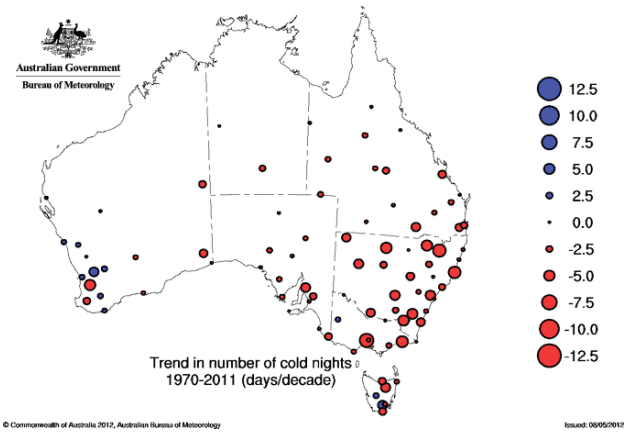
Figure 4.7 (a), (b), (c) and (d): Trends in several indicators of hot days

Source: Bureau of Meteorology: http:// www.bom.gov.au/climate/change/acorn-sat/.

Observed trends: cold nights

The number of cold nights (minimum less than 5°C) has generally decreased by 2.5–5 days every 10 years in the Gippsland study areas (Figure 4.8a). A similar trend is observed in the number of frost nights, with a decline of 2.5 days every 10 years on the Gippsland coast. As can be seen from Figure 4.8b showing data from Australia as a whole, this trend is superimposed on a high degree of year-to-year variability. There have been increases in the temperature of the coldest night recorded each year of between 0.2 and 0.4°C over the past 40 years over the south-east Australian coast.

(a) Trends in the number of nights less than 5°C (in days per decade) over the period 1970 to 2011



(b) Annual number of nights colder than 5°C, averaged over Australia

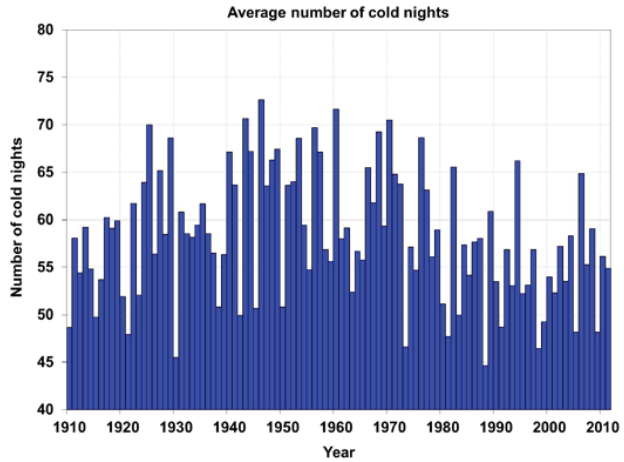


Figure 4.8 (a) and (b): Trends in several indicators of cold nights

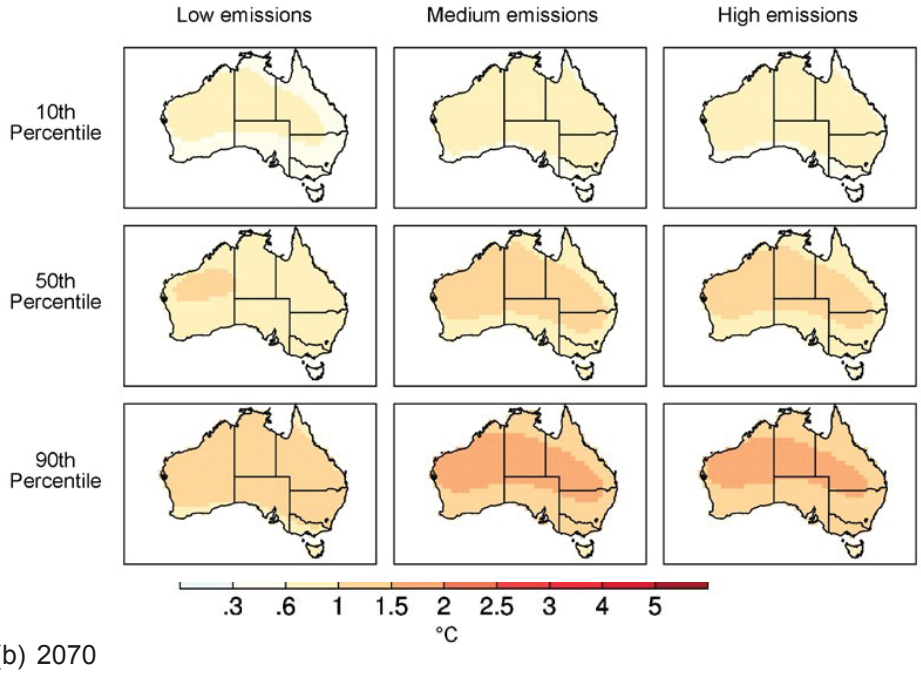
Source: Bureau of Meteorology: http://www.bom.gov.au/ climate/change/acorn-sat/.

Future trends: average surface air temperature

By combining the low emissions scenario with the 10th percentile and the high emissions scenario with the 90th percentile, a range of temperature increase for the south-east Australian coast by 2030 can be given as 0.3 to 1.5°C compared to a 1990 baseline (Figure 4.9a). By combining the low emissions scenario with the 10th

percentile and the high emissions scenario with the 90th percentile, a range of temperature increase for the south-east Australian coast by 2070 (Figure 4.9b) can be given as 1 to 4°C, compared to the 1990 baseline (1980–1999 average).

(a) 2030



(b) 2070

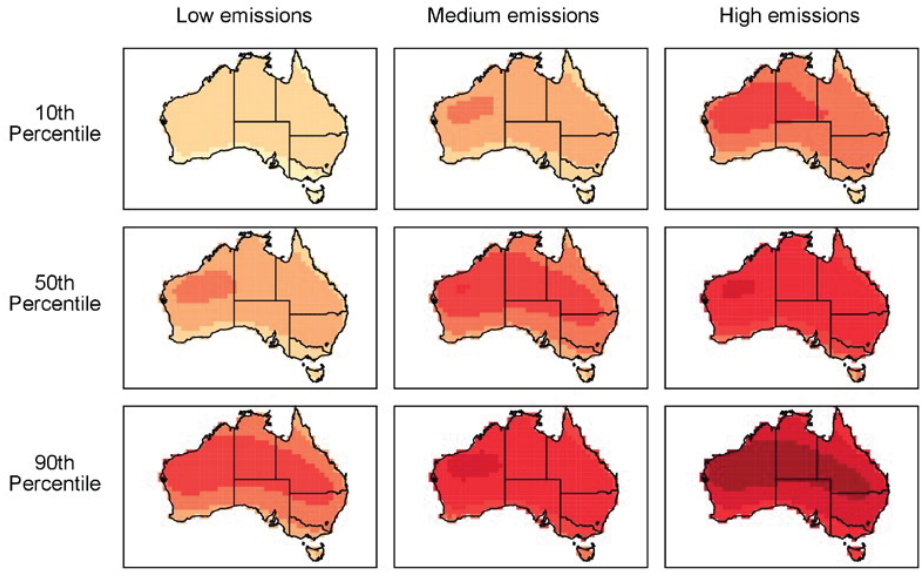


Figure 4.9 (a) and (b): Projected changes in annual average surface air temperature

Source: CSIRO and Bureau of Meteorology (2007); Climate Change in Australia: http://www.climatechangeinaustralia.gov.au.

Future trend: hot days

Figure 4.10 shows the change in frequency of the hottest day, which now occurs on average once in 20 years over southern Australia. Results are shown for three IPCC emissions scenarios (B1, A1B and A2). Note that the time periods for these projections are different from those given earlier; namely, the 20-year periods centred on 2055 and 2090. The figure shows that a 1 in 20-year hottest day today is projected to become about a 1 in 3 to 1 in 5-year occurrence by 2055 and a 1 in 3.5-year to almost an annual occurrence by 2090.

A decrease in return period implies more frequent extreme temperature events (i.e. less time between events on average). The box plots show results for two time horizons: 2055 (2046–2065 average) and 2090 (2081–2100 average), and for three different SRES emissions scenarios: B1 (blue, low emissions), A1B (green, medium emissions) and A2 (red, high emissions). Results are based on 12 global climate models contributing to the third phase of the Coupled Model Intercomparison Project. The level of agreement among the models is indicated by the size of the coloured boxes and the length of the whiskers.

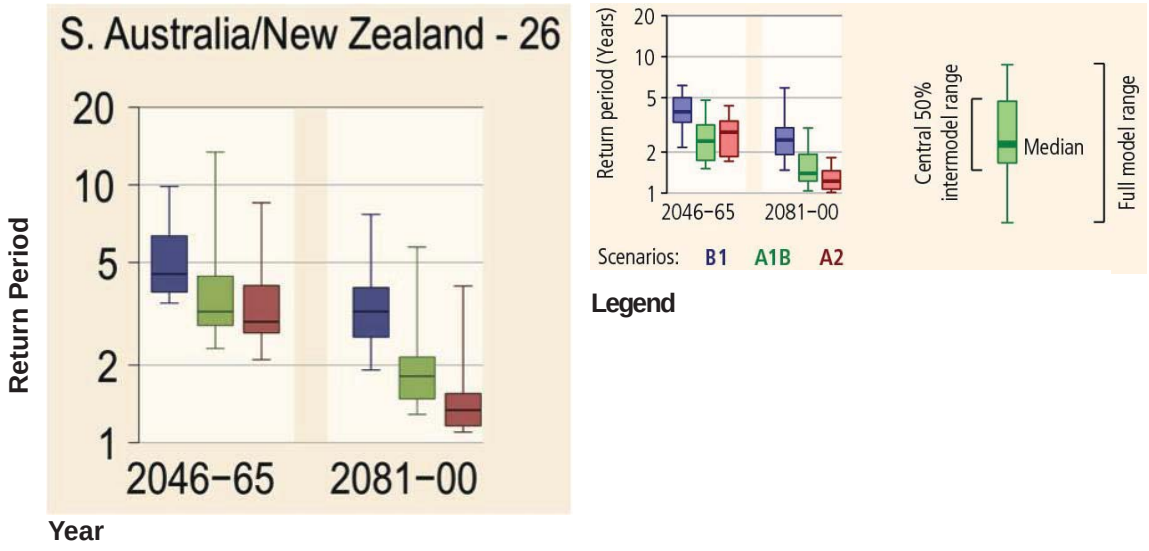


Figure 4.10: Projected changes in the return period for the maximum daily temperature that was exceeded on average once during a 20-year period in the late 20th century (1981–2000), averaged over southern Australia and New Zealand

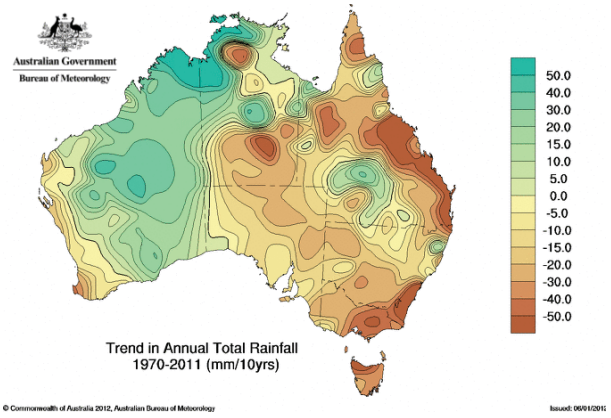
Source: Adapted extract of Region 26 – Southern Australia/New Zealand from Figure SPM.4A of IPCC (2012) Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, http://ipcc-wg2.gov/SREX/.

Observed trends: average rainfall totals

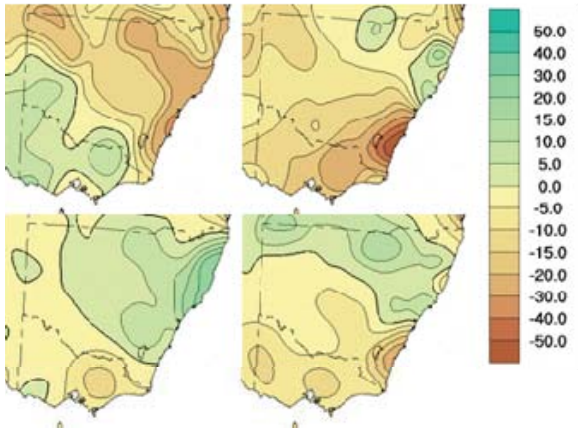
Over the past 40 years there has been a strong drying trend along the south-east Australia coast, with a decline of 30–50 mm per decade in the Gippsland coast area (Figure 4.11a). Mirroring the decrease in total rainfall over the past 40 years, the number of wet days has also declined in the south-east Australia coast area (Figure 4.11c). The observed trends in rainfall show pronounced seasonality (Figure 4.11b), particularly for the NSW south coast. There the drying trend is especially strong in autumn, and somewhat less pronounced but still clear in summer and spring. For the

Gippsland coast, the drying trend is more evenly distributed throughout the year, but slightly more pronounced in autumn.

(a) Annual trends in total rainfall (in mm per decade) from 1970 to 2011



(b) Seasonal trends in total rainfall (in mm per decade) from 1970 to 2011



(c) The number of wet days (days with more than 1 mm of rainfall

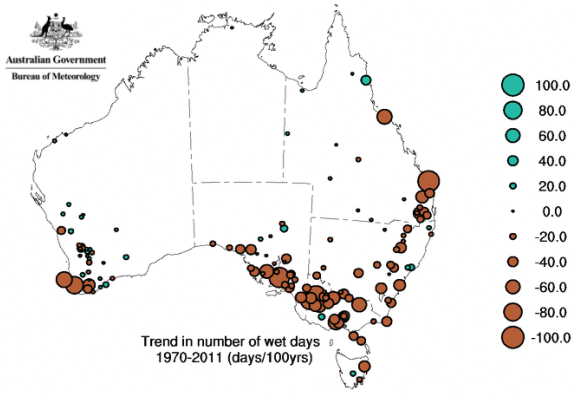


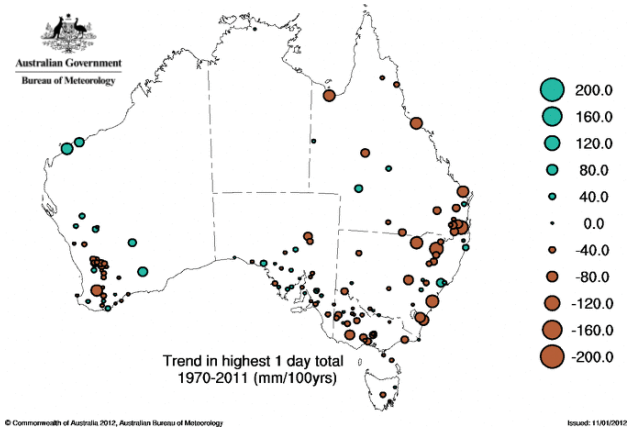
Figure 4.11 (a), (b) and (c): Trends in total rainfall

Source: Bureau of Meteorology, http://www.bom.gov.au/climate/change/.

Observed trends: extreme rainfall

Over the past 40 years, extreme rainfall has declined in line with the decline in total rainfall, as shown by: (i) the number of days with heavy rainfall (Figure 4.12a); and (ii) the highest daily precipitation each year (Figure 4.12b). Both of these indicators have decreased over the 40-year period.

(a) Trends in the number of days with heavy rainfall (i.e. rainfall greater than 10 mm per day)



(b) Trends in the highest daily rainfall recorded each year

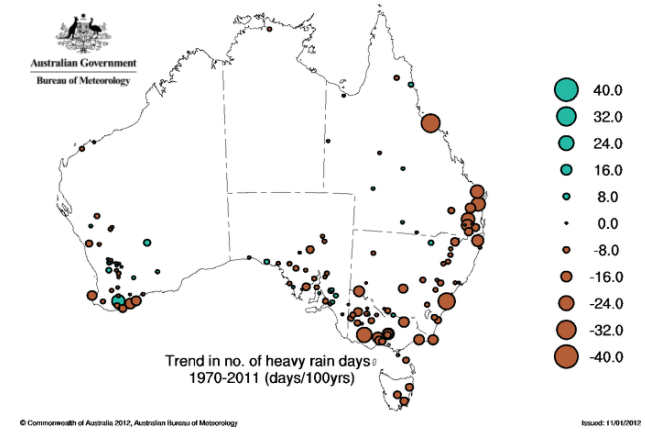


Figure 4.12 (a) and (b): Trends in indicators of extreme rainfall

Source: Bureau of Meteorology, http://www.bom.gov.au/climate/ change/.

Observed trends: dry periods

While annual total rainfall has declined over south-east Australia, the number of consecutive dry days (Figure 4.13) has slightly decreased along the coast (shorter periods of dry weather), but has increased inland (longer periods of dry weather).

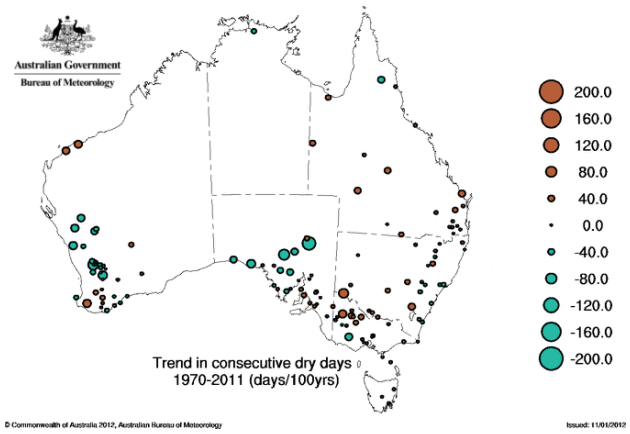


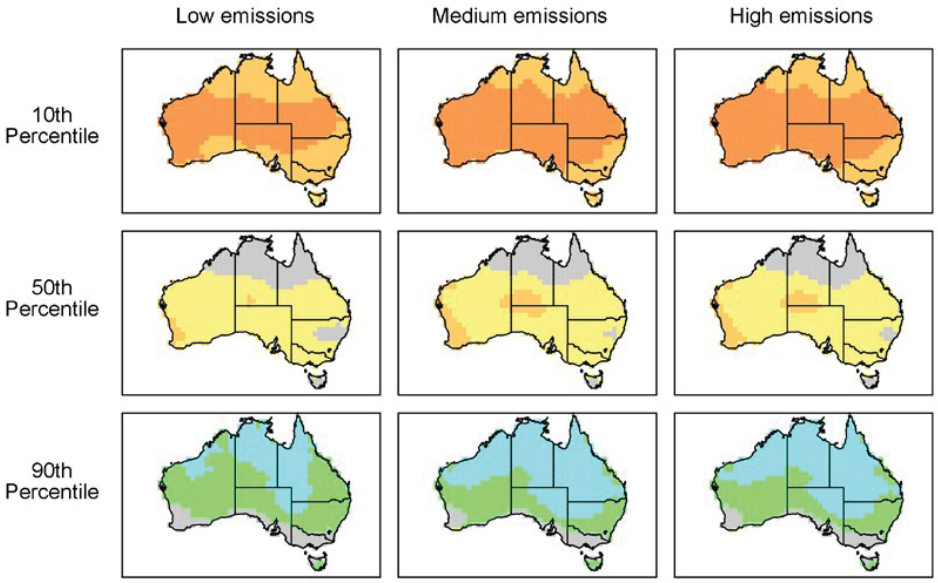
Figure 4.13: Trends (in days per century) in the maximum number of consecutive days with daily precipitation less than 1 mm each year over the period 1970 to 2011

Source: Bureau of Meteorology, http://www.bom.gov.au/climate/change/.

Future trends: total rainfall

The range of uncertainty for projected rainfall change in 2030 across Australia is very large (Figure 4.14a). The Gippsland coast ranges from no change in rainfall to a decline of up to 10%. The range of projected rainfall changes in 2070 is high (Figure 4.16b), indicating a high level of uncertainty in both the future direction and magnitude of rainfall trends. For the Gippsland coast, trends in projected rainfall vary from no change to a decline of up to 40%. The 10th and 90th percentiles (lowest 10% and highest 10% of the spread of model results) provide a range of uncertainty.

(a) 2030



(b) 2070

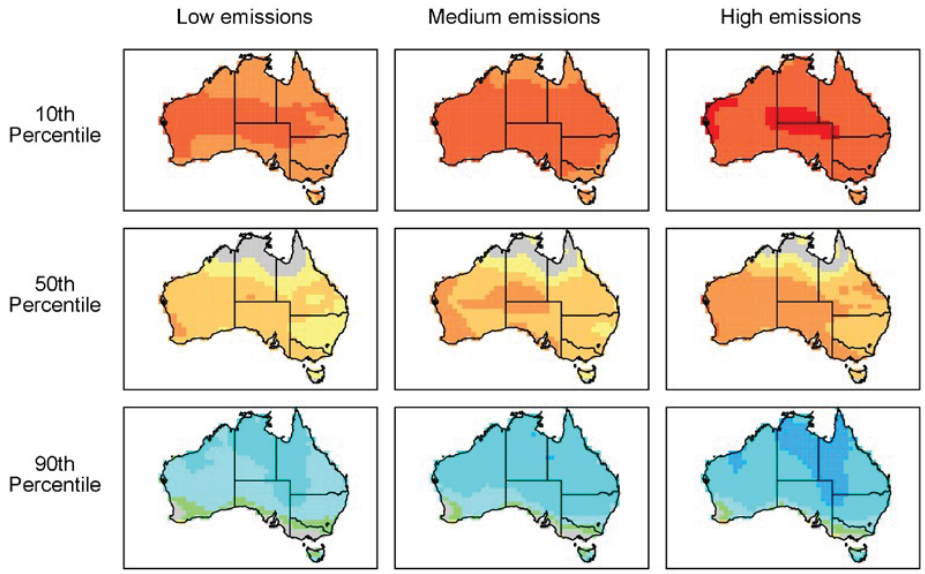


Figure 4.14 (a) and (b): Projected changes in annual rainfall

Source: CSIRO & Bureau of Meteorology (2007), Climate Change in Australia: http://www.climatechangeinaustralia.gov.au.

Future trends: extreme rainfall

Figure 4.15 shows the change in frequency of very heavy daily rainfall events that now occur on average once in 20 years over southern Australia. Results are shown for three IPCC SRES emissions scenarios (B1, blue, low emissions; A1B green, medium emissions; and A2 red, high emissions).

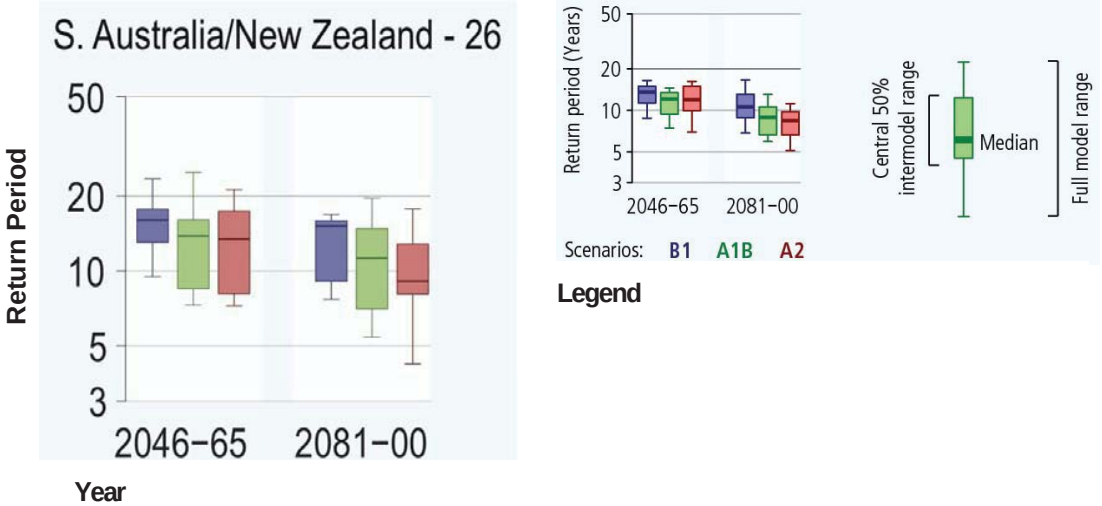


Figure 4.15: Future trends – Extreme rainfall Projected changes in the return period for daily rainfall that was exceeded on average once during a 20-year period in the late 20th century (1981–2000), averaged over southern Australia and New Zealand

Source: Adapted extract of Region 26 – Southern Australia/ New Zealand from Figure SPM.4B of IPCC (2012) Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, http://ipcc-wg2.gov/SREX)

Note that the time periods for these projections are the 20-year periods centred on 2055 and 2090. These results indicate a modest increase in extreme rainfall events over the southern Australian region. Results suggest that daily rainfall events that now occur once every 20 years will occur once every 15–17 years by 2055 (2046–2065 average) and once every 9–17 years by 2090 (2081–2100 average) . A decrease in return period implies more frequent extreme rainfall events (i.e. less time between events on average). The level of agreement among the models is indicated by the size of the coloured boxes and the length of the whiskers.

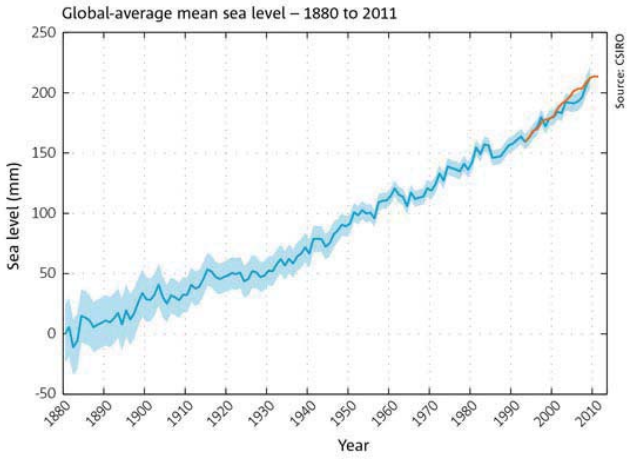
Future trends: Dry periods

Projections indicate an increase in the number of consecutive dry days in south-eastern Australia by 2090 (2081–2100 average). However, projected decreases in soil moisture are less consistent for the same region, suggesting low confidence in future drought projections.

Observed trends: Sea level

The average global sea level (Figure 4.16a) has risen by approximately 210 mm (21 cm or 0.21 m) from 1880 to 2011, owing both to thermal expansion from the warming of the ocean and the additional water provided by melting glaciers and ice caps. The trend from 1993 to 2011 as measured by satellites (red line in the figure) is approximately 3 mm per year, compared to the longer-term average of 1.7 mm per year. When compared to the global average rate of sea level rise, there is much variation around Australia's coasts (Figure 4.16b), which is crucial for understanding current and future risks associated with rising sea level. For our study area, the observed sea level rise from 1993 to 2011 is close to the global average of 3 mm year.

(a) Global average sea level measurements from tide gauges (blue) and satellites (red)



(b) The rate of sea level rise around Australia as measured by coastal tide gauges (circles) and satellite observations (contours) from January 1993 to December 2011.

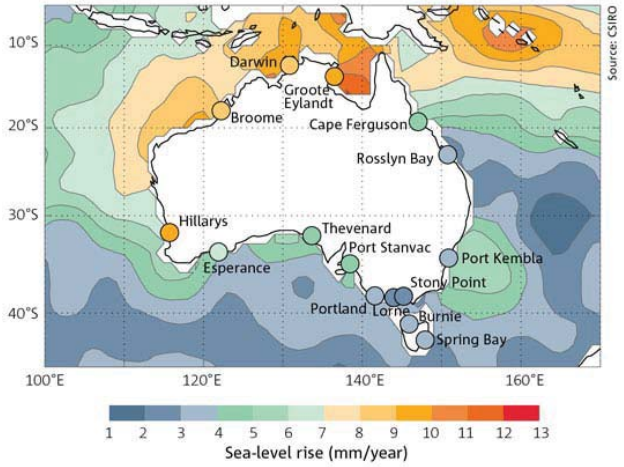


Figure 4.16 (a) and (b): Observed global and regional sea level rise

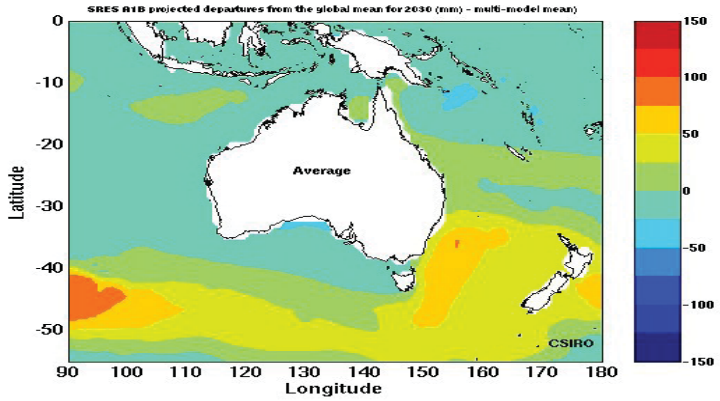
Source: CSIRO & Bureau of Meteorology, State of the Climate 2012: http://www.csiro.au/State-of-the-Climate-2012.

Future trends: Sea level

Projections for global average sea level rise for 2100, compared to the 1990 value, reveal a large range, from an additional 20 cm to a maximum of 80 cm. Much of the uncertainty is linked to the stability of the large polar ice sheets (Greenland and Antarctica), with the dynamical processes by which they can lose ice to the sea not yet well understood. Thus, the IPCC also notes that larger values (greater than 0.8 m) cannot be ruled out. The observed sea level rise is currently tracking near the upper limit of the envelope of IPCC projections.

Figure 4.17 shows the difference from the projected global average sea level rise for areas around Australia. For our study area, the Australian regional projections show a further increase of 2.5–5.0 cm on top of the global average sea level rise for 2030, and 5.0–7.5 cm for 2070 for the south-east coasts. This means that, for planning purposes, the maximum projected sea level rise for the study areas becomes approximately 20 cm in 2030 (compared to the 1990 baseline) and approximately 52 cm in 2070. However, because of the uncertainties in regards to polar ice sheet dynamics, higher values cannot be ruled out.

(a) 2030



(b) 2070

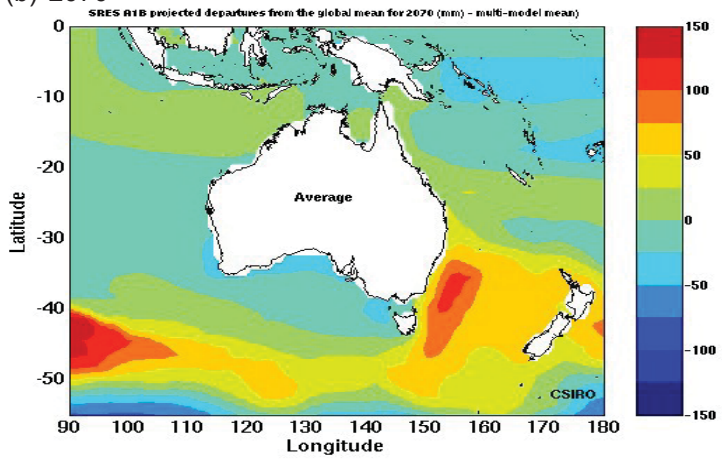


Figure 4.17: Projected departures (in mm) from the: (a) 2030 and (b) 2070 global-mean sea level from 17 SRES A1B simulations

Source: CSIRO and Antarctic Climate and Ecosystems CRC sea level rise website: http://www.cmar.csiro.au/sealevel/index.html.

Coastal inundation and erosion

Inundation (flooding) of property and infrastructure ('high sea level events') and coastal erosion are the most important risks associated with a rising sea level. The flooding events are usually associated with high tides and storm surges, with changes in sea level playing a role over longer periods of time. A rise of 0.5 m (50 cm) in sea level can increase the frequency of high sea level events by a factor of 10 to 1000. These are surprisingly high multiplication factors. A multiplying factor of 100 means that a flooding event that currently occurs once in every 100 years would occur every year with a 0.5-m sea level rise. Although there are no estimates of these multiplication factors for our study area, the multiplication factors for Sydney and Melbourne (from 100 to 1000) suggest the potential for a very large increase in flooding events for the south-east Australian coast towards the end of this century.

Many coastal flooding events are associated with simultaneous high sea level events and heavy rainfall events in the catchments inland of the coastal settlements. Little research has been done to connect these two phenomena and produce an overall

change in the risk factor for these ‘double whammy’ coastal flooding events. For our study area there is a strong correlation between storm surges and heavy rainfall events as both are often caused by east coast low pressure systems. Unfortunately, climate models cannot yet simulate the behaviour of east coast lows so projections of changes in their frequency or intensity cannot be made. In addition, no clear trends in changes in the nature of east coast lows are evident from the observational records. Indirectly, the rises in sea level over the 21st century, which are virtually certain, coupled with the projections of a modest increase in the frequency of heavy rainfall events for southern Australia (IPCC 2000) would suggest that an increased risk of these ‘double whammy’ flooding events is more likely than not.

Bushfires

Although changes in the risk of bushfires can be expected as the climate warms, much uncertainty remains in regards to observations of changed bushfire behaviour and projections of changes in the future. The Black Saturday bushfires of 7 February 2009 in Victoria illustrate the possible connection between climate change and fire risk in areas very similar to the hinterlands of our study area.

The four factors that form the MacArthur Forest Fire Danger Index (FFDI) are directly related to climate, and three of them (maximum temperature, relative humidity and a drought factor) set record values on 7 February, values that are consistent with the observed and projected trends in those variables due to climate change (Karoly 2009). The FFDI itself reached record levels, ranging from 120 to 190 across sites in Victoria compared to a value of 100, which was based on the FFDI for the Black Friday fires of 1939. The IPCC Fourth Assessment Report (IPCC 2007b) analysed the climate-related factors that influence fire danger, and noted that an increase in fire danger is likely to be associated with a reduced interval between fires, increased fire intensity, faster fire spread and a decrease in fire extinguishments. In our study area, the frequency of very high and extreme fire danger days is likely to rise 4–25% by 2020 and 15–70% by 2050 (IPCC 2007b).

Other climate-related risks

The ability to have confidence in projecting changes in the direction and magnitude of climate extremes depends on issues such as the region and season, the available data, how the underlying processes are understood, and the reliability of simulation models (IPCC 2007b).

The IPCC (2007b) goes on to note that the:

> *projected changes in climate extremes under different emissions scenarios generally do not diverge strongly in the coming two to three decades, but these signals are relatively small compared to natural climate variability over this timeframe. Even the sign of projected changes in some climate extremes over this timeframe is uncertain. Low-probability, high-impact changes associated with the crossing of poorly understood climate thresholds cannot be excluded, given the transient and complex nature of the climate system.*

Assigning ‘low confidence’ for projections of a specific extreme neither implies nor excludes the possibility of changes in this extreme.

The IPCC (2000) Special Report on Emissions Scenarios provides estimates of global projected changes in other variables not already covered earlier in this section and also indicates where our current state of knowledge is insufficient to make projections with any degree of confidence. Two of these changes are of particular relevance to the

study region. Firstly, as much of the rainfall in the study regions, particularly in the autumn–winter–spring, comes from frontal systems, any southward shift in these storm tracks is likely to lead to further reductions in rainfall. The southward shift in the sub-tropical ridge and the resultant observed southward shift in storm tracks appears to be one reason why the south-east Australian coast has already observed rainfall declines.

Secondly, the low confidence in how the El Niño-Southern Oscillation (ENSO) phenomenon will be affected by climate change contributes to the uncertainty in future rainfall patterns in the study regions. Although El Niño has more profound effects on the weather of some other parts of Australia, it does also affect the weather patterns experienced by the study region. For example, El Niño events are associated with moderate reductions in winter and spring rainfall, whereas La Niña events, the counterparts of El Niño, are associated with moderate increases in rainfall.

4.3 Sea level rise and storm surges in Inverloch and Sandy Point

Issues for consideration in relation to the future of the built environment of Inverloch and Sandy Point include:

- How to resolve existing problems with stormwater disposal/drainage backup in Inverloch and Sandy Point; these issues are likely to be exacerbated by climate change, which may mean that the effects of extreme storm events will become more severe.
- Whether a conventional gravity sewerage system will still be appropriate for Sandy Point under a climate change scenario, which may raise water tables and lead to periodic inundation of low-lying areas. Options might include a STEP system (utilising the existing septic tanks) in the medium term, followed by consideration of low-pressure or vacuum systems in the future.
- The likely impact of sea level rise on inundation risks in the townships and erosion of foreshores and dune systems.

While inundation from storm surges will occur in the future (Figures 4.18 and 4.19), it can be seen that there is time to address these climate adaptation issues facing the settlements. A severe storm event for Inverloch is discussed in detail in Chapter 8. In Inverloch, there are some areas in the centre of the township near the caravan park that are vulnerable to increased flood risk from the seaward side over the medium term, particularly when combined with catchment-based flooding. For Sandy Point, the major inundation risk is severance of access due to water travelling overland from Shallow Inlet and cutting roads leading into the settlement. The maps do not indicate the depth of the water that would overtop the road, so more detailed studies would be necessary to determine how much of an issue this might be. The most serious risk to both Inverloch and Sandy Point from sea level rise is likely to be increased erosion of beaches and dune systems.

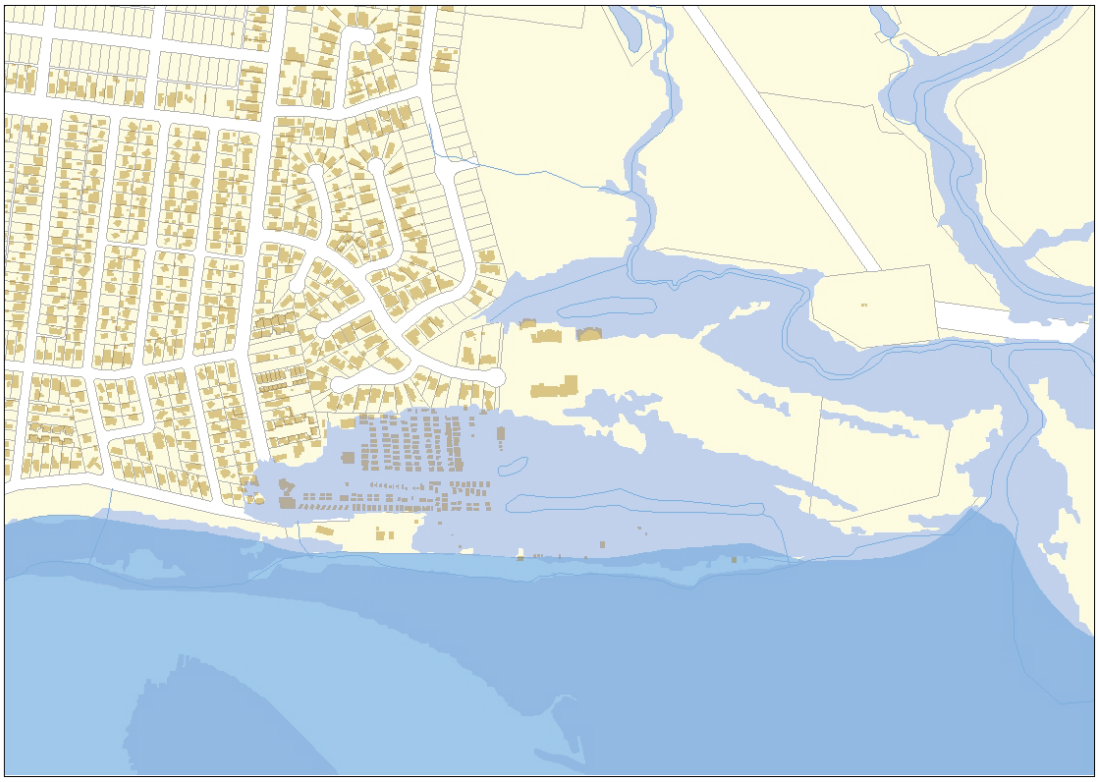


Figure 4.18: Future Coasts - Coastal Inundation Dataset: 2040 Storm Surge

Source: Shire of Bass Coast 2012

Figure 4.19: Sandy Point Sea level rise 0.2 metres by 2030 and 0.8 metres by 2100
Source: West Gippsland Catchment Management Authority

4.4 Legislative and policy context

4.4.1 Victoria

The main Victorian legislation dealing with climate change adaptation is the *Climate Change Act 2010*, which requires decision-makers to consider climate change in preparing or approving a range of strategies and plans under various Acts. It requires the minister to prepare a Climate Change Adaptation Plan for Victoria, to consider potential impacts and risks, and to identify state-wide priorities and strategic responses. Victorian plans, strategies, policies and research programs with specific relevance to adaptation to coastal climate change include the following.

Victorian Coastal Strategy 2008

The Victorian Coastal Strategy considers the potential impacts of climate change on the Victorian coast and sets a planning benchmark of not less than 0.8 m of sea level rise by 2100.

State Planning Policy Framework

The State Planning Policy Framework included in all municipal planning schemes in Victoria contains provisions on coastal climate change. These reflect the policies in the Victorian Coastal Strategy, in that there is a requirement to plan for possible sea level rise of 0.8 m by 2100. A recent amendment that has provided responsible authorities with an option of using a figure of 0.2 m over current 1 in 100 year flood levels by 2040 may be used for new development in close proximity to existing development (urban infill).

Future Coasts

Future Coasts is a major program undertaken by the Victorian Department of Sustainability and Environment (DSE) that has included detailed digital elevation modelling of the Victorian coast and research on the likely impacts of climate change on sea level rise, rainfall, storms and storm surge. The modelling has now been made available to local government. It is designed for use at a regional scale (1:20,000) rather than at the local or property level. It does not consider the effects of existing protective structures, natural flood reservoirs or coastal recession.

The DSE is also sponsoring four local assessments across the state, at varying scales in areas representing a range of different environments and adaptation challenges. The case study towns for this project, Inverloch and Sandy Point, are outside the areas being covered by the local assessments.

Funding for adaptation planning

An amount of $6 million has been allocated to the Victorian Adaptation and Sustainability Partnership to support the local government sector in a number of ways, including grants and partnership projects to undertake climate adaptation and enhance sustainability locally.

Planning for the health impacts of climate change has been a major focus in Victoria, and includes the following.

Victorian Health and Wellbeing Plan 2011–2015

The Plan recognises that severe weather events present environmental, economic and health challenges; some people will be at higher risk of health problems, including children, older people, people with existing medical conditions, people who work outdoors, and those in areas most likely to be affected, such as rural and coastal communities.

Victorian heatwave framework

The main components of the Victorian heatwave framework are: the 2011 Heatwave Plan for Victoria: Protecting Health and Reducing Harm from Heatwaves; the Heat Health Alert System, which notifies agencies of impending heatwaves and the need to activate their heatwave plans; and local council heatwave plans prepared with state funding assistance, in line with the Heatwave Planning Guide.

Planning for the effects of climate change on the natural environment and natural resources in Victoria includes the following.

Sustainable water strategies

Sustainable water strategies have been prepared for all Victorian regions, considering the likely impacts of climate change on waterways, wetlands and water supplies for urban, industrial and agricultural use.

Reducing the impacts of natural disasters (mitigation, response, relief and recovery)

Following major bushfires in 2009 and floods in 2011, the Victorian Government has revamped its arrangements for planning, monitoring and warning systems, emergency management, and community recovery from natural disasters.

4.4.2 Local government

Bass Coast and South Gippsland Shires have undertaken a range of land use and health planning activities to assist with adaptation to climate change in coastal settlements. These include:

- working with the South East Climate Change Alliance (Bass Coast);
- amending planning schemes to refer to the need to plan for the potential impacts of climate change and to incorporate strategic framework plans or urban development frameworks for all coastal settlements (both shires);
- requiring coastal hazard vulnerability assessments for major developments in areas potentially at risk (both shires) or Section 173 Agreements on land titles for planning permits on low-lying land (South Gippsland);
- hosting workshops with key stakeholders, including emergency services agencies and people with specific needs, to discuss climate change adaptation (both shires);
- preparing Heatwave Plans to be incorporated into the Bass Coast Shire Council Municipal Emergency Management Plan (both shires);
- using the Future Coasts dataset and the shire's GIS to identify areas of existing settlements that may be at risk of future coastal inundation, overland flow or coastal recession as a result of climate change (Bass Coast); and
- preparatory work on a whole-of-council Climate Change Adaptation Strategy, which will cover mitigation as well as adaptation, emergency management and community engagement (Bass Coast).

5. RESULTS AND OUTPUTS: PART 2, WHAT SORT OF SETTLEMENT DOES THE COMMUNITY WANT?

This chapter addresses the following research questions. First, what is the community's vision of a climate-adapted settlement, what sort of settlement does the community want and how can wellbeing be maximised for all residents? Second, how can this preferred form of settlement be achieved? Who makes what decisions about adaptation and where does responsibility lie?

5.1 Inverloch

5.1.1 Description of participants

The consultation, held on a Saturday, was attended by 43 local full-time and part-time residents of Inverloch. In addition to individual participants, the following groups and organisations were known to be represented:

- Bass Coast Shire Council, including the mayor and a councillor;
- South Gippsland Conservation Society;
- Groundswell Bass Coast;
- Department of Sustainability and Environment;
- South Gippsland Shire Council;
- Monash University;
- Hands Across the Inlet;
- Tarwin Lower/Venus Bay Association;
- South Gippsland Yacht Club;
- Inverloch Historical Society; and
- Inverloch Garden Club.

Many of the participants were over 50 years of age. The research team was aware of a bias towards those interested in climate change, although there were a few people present who identified that they did not believe in climate change. The research team had initially invited to the consultation a randomly-selected group from the council rate list but there was little interest in attending. It was realised that only people who were aware and interested in the topic would attend, so a less formal invitation approach was adopted. All known community groups were invited and asked to let their members know about the event; posters and advertising was undertaken in the local media. The self-selected group tended to be older (retired), aware and already involved in community activities.

5.1.2 Vision

Participants had difficulty in forming a comprehensive longer-term vision of Inverloch and surrounds. Most people were more likely to express a perspective on an issue where they had some concerns, such as the growth of urban development in Inverloch. Thus, issues raised were more short term and pragmatic. Many of the participants had moved to Inverloch on retirement, although they had been a resident, or a part-time resident, for over 10 years. The predominant view was that Inverloch should remain as it is now, 'an attractive place to live with great natural beauty and a strong village

atmosphere'. Concerns were expressed around perceived threats to this vision and there was recognition that some changes in response to adaptation would be necessary.

Many of the expressed issues related to current trends that will impact on the process and directions of adaptation, as well as possible outcomes of adaptation. The major themes that will impact on the shape and character of Inverloch in 2030 are outlined below.

Theme 1: population growth, urban development and the loss of a boundary between urban and rural areas

The rise in the population and growth of urban development was a concern expressed by many people. Some were worried about developments creeping into farming land and along the coast, and the size and predominance of the houses presently being built. A suggested solution was that town boundaries be defined and held, to be reviewed at 5-yearly intervals. They desired a consistent and shared vision to be developed around town planning. This perspective can be summarised as what was needed was: 'restricted development of housing to maintain the 'village' feel of the township and surrounds', and: 'it would be wonderful if we could maintain the current boundary for the town and have an extensive natural environment'.

Theme 2: Sustainable urban development and adaptation

Discussion took place about the densification of urban Inverloch. There was recognition that this will be necessary but there were some mixed feelings about this. The outcome seemed to be a desire for medium density and smaller housing to prevent urban sprawl and to also improve transport and plan open/green/wild spaces between built structures. The provision of housing above shops was suggested. The urban development discussion touched on building an attractive higher density aged-care facility with shared common space. Buildings and town planning should also incorporate planning for future water needs. They could 'collect storm water in giant underground tanks or provide tanks for all properties'. However, views were divided here as some felt that Inverloch should be safe for water provision with the desalination plant now completed near Wonthaggi.

There was a desire for new developments to be 'green'. Properties should be provided with solar generators, especially for older people and for those who are financially disadvantage. The problem of solar generation on rental properties was raised. There was said to be a need for a transport strategy, encompassing local transport and taking into consideration transport access for those living longer distances from Melbourne. There was a desire for pedestrian precincts in the town that exclude cars, along with increased walking and bicycle infrastructure. A car park on the edge of town was suggested, served by a frequent shuttle bus service and a circular bus service around town.

It was felt that attention was needed on drainage issues in Inverloch central, the participants pointing out that, at times, there was stormwater with high nutrient levels running through the town. Concern was expressed about sea inundation, which will impact some houses. A subgroup suggested the solution was the provision of alternative land on which the impacted people could build, with the possibility of building houses that could be relocated: moveable houses. Additionally, it was felt that planning permits should not be issued where land could be subjected to inundation. A small group of participants expressed the view that emotional and social support should be offered to those people whose properties were under threat.

Theme 3: Environmental issues

Participants raised the issue of the current visible erosion along the foreshore, especially as the main public space in Inverloch is a strip park along the edge of the sea and there is not enough space to extend this further inland. Loss of ecosystems was seen as a problem, with the need to protect the natural environment and coastal vegetation, particularly mangroves and seagrass, and to reclaim local wetlands. The loss of funding from the Victorian Department of Sustainability and Environment, and Parks Victoria was of particular concern to the participants. Suggestions were made about possible ways of addressing these environmental issues, such as getting school children involved and gaining carbon credits for revegetation.

Theme 4: Amenities to improve wellbeing of residents and maintain inverloch as a holiday town

The ideas expressed here include the re-greening of Inverloch by providing green belts to address issues of heat. Participants wanted more and better-managed public spaces with generally a greater emphasis on communal rather than private recreation. The need for more footpaths for older people was communicated, and for the surf beach car park to be larger and safer. Retaining and attracting younger people was seen as critical by many participants. The strengthening of Indigenous culture was viewed as important by a cluster of participants. Participants expressed that they wanted 'a contented population', with interest groups, a library, sporting facilities and cultural opportunities. Inverloch as a holiday town was seen as both a positive and a not so positive issue; residents, at times, had different priorities to the holiday population. However, there was general agreement about a desire to keep Inverloch as a holiday/rural character town.

5.2 Sandy Point

5.2.1 Description of participants

The community consultation was held at the Surf Life-saving Club at Sandy Point. Eighteen local participants attended, most being full-time residents of Sandy Point, a few part-time residents and some from the surrounding area. Amongst attendees, the following groups and organisations were represented:

- Sandy Point Surf Lifesaving Club;
- Sandy Point Foreshore Committee;
- South Gippsland Shire Council;
- Department of Sustainability and Environment; and
- Monash University.

A broader range of age groups was represented than at Inverloch. Most people who attended had been associated with Sandy Point for a long time, some of whom were farmers over a couple of generations. Many of those present accepted climate change as a fact, but there were some who did not accept that it was anthropogenic and, as such, felt that there was nothing that could be done about it. A couple of people felt that people who believed in climate change had extreme views.

5.2.2 Vision

As with Inverloch, it was very hard to elicit a vision of what a climate-adapted settlement would look like. Interestingly, a couple of the residents noted that Sandy Point should have a vision about adaptation to direct action. However, there was a general consensus about what they liked about the settlements already present, how

they would like Sandy Point to remain much the same and what they did not want to lose. The participants largely focused on specific issues of concern to them, commonly around the urban form and location, and their view of the future tended to be short term in outlook.

When asked about their vision for the community, what the group expressed was a perspective of people who care deeply about their community and its future, and are cohesive in their vision for the future. The central theme of this vision is that they do not want the community to change much, if at all, and only then if it is done with the control and oversight of the community. They felt very strongly about this. When asked about the special qualities of Sandy Point, a sense of pride, familiarity and enjoyment of the location was expressed. They believed that most people had good qualities, with the area:

- being peaceful and quiet;
- not overdeveloped;
- having a natural environment; and
- being cheaper to live in that other parts of Victoria.

The importance of lifestyle and continuity dominated the vision. This was reflected in comments such as: 'Sandy Point has old holiday houses – you could build a better house but you don't want to'. 'People who have holiday houses here have them forever'. 'People come in winter – even the non-permanent residents'. 'Third generation people come to the town.' The participants' responses reflected a strong emotional attachment to the area.

Part of the lifestyle attraction was the local environment, with most participants voicing strong feelings about the environment. Comments included: 'I haven't seen a better beach in the world anywhere'. Another, who had been coming to Sandy Point for 56 years, said:

> *People ask me why I don't go somewhere different but every time I come down I see something different to see. Fishing on the beach – seen the auroras, seen whales and dolphins in the surf, seen migratory birds come 'unbelievable' to see the great flocks descend on the beach. That's what we like and why we keep coming back.*

The central theme was the community remaining the same, with community input and keeping natural values, with some specific issues being raised in relation to what the community wanted in the future. The following themes were discussed:

Theme 1: Issue of development

Participants were very keen to keep development out of Sandy Point as it was said to be in 'a sustainable steady state', and stated they and would like it to remain a 'sleepy hollow'. The participants contrasted the lack of development in Sandy Point with the suburban-like development at Inverloch. Most of the participants reflected disapproval of the little bit of 'new money' that has come into the town, coinciding with the building of some big new houses. The participants pointed out that there were a number of factors preventing development, such as the low lying land behind the town, the distance from Melbourne, the cold weather in winter and the fact that there is not a hotel. There are also vacant blocks in town that can be built on, so the urban boundary does not have to be increased.

There were divergent views among participants regarding whether a sewerage system should be installed at Sandy Point. On the one hand, it was felt that the absence of

sewerage was good as it stopped more development; there was a perceived risk that newcomers would demand infrastructure and services that the locals do not want. The other view was that sewerage should be put in as the present situation was a health risk. In addition, the absence of parking near the couple of shops was seen by the participants as stopping further development, with the provision of parking adding to visitor numbers. The participants wanted maximum height regulations enforced and no encroachment of buildings onto the dunes. Sandy Point was said to be covered by an environmental significance overlay, but participants did not believe it was strictly enforced.

Theme 2: Adaptation

Sandy Point has a long sea wall (bund), built in the 1930s and 1950s, to protect agricultural land from flooding around the back of the town. The participants told of how the wall is safe for a 20-cm rise in sea level but not an 80-cm rise, and stated that associated storm surges may challenge the wall. Some time ago a king tide breached the sea wall and, subsequently, the wall was strengthened. However, farmlands are now at risk of flooding, high water tables and salinisation. Participants noted that there are different committees of management for the seawall, but it is unclear who maintains it and who is liable. It was queried whether it would be better to revegetate the area. There were two views expressed about this. Some believed that when an attempt was made at revegetation, the mangroves would not grow because outside the sea wall it is too salty. Others believed that the mangroves grew too well and were, in fact, pulled out.

Participants noted that Sandy Point had problems with stormwater runoff as there is no constructed drainage and water funnels down driveways and roads, and can flood properties lower down. Other participants noted that although in the past few years there have been multiple scenarios of flooding, this is not a big issue as the water has mostly gone within a day. However, the new concrete driveways were said to be unhelpful.

Sandy Point's inaccessibility, although part of its charm, was said to be its biggest flaw; the one road in is also a fire risk. Wide concern was expressed about the threat of fire. The participants noted that Sandy Point used to have a town fire plan but there is not one at present. While there is a fire-tanker and a station at Sandy Point, the fire brigade is not manned, the closest Country Fire Authority being based at Fish Creek. It was noted that a fire plan would need to include provision for the high number of visitors in the holiday season. The participants at the meeting discussed a suitable safety area for the town people in the event of a fire. While the town centre is not designated as a safety area, some thought it likely that people would go there or head for the beach. The participants supported a track to Waratah Bay for both fire and recreation uses. Other issues raised in relation to fire were road access in an emergency for people evacuating and emergency vehicles coming into the town; there was a clear need to improve mobile phone services, partly so that text messages could be received during emergencies. General concern was expressed about the age profile and the ability of older people to cope in an emergency.

Discussion took place around a number of other issues relating to adaptation. There was said to be a need to think about how to prepare for interruptions to power supplies. Participants noted that Neighbourhood Watch used to have a list of vulnerable residents to check on, but those at the meeting were not sure whether the list or even the organisation still existed. Supply of food and essentials in the event of a flood was said to be an issue.

Sustainable practices were desired by most participants, but concern was expressed about the different values of holiday-makers. A couple of people expanded on this further. They thought that Sandy Point should be a self-sufficient town and have a community garden. Some participants noted that they had incorporated sustainable design in their houses. Some felt that every new house should have subsidised mandatory solar generation. Views were expressed about a need to educate people about adaptation, for example, explaining what to do in a heatwave. Wide concern was expressed that the new community hall was not built sustainably, although this was what the community wished for, even to the point of considering whether the hall should be able to be moved to avoid the prospect of inundation.

Discussion took place about erosion and the sand dunes. While the dunes provide a barrier on the ocean side against sea rises, they shift. Two years ago a lot of sand was lost, but then the dunes rebuilt naturally. The risk is that rebuilding will not occur often. A couple of the participants believed that there was a need to remove the fear factor associated with climate change: people talking doom and gloom all the time. Education should be undertaken to relieve the fear.

Theme 3: Protection of the natural environment

All the participants expressed that the environment was highly valued: 'this is a natural park – koalas, possums and blackbirds and feral cats – where else would you see all this from my house window'. There was, however an absence of discussion of any threat to this from climate change. There was a desire by almost all participants for development to be in keeping with the natural environment, with no housing on the cliffs and no more high-rise buildings. It was noted that when the Surf Life Saving Club was built (in the sand dunes) there was a query as to why it had to be so big.

Theme 4: Amenities to improve wellbeing of residents and maintain Sandy Point as a holiday town

The participants informed the research team that there are approximately 6,000 people at Sandy Point for 3 to 4 weeks over Christmas and Easter. They stay in around 600 to 650 holiday houses over summer, all being full at Christmas. They noted that the Census number of 63 households is a bit low (some people did not do the Census), and that there was a total floating population of approximately 300 people.

All the participants were interested in ensuring the wellbeing of all Sandy Point residents and in maintaining a strong community presence and engagement. Economic survival was raised as an issue for the town. It was felt that there is a need for education for tourists (and some residents) about the meaning of shared roadways for walking, cycling, horse-riding and vehicles, but it was seen as positive to encourage walking or riding to the shops rather than using cars. There was general that some services for the aged could be improved (e.g. delivery of meals-on-wheels and other care services). More people are living on their own, and isolation is a big problem. It was put forward that resources should be improved for younger age groups at Sandy Point, and that there is not much for older children/teenagers to do unless they surf. A lack of opportunities for local employment was highlighted.

5.3 How can the vision be achieved? Community view

The participants in the consultations were asked to consider who makes decisions about adaptation in and around Sandy Point and Inverloch, who should be making decisions, how decisions should be made, by whom and when, what part the community can play and when particular decisions need to be made.

While the residents of both places saw being sustainable as important, adaptation was commonly viewed as part of a regime of change taking place rather than as a discrete issue that needs to be handled separately from other issues. Most people have an understanding of the changes taking place that they were not so happy about and how this adversely impacts on their view of their settlement but do not appear to have thought about a strategic and planned view of adaptation to climate change. Personal adaptation behaviour did not feature strongly among participants.

5.3.1 Inverloch

Participants were aware that the need was for an 'adapting' community, this not being a once-off event. Adaptation must be participative and cooperative and ahead of the need to adapt and ahead of the risks to which they are adapting. Considerable concern was expressed by the most participants about the power of developers to influence council decisions. The balance between wise community decision-making and dollar-driven development was seen as too much in favour of the developers who have no interest in the consequences of their decisions once properties have been sold. Some participants expressed concern that, along with developers, the state government and the Victorian Civil and Administrative Tribunal (VCAT) had too much power to overrule local decisions.

Indeed, a feeling of powerlessness and some feelings of despondency were indicated by people. There was a view that their voices are not being heard in council. An example of this was given where a local environment group had undertaken planting along a creek. Developers wanted to put in residential size blocks along this creek. An environment group who objected advised against this because of the propensity of the land to flood. However, the developer persisted and a 5-acre subdivision was allowed along the creek, which eventually turned into smaller residential blocks. Due to a problem with flooding, council wants to pipe the creek and put in large drains. Environmental groups have objected and are now being labelled 'negative'.

Other difficulties in relation to gaining a voice in decision-making and action were expressed. These included the complexity and lack of influence over the financial processes to fund adaptation and the time taken to apply for small funding grants. A lack of leadership was perceived around adaptation. Local groups spent a lot of time doing on-the-ground work, such as tree planting and maintenance, but the number who are active are limited and are mainly older. Many people who attended the consultation are leaders in different community groups. They saw a tension between the necessity to look after their own adaptation needs and community needs. There is considerable difficulty in attracting younger people to do on-the-ground work, including a lack of incentives to get them involved.

Some participants expressed frustration that more was not being done in relation to adaptation. It was felt that the community should have access to experts to advise on vision/planning and there is a need for better integration between all planning schemes. A small group of the participants said that they did not really want to make decisions, and preferred not to consider adaptation. They expressed a fear of the future: 'all this is just putting fear into the older people and when you think about it the older people will be no longer with us when this happens'.

Many participants offered ideas about how to involve people more widely in adaptation decision-making. For example, someone suggested that a shared vision of adaptation of Inverloch into the future could be obtained through a photography display at the local primary school, where students could offer pictures of what future they desired.

A group of participants suggested the formation of a group called the 'Voice of Inverloch'. This would act as a conduit for information from council, making sure the community was aware of what was happening and had a chance to participate in decision-making that affected them. The group could also take responsibility to find solutions through consultation and speak on behalf of the community. It was suggested that this process would give the community a sense of empowerment. The community could have a say and would be less likely to be depressed by changes occurring at Inverloch. It was felt that by 2030 most of the work on adaptation should be done. We'll have a strong community group that will be able to influence (force) the state government. The Voice of Inverloch would be innovative, be trail-blazing and be prepared to take risks.

5.3.2 Sandy Point

The participants at the Sandy Point community consultation were all proactive in the community and were involved in formal and informal decision-making concerning their town. The formal decision-making took place through membership of local groups, such as the Foreshore Management Committee, where decisions about the up-keep and improvement of the foreshore were supported by small task-specific grants from the Department of Environment and Sustainability. Other local organisations include the Committee of Management for the TP Taylor Reserve, and those involved with the community hall. There is a strong local Sandy Point Community Group, which has approximately 200 regular members and individual champions who feel strongly about the cause. It was said that the Sandy Point Community Group meetings provide a forum for ideas but one voice to deal with the shire. This involvement extends to some of the non-permanent residents who spent a considerable time in the area. For example, two-thirds of the members of the Surf Lifesaving Club come from Melbourne; the rest are 'local' (including Foster and the Latrobe Valley). However, young people were said to be less active.

Almost all participants believed that the community had strong local input into decisions about the community. Comments included: 'anything that happens in the town has been driven by the community'; development is 'controlled by the community'; and 'we can influence the council'. However, the view also came through that there was a need to be influential to get things done. Comments included: 'if you didn't do it, it wouldn't happen'; 'we are pretty good at stopping what we don't want'; and, 'the last 12 years there has been no engagement with the community – you are on your own'.

The participants appeared confident about who and how to influence in relation to local decision-making, planning for the future and a good way of life. It was stated that 'this is the sort of thing the community does well'. 'We have people who are professionals in the town who we can call upon.' Melbourne-based planners who have properties in Sandy Point are able to provide the expertise to form coherent and effective arguments to get what was wanted. Participants noted that other communities are not as self-organised or self-driven. Participants made comments like: 'to get council on side and do things is a huge job' as 'council don't listen to local communities', and 'state and federal government think too small'. An example was given where the electricity supply was erratic in Sandy Point. The project team was told that residents followed the minister around to every meeting he went to asking for this to be fixed and eventually he told someone to fix it. However, the project team was told that there is a new planning design now because everyone objected to the one the council put up. The community has been able to stop development so far.

The project team was told that Sandy Point is a stable and cohesive community. However, the project team experienced some strong divergence of views outside the

community meeting. A couple of the participants noted that there is friction between some of the community groups (often personality-driven), but this is changing as people are working to respect each other's interests and making a more conscious effort to support each other. Interestingly, Sandy Point went through a charrettes program in 2000 and identified what was important to the community. This seems to have focused the community and empowered action. 'There is community confidence in [our] ability to guide what happens down here.'

There was discussion around the building of a new community hall, given as an example of decision-making. The community raised $150,000 for the community hall/centre, the council provided $150,000 and the Federal Government gave the rest, $1.5 million, under the economic stimulus package. It would seem as though the community did not have the final say on the building design as they wanted a sustainable building and one that could be moved as an example to the community; however, the local government felt that this would be too expensive. The participants noted that they had done a business plan but 'the council paid a consultant $20k to rewrite our plan'.

The participants raised the issue that there has not been a lot of decision-making regarding an emergency plan around fire or other emergency events. There was said to be no State Emergency Service in Sandy Point, the nearest service being in Foster. Participants thought the fire plan for Sandy Point had not been worked through as well as it might be, particularly the idea of using the hall as the 'neighbourhood safer place'. Summer visitors are more likely to instinctively head for the beach.

5.4 Consultation with local community leaders

5.4.1 What is the vision for the settlements?

A vision for the settlements in 2030 was not able to be holistically defined, although some people could talk about particular aspects. No person was thinking more than a few years ahead. Indeed, adaptation to climate change itself was not clearly elucidated. Sea level rises were most commonly mentioned in relation to the need to adapt, but heat, food security and the impact on roads were discussed by some people. Frequently, issues other than adaptation, or in association with adaption, were mentioned. Despite most reporting population increases, retaining the present character of the settlements was viewed as important. Commonly, the vision was a description of the current town rather than an adapted town.

Themes in the vision related to people being self-sufficient, especially in terms of power (solar panels) and water. The settlements would have established food security with food grown and controlled by the community, and supplies available should there be water inundation. There would be small community cooperatives and systems for providing the community with tools and assistance: for example, energy audits, interest-free loans, access to information, tools to put changes in place, and incentives (rebates and interest-free loans).This would mean that local agricultural land would need to be maintained but there would be more diversity in local farming, and farming practices would adapt due to climate change.

Self-sufficiency would involve the placement of some houses on stilts, to adapt to sea level rises. While the issue of a sea wall and planned retreat was raised by a few people, others felt that this would not be important until after 2030. A couple believed that waste water would be handled better in Sandy Point, to avoid health concerns. There could also be a waste transfer station. Transport was mentioned often, with support for the use of bicycles and walking and less reliance on cars, and people lift-

sharing and car-pooling. Good road infrastructure was seen as important to enable people to get in and out of settlements under adverse conditions.

Tree cover and vegetation in the town were viewed as important, as well as open space and parks in general. Some people mentioned that they did not wish to see a future with extensive housing development covering previously agricultural land. Others talked about maintaining natural vegetation and controlling future weed invasion. There were differing views about the impact of climate change on movement in and out of the settlements. Some people wondered if people would be attracted to the settlements in the context of climate change, while others thought perhaps people would leave the area and move back to Melbourne due to the availability of public transport and the likely high cost of petrol in the future. A few people expressed the view that the local community would be strong and work would continue to be done on community building.

5.4.2 Key themes

People referred to some issues about which they had concerns or which needed attention. Some of these related directly to adaptation, some had adaptation as a component and some were unrelated to adaptation. The key points are highlighted below using participants' comments.

Theme 1: Climate change

Many views were expressed about climate change. Most people interviewed felt that climate change was a very important issue, and that the case-study settlements needed to take it very seriously and prepare for the future:

> *climate change poses considerable risks to the local community and here I'm thinking about Sandy Point* (Participant 1);
>
> *climate change is a significant problem with South Gippsland one of the most vulnerable areas to drought, changes in weather patterns and high storm surges* (Participant 24).

However, a minority felt less certain and emphasised other priorities, at least in the short to medium term. Those in this group did not make links between issues such as fire and sea level rises and climate change. Few of those interviewed spoke about the co-benefits of addressing climate change and the adaptation process as a means to take action in relation to other community issues. An exception was mention of the relocatable design of three amenities blocks in the Inverloch Caravan Park, where 'the effects of climate change on the Shire might be quite positive for caravan parks'. However, even where there were some doubts, the precautionary principle was generally seen as the best option, and preparation 'in case' as the best option.

When talking about the community view of climate change, most expressed the idea that considerable ambivalence and extreme views existed in the community:

> *There's, on one side, very much 'climate change is nonsense, we don't believe it's happening, we don't believe it has the impact that it's going to have and this nonsense is causing us a great deal of grief because of not being able to build on our land.' The other extreme are the people that very much are aware of what's happening and are doing very interesting things, in terms of that* (Participant 15).

Most of those interviewed expressed the view that while most members of the community saw climate change as relevant, some also saw it as an issue to be feared and best overlooked. This was due to fear of change itself. It is also due to a fear of economic loss, where people have spent considerable money moving to the seaside and they may have moved to a place subject to inundation. A few made the comment that the community was not making the links between observed changes and climate change, and climate change and the need to be sustainable. The potential for conflict was also mentioned. For example, where one neighbour has adapted well, with water tanks and solar PV panels, what happens when another neighbour finds they have not prepared and are without water and electricity?

Eight participants spoke about adaptation in itself. They spoke about who was adapting and who was not, how adaptation interfaced with other issues of concern to people, barriers to adaptation, and the sort of areas where adaptation will need to take place. It was felt that knowledge about adaptation was 'probably fairly low' but growing and many people think it will only impact people around the coast. Those interviewed felt that knowledge was unevenly distributed, but views varied about who was doing more about adaptation. Some believed that farmers, others young families, and others young people in general were more aware of the need to adapt, the latter expressing concern as to why older people are not more worried about the future of coastal areas. A few spoke of 'pockets' of people who are trying to be more conscious of their decisions and how they can be sustainable, both personally and on a community basis, such as through group purchasing of products. In contrast, one participant expressed the view that if it meant that jobs and infrastructure (schools, kindergartens, transport and supermarkets) would be maintained and if it meant that young people could stay in the area, then a lot of communities would prefer to maintain the use of coal energy than move to renewables.

Every participant raised issues of concern to them in addition to adaptation, and a significant minority felt that other issues were more important, such as the population increase over the summer months, transport and parking, disability access and the council's inclusion plan. There was also concern about isolated communities and isolation of particular people within communities, as well as the ageing and decreasing population in certain areas. However, some felt that climate change would be a 'massive issue' in the future and the need for a special purpose group to work just on climate change was expressed.

Quite a few people referred to specific issues where adaptation was necessary. These included the adaptation of agricultural practices and food security. However, it was felt that people would not adapt before a storm – only after! The issue of more volunteers being needed in the future to address adaptation was discussed, and how the adaptation process must not allow the gap between those who are well off and those who have little and are powerless to widen.

Theme 2: Housing development

Population pressure and the development of land for housing were viewed as a source of tension by many of those interviewed:

> *I think the major threat to this community is that the land is still fairly cheap, and accessible, and there's not enough controls over it, particularly the value of the farming land* (Participant 5).

This view was particularly common in relation to housing development being undertaken on what was good agricultural land. A couple of people expressed the view that the government will increasingly seek to protect the best arable land, especially as

the market gardens on the edge of Melbourne are in the process of being taken over for housing. A couple of people mentioned that work is being done in the area to promote sustainable food systems, with local access and local production. Cooperatives have been established and seminars run on food growing and food sharing so the smaller towns can produce their own food.

A view commonly expressed was that it was the lack of sewage disposal infrastructure that was preventing development in some areas, and some communities, such as Venus Bay, were said to be resisting establishing a sewerage system for this reason. There were differing views regarding tourism and population growth. The issue of development risking the intrinsic value of the present community was raised. It was noted that climate change may have an impact on tourism, but the direction is uncertain. For example, while wet winters and storms (such as occurred at Wilson's Promotory in 2011) have reduced the income from tourism, which is approximately 20% of South Gippsland's economy each year, increasing temperatures in future will mean more beach days and possibly longer holiday periods, and, therefore, more people. A couple felt that there was capacity for population growth.

Theme 3: Coastal erosion and sea level rises

Coastal erosion and the rising sea level were commonly expressed as issues of concern. Indeed, sea level rises were seen as the major issue of adaptation in relation to its effects on settlements and agriculture. Inverloch has lost many beach access points, preventing people getting down to the beach:

> *The cliff this year was above my head height. Normally, it's a bit of a drop-off that's not too much to worry about, but this year, it was pretty huge, and it required a bit of work from us to get that back to be safe …* (Participant 1).

It was noted that the life of constructed beach access, such as steps, may now only be 5 years, as opposed to 20 years in the past. The coastal vegetation is being washed away in some areas, creating loss of biodiversity and larger heat impacts for people. Venus Bay has a lot of mobile sand, so erosion and loss of beaches may be a risk. Port Welshpool is one of the settlements most vulnerable to inundation and there have been problems of illegal filling of lots creating flooding in adjoining blocks. Sandy Point is vulnerable to inundation from the back once bunds (sea walls) fail or the water goes over.

Theme 4: Water and flooding

Inland flooding was also viewed as a problem by many people, with the Powlett River breaking its banks five or six times in 2012. Sewage pollution during flooding was viewed as a potential problem, but locals have been advised that South West Water is developing emergency procedures, including the redesign of pump switchboards. Kerbside pumping could be used in Inverloch. Bass Coast Shire has mapped low lying areas likely to hold water due to high water tables, saturated soils or poor drainage:

> *The area being developed near Wreck Creek in Inverloch has similar problems. Its drainage system has pits that drain into the sand, but they fill up quickly (within 2 hours) in a storm. There is a belief that the owners (land bankers) are releasing this area now to pre-empt possible future controls, such as a Special Building Overlay* (Participant 12).

There has been a shortage of water in the past, but a pipeline that provided water in the construction phase of the desalination plant is able to supply water back to Inverloch. In Sandy Point, there was said to be a need to do a proper audit of what water is being used and proper underground water monitoring to understand what

underground water is being used and where it goes, and the level of nutrients and pathogens, which may impact on health and local vegetation.

Theme 5: An aging community and farming

The aging community, especially among those on farms, was seen as an issue of concern in the community by a couple of participants:

> *The economy of this area is actually still based on farming communities, and the average farmer is now well into their sixties, and they don't have an exit strategy* (Participant 5).

It was felt that that the local council did not fully understand the importance of agriculture to the area, and spent a lot of money on tourism. The people who spoke of this felt that climate change was compounding the problem, by reducing productivity, leading to youth looking for opportunities away from the farm because of the uncertainty with climate change and some older farmers being reluctant to change their farming practices. In the 2008 drought there drought counsellors assisted farmers.

Housing of aged people was viewed as an issue that reflected the necessity with population growth to provide improved infrastructure and services for aged people. There has been a large growth in meals-on-wheels and a large part of council provisions is in Home and Community Care services: 20% of Bass Coast Council staff.

Theme 6: Transport

Transport was identified as a problem by many, especially in terms of the poor condition of roads (in part due to climate change), the lack of public transport, and the issue of isolation. Climate change and more severe storm activities were said to have caused the road surfaces to break up; consequently, there was an increased risk of heavy vehicle accidents.

The lack of public transport in South Gippsland was seen as a big problem: 'it is virtually non-existent'. This was seen as particularly problematic for Sandy Point, as well as many like small communities, especially if there is water inundation or an emergency. The lack of transport was also identified as problematical for retired farmers still living on their farms. After aged people have moved, their houses are often rented cheaply to low income families who, in turn, have transport problems. Services often need to travel to these people, commonly at considerable cost.

Work is being done on car sharing schemes and there is advocacy to transfer the funding for the provision of parking in Inverloch (said to be $9,000 a parking spot) to use on funding other forms of transport provision.

Theme 7: People experiencing disadvantage

Greater difficulties in adaptation for those already experiencing disadvantage was mentioned by a few people. The extent of vulnerability was discussed, with Home and Community Care services delivered to 2,500 aged services clients in the Bass Coast Shire, and over 30% of the population aged over 60 years. The combination of isolation and disadvantage was seen to be a problem when the price of food and petrol rises, as was the lack of ability to travel, and the cost of air-conditioning and insulation. Changing weather patterns will adversely impact on those who are already frail, and the increase in rain will make unmade footpaths more difficult to use by those with a disability.

This subgroup felt that disadvantage was relatively high in the Inverloch area, with a lack of access to services, poor integration of services and a shortage of transport

options. Heat and bushfire in some areas (apart from Inverloch) will be a problem for people, as well as any exacerbation of current health problems. While the Inverloch area is fairly well serviced by general practitioners at present, the health services structure in rural areas is more vulnerable than in urban areas. This is due to difficulties recruiting and replacing staff in smaller centres.

A solution to the lack of local opportunities for youth was proposed. Young people could be offered tertiary education relating to climate change and adaptation and environmental science and farming practices. This would channel the many ideas that young people have. There was said to be a gap in teaching about climate change and adaptation and political processes in secondary schools:

> *We should be making sure our kids are better equipped to make decisions that we want them to make. … They are going to be making decisions over what happens to me when I'm an old person and I'm frightened by that* (Participant 19).

Other issues

Concern about bushfire in the context of climate change and higher temperatures was mentioned by four people, especially in relation to Sandy Point due to the problem of evacuating the area, the lack of town water and the distance from the nearest fire truck at Tarwin Lower.

The problem of maintaining a small town (there are 28 in Gippsland South), was mentioned by a few participants. It was felt that there may not be the infrastructure to cope with longer, hotter and drier summers. The problem is compounded by government, which supports regional centres rather than the smaller towns.

One person was particularly concerned about the spread of weeds and pests, such as the lacy fungus, which impacts native plants, especially in the context of climate change. One person spoke of the impact of extreme weather on farming animals and the need to increase shelter belts on farms. Interestingly, the impact on the natural environment and ecosystem services was rarely raised in the discussions, most conversations being people-centric.

5.5 How can the vision be achieved? Community leaders

5.5.1 All people working together

Many people felt that all players should be involved in decisions about adaptation, including the community and all levels of government. This view was expressed well by the following participant:

> *I think it has to be across all levels. I think there's a role for all to play … and I think we have to work with the community. I mean I'm a member of the community as well so I think we have to work with our communities, as I say, to make it known in language that is generally acceptable. Not government speak, not university speak. It's got to be in community speak* (Participant 6).

An idea was expressed that while it would be preferable to work through existing bodies and institutions to deal with adaptation and climate change,

> *a specific policy unit in council to advise on climate change adaptation and coordinate action would be beneficial* (Participant 12).

5.5.2 The place for individual responsibility

A range of views were expressed about individual action and responsibility. Many noted that individuals need to take responsibility for their own actions. The issue of how much responsibility should be placed on individuals, when decision-making is both top–down as well as bottom–up, was discussed:

> *It's about – and the responsibility, well, I think that everyone has a responsibility, but I guess I get a bit frustrated with sometimes the responsibility that's put on the individual, when really, as an individual, they're being asked to be concerned about whether they've got their lights on, or put solar panels or energy saving light globes, when we have so much pollution that we are emitting from corporations and all the rest of it. I think that there is definitely a role that all levels of government need to play and that it needs to, I think, be two-fold. That it comes from the top down and from the down up, from bottom up* (Participant 15).

The view was also expressed that the community needs to be helped with making informed decisions about adaptation. It was suggested that community leaders and champions need to be provided with relevant information and encouraged to lead the community. It was put forward that there is a feeling in some communities, particularly Sandy Point, that the government will act for you:

> *I think one of the threats is the underlying and deep seated unexamined belief that the government will look after you. … there is generally this deep belief that 'someone should'.* [This] *breeds fragility in any community when they rely on someone else to fix their problem* (Participant 7).

A couple of people expressed confidence that the community is capable of taking responsibility for adaptation. They spoke of the 'community spirit' of many small communities, where:

> *people actually, by and large, seem to value that, but also understand that if they are going to have a vibrant community life they've actually got to pitch in and do stuff. They can't wait for some big organisation to do it. … Gippsland is an activist community on the ground* (Participant 3).

Indeed, it was felt that the community has to change and be prepared to work together and accept that they should be leading the change, and not wait to be told, as 'the community ultimately has to make the decision to adapt'. If communities do not take up this responsibility and challenge, then, ultimately, the federal and state government will have to step in if there is an emergency and may make a decision that the community does not like, such as moving a whole town. In the end, the state will do those things that are critical to ensuring food and energy.

It was noted that some communities are proactive about climate change, with a lot being done by some community groups, such as the South Gippsland Conservation Society and Groundswell Bass Coast, to raise awareness of climate change. However, this is not happening generally as there needs to be agreement about the problem of climate change and the urgency is not in the community. It was felt that the community could be taking more action, such as the cooperative buying of solar panels or solar hot water, and furthering communication about the purchasing of local food.

The issue of transient populations, particularly in Sandy Point, and how you engage them in adaptation was raised. The transient populations mean that it is difficult for

council to focus investment in adaptation. Another view expressed was that while people talk 'emphatically' about adaptation, they do not actually do much about it. However, it was pointed out how difficult it might be at times for the community to take action for adaptation due to not understanding the policies and processes in play. In fact, it was felt that people have been 'dumbed down' such that we now do not actually know how to deal with big problems. Unfortunately, the problem is solved by distraction through consumerism, which, in turn, has taken away people's ability to actually engage.

While a view was expressed that local industry was taking adaptation seriously and reducing energy and water consumption and their waste outputs, an alternative view was offered that the business community has not yet got the message and is not engaged with adaptation. Apart from some sections of tourism business, 'adaptation seems not to be on their radar'.

5.5.3 Role of government

Many participants also expressed ideas about the role of the three levels of government. There was a widely-held view that local, state and federal government have a responsibility to help communities understand what may be going to take place with climate change and to help them understand what opportunities might be involved, as 'an important service role', rather than telling them what to do:

> *There is a need for integration of Commonwealth, State and local government policy and approaches to adaptation. Land use planning is state responsibility but substantial funding has to come from the Commonwealth* (Participant 13).

A number of themes came from the conversations relating to an uncertainty about the roles of the three levels of government and a feeling that the higher levels of government were not playing their part, as well as the importance of local government and the need to adequately resource adaptation.

Uncertainty about state government requirements

A number of participants expressed the view that it was frustrating trying to progress climate change action in the absence of guidance from the state or when the policy is shifting. The example was given of the recent change from planning based on 0.8 m of sea level rise by the end of the century to the option of using a figure of 0.2 m for evaluating infill development proposals within existing settlement boundaries. However, council decided to continue to plan for the 0.8-m rise as they had done a lot of work around this level and the Catchment Management Authority was sticking with 0.8 m. An example given by another participant was the removal of the solar rebates. The same person also commenting that:

> *The money that got given out during the financial crisis, why wasn't that put into water tanks for every house or something like that? Simple things like that, just rethinking about the way we do things and where we spend the money but we need strong leadership* (Participant 4).

Two participants spoke of problems with the Future Coasts mapping, where state government does not want this to be used for planning in relation to the potential for future flooding at the property level. It was said:

> *The state government should develop firm policies on allowance for coastal climate change and apply the relevant overlays in planning schemes. This*

would ensure that it was done on a consistent scientific basis across the State. Councils are too close to pressures from their communities (Participant 11).

The need for better data was spoken of as council cannot justify expenditure on particular adaptation issues when the concrete data is not available. This was said to be a particular problem in relation to VCAT, where council planning decisions were regularly overturned. VCAT is having a huge impact on planning. Some mapping still lacks protective structures in relation to flooding. State-level mapping of inland waterways was said to not be sufficient for areas of overland flow, and some creeks have not been recognised as declared waterways. Consistency of approach between levels of government is essential.

State and federal government need to play a stronger role

A common view expressed was that the state and federal governments must play a stronger role, particularly the federal government as they have the necessary financial resources. They need to show leadership and provide incentives for people to change their thinking. Clear messages from state government, such as their expectations about standards in local council buildings, is required, but this is not happening. Quite a few expressed the view that the state and federal governments had:

> *dropped the ball and don't want to acknowledge that and they should be leading the way. … The government's certainly watered down its [activities on adaptation] - federal and state have both really ignored climate change… It's just pretty exasperating* (Participant 7).

Part of the explanation for this is the short-term political cycle. Concern was expressed about 'inadequate planning', the 'dormitory suburbs' developing and a 'loss of community', all exacerbated by poor and uncoordinated planning.

A view was expressed that it would be helpful to have a sharing of information auspiced by the federal or state government around sustainability and climate change:

> *every council and every organisation's doing it differently. We could save so much time and money if we were all consistent in our approach and also rather than me spending my time trying to lobby council to get it on their list of importance, it would be great if it was coming from above to say 'This is stuff that you need to do.' We're all trying to do the best that we can, … We're still obviously having the ability to tailor it to your area because everybody's area's different, but we spend so much time trying to research our own stuff …* (Participant 18).

Local government should be a resource for the community

Mixed views were expressed as to how much attention local councils had given to adaptation. These views ranged from 'the council being quite engaged in the issue', to 'the council hasn't done much work yet'. Some felt that there was room for improvement in the adaptation approach: 'something we need to do better' and they were only at the beginning of the journey to integrate it better into core business.

It was felt that council work on adaptation is a bit disjointed and lacks focus. It was noted that the:

> *First priority for action is the preparation of a Shire climate change adaptation strategy. It will focus on impacts on council assets and services, then foreshores, then communities. It will be built into the council plan. [This] will improve the efficiency of responses and value for money* (Participant 12).

Others noted that a council climate change adaptation strategy was being prepared, which will cover mitigation as well as adaptation, emergency management and community engagement. The adaptation component will be prepared in-house. The strategy will cover risk assessments for assets and services and planning advice to owners of private infrastructure.

While council could be very proactive and a leading advocate to introduce climate change and environmental issues:

> *it's not their core business and they're not funded to do that as against what I believe we should be doing it for our residence and our community, and in the long term that would have financial benefits but it's a speculative long term. Whereas the council is still roads, rates and rubbish* (Participant 6).

Many people felt that local government should be used as a resource for adaptation and adaptation support needs to be provided at the local level:

> *I think is a cause that should be championed by council to its local community, as against the state delivering – it should be delivered by us with the state supporting us* (Participant 7).

However, the issue is not seen as necessarily straight-forward:

> *We have a heatwave strategy, too, actually, which defines all that sort of stuff. But it's still finding that balance between personal responsibility, I think, and agency responsibility, and I think we struggle to define what that is* (Participant 1).

The tasks taken by local government included making links between people, getting ideas to the community and taking ideas from the community: giving them a voice and celebrating the success stories or helping them along if they stall. It was noted that:

> *Part of what I see our role, and we're still not doing it perfectly, but I think we're getting better at it, is the communication across the community groups so that they have better use of their time. So we're being a little bit more strategic and talking to networks. How they communicate is up to them but it's that communication process and I think's important so that they might be looking at the same funding and if they pool their resources there'd be that much further up the train than working separately. So, I think communication and engagement is very strong for us. So, not only getting the message from the community to council but getting the message across community and helping them find their own identity and coming back to the identity what they find as the identity* (Participant 6).

However, integrating the community's voice in council work was not felt to be easy, as 'too often we give them the voice and then it goes into a nice little report that sits up on the shelf'. Quite a few of the participants spoke in general about the role of local government in the community and the need to empower the community, where council has:

> *the responsibility to take – we've got the capacity to take the lead and to empower our communities to move forward. … we have the position, a whole range of power structures behind us that actually allow us to do things, and I think that we …have the opportunity to take the lead and to set a tone. And there are members of our community who are asking us to do that* (Participant 7).

Legal complications

Two participants raised concerns about potential legal complications. Three issues were raised. Firstly, there was unease about the requirement, as a condition of approving a planning permit in areas 5 m below the Australian Height Datum (AHD: the point from which the height of land is measured and the technical equivalent of 'above sea level', so heights are so many metres AHD), that the owners enter into a Section 173 Agreement (under the *Planning & Environment Act 1987*), acknowledging that the land may be affected by future climate change impacts and agreeing, amongst other things, to remove buildings and ancillary buildings if the land becomes uninhabitable. The agreement is registered on the title to the land. No-one has yet refused to sign, but the strength of the provisions have not been tested in a court. For larger developments, a coastal hazard vulnerability assessment is required. Secondly, concern was expressed about the 'moral hazard' issues involved in provision of state assistance to uninsured households after a disaster. Thirdly, there were issues around maintenance of sea walls. The participant noted that many million of dollars worth of land would be at risk if the sea wall at Sandy Point fails, so decisions about who is responsible for this need to be made.

5.5.4 Resource adaptation

A few people remarked on the lack of resources both for local government and the community to undertake adaptation. It was said that the lack of funding for adaptation was an ongoing problem for local government.

> *Rural communities are not likely to be externally funded for protection works. There is a long term question about responsibility for management and maintenance of any infrastructure that is erected* (Participant 11).

Many of the adaptation issues, such as waste water, and improving roads and sea walls, need to be supported by federal or state government but implemented by local government as it is unreasonable to expect that people will give their time free to work on adaptation when they already work 5 days a week and lack appropriate resources. People would say:

> *you want me to go and do something on a Sunday around climate change? I don't want that responsibility. But if you come to the community and say there is some money to support you to work to look at ways in which you can either contribute to what you're doing to support it to make it better, or to allow you to become innovative in your techniques which provides some real money in terms of resources and admin to do some stuff in your community, then people say, oh, yeah, I'll give them my Thursday night up because it's a good cause. You can't expect people to keep on doing. …They've got to keep their towns going, so start looking at ways that you can provide some financial assistance back at a local level* (Participant 2).

5.5.5 Not frightening people or creating division in the community

A few participants talked about the difficulties of giving people information but not scaring them. It was felt that council has to learn how to do this well, but the information is not always clear to council, who need to decide which is the right data. One person felt that if you do it in the right way, you can inform people without scaring them, but sometimes people are not told. Sensitivity was needed where a community is 'fragile both environmentally and socially' and where the community population is aging. They said:

so it's how do those people actually get their heads around the issues to do with climate change; how do you talk about it with farmers, how do you talk about it in a way that is not laced with fear but actually looking at the potential (Participant 7).

The fragility of the community was illustrated in relation to the building of the new community hall, which created tension regarding the use of the surf life-saving club, a facility largely used by non-permanent residents. The problems are exacerbated by the high number of people who move to Sandy Point for a short time, 'so any change is hard and clumsy'.

5.5.6 Uniqueness of each small town/community

It is interesting to reflect on what people commented on in relation to the question of whether it is possible to generalise the adaptation process and develop general principles to be followed. Many people commented on the nature of their local communities. Those from the Gippsland South Local Government Area commonly mentioned that there were 28 small communities in the shire. While Korumburra and Leongatha were the biggest towns, many of the smaller settlements displayed unique characteristics, such as Loch having a niche for arts. However, they all also share common characteristics, including: isolation, although valuing some aspects of remoteness; a love of the rural environment; being caring communities that come together under adversity, such as during bushfires; and a low rate of crime. The communities also tended to be conservative. There was said to be a sense of loss in the communities, in terms of loss of industry, a decreasing population and loss of services. Although the community is small, there is not necessarily a common view among the members as there are people who have been in the area for a long time as well as new 'tree-change' arrivals.

6. RESULTS AND OUTPUTS: PART 3, INTERSTATE WORKSHOPS

This chapter describes the workshops that were held in Western Australia (WA), Tasmania and South Australia (SA). The workshops comprised a mix of people from state and local government, academia and the project team. The WA workshop was conducted in a coastal settlement, the view of local government being strong. The Tasmanian workshop participants drew on the experience of adaptation gained from a recently completed adaptation project in four coastal settlements in Tasmania. The SA workshop participants drew on their experience of the promotion of local adaptation initiatives using a pre-existing governance structure that had been originally established for the management of natural resources in SA.

6.1 Interest workshop: Western Australia

6.1.1 Vision of the settlement in 2030

The participants offered their ideas about what a climate-adapted settlement would look like in 2030. It was noted that not one member of the workshop had known a community member to suggest a view of what the community will be like in 20 or 30 years' time. It was acknowledged that it is hard to predict what an adapted community will look like and what will make the community adaptive in the future. However, the workshop reported some public opinions. The participants indicated that most of the public thought that the future will be much the same as now, with just the sea level a bit higher and a few more bushfires. However, the workshop participants acknowledged that a minority of the public believed that the future may be dramatically different politically and economically, with some young people talking about the demise of humans, or at least Earth being a less valuable place compared to what it is now. In contrast, the workshop participants noted that some older people say they are not worried about the future because if Mandurah does become inundated by the sea, they will not be around. The workshop participants expressed the view that there is a need to build community capacity so people can understand for themselves how the world is changing and how they can best adapt.

The workshop participants agreed that a climate-adapted community will be flexible and self-reliant. It will be 'dynamic' and 'changeable'. Local communities will be more engaged with each other as having strong social capital so there are multiple lines of communication between people. People will be informed, educated and empowered, and will be interested in what they do. They will understand and accept that there will have to be winners and losers. An adapted community will appreciate cultural diversity, will respect each other and will respect traditional cultures. People will pay more attention to values. The community will understand the risks associated with climate change over time. Monitoring systems will keep track of impacts, not only for sea level rises and coastal erosion, but also for issues around human health. There will be a whole of government approach, with government also being more flexible.

A climate-adapted community will be much more sustainable than at present. People will not travel as far each day for food as there will be localised food production. The air, the water and the environment will be healthy, an adaptive community being more in tune with the environment. There will be improved public transport and greater diversity in the economic base of the local economy.

6.1.2 How can the vision be achieved?

All people working together

The WA workshop participants felt that people were much less fearful about engaging in climate change action than some local governments originally thought. The expectation held by those in the workshop that discussions around climate change and sea level rises at Mandurah would scare people and raise concerns about land prices has not been borne out. It was found that if you provide people with good information, explain carefully the consequences of various decisions and handle meetings carefully, then the community generates very reasoned and valuable ideas. With good resources people feel they can:

> *partake and focus on the knowledge, rather than on the emotional and political and anxiety around those issues.* [At a community workshop] *the community showed that they really had taken on board what the experts had said.*

At a local community meeting a range of suggestions were made about sea level rises, such as providing a new and clearer set-back zone, not allowing further development next to the water, and increasing the height of sea walls until other decisions can be made (e.g. moving the town further inland). It was felt that the community were concerned about economic, cultural, social and ecological values, although most of the issues related to people's immediate environment, such as the tree in front of their house.

The issue about an informed public was repeated often in the workshop:

> *You don't have to be intelligent either to make good decisions, you just need to be informed and have all the tools and resources available to do that. You don't have to a highly intelligent individual. If you've got it all there for you, and you're willing.*

People need to, and are, taking responsibility for themselves

The workshop participants noted the complexities associated with decision-making by the community and individuals around adaptation. While community consultations have been held in Mandurah and surrounds, the workshop participants spoke about how 'prominent' individuals bring their concerns directly to the local council staff, which was believed to be a good outcome. The workshop participants reported that they found that some community consultations left the community feeling 'incredibly disempowered' as they felt their ideas were being ignored, while other communities made sure that their perspectives were translated into action.

The workshop participants expressed the view that the coordination between the top–down strategic decisions and bottom–up community decisions is not working as it is the government who are the decision-makers and the community can provide 'input'. There are other barriers:

> *many organisations, including state agencies, can be very reticent to open the decision making and engagement and consultation processes that broadly, because by definition, if it's really done generally, then they lose control of the decision making. And they are held accountable to their minister and their government for outcomes, for meeting the policy objectives, for avoiding catastrophes of various sorts. And it's just not the current practice, certainly in WA, for decision making to be shared to that degree. So there's a whole cultural – there's the resource thing, there's the timeframe thing, there's having enough*

citizens willing to participate sufficiently to make it work, but then there's all kind of institutional barriers within the existing decision making institutions, including just not wanting to lose control.

Adaptation was said to involve both high-level decision-making and decisions made by individuals, such as where they buy a house, what kind of house and what particular adaptations they make. Conversations have taken place with the community about what they value and what is important to them. Leadership also has to come from the community. Early decision-making with the community was felt to be important, rather than trying to get them on board at the end. However, the workshop participants did note that community engagement was felt to be done honestly in some cases.

Role of government

The workshop participants recognized that a multidisciplinary and whole of government approach was necessary for successful adaptation. Climate change must be part of all government portfolios. The workshop participants told of the recent establishment (less than 2 years ago) of a regional group of nine councils along the coast, the Peron Naturaliste Partnership. This is a voluntary association, the purpose of which is to facilitate adaptation responses to climate change. This new governance structure was established to improve government responses that may have been hampered by artificial boundaries and not well covered under previous arrangements:

One of the other things I think that's a problem probably across the board in Australia is some response times for institutions can be very slow, and there are some cases where our response times just need to pick up really quickly.

The work that is done under this umbrella still operates within the planning framework. It was hoped that this organisation will be proactive and start early conversations, and build resilient communities. This will assist understanding about where communities can make decisions and where there has to be a strategic overview.

Another opportunity for improvement of government expressed by the workshop participants was in relation to the need to monitor, evaluate and report on adaptation progress. This should be done by an independent advisory group outside of government, such as a sustainability commissioner. It was hoped that Mandurah Council will provide and monitor data on community cohesiveness and wellbeing, looking at vulnerability assessments and risk assessments, adaptive capacity and resilience.

Lack of information that is integrated

The workshop participants identified that a major problem in achieving successful adaptation was obtaining the right information and achieving data standardisation so it could be integrated in one model:

I think the most important thing is the problem we're having today we could still be having in 30 years' time. To actually get a picture on what it looks like or to be able to adapt is being able to get access to useable datasets. ... We've hit so many walls with different tables (within the same departments sometimes) that we didn't know [existed]. There's no place to house them at a state-wide level, to even access them. They're not publically available. Local governments can't even put up a map on their computer, because they don't have access to that sort of data sharing software.

The workshop participants felt that a national adaptation template or framework with core support tools would be helpful, as there is uncertainty about when actions need to

be taken, what the timeframes and the priorities are, and what should happen immediately:

> *I think you need to have a framework Australia-wide to give you some general guidance and direction. That's very much obviously lacking.*

Some members of the workshop pointed out that although there are a growing number of frameworks, the problem is that little adaptation has been done on the ground, let alone proven or tested. Adaptation literacy was also needed in the community, as:

> *How can you have a candid conversation if you don't even have the building blocks?*

In addition:

> *There's some early learnings, but we're still speculating because not enough organisations have gone far enough down the whole cycle of actually implementing programs, evaluating them and doing a new generation of them. We're still launching on the first generation in many cases.*

The Peron Naturaliste Partnership is planning the production of a regional adaptation framework in the absence of a national approach. While a national approach was recommended by the workshop participants,, they acknowledged that local planning did vary according to scale and landscapes.

State and federal government must play a stronger role

There was discussion in the workshop about the need for state government to be more proactive rather than risk adverse. While there are many good ideas generated at state government level, the main task is not innovation, but maintaining the status quo. There even appeared to be a fear in government about adopting innovation ideas. This extended to the issue of integration of community ideas. An example was given where a detailed planning process was followed regarding the development of Perth:

> *When people are given that challenge, they came up with quite considered ideas, they supported an urban growth boundary idea. … Then the results of that went back to stakeholder committees within the department of planning to try and translate that into what could be [put into] planning, and the developers and a lot of the department of planning planners were all working to try to dilute it, 'there's all these problems'. I was one of the community representatives on a couple of stakeholder committees and it was incredibly frustrating. … the final outcome, which was a vast improvement, but still didn't go nearly as far as what the community said they would want when they really understood the problem. And it also hasn't helped the problem that so much land on the outskirts of Perth is held by private developers, and they've been able to jump into development funds and go on with developing up the sprawling suburbs ….*

The workshop participants agreed that the state government should have the role of mainstreaming adaptation into local government, so every local government is not starting from scratch and can build from the experience of others. There needs to be leadership and political will as well as cooperation at every government level. The workshop participants reported that this culture had originated well over 4 years prior to the establishment of the Peron Naturaliste Partnership.

Resource adaptation

The lack of resources targeted at adaptation was raised as a problem by the workshop participants, as there are many competing interests for local government funding:

> *It's just that there are things we know we could do, that we don't have the money to do. So one of the fundamental constrains is we're not allocating sufficient funds to do what we know we need to do.*

Again, the issue of government cooperation was raised in this context:

> *I know that quite a few of the issues that* [Local Government] *want to address and the adaptations they need to address them are outside of their control, i.e., they need state government policies to change or to help fund – they need federal and state government funding to assist them.*

The workshop participants made suggestions about how to raise funds through shifting priorities and reforming the taxation system to encourage sustainability, such as giving tax relief to those who are practising sustainability and penalising those who are not.

6.2 Interstate workshop: Tasmania

Tasmania secured funding to undertake the Tasmanian Coastal Adaptation Pathways Project (the Pathways Project). This looked at adaptation in four coastal councils in Tasmania. The project worked with local government, communities and industry groups. The project first gathered information about four settlements and then explored the values expressed in those settlements. Residents were invited to review four potential adaptation scenarios, ranging from retreat to the establishment of defences. Detailed information and mapping of sea level rises was provided. Those attending the community meeting were self-selecting and not necessarily representing the whole community. They tended highly active and locally engaged people, commonly retirees. Insights from the Tasmanian Coastal Adaptation Pathways Project informed the workshop.

6.2.1 What is the vision for the settlements?

The workshop participants believed that a shared vision and clear objectives were important for a settlement. However, it was also felt that a vision was difficult for settlements, even without climate change. Community visions tended not to go beyond 5, 6 or 7 years. This was partly due to the fact that people in smaller townships, especially along the coast, had often moved there at retirement or used their township residences as second homes, so only saw themselves as resident for a relatively short time and, therefore, were not particularly interested in a vision for 2030. People also felt no immediacy for adaptation; it was perceived more as something that will occur in the future. The workshop participants also noted that the lack of vision was due to psychological, not physical, changes being the big issue:

> *I think circumstances will force it* [change] *in the long run. I just don't see we're going to see that before 2060 or something ….*

It was felt that change might be easier for the next generation, who seem to be more intellectually mobile and will be better able to integrate adaptation into their behaviour. It was pointed out that it may be very hard to change behaviour when people are not sure what to change their behaviour to. The workshop participants recognised that

coastal planning, even without climate change, is not done well in Australia and globally.

The workshop participants heard about how the communities saw the future, from the Tasmanian Coastal Adaptation Pathways Project. Communities wanted protection of the coastline and to retain the coastal values that attracted them to the area; they did not want complete reinforcement/fortification of the coastline. A couple of Tasmanian coastal areas have immediate inundation problems, which people wanted addressed, so for many people it was irrelevant to look to a longer future, to 2030 and beyond.

The workshop participants felt that the vision of an adapted settlement in 2030 depended on what action was taken and what choices were made. An example was given of the suggestion that a $7 million sea wall would be needed in one township by around 2070. An alternative approach suggested was the early purchase of the golf course, and allowing inundation. Infrastructure that the community valued could be placed on higher ground. A sea wall may interrupt a sea view, said by the community to be important to their mental wellness, so they may be happy to live with the risk of inundation. Building a sea wall will remove the beach and the cost of beach replenishment will become expensive, and sources of sand will disappear. The workshop participants agreed that a vision was not necessarily straightforward and rested on values articulated by the community. Often the decisions to create an adapted settlement involve private versus public interests.

The workshop participants noted that there may be two types of adapted futures, a planned future and one where adaptation evolved. The workshop participants agreed on a number of features that an adapted community would hold. Sustainability was said to be important, and sustainable behaviour was already occurring, with the formation of local climate change groups, growing local food and recycling. The community will be informed with a good education, as well as be flexible and involved but able to be pragmatic. They will have a good sense of place but be accepting of change. An adapted settlement will be an adapting settlement, so ‘business as usual’ will be an evolving process.

An adaptive community will be one where risks are managed to an acceptable level and people are not subsidised to live in hazardous areas. Planning will not rely on historical experience. Once you get to 2030, if you have not planned for 2050 and 2070, then you are not adapted at 2030. The adapted community will be informed about emerging hazards. To be adapted by 2030, it was felt that there was a need to go the extra step now, to, for example, account for future storm water in infrastructure currently being build. The workshop participants were divided in that some members felt that it is not likely that the adapted settlement will not look very different from the way the community looks now. However, some workshop members held a more pessimistic view, that depending on policy schemes, an adaptive community could be a dying community, if adaptation involves retreat.

6.2.2 How can the vision be achieved?

All people working together

There was felt to be a need for a whole of government perspective, showing consistency in approaches. It was said that:

> *behind the scenes you’ve got a lot of argy bargy between whether it’s state government or local government, and I know federal government tries to weigh in, in terms of assisting issues, and there are calls from federal government to*

actually have some kind of overarching policy, even though they're not really players in that space at the moment.

This coordination also extended to local councils sharing knowledge.

People taking responsibility for themselves

Drawing on findings from the Pathways Project, the workshop participants felt that people were not recognising the consequences of not adapting to climate change. Where they did, concern centred on personal rather than public property. For example, people were not recognising the possible severity of an extreme event. They also had the view that the government would help them recover and pay for the clean-up. This was illustrated with an example of a particularly severe storm in Tasmania in July 2011 when dunes in front of houses were eroded to within metres of back doors. The reaction was described as follows:

'We always knew this would happen but we're absolutely shocked at the extent; we never knew it would happen so fast.' And it's really interesting over the last couple of weeks in New York because on the television, you've heard exactly the same words come out of the New Yorkers. And so people are aware of the issue, but they're not prepared for the quickness and the rapidness of their need to respond when it does occur.

The workshop participants pointed out that this raised the whole issue of responsibility around adaptation, whether this is personal, community or government. There needed to be greater clarity about who is taking the risk, and where the legal liability and loss sits. It was noted that it may be a legitimate perspective that people decide not to adapt or change in the near future, waiting until they have to take action, so they can enjoy the original environment for as long as possible.

The workshop participants were told that people at the Pathways meetings were largely interested in their own needs and property, there being not a lot of interest in common property. For example, in one area there is a critically endangered starfish that no-one spoke up for in the consultations. The view was expressed that:

if wetlands were lost … so be it, they want to protect their properties.

Despite this, there was a lot of vagueness around insurance and whether or not people would be insured for an extreme event such as flooding. Perspectives largely clustered around community subgroups, such as those who were interested in fishing and playing bowls, rather than the broader community. The workshop participants felt there was a need to better motivate people to adapt through focusing on the present risks and tax incentives, and to increase involvement using local champions. This would have other benefits for the community, such as improving sustainability more broadly.

The role of government

State and federal government need to play a stronger role

In recognition of the need for leadership around adaptation, the Tasmanian Government formed the Adaptation Unit in Premier and Cabinet. The workshop participants expressed the view that communities and local government, in particular, would like to see the state government more actively involved in adaptation. The included 'brave leadership', more decisive and timely policy to assist with local planning, and funding for research and planning based more on need than being on a competitive basis.

Less confusuion

The Pathways Project found that there was a lack of clarity between the roles of local and state government around adaptation. Local wanted surety from state government but was not getting it, as well as agreement about how to respond to issues. For example, one local government felt that the dunes were best left to change as weather determined, while the other party felt that there was a need to control this change. This left an unclear message to the local community. There was also frustration in councils about what the community wants from the local government. It was felt that communities need to know the space they have to play with, so they are clear about where they can make decisions. The institutional arrangements between government, science and the community need to be re-thought.

While local government can make a decision, this may by overruled in a tribunal as the state government's position is different – 'it is undefendable in the tribunal under current legislation'.

Local government

Local government in Tasmania was said to be grappling with many issues around understanding the impact of climate change, governance, roles and responsibilities, and liability. Local government has:

> *experienced to varying degrees levels of frustration with their interactions, not only with other levels of government, but also sometimes with their communities as well, and trying to understand what it is that their community wants from them.*

Local government is often unsure how to use information:

> *there's a whole heap of tools out there. Which ones should be in my toolbox and how the hell do I use them? Where's the manual? Which one do I go to first? How can I look at one and go that's not relevant to me?*

This problem extended to commissioned research, especially where there was not engagement in the project from senior management in local government, where:

> *something will be given to them at the end, they go thanks very much, no idea what to do with that. I will pop it on the shelf and hopefully an epiphany will occur within the next two years and I will work out how this is actually relevant and useful to me.*

The problem of too much information was described as how:

> *the email boxes and stuff are full and overflowing with all this useful information that's coming their way, but they don't actually have time generally to actually filter through it all and work out what's relevant to them and work out what's actually something that they can take and adapt to their area.*

Decision-making and action

The workshop participants reported a realisation that once the Pathways Project had been completed and a work plan was established, neither the government nor the community were sure what to do with it. It was not clear what decisions the government should make and what to do should these decisions be contrary to what the community wanted. For example, hazard maps were produced, but these maps do not say what the policy should be and how this hazard relates to other considerations in planning

zones and the broader economic, social and environmental issues. The workshop participants expressed the view that what is going to be important in the future is not just the governance for ongoing decision making but the governance for working out how to get there.

The workshop participants noted that in contrast to the 2009 Victorian Bushfire Royal Commission where there were no consultations with the community on changing actions, there is not the public acceptance of this government decision-making around coastal adaptation in Tasmania. Conflict also arises where local government engages with the community and then a different perspective comes from state government:

> *So you've got two chalk and cheese approaches going on there, which from a community perspective, becomes very, very confusing trying to make the community understand what's going on and why two levels of government have completely different approaches in the same physical space.*

A clear articulation of roles and responsibilities, including the process of decision-making, is required. This should include the community's perspective, especially if you empower communities and where an individual's decision about their property may be different to the community decision. There is also the issue of legal liability. The workshop participants felt that the issue is one of values but whose values and what is valuable? There is no mechanism to resolve differences in values and values change. The workshop participants felt there is a need to develop and implement processes and mechanisms to enable deliberation of values, knowledge, goals and options across scales and jurisdictions. This would entail a new governance paradigm based in openness, trust and the ability to take risks. It was noted that this change in relationships would not be easy as:

> *state government is going to be quite resistant to empowering the communities to make decisions for themselves… So that's the tension I think there where we have to kind of bring states along… as much as possible – as risk but also opportunities there, and come up with frameworks… because I think some of those risks are in local government as well – in moving these things forward. … it's not going to be easy.*

There was felt to be growing interest nationally in community driven and open decision-making, especially in urban areas. However, there is a problem as to how you sustain the empowerment of a community and move from business as usual:

> *without a complete change in the way business is done in this space, I don't understand how we can shift a mindset of a community.*

The workshop participants made a couple of other points about decision-making. It was noted that the timing of decisions should relate to the life of the asset. However, temporary measures can be put in place, for example, a new drainage system may need to take account of the fact that there is an intention to landfill at a later stage. The issue of trade-offs in decision-making was discussed. For example, there may be a choice about funding the preservation of salt marshes in southern Tasmania, versus a new power station. The workshop participants acknowledged that it was hard enough to get planning right across Tasmania, let alone add climate change on top of this. Finally, it was suggested that the role of federal government is to provide greater harmonisation between approaches to adaptation, improved consistency between states including in a regulatory framework and provide a common information base.

Resource adaptation

The need to adequately fund adaptation came through strongly. This is especially so if there is a governance shift to community management of the commons. There was said to be a lot of argument at present about who should pay and who is going to meet the costs on an on-going basis? The workshop participants discussed whether there is a need to save money now for future identified problems. It was felt possible that this could be done for a 5 or 10-year timespan, but not 70 years, where a different form of financial arrangement will be needed. Discussion took place about tax incentives to adapt or a tax if they do not. The example was given of water saving and house water tanks in Queensland where subsidised plumbing was offered. This was felt to lead to people doing other initiatives – a social momentum started.

> *I think you need capacity to do it, when you think about it you can provide people with all the information that they need and they might value something but they actually need some capacity to do it as well, resources, people, money, information. If you're talking about a capacity building program you would be providing a community with all those things that it needs to actually adapt, it has to have the capacity to do it.*

The need for knowledge

The question of how you empower communities with knowledge was considered. The workshop participants reported that the views of the community at times were very different to the scientific community. It was suggested that the community should be more involved in science research in order to improve two-way communication and better integration of knowledge into the community. It was said that:

> I suppose coming out of that, we recommend that a citizen science oriented approach that the integration of perspectives and knowledge can be built further by engaging the community in science rather than just on ground works – planting trees on the dunes and things like that. And the school as well can be part of the monitoring process *and building this capacity. We're talking long time frames here … It's not just about the legal limitations and capacities; it's about how you empower communities to gain knowledge, [which is] integrated into the governance of the environmental resource.*

It was recognised that some information still was not available and people need better information on which to make decisions. Improved mapping was undertaken and made available as part of the Pathways Project. Information for government was also felt to be a problem, for example erosion mapping will come out in 2013 and then only be indicative. This uncertainty was said to make decision-making for council very difficult. It was noted that the Pathways Project is now asking:

> *how much more information does the government need around general risk and general options and so on before it starts to make some decisions on its role and responsibility and actually start to getting a sense of the magnitude of the problem and the scale of the issues. How much more information do we need to do?*

The view was expressed by some at the workshop that there was not integration between adaptation knowledge with other council practices and actions.

The interface lies between national principles and local features and attributes

Questions arising from the Pathways Project included: how much more information is needed? Do we repeat the process with other areas and how many? How deep do we

go into local issues? How much can the information from the four Pathways Project settlement sites be generalised to the rest of Tasmania? While there was thought that the answers to these questions are not yet available, the workshop participants expressed the view that each settlement needed to be consulted as there was very little commonality. Information is localised and particular issues will vary. There is a potential conflict between how widely you consult and how many issues you consult about. From a local government perspective it is hard to manage the issue that two settlements in the same Local Government Area might make very different decisions. It was noted that councils were 'desperate' to get the information to use elsewhere due to limited resources but it was unclear which were the best tools to use and what the key learnings are which can be transferred to other areas.

6.3 Interstate workshop: South Australia

6.3.1 What is the vision for the settlements?

The workshop participants described characteristics that would encompass a well-adapted settlement. The settlement will build in resilience so that it can protect itself against extreme events. All people will be insured. People will be self-reliant and empowered and able to take action themselves rather than waiting for government to come and tell them. They will have alternative systems in place in the event of system failures, such as if the electricity grid. They will be 'autonomous communities':

> *Communities that can be themselves, look after themselves in extreme events, generate their own electricity, catch all their own water so in the event that you have circumstances that cut them off from other areas or their transport links have broken down, that networks start collapsing like during heatwave events and power. Where water networks can't maintain critical human needs and those sorts of things, that the community is autonomous in its capacity to be able to provide a lot of that at a local level, within its boundaries.*

An adapted settlement will be built on natural processes and ecosystem services and working with nature rather than against it. A 'well environment' will live with a 'well community'. Solutions to economic and social issues are integrated with climate change adaptation.

> *It also is driven by peak oil and the rising costs of fuel and electricity, so you get these win/win things again where you can make your community resilient to climate change but you're also autonomous to all these other resource dependent issues that are going to create problems in the future as well.*

The settlement will be responsive to data information and planning systems will respond. The people will be comfortable to make the decisions which need to be made, even in the absence of precise data. People will be able 'to wear six different hats' and therefore know both sides of the story and be resilient and able to take on different roles. This is not just the leaders, but all members of the community.

The community will be remotely connected with broadband so remote communication is easy and people can respond quickly if necessary. This is important for tasks such as setting up relief centres and set up points on the street to charge mobile phones and to help people cope with the impact of an extreme event. However, it was also noted that total dependence on the electronic network may lead to problems if this network fails. Construction materials will be suitable for specific sites, such as making allowance for wind tolerance.

An adapted community will have inspired people to have a shared vision for the community at the emotional level. Once an emotional response is triggered in people they will get a vision and values and they will change what they want for their family for the better. The workshop participants reported differing views from their community consultations. Some economically driven people put more value on the economy and building wealth and this is a barrier to dealing with climate change. Other communities valued preserving their environment. So an adapted community will decide their values and trade-offs based on their emotional attachments. An alternative perspective was put forward by some in the workshop, that a well-adapted community probably has trust in decision-makers and a lot of actions just happen.

The adapted settlement will have food security. It will be a bit like a 'lifeboat' community:

> *… so that the settlement is safe for people to live in, or as safe as it can be and it has that resilience but it is appealing so it is, in a sense, a place of safety when other things are going awry.*

A simpler society is more likely to be able to adapt, as it is more likely to managing with less. The adapted settlement will be:

> *making a place where people want to go, taking account of the emotional, restorative values, the community social wellbeing, the community structure and all of those things.*

The workshop participants agreed that there is a risk that maladaption. For example, there is a lot of pressure to build sea walls. Physically a climate adapted coastal settlement might:

> *have a big sea wall around it, a levy bank, the air conditioners hanging out of the walls if they're connected to mains water, be cleared of native beech around the dwellings so they're safe from increased bushfire risk. There'd be people in the community that'd say, 'That'll do, that's the sort of settlement I'm after.'*

The workshop participants agreed that this outcome may be difficult to address.

6.3.2 How can the vision be achieved?

Role of government and the governance structure

In 2004 the South Australian Government introduced new legislation, *The Natural Resources Management Act 2004* (NRM), to cover the management of natural resources in SA: soils, water, plants, animals and the diversity of landscapes and ecosystems. The state was divided into 12 management regions, and it is this existing structure which was further resourced and used as the basis for much climate change and adaptation work that has been undertaken in more recent years.

The workshop participants spoke of how the original design used the state representatives who were department heads or other senior executives. However, regional people felt that the meetings morphed into them 'reporting' to Government, rather than it being a partnership. The design was changed so there was only one permanent departmental representative, others being invited to attend for discussions on particular topics. The model looks for the existing local power mechanisms, looking for the leader and further empowering them by promoting them to various positions.

From one champion, others arise and people become more involved. Regional leaders were asked to:

> *sit down together, go through a relatively robust process of planning for the impacts of climate change in the context of all the other drivers in their regions and then start to plot a future for themselves.*

The system was funded by state government initially, but now has a permanent position funded to facilitate the network, and a climate change budget within the NRM structure.

The workshop participants reported that there was a great deal of research being done but no understanding of priorities or a means to capture the findings. It is proposed that each region will produce an adaptation plan and under this will sit sector plans, such as fishing, agriculture and mining. A process for each region was developed so it could be coordinated at state level. All the research is then coordinated and made available.

> *[The] research feeds straight into now what we're being funded for which is to then work with the sectors to say what are the commonalities, what are the impacts, what is the future going to look like through different scenarios and how can we build a plan up beneath that.*

The next step is to explore the adaptation options available to the different sectors.

The workshop participants reported that work done in SA empowers local networks to make decisions, only the word 'empowerment' is not used as it was felt to be a bit belittling, more facilitation. The state government supplies the capacity and funds and knowledge to act. The existing power structure is used, so the Natural Resource Management (NRM) and local government and the regional development board have their priorities and decision-making areas. The Regional Board and sector agreements bring decision makers to discuss decisions and then go back and implement them within their own mechanisms. This also provides economies of scale, but still does not fully address community empowerment. While there are also locally based projects the workshop participants reported that there was not yet a state perspective about how to support local communities deal with their issues. However, this bottom up process was said to be forcing government to deal with this information and incorporate it into planning. The planned process is to set priorities at the regional level and understand how other issues fit in with climate change, what needs to be done at state and federal level and what needs to be supported.

The methodology of vulnerability assessments was described in the workshop. The impetus for these came from the local council insurer who requested that every council undertake a climate change risk assessment. The assessment was done in conjunction with the NRM Council, emergency management and councils. A matrix is developed for each region identifying key vulnerabilities and adaptive actions required (to build adaptive capacity and reduce exposure). It identifies priorities, actions to be implemented and appropriate timing. The SA Local Government Association has developed guidelines setting out very specific steps to prepare the assessments. It is a top–down matrix and scoring system and a bottom–up discussion of actions and priorities but the structure allows for state-wide consistency. Some actions are win/win, and other actions are more difficult, perhaps expensive and with outcomes that people do not value.

It gets very complicated, but by bringing everybody in the region, key stakeholders all into the same room and talking about it you get these wonderful conversations where people start to realise, we can't have that and that and that because you can't.

The workshop participants reported that each region varied in terms of their approach and who became involved. There were also differences in their priorities for adaptation, as well in progress towards adaptation.

Of the 12 regions in SA, 11 have completed or are working on climate change adaptation plans. It was reported that there is a window of opportunity over the next 18 months, that funding is available and that there is a good base to work from. Many regions are doing good work, such as the Eyre Peninsula region.

The *Eyre Peninsula Integrated Climate Change Agreement* involves 11 councils, Regional Development Australia and the NRM Board. In 2007, while the NRM plan for the region was being prepared, an inspirational local leader determined that everything should be looked at through a climate change lens. This was a fairly radical position at the time, but was accepted.

The Eyre Peninsula people felt rather isolated as the first region to implement a regional sector agreement on climate change, but working with the state government representatives gave them confidence. An integrated vulnerability assessment for the Eyre Peninsula region has been prepared. The assessment involved a substantial amount of research. A regional adaptation plan is now being developed, under the SA Climate Change Adaptation Framework. Each sector will prepare its own adaptation plan under this framework.

When asked whether it would to be more effective to work through existing organisations or to set up special-purpose bodies, the workshop participants felt it was better to work with existing bodies, but not necessarily the same combinations in each region. They suggested looking for leaders (or champions) in relevant organisations, utilising existing structures and extending their mandate to cover climate change. The state is trying to ensure that the same methodologies are applied in the regional frameworks, and that they are comparable.

Local government

The workshop participants spoke of the work being done in relation to local government and rising sea levels. In SA and NSW the local government insurer required the councils to do assessments of vulnerability of their own resources and processes, which has forced councils to take part in climate change issues for some time now.

The workshop participants spoke of work being done at Mallala and Onkaparinga in SA that examined decision pathways and cost-effective approaches for councils to address protection or retreat, and how to best accommodate to sea level rises and erosion. It was realised that there are some fairly constraining legal requirements that councils have to take into account before they can even think about what they might physically do in the landscape:

if a council was to build a protection wall they would then become legally liable for maintaining that and any damage that would occur in the event that it collapsed. If they don't build the wall they have no legal liability for any of the houses behind it because they're not owned by the council.

The workshop participants reported considerable tension occurring around the issue of sea walls, where the community feels it is the council's responsibility. Some places have a sea wall or sand bagging, which can make other areas worse off, with 'a cascading effect of protection'. It was found to be more cost effective to pay to raise the houses rather than build a sea wall. In the Lockyer Valley, the council has offered people an alternative block of land on which they can move their house and some people have done this. Only built structures were reported as being examined, not the option of planting or consideration of the value of the beach. It was found that the community can get very angry about this. The issue is further complicated by the presence of beach shacks, originally illegally built but now in existence for a long time. Some farmers have rebuilt the beach and others have pulled the shacks back from the edge of the sea. Sea level rises on Crown land are associated with additional complications.

People taking responsibility for themselves

The workshop participants spoke of the difficulties in engaging the community in conversation about adaptation and how it is a long and fairly costly process:

> *we've always felt that we're really bad at community engagement, and we've grappled with it … and what we've realised was in actual fact that's not really our job. Our job is not to engage the whole community, our job is to make sure that the feelers that go out can engage the community and that's lifted a whole heap of pressure from the sector table.*

Some members of the workshop noted that this approach to community engagement proved to be difficult in Whyalla. A consultant was employed to work with individuals, providing them information about sea level rises and seeking to identify what they valued about the place. The idea was that the individuals involved would reach out to their groups and spread the information. However, this did not really work, part of the problem being insufficient funding. In the Eyre Peninsula agreement work, it was decided that they did not need to engage all the community first-off, but set it a system so that the message would filter out over time. It was found to be important to keep the 'conversation table' going, using the top level people from the participating organisations.

The workshop participants noted that a larger town expects people to do things for them and a smaller town is used to doing things for itself.

> *The further away you get from an epicentre … like down on the Peninsula and places like that, I think that there's always been a sense of resilience in there because they have to rely in each other. To talk about this process to them I think would be easier.*

Decision-making

The workshop participants discussed the issue that decisions have to be made now for future events. It was agreed that this raises problems in relation to land development:

> *if we're going to deal with this properly we've got to deal with the whole power issue, like a developer has ten times more power than any other interest group in a community so if you're going to do this properly you have to have a mechanism that deal with those power imbalances.*
>
> *There's a thing about time frames there too, because the developer comes in and does his thing very early in the piece and somebody else lives with the*

consequences of the decisions or the shortcuts that he's made, you've got to find some way of bringing forward the consideration of later consequences.

Another important question about decision-making relates to whether it is reasonable to delay longer-term adjustment for the short-term gain of benefits prior to adapting. However, there is a risk that the whole community will have to pay for the consequences of a private decision. The view was expressed that the issue relates to, for example, how often is a person prepared to cope with their house being flooded before they decide to change the situation:

There's a certain critical point we have to make a decision on one or the other and that leads you down certain pathway.

This issue is who makes this decision, the individual or the government? It was felt that this decision has to come from the community. If only individual decisions are made and people decide to retreat, eventually the community will just shut down. The only situation where a government will decide is if there is a massive infrastructure failure or massive erosion event. However, some communities will watch what happens elsewhere and learn.

The workshop participants noted that a lack of information hinders decision-making. For example, digital coastal mapping is presently being undertaken but it does not include erosion at present, so it was felt to be very helpful in terms of the vulnerability of a particular area. There is also a fear about telling people what is likely to happen as it might scare them. It was noted that the media needs to be more balance in reporting as good communication is important to achieving a well-adapted settlement. There needs to be conversation about specific trade-offs, such as: Do you want to use the water for a mine or for the vineyards? Agreement is needed on what is going to be saved and what is not going to be saved.

Generalisation of adaptation

It was felt that you may be able to obtain a framework and a methodology or a set of principles that can be generalised to other areas, but you cannot get answers, as:

each location, even within 20 kilometres of one another are all different. So the idea that you might come up with some findings that will be applicable to all your coastal settlements I will say is unrealistic.

7. RESULTS AND OUTPUTS: PART 4, THE TASK TO ACHIEVE ADAPTED SETTLEMENTS

This chapter presents the findings on three components of the project which further examine the tasks for Inverloch and Sandy Point leading to a climate-adapted settlement in 2030. These are: an illustrated vision for Inverloch, a framework of adaptation tasks and economic modelling of climate change induced natural disasters in Inverloch and Sandy Point. These findings further address research questions 4 and 5, being:

4. What is the community's vision of a climate-adapted settlement, what sort of settlement does the community want and how can wellbeing be maximised for all residents?
5. How can this preferred settlement be achieved? Who makes what decisions about adaptation and where does responsibility lie?

The Inverloch community's vision of an adapted settlement is presented in visual form. The tasks required to move the settlements from the present towards being better adapted are illustrated in a matrix, and the costs of an extreme event for the settlements are examined.

7.1 An illustrated vision of Inverloch

The participants in the community consultation at Inverloch spoke about their vision of a climate-adapted settlement. The ideas they expressed, including input from the research team, have been integrated into visual representations of Inverloch township and surrounds and of the urban town centre. Figure 7.1 shows an aerial photograph of Inverloch in 2012. Figure 7.2 shows a climate-adapted Inverloch in 2030.

The following tasks are introduced for an urban adapting Inverloch:

- to maximise surrounding farmland through sustainable agricultural practices and use crops and vegetation to reduce problems with town land born water runoff;
- to create a solid town boundary to protect productive farmland and create a more compact township less dependent on private car use;
- to help counteract erosion of headlands with a combination of solutions, including mangrove type vegetation;
- to create new vegetation bands around the town to allow wildlife and natural vegetation to connect to existing surrounding reserves;
- to increase the town centre density. Allow mixed-use developments along the main commercial strips;
- to create better connections between the town and waterfront;
- to protect the coastal vegetation, but allow a better connection between the town and the waterfront to increase awareness of the coastal conditions;
- protect Screw Creek vegetation area;
- and to rezone low lying areas and have a relocation strategy in place for low level properties.

Figure 7.1: Areal view of Inverloch now (Source: Google Earth)

Figure 7.2: Areal view of Inverloch adapting to climate change (Adapted from Figure 7.1 for this report)

Figure 7.3 shows Inverloch now and Inverloch as an adapting settlement. An adapting Inverloch has the following features:

- an increase in the density of the town centre to reduce pressure on greenfield sites, help build commercial viability and improve liveability in the town's urban heart, and assist with the implementation of a public transport system;
- better connection of the town centre and the sea and estuary;
- enhanced existing foreshore vegetation and bring it further through the commercial centre;

- limited cars through the centre of town to make the public spaces more people friendly (Roads and car parks could be brought into the rear of the shopping strip and the fronts could remain pedestrian and public transport accessible. The community meeting participants also suggested that cars could be kept totally out of the town centre, access to town being provided by a continuous circuit bus to reduce car reliance and increase equitable access to town services.);
- more pedestrian and bike friendly infrastructure;
- key historical and iconic buildings are retained;
- a range of housing types to suit all income levels to increase equity and social cohesion;
- use of alternative energy systems wherever possible;
- increase in permeability of ground surfaces and a feature stormwater runoff through a dry creek bed; and
- plant vegetation to reduce heat load and to assist with rainwater runoff.

Figure 7.3: Inverloch township now and an adapted Inverloch in 2030

7.2 Adaptation tasks to be undertaken

The consultations and workshops suggested a need for clear guidance about the tasks required to achieve a climate-adapted settlement. There was also a need for guidance in terms of where responsibilities lie for the different decisions that have to be made. A comprehensive review of the literature on adaptation led to the construction of a matrix to guide the adaptation required for each of the settlements, and to highlight where the responsibilities lie for each of these tasks. Table 7.1 provides the actions for Inverloch and Table 7.2 the actions for Sandy Point.

The matrices outline the major threats and overview the action required as well as indicate where responsibility for action will lie: with the individual/household, local organisations, local government, regional organisations, state/national governments, or elsewhere (other). Specific actions have been identified that will deliver co-benefits and/or mitigation of climate change: those actions that will need to be carefully managed to ensure they do not have an adverse impact on mitigation of climate change or conflict with other desirable adaptation actions.

Table 7.1: Inverloch actions to become a climate-adapted settlement in 2030

Actions that will deliver co-benefits and assist with mitigation of climate change.

Actions that need to be managed to ensure that that they do not have adverse effects on mitigation of climate change

Actions that have the potential to conflict with other desirable adaptation actions or to go against expressed community preferences.

a. Impact/threat – Heatwave

Adaptation / action required	Sector responsible for action					Other issue
	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	
Planning for heatwaves		Maintain list of vulnerable individuals	Update & implement Shire Heatwave Plan Provide health information	Hospitals & health centres – preventative approaches, planning for increased intakes, power supply security, etc.	Update & implement Victorian Heatwave Strategy	Doctors & HACC workers – preventative approaches
Adapt existing houses to stay cooler	Install insulation, double glazing & ceiling fans	Potential group purchase schemes	Encourage group approaches	Dissemination of information and best practice	Subsidy schemes Building regulations	
	Install air conditioning					
Build new houses to appropriate standards	Design, orient & construct houses to minimise need for artificial cooling		Design & development overlays	Dissemination of information and best practice	Planning and building regulations	
Green public & private spaces	Retain trees on private properties *	Assistance from Landcare and other groups - tree planting*	Install water-recycling for parks, playgrounds and street trees			
			Require additional open space in new developments & agree to maintain			
Protect vulnerable individuals	Watch out for elderly / frail friends & neighbours	Check vulnerable individuals in heatwave emergencies	Provide 'cooling relief centre' with back-up power supply	Hospitals & health centres – schedule additional staff to deal with increased intakes	National Disability Insurance Scheme – more resources for people with a disability. No-interest grants for low income families	
Ensure safe water supply available	Install rainwater tanks	Group purchases	Install large rainwater tanks at community centre Update Domestic Wastewater Management Plan		Low interest grants	Standards Australia – review & update health standards
Increase resilience of infrastructure	Undertake a review of risk choices	Examine potential for community-owned renewable energy generation system(s)				SP Ausnet – maintain transmission lines, etc.

b. Impact/threat – Flash flooding

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Reduce threat to life & property	Limit extent of hard surfaces on lots to encourage stormwater penetration	Community-led choices on adaptation options	Design stormwater drainage systems in new areas for more intense storms & retrofit existing areas		Met Bureau – forecast potential flash flooding	Engineers Australia – update rainfall & runoff guidelines
Effective emergency response	Heed warnings & avoid driving or walking in floodwaters	Facilitate an emergency support scheme to compliment official responses where people are known to be vulnerable	Provide community information Establish relief centre if required		SES – respond to calls for assistance	Red Cross – staff relief centre if required
Recovery	Be aware of personal needs, provide assistance to friends & neighbours Clean up & restore properties	Practical assistance to affected individuals / households, e.g. clean-up, fencing	Reinstate affected Shire infrastructure promptly & efficiently	Advice, resources	DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)

c. Impact/threat – Coastal erosion

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Planning for coastal erosion (including longer term coastal recession)	Personal decision-making about issues such as house location, planting	Develop awareness of risks of erosion & longer term coastal recession & support community education programs of Shire & agencies. Advise to Council on issues such as planting. Community-led choices on adaptation options	(With DSE) - Commission studies of coastal erosion / recession & plan for appropriate protection (soft & hard measures, e.g. renourishment, geotextile bags or seawalls) * or other adaptation actions (With DSE) - Identify areas where land acquisition or agreements with landholders may be required to provide public access &/or allow adaptation of ecosystems	Gippsland Coastal Board – prepare coastal action plan to identify areas at risk, develop CC adaptation actions for foreshores & prioritise implementation	Assist Council to undertake studies of erosion potential, storm bite analysis, etc.	
Protect foreshores	Avoid activities that damage coastal vegetation or cause erosion	Coastcare / Comm of Management – help maintain biodiversity & quality of coastal foreshore vegetation	(With DSE) - seek funding & implement adaptation actions with the highest net community benefit		DSE (with SGSC) - seek funding & implement actions with the highest net community benefit	
Protect, adapt or relocate assets (private & public) located on or behind foreshores at risk	Avoid significant new investment in areas that may be at risk of coastal erosion	Local support structures	Ensure planning of new Council assets on or adjoining foreshore land takes account of CC risks, facility's design life & the consequences of failure	Advice, resources, dissemination of information	Ensure design of State (or State-approved) assets on foreshore land takes account of CC risks, design life & the consequences of failure	
	Build protective structures on private land (where permitted & where no risk to other properties or the environment) *					
	Relocate houses on lots or to other lots as erosion progresses		Ensure new development on private land is located & constructed to minimise risks from coastal erosion		Provide appropriate 'tools' & standards in the planning system Review status of reserved Crown land & acquire additional land if needed	

d. Impact/threat – windstorm

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Reduce threat to life & property	Design & construct houses to withstand higher winds		Remove dangerous trees from roadsides and public places * & replant new trees		Planning and building regulations Met Bureau – storm / wind forecasts	
Effective emergency response	Remove loose objects around houses Avoid walking or driving in windstorms	Organise community support and assistance	Provide community information Establish relief centre if required		SES – respond to calls for assistance	Red Cross – staff relief centre if required
Recovery	Be aware of personal needs, provide assistance to friends & neighbours Clean up & restore properties	Practical assistance to affected individuals / households, e.g. clean-up, fencing	Reinstate affected Shire infrastructure promptly & efficiently		DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)

e. Impact/threat – Inundation from the ocean, combined with land-based flooding

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Planning for adaptation to potential future inundation	Undertake 'due diligence' investigations before purchasing property Avoid investment in areas vulnerable to future inundation Be aware of whether house is at risk; prepare relocation kit	Develop awareness of inundation risks & support community education programs of Shire & agencies	Plan for possible inundation, taking account of sea level rise, storm surge and catchment-based flooding Identify cost-effective, efficient, equitable & environmentally sustainable adaptation pathways Ensure that new development in vulnerable areas takes account of risks & life-span of proposed buildings or works	WGCMA – act as floodplain management authority & referral authority for building in areas at risk of flooding &/or coastal inundation With WGSC, prepare flood management plan(s)	Complete coastal hazard vulnerability mapping for Victorian coast & make information available to Councils Planning and building regulations Review status of reserved Crown land & acquire additional land if needed	Real Estate Agents / rental house owners – ensure emergency response information is available in rented properties
Improve resilience of infrastructu re networks		Facilitate community choices to prevent flooding		South Gipps Water – avoid siting sewerage pumping stations in low-lying areas & develop emergency procedures	Improve/resource infrastructure such as around transport and government buildings such as schools	
Reduce threat to life & property	Take permitted protective action where not impacting on other property owners or the environment *		Implement identified adaptation pathway(s) – e.g. relocate assets, install soft protection measures, build seawalls *, mangrove planting			
			Require owners to adapt (raise floor levels, adjust building services) or remove buildings from areas permanent affected			
Effective emergency response	Heed warnings & evacuate if advised		Establish Municipal Emergency Co-ordination Centre		SES – respond to flooding & risks to individuals Staff Incident Control Centres Victoria Police – manage MECC & relief centres VicRoads – control road closures & re-openings	Red Cross – staff emergency relief centres
Recovery	Be aware of personal needs, provide assistance to friends & neighbours Clean up & restore properties (if appropriate) or adapt	Practical assistance to affected individuals / households, e.g. clean-up, fencing	Management of recovery activities, including community information Establishment & management of Recovery Centres	South Gippsland Water – ensure any damage to water & sewerage systems (if installed) is repaired quickly & effectively	DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)
Recovery (cont)	Remove buildings & works from property if directed by Council (if land no longer safe to occupy)		Restoration of Shire infrastructure – roads, etc. Community development, tourism / economic recovery services	South Gippsland Water – ensure flushing of water mains & restoration of sewerage services		

f. Impact/threat – Saline penetration of groundwater

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Identify areas at risk & take into account affects on water quality, foundations & utilities	Consider impacts of reduced groundwater quality on household water bores & livestock operations		(With DPI) – identify areas at risk from saline penetration of groundwater & apply appropriate controls	Southern Rural Water – monitor impacts on groundwater extraction for beneficial uses	DPI (with SGSC) – identify areas at risk from saline penetration of groundwater Building regulations	Utility providers – consider risks of saline groundwater in planning

g. Impact/threat – Squeeze of coastal vegetation

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Reduce impediments to spontaneous relocation of coastal ecosystems in response to rising sea levels (e.g. mangroves, saltmarsh)	Remove privately constructed barriers that prevent landward movement of ecosystems Enter into voluntary agreements with Council or DSE to remove or not construct barriers (with or without incentives)	Coastcare / Landcare – assist with planting of mangroves or other coastal vegetation, where spontaneous adaptation is not likely to be effective	(With DSE) Identify areas where landward movement of ecosystems could occur Prohibit construction of physical barriers to landward movement of ecosystems * Develop systems of regulation &/or incentives for owners to remove existing barriers or not construct new ones	Gippsland Coastal Board - prepare coastal action plan to identify areas at risk, develop CC adaptation actions for foreshores & prioritise implementation Educate the community re the importance of mangroves & saltmarsh	DSE (with SGSC) - identify areas where landward movement of ecosystems could occur DPCD - Provide appropriate 'tools' in the planning system Provide funding for incentive programs Review status of reserved Crown land & acquire additional land if needed to facilitate adaptation of ecosystems	

h. Impact/threat - Bushfire

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Planning for bushfire safety	Develop personal/ household bushfire survival plan, using CFA Fire Ready Kit & Sandy Point Community Information Guide	CFA – community education, recruitment, training. Update & implement Township Protection Plan for Sandy Point (with SGSC & DSE / PV)	Update & implement Shire Emergency Management Plan & Bushfire Prevention Plan	Support, resources, advice on best practice	Fund equipment & training Update & implement Local Fire Management Plans for public land Planning and building regulations	
Reduce threat to life and property	Clean up around houses, remove overhanging vegetation, etc.* Retrofit existing houses to increase their resistance to bushfires (radiant heat & ember attack) Construct new houses to increase their resistance to bushfires (radiant heat & ember attack) Install air-conditioning to reduce risk of respiratory disease in vulnerable people from particulate matter in atmosphere	CFA –fire preparedness, fuel reduction measures on roadsides * Reinforce message to residents about need to take responsibility for own safety	Identify neighbourhood 'safer place' & equip for emergency use Maintain safe access and egress to township Consider road along foreshore to Waratah Bay for emergency use * Provide free green waste disposal pre fire season Ensure new development is located & constructed to minimise risks Check buffer areas on permits are maintained		DSE, PV - Fuel reduction measures on public land adjacent to township *	SP Ausnet – consider underground electricity supplies * Real Estate Agents / rental house owners – ensure emergency response information for occupants is available in rented properties
Ensure adequate water supply available	Install fire fighting measures, especially in rurally based houses, such as pumps, water systems			South Gippsland Water – ensure bulk water supplies available for emergencies		
Improved emergency communications - preparation					Roll out National Broadband Network with appropriate band width for emergency services Standardise DSE/PV/ CFA communications systems & protocols	Telcos – increase resilience of mobile phone networks
Improved emergency communications - operational	Ensure household has battery radio & a telephone or Internet device that does not rely on electricity				Met Bureau –fire weather warnings Vic Fire - timely & accurate fire warnings Staff Bushfire Information Line. Ensure information on CFA and DSE websites is current	ABC Radio (or other designated emergency services broadcaster) – disseminate emergency information

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Effective fire response	Enact Bushfire Survival Plan – leave early or stay & defend (an appropriately prepared property)	CFA –suppress fires on private land; co-operate with DSE & PV on Crown land Staff Incident Control Centres (ICC), maintain Regional Emergency Co-ordination Centres	Establish Municipal Emergency Co-ordination Centre (MECC)	Health services & hospitals	DSE & PV – suppress fires on Crown land; co-operate with CFA on private land Staff Incident Control Centres (ICC)	Red Cross – staff emergency relief centres
Effective fire response (cont)					Victoria Police – manage MECC & relief centres VicRoads – control road closures & re-openings	
Protect vulnerable individuals	Watch out for elderly / frail friends & neighbours, ensure they can implement their fire plans	Maintain list of vulnerable individuals & check in emergency situations	Ensure vulnerable individuals identified & checked.		National Disability Insurance Scheme – more resources for people with a disability	
Recovery	Clean up & restore properties Be aware of personal needs, provide assistance to friends & neighbours	Provide practical assistance to affected individuals / households, e.g. clean-up, fencing	Manage recovery activities, including community information Establish & manage Recovery Centres Community development, tourism / economic recovery services Co-ordinate disposal of dead stock, etc.		DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)

i. Impact/threat – Spread of vector-borne diseases

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Reduce vulnerability of population to vector-borne diseases	Install effective insect screens on houses, wear protective clothing &/or use insect repellent		Implement prevention programs & minimise community exposure to risk * Implement surveillance programs	Hospitals, health centres, medical practitioners – recognise symptoms, diagnose & report cases	Maintain registers of occurrence of vector-borne disease Provide resources for improved prevention & surveillance	

j. Impact/threat – Interruption of food supply

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Increase locally produced food	Grow more vegetables & fruit	Develop community gardens. Encourage local food supplies	Encourage community gardens on Shire land			Salvation Army ? - stock-pile non-perishable food

k. Impact/threat – unsustainable urban form

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Increase sustainability	Accept changes in average density & urban structure Build houses (or retrofit existing ones) to decrease water use Recycle greywater Consider issues such as location of the house on the site	Information	Adopt water sensitive urban design Encourage higher density housing Retain & enforce urban growth boundaries Install water-recycling for watering parks, playgrounds and street trees Install gross litter traps on all stormwater outlets to Inlet		Planning controls Building regulations Incentive schemes	Developers – adopt higher standards of environmental design & consider installing 3rd-pipe systems Businesses – innovation & new technology

l. Impact/threat – greenhouse gas emissions

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Mitigate climate change by reducing GG emissions (actions not listed elsewhere)	Install solar hot water & household solar energy generation systems and other mitigation approaches	Potential group purchase schemes Potential for community based alternative energy generation & distribution	Encourage group approaches Establish or support community transport systems Install networks of walking & cycling paths		Planning controls Building regulations Incentive schemes Taxation / emissions trading schemes	Developers – install solar systems in new housing Businesses – innovation & new technology

Table 7.2: Sandy Point actions to become a climate-adapted settlement in 2030

Actions that will deliver co-benefits and assist with mitigation of climate change.

Actions that need to be managed to ensure that that they do not have adverse effects on mitigation of climate change

Actions that have the potential to conflict with other desirable adaptation actions or to go against expressed community preferences

a. Impact/threat Heatwave

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Planning for heatwaves		Neighbourhood Watch? – maintain list of vulnerable individuals	Update & implement Shire Heatwave Plan	Hospitals & health centres – preventative approaches, planning for increased intakes, power supply security, etc.	Update & implement Victorian Heatwave Strategy	Doctors & HACC workers – preventative approaches
Adapt existing houses to stay cooler	Install insulation & double glazing	Potential group purchase schemes	Encourage group approaches		Subsidy schemes Building regulations	
	Install air-conditioning for vulnerable people					
Build new houses to appropriate standards	Design, orient & construct houses to minimise need for artificial cooling		Design & development overlays		Planning and building regulations	
Green public & private spaces	Retain trees on private properties *	Landcare etc - tree planting *	Install water-recycling for watering parks, playgrounds and street trees			
Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Protect vulnerable individuals	Watch out for elderly / frail friends & neighbours	Neighbourhood Watch? – check vulnerable individuals in heatwave emergencies	Provide 'cooling relief centre' with back-up power supply	Hospitals & health centres – schedule additional staff to deal with increased intakes	National Disability Insurance Scheme – more resources for people with a disability	
Ensure safe water supply available	Retain rainwater tanks (even if reticulated water supplied to township), install 1st flush bypass, fit diesel or solar-powered pump on bores Consider upgrading septics (especially WC-only) to package plants or composting toilets		Install large rainwater tanks at community centre Update Domestic Wastewater Management Plan Monitor operation of septic tanks / package plants Monitor groundwater quality			Standards Australia – review & update health standards

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Upgrade water supply in longer term	Pay for installation of reticulated water & sewerage *		Initiate action for provision of reticulated water & sewerage *	SGW – install reticulated water & sewerage (if groundwater contamination identified) *		
Increase resilience of infrastructure		Examine potential for community-owned renewable energy generation system				SP Ausnet – maintain transmission lines

b. Impact/threat Bushfire

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Planning for bushfire safety	Develop personal/ household bushfire survival plan, using CFA Fire Ready Kit & Sandy Point Community Information Guide	CFA – community education, recruitment, training. Update & implement Township Protection Plan for Sandy Point (with SGSC & DSE / PV)	Update & implement Shire Emergency Management Plan & Bushfire Prevention Plan		Fund equipment & training Update & implement Local Fire Management Plans for public land Planning and building regulations	
Reduce threat to life and property	Clean up around houses, remove overhanging vegetation, etc.* Retrofit existing houses to increase their resistance to bushfires (radiant heat & ember attack) Construct new houses to increase their resistance to bushfires (radiant heat & ember attack)	CFA –fire preparedness, fuel reduction measures on roadsides * Reinforce message to residents about need to take responsibility for own safety	Identify neighbourhood 'safer place' & equip for emergency use Maintain safe access and egress to township Consider road along foreshore to Waratah Bay for emergency use * Provide free green waste disposal pre fire season Ensure new development is located & constructed to minimise risks Check buffer areas on permits are maintained		DSE, PV - Fuel reduction measures on public land adjacent to township *	SP Ausnet – consider underground electricity supplies * Real Estate Agents / rental house owners – ensure emergency response information for occupants is available in rented properties
Planning for bushfire safety	Develop personal/ household bushfire survival plan, using CFA Fire Ready Kit & Sandy Point Community Information Guide	CFA – community education, recruitment, training. Update & implement Township Protection Plan for Sandy Point (with SGSC & DSE / PV)	Update & implement Shire Emergency Management Plan & Bushfire Prevention Plan		Fund equipment & training Update & implement Local Fire Management Plans for public land Planning and building regulations	

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Reduce threat to life and property	Clean up around houses, remove overhanging vegetation, etc.* Retrofit existing houses to increase their resistance to bushfires (radiant heat & ember attack) Construct new houses to increase their resistance to bushfires (radiant heat & ember attack)	CFA –fire preparedness, fuel reduction measures on roadsides * Reinforce message to residents about need to take responsibility for own safety	Identify neighbourhood 'safer place' & equip for emergency use Maintain safe access and egress to township Consider road along foreshore to Waratah Bay for emergency use * Provide free green waste disposal pre fire season Ensure new development is located & constructed to minimise risks Check buffer areas on permits are maintained		DSE, PV - Fuel reduction measures on public land adjacent to township *	SP Ausnet – consider underground electricity supplies * Real Estate Agents / rental house owners – ensure emergency response information for occupants is available in rented properties
Ensure adequate water supply available	Retain rainwater tanks, fit diesel or solar-powered pump on bores		Install large rainwater tanks at community centre & other key locations	South Gipps Water – ensure bulk water supplies available for emergencies		
Improved emergency communications - preparation					Roll out National Broadband Network & ensure appropriate band width for emergency services Standardise DSE/PV/ CFA communications systems & protocols	Telcos – increase resilience of mobile phone networks
Improved emergency communications - operational	Ensure household has battery radio & a telephone or Internet device that does not rely on electricity				Met Bureau –fire weather warnings Vic Fire - timely & accurate fire warnings Staff Bushfire Information Line. Ensure information on CFA and DSE websites is current	ABC Radio (or other designated emergency services broadcaster) – disseminate emergency information
Effective fire response	Enact Bushfire Survival Plan – leave early or stay & defend (an appropriately prepared property)	CFA –suppress fires on private land; co-operate with DSE & PV on Crown land Staff Incident Control Centres (ICC), maintain Regional Emergency Co-ordination Centres	Establish Municipal Emergency Co-ordination Centre (MECC)	Health services & hospitals	DSE & PV –suppress fires on Crown land; co-operate with CFA on private land Staff Incident Control Centres (ICC) Victoria Police – manage MECC & relief centres	Red Cross –staff emergency relief centres
Effective fire response					VicRoads – control road closures & re-openings	

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Protect vulnerable individuals	Watch out for elderly / frail friends & neighbours, ensure they can implement their fire plans	Neighbourhood Watch? – maintain list of vulnerable individuals & check in emergency situations	Ensure vulnerable individuals identified & checked.		National Disability Insurance Scheme – more resources for people with a disability	
Recovery	Clean up & restore properties Be aware of personal needs, provide assistance to friends & neighbours	Provide practical assistance to affected individuals / households, e.g. clean-up, fencing	Manage recovery activities, including community information Establish & manage Recovery Centres Community development, tourism / economic recovery services Co-ordinate disposal of dead stock, etc.		DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)

c. Impact/threat Inundation

Adaptation / action required	Individuals / households	Local organisations	Council	Regional	State / national Government	Other
Planning for adaptation to potential future inundation	Undertake 'due diligence' investigations before purchasing property Avoid investment in areas vulnerable to future inundation Be aware of whether house is at risk; prepare relocation kit	Develop awareness of inundation risks & support community education programs of Shire & agencies	Plan for possible inundation, taking account of sea level rise, storm surge and catchment-based flooding Identify cost-effective, efficient, equitable & environmentally sustainable adaptation pathway	WGCMA – act as floodplain management authority & referral authority for building in areas at risk of flooding &/or coastal inundation	Complete coastal hazard vulnerability mapping for Victorian coast & make information available to Councils Planning and building regulations Review status of reserved Crown land & acquire additional land if needed	
Planning for adaptation to potential future inundation (cont)			Ensure that development in vulnerable areas takes account of risks & life-span of buildings or works Ensure owners accept risks (S.173)	With WGSC, prepare flood management plan(s)		
Improve resilience of infrastructure networks			Raise level of access road (Waratah Road)	WGCMA – maintain bund on Shallow Inlet (recoup costs), consider cost effectiveness of raising height * South Gipps Water – design sewerage system (if installed) to avoid siting pumping stations in low-lying areas		

Adaptation / action required	Individuals / households	Local organisations	Council	Regional	State / national Government	Other
Reduce threat to life & property	Take permitted protective action where not impacting on other property owners or the environment		Implement identified adaptation pathway(s) – e.g. facilitate building of seawalls *, require owners to adapt (raise floor levels, adjust building services) or remove buildings from areas permanent affected			Real Estate Agents / rental house owners – ensure emergency response information is available in rented properties
Effective emergency response (cont)	Heed warnings & evacuate if advised		Establish Municipal Emergency Co-ordination Centre		SES – respond to flooding & risks to individuals Staff Incident Control Centres Victoria Police – manage MECC & relief centres VicRoads – control road closures & re-openings	Red Cross –staff emergency relief centres
Recovery	Be aware of personal needs, provide assistance to friends & neighbours Clean up & restore properties (if appropriate) or adapt as required Remove buildings & works from property if directed by Council (if land no longer safe to occupy)	Practical assistance to affected individuals / households, e.g. clean-up, fencing	Management of recovery activities, including community information Establishment & management of Recovery Centres Restoration of Shire infrastructure – roads, etc. Community development, tourism / economic recovery services Co-ordination of disposal of dead stock, etc. Ensure pump-out & reinstatement of flooded septic tanks	South Gippsland Water – ensure any damage to water & sewerage systems (if installed) is repaired quickly & effectively	DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)

d. Impact/Threat flash flooding

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Reduce threat to life & property	Design driveways & hard surfaces to retain stormwater on the property, & protect adjacent land		Install & maintain urban stormwater drainage system designed for more intense storms		Met Bureau – forecast potential flash flooding	Engineers Australia – update rainfall & runoff guidelines
Effective emergency response	Heed warnings & avoid driving or walking in floodwaters		Provide community information Establish relief centre if required		SES – respond to calls for assistance	Red Cross – staff relief centre if required
Recovery	Be aware of personal needs, provide assistance to friends & neighbours Clean up & restore properties	Practical assistance to affected individuals / households, e.g. clean-up, fencing	Reinstate affected Shire infrastructure promptly & efficiently		DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)

e. Impact/ Threat Windstorm

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Reduce threat to life & property	Design & construct houses to withstand higher winds		Remove dangerous trees from roadsides and public places * & replant new trees		Planning and building regulations Met Bureau – storm / wind forecasts	
Effective emergency response	Remove loose objects around houses Avoid walking or driving in windstorms		Provide community information Establish relief centre if required		SES – respond to calls for assistance	Red Cross – staff relief centre if required
Recovery	Be aware of personal needs, provide assistance to friends & neighbours Clean up & restore properties	Practical assistance to affected individuals / households, e.g. clean-up, fencing	Reinstate affected Shire infrastructure promptly & efficiently		DHS – accommodation, financial support, personal support	Churches & charities – material aid, counselling (with DHS)
Planning for coastal erosion (including longer term coastal recession)		Develop awareness of risks of erosion & longer term coastal recession & support community education programs of Shire & agencies	(With DSE) - Commission studies of coastal erosion / recession & plan for appropriate protection (soft & hard measures, e.g. renourishment, geotextile bags or seawalls) * or other adaptation actions (With DSE) - Identify areas where land acquisition or agreements with landholders may be required to provide public access &/or allow adaptation of ecosystems	Gippsland Coastal Board – prepare coastal action plan to identify areas at risk, develop CC adaptation actions for foreshores & prioritise implementation	Assist Council to undertake studies of erosion potential, storm bite analysis, etc.	
Protect foreshores	Avoid activities that damage coastal vegetation or cause erosion	Coastcare / Comm of Management – help maintain biodiversity & quality of coastal foreshore vegetation	(With DSE) - seek funding & implement adaptation actions with the highest net community benefit		DSE (with SGSC) - seek funding & implement actions with the highest net community benefit	
Protect, adapt or relocate assets (private & public) located on or behind foreshores at risk	Avoid significant new investment in areas that may be at risk of coastal erosion		Ensure planning of new Council assets on/near foreshores takes account of CC risks, design life of proposed facility & the consequences of failure		Ensure planning of new State (or State-approved) assets on foreshore land takes account of CC risks, design life of facility & the consequences of failure	
Protect, adapt or relocate assets (private & public) located on or behind foreshores at risk (cont)	Build protective structures on private land (where permitted & where no risk to other properties or the environment) *					
	Relocate houses on lots or to other lots as erosion progresses		Ensure new development on private land is located & constructed to minimise risks from coastal erosion		Provide appropriate 'tools' & standards in the planning system Review status of reserved Crown land & acquire additional land if needed	

Adaptation / action required	Individuals / households	Local organisations	Council	Regional organisation	State / national Government	Other
Identify areas at risk & take into account affects on water quality, foundations & utilities	Consider impacts of reduced groundwater quality on household water bores & livestock operations		(With DPI) – identify areas at risk from saline penetration of groundwater & apply appropriate controls	Southern Rural Water – monitor impacts on groundwater extraction for beneficial uses	DPI (with SGSC) – identify areas at risk from saline penetration of groundwater Building regulations	Utility providers – consider risks of saline groundwater in planning
Reduce impediments to spontaneous relocation of coastal ecosystems in response to rising sea levels (e.g. mangroves, saltmarsh)	Remove privately constructed barriers that prevent landward movement of ecosystems Enter into voluntary agreements with Council or DSE to remove or not construct barriers (with or without incentives)	Coastcare / Landcare – assist with planting of mangroves or other coastal vegetation, where spontaneous adaptation is not likely to be effective	(With DSE) Identify areas where landward movement of ecosystems could occur Prohibit construction of physical barriers to landward movement of ecosystems *	Gippsland Coastal Board - prepare coastal action plan to identify areas at risk, develop CC adaptation actions for foreshores & prioritise implementation	DSE (with SGSC) - identify areas where landward movement of ecosystems could occur DPCD - Provide appropriate 'tools' in the planning system Provide funding for incentive programs	
Reduce impediments to spontaneous relocation of coastal ecosystems (cont)			Develop systems of regulation &/or incentives for owners to remove existing barriers or not construct new ones	Educate the community re the importance of mangroves & saltmarsh	Review status of reserved Crown land & acquire additional land if needed to facilitate adaptation of ecosystems	
Reduce vulnerability of population to vector-borne diseases	Install effective insect screens on houses, wear protective clothing &/or use insect repellent		Implement prevention programs & minimise community exposure to risk * Implement surveillance programs	Hospitals, health centres, medical practitioners – recognise symptoms, diagnose & report cases	Maintain registers of occurrence of vector-borne disease Provide resources for improved prevention & surveillance	
Increase locally produced food	Grow more vegetables & fruit	Develop community gardens	Encourage community gardens on Shire land			Salvation Army ? - stock-pile non-perishable food

8. RESULTS AND OUTPUTS: PART 5, CLIMATE CHANGE INDUCED NATURAL DISASTERS IN INVERLOCH AND SANDY POINT: AN ECONOMIC ANALYSIS

Although it is certain that climate change will impact on Inverloch and Sandy Point within the next few decades, its exact manifestations are far from certain. Some would argue that the manifestations of climate change are so uncertain that it is pointless to prepare. The purpose of this section is to consider the case for preparedness.

8.1 Vulnerability to climate change

The project strategy envisaged that this case would be assessed by adding localised economic, social, environmental and climate trends to the National Institute of Economic and Industry Research (NIEIR) model and running the model to examine these trends to 2030 within the context of the existing model of economic, social, structural and climate change projections. The consequential impacts of climate change on the economy, on people and on the environment will be examined in this context, such as changes in the natural environment (e.g. increased risk of fire), changes in agricultural viability and changes in employment opportunities. The findings will be examined in relation to capacity strengths, and capacity limitations will be examined in the light of projected climate changes. This section aims to outline the climate change scenario for 2030 for each of these settlements, to provide information on the major domains projected to 2030 and to provide a perspective of what each of these settlements will look like in 2030 based on the current trajectories. We also aim to identify intervention points and to outline the main decisions on specific domains in order to understand where choices can be made to vary the present trajectory of outcomes.

The contrast examined is between a scenario in which adaptation is purely reactive and one in which pro-active adaptation takes place. Climate change trends and the probability of related events are, therefore, the same in the two scenarios. This requires an artificial separation between the climate change scenario and the progress of adaptation, whereas in reality the two are likely to interact: progressive adaptation is more likely to occur under a climate change scenario that includes a series of warning events than under a scenario in which climate change manifests itself suddenly and disastrously.

The trends underlying climate change are gradual: the increase in greenhouse gas concentrations, the increase in average temperatures and the rise in mean sea level are all projected as inexorable but slow changes over the projection period. In some places and at certain times, these trends may favour human activities, but, in general, the predictions for the Australian coast are unfavourable. In particular, rising sea levels will lead to loss of coastal features and land area and rising temperatures will be associated with increased storm activity. It is not considered likely that the trends will be discernible to people who do not have the equipment to make the relevant scientific observations.

An important feature of these slow underlying trends is that they change the probabilities of different kinds of weather events. The underlying trends may be gradual, but the events may be experienced as drastic and unprecedented. The events projected for south-east Australia, as outlined in Chapter 4, include:

- droughts, more frequently and more severe;
- hot spells, more frequently and hotter;
- storms and stronger winds;
- high-intensity rainfall, associated with the storms, resulting in floods; and
- increased bushfire danger, associated with the hot spells and high winds but also dependent on other factors such as good seasons, which increase the supply of flammable material.

All of these events may occur in coastal areas, but such areas are particularly exposed to storms and high winds. Summarising from the rest of this report, three major manifestations of climate change can be expected with potential to harm people and property in coastal settlements like Inverloch and Sandy Point. They are:

- a rise in sea level;
- an increase in the probability that severe storms will hit the coast, with strong onshore winds and high rainfall; and
- an increase in the probability of drought culminating in hot days with strong offshore winds.

Almost by definition, extreme storms have no precedent, at least in the relatively short settlement history of Australia. The usual way to prepare for extreme events is by assessment of probability. The rule of thumb used in town planning is that provision should be made for events such as storms or floods considered likely to occur once in 100 years, but not once in 1000. Such probabilities are necessarily approximate but can be assessed by extrapolation from relatively frequent events. The projection period runs for 17 years, which gives an approximately 16% chance that a once-in-a-100-year event will occur within the period. The converse probability is an approximately 16% chance that the worst event that will occur in the 17-year period will be a once-in-10-year event. Given the current town planning rule of thumb, it would seem reasonable to include a once-in-a-100 year event as one case, offsetting this against a case in which the worst event encountered is once-in-10 years. Effectively, this latter case is one for which both Inverloch and Sandy Point are already prepared (or will be, once current drainage works in Inverloch are complete.)

Climate change introduces a further problem, which is that the severity of all events increases with time; or, to put the same point differently, the frequency of events of given severity is expected to increase. The event modelled is of a severity that would currently be considered once in 100 years, but by 2030 it is expected that its probability of occurrence in any particular year will have increased. If the increase is to once in 25 years, the probability of the modelled event occurring within the decade centred on 2030 increases to 40%. It will be readily apparent that we are here in the presence of considerably uncertainty, such that speaking in terms of probability is not strictly appropriate, but probability language has the advantage of formalising the assumptions. The following analytical strategy was adopted:

- For each settlement, develop 17 weather scenarios in which an extreme event occurs in each year up to 2030 plus a scenario in which no extreme event occurs during the projection period. The severity of the event is defined with respect to past experience.
- Attach a probability to each scenario. The probability of occurrence in 2013 is a little in advance of once a century, while the probability of occurrence in 2030 rises to four times a century. Given the above calculations, the probability that the event will not occur during the projection period is 60%, while the probability

that it will occur in 2030 in 4%, tapering back towards somewhat over 1% in 2013 (given that climate change has already increased the probability).

- Value the damage likely in each settlement due to the event if no preparation is undertaken. This avoids preparedness costs but incurs damage costs, and constitutes the 'complacency' scenario.
- Develop and cost a list of measures that would allow each settlement to weather their one-in-100-year events with little damage. Assume that these measures are implemented in the 10 years from 2015 to 2025, with corresponding reduction in damage costs for events occurring after 2025. If the event occurs in 2025 or before, preparedness will be incomplete and full or partial damage costs will be incurred.
- In keeping with the terms of reference, the study period was not extended beyond 2030 and no benefits were estimated for events occurring after this cut-off date.
- The difference between the scenarios will then reveal the returns to abatement action, provided the probabilities have been correctly assessed.

The increase in sea level as a result of climate change is expected to express itself in coastal areas chiefly in two ways: increases in the severity of storms and increases in the frequency of storms of particular severity. Thus, an estimate for Stony Point is that a storm tide peak of 1 m above mean sea level is currently expected, on average, once a year, one of 1.55 m above mean sea level once in 10 years, a peak once in 30 years of 1.85 m, and once in 100 years of 2 m. Under a rapid climate change scenario, as now considered probable by the World Bank, these peaks will rise to 1.2, 1.75, 2.1 and 2.25 m, respectively, in relation to current mean sea level, with most of the increase due to rising sea level but some due to increasing wind speed. To put the same data the other way round, a peak of 2 m above current mean sea level is expected once a century at present, but more like once in 25 years by 2030. These calculations are for a relatively sheltered site; Inverloch and Sandy Point are both exposed to the ocean and somewhat higher wind effects may be expected. We add an extra 0.1 m for these effects plus additional assessment for flash floods.

Storms can also affect areas that are over 2 m above current mean sea level through flash flooding due to slow drainage of stormwater. It has been reported that, in Sandy Point, heavy rainfall can result in water flows down streets and drives with possible entry into houses. In all cases, the catchments are very small, not more than two or three properties. Much of the problem would be due to detailed on-property design, which failed to predict flash flows. Once the flows are identified, abatement action should be available at relatively low cost. It is doubtful whether storm flooding is sufficiently serious to be included in modelling for Sandy Point.

The case is quite the opposite for Inverloch, parts of which currently fail to meet the one-in-100-year town planning criterion for acceptable flash flooding. The creeks responsible do not drain large areas but their catchments extend back into the farmland behind the town. Over the past century, runoff from these areas has increased due to clearing. Flooding has been further exacerbated by the increase in paved area due to the extension of the town. There is no official estimate of the current frequency of flash flooding but we can assume that current investment by Bass Coast Shire will reduce the immediate danger of flash flooding in the Inverloch business district.

Consideration of storm threats to Sandy Point produced the conclusion that even 1/100 events are not likely to inflict serious damage on the settlement, at least within the time horizon of this project. In contrast, local discussion led to the conclusion that the settlement is vulnerable to fire: not fire of Black Saturday intensity, but serious fire

nevertheless, capable of destroying houses if there is inadequate preparation and there are not enough people around to man the defences.

Although the climate change scenario concentrates on events at Inverloch and Sandy Point, the effect of these events depends on what happens elsewhere. If storms hit Inverloch and Sandy Point, it is a fair bet that they will also hit the coast east and west, and probably in Tasmania as well. Similarly, the negative effects of storms, which reduce the attractions of life on the coast, will probably be matched by the negative effects of bushfires, which reduce the attractions of life inland.

We now turn to the features of each settlement, which will determine both their vulnerabilities and priorities for adaptation. These priorities are considered with the aim of reducing vulnerability to the extreme events considered reasonably likely by 2030. These responses are not necessarily sufficient responses to the extreme events likely by 2050 or beyond and assume that the basic locations of both Inverloch and Sandy Point remain viable to at least mid-century.

For Inverloch, we consider the effect of sea level rise by 2030 coupled with a storm event considered to be currently of 1/100 year frequency, save that the same event is likely to be 1/25 years by 2030. In the abatement case specified, preparations are made and property damage is reduced compared with the complacency case, in which preparations are not made.

It is not considered that Sandy Point will be seriously affected even if a 1/100-year storm event occurs in the next three decades. However, the settlement is vulnerable to fire: not as seriously as settlements in the forests north-east of Melbourne, where 1/100 year events can cause total destruction, but enough for substantial damage to occur if an effort is not made to improve fire readiness. Once again, 1/100-year events are likely to become more frequent as the climate changes. In the abatement case specified, preparations are made and property damage is considerably reduced compared to the complacency case.

The scenarios are assessed using the NIEIR regional model, which nests Inverloch and Sandy Point within their respective shires, in turn nesting Bass Coast and South Gippsland shires within Victoria, and, in turn, recognising that Victoria is part of Australia. The modelling philosophy is described elsewhere, but broadly includes the following elements:

- the modelling is dynamic and all variables are subject to change through time;
- modelling is anchored in the Australian Bureau of Statistics National Accounts, but many other data sources are used;
- inter-industry relationships are modelled via input–output tables;
- interregional trade and financial flows are observed and modelled.
- capital accumulation is modelled by industry and place; and
- economic behaviour both generates and responds to prices under conditions of imperfect competition, with the degree of departure from perfect competition depending on observations of behaviour in each industry.

8.2 Inverloch

Inverloch lies on a low hill overlooking Bass Strait. The hill is formed from sedimentary rocks, including sandstone, mudstone and coal. The coal deposits are non-commercial, although a mine at Kirrak, approximately 6-km west, lasted into the 1950s. However, the presence of coal is thought to indicate prospectivity for coal seam gas or perhaps

for shale gas. Exploration licences have been granted, although the grants have roused considerable local opposition, especially among farmers in Bass Coast: less so in Inverloch itself. The farmers and environmentalists have made a case that exploration for coal seam methane, and even more production of the gas, will negatively affect farming and the environment. In contrast, exploration and production can be expected to generate employment in the construction sector, which may partly, and with a time lag, compensate for the loss of construction jobs with the completion of the Wonthaggi desalination plant. This loss is currently affecting the demand for year-round house tenancies in Inverloch.

8.2.1 Vulnerability of the foreshore to storms

The foreshore near the Inverloch shopping centre features a pair of bowling greens, which are defended from coastal erosion by a rock sea wall flanked by boat launching ramps. To the east of this wall the coastline is 'soft', meaning that it comprises a beach backed by a low dune. In common with other 'soft' coastlines, this beach could recede should it come under storm attack; however, it is directly exposed to Bass Strait only when the wind is from the south-west, which happens to be the most frequent direction for gale-force winds. The extent of its shelter is also falling due to erosion of Point Smythe: there has been significant removal of sand from this point over the past decade.

East of Screw Creek the shore line is more sheltered and becomes the northern shore of Anderson Inlet, part of which is infested with spartina but much of which is bordered by mangroves. Pastures along the shore are protected by a low bund. To the west of the boat ramps the foreshore comprises a beach backed by low cliffs. West of Munroe Street, this foreshore faces south; east of Munroe Street it faces south-east and is, accordingly, somewhat less exposed. The average width of this beach has recently been reduced by erosion, but it is not known whether the sand has been shifted away from the area or merely recycled to shallow water offshore. As a result of the prevailing winds, there is mild west to east longshore drift. The sand appears to be of onshore origin, but it is not known how much is from the immediately adjacent cliffs and how much has drifted in.

The bedrock is sedimentary and is in layers of various hardness, such that when undercut by the sea the hill forms cliffs, none of which are particularly high because the hill itself is of modest height. The cliff face is currently protected by the beach, but in severe storms this protection may disappear and the cliffs once again be undercut by waves. Increased storm severity may, therefore, increase the rate at which the cliffs recede. Cliff recession will first eat into the foreshore reserve, then the roadway of Surf Parade, then the properties on the inland side of Surf Parade. It seems to be most likely that by 2030 the foreshore reserve will be diminished a little and access to such pockets of beach as remain may be disrupted, but Surf Parade and properties will not be threatened until later in the century. Therefore, the major threatened loss to property arises from inundation of low-lying properties due to a major storm combined with rising sea level. This is likely to combine with flash flooding of some properties at higher levels (see below).

It is arguable, but not proved, that beach erosion has already been accelerated by climate change: erosion has taken place at many points along the Victorian coast over the past 5 years, but the storms that caused this could with reasonable probability have taken place under a constant climate. This said, beach erosion is certainly associated with storm severity. A severe storm, as defined for the scenario, can be expected to have the following consequences for the immediate foreshore:

- The ocean beach will lose its continuous sand, although there will still be pocket beaches.
- The town beach will, likewise, lose much of its sand, being replaced west of the boat ramps by rocks.
- The cliffs facing the ocean beach and the west portion of the town beach will recede; not so far as to threaten housing or Surf Parade, but reducing the width of the recreational reserve. There may also be loss of facilities in the reserve and of beach access.
- The view from the top of the cliffs will change, with further retreat of Point Smythe reducing the value of Inverloch's location on an inlet as compared with other resorts, which only have ocean beaches.
- East of the boat ramps, the beach may become narrower and the low dune may attempt to migrate inland. Once again, reserve facilities may be lost, but it is not expected that the Esplanade will be affected.
- Point Smythe will continue to retreat, reducing the shelter available at the boat ramps and, possibly, hindering boat launch and retrieval during periods of rough seas.
- The pattern of deep water and sandbanks in Anderson Inlet will change, but, so long as there is sufficient depth for recreational boating, this should not be seriously affected. However, fish stocks may be affected by reduction in mangroves around the shore of the inlet.

For a location which depends for its sense of identity on its beaches these are serious threats. However, it should be remembered that the fundamental qualities will remain: there will still be views generated by the turn of the coast into Anderson Inlet and neither the ocean beach nor the better-protected town beach is likely to disappear completely. These threats should also be seen in relation to those operating elsewhere on the Victorian coast. The following adaptation actions may be suggested:

- Dump hard rocks at the base of the cliffs, as has already been done to some extent. This is presumably effective in preventing cliff recession but tends to be at the expense of the beach. A judgement is required as to whether loss of the beach is more or less serious than cliff recession. In the present exercise, we assume that there is no resort to this measure, but that there may be as the 21st Century proceeds.
- Groynes to hinder longshore loss of sand. A beach so retained does not look as good as one that has a natural curve of sand, but works if sand is being removed by longshore drift.
- Pump sand to replenish the beach. This has already been tried in parts of Port Philip Bay, with varied results. Between 1975 and 1987 the Port Philip Beach Renourishment Program renourished 19.3 km of Melbourne's beaches at a cost of $12,176,896 (indexed to $A2005 using the consumer price index). This equates to $630,900/km of sand. As of 2012, a further $9.54m has been dedicated to again renourish these beaches around Port Philip Bay. These works will include rock groynes. Renourishment only works if nearby supplies of sand can be found for pumping; more generally, the loss of sand has been due to removal to the near inshore rather than by longshore drift, in which case groynes are more appropriate. The beach front at Inverloch is approximately 5 km long and different parts are likely to respond to different treatments. Let us assume that, one way or the other, an expenditure of $3m on beach maintenance would prove effective.
- Allow space for the coast to recede. Thus, Crown land should not be alienated in areas where there is erosion risk to development, and, indeed, this not a risk in Inverloch. It is harder to allow space for the coast to recede when the land in

question is private property. If land is made available for coastal recession, it can no longer be available for private use. A case can be made that this should be the owner's loss, and that owners concerned about this loss should insure (if they can). However, when land is made part of a coastal reserve in anticipation of coastal recession, the owners are sure to demand that it be bought back. There are already precedents for such buybacks, raising the question of values. When land is expected to disappear due to coastal recession there is an argument that its value should be low, but owners are likely to argue that, due to the strong demand for seaside land, its value is high. In view of the limited recession of the cliffs expected over the next couple of decades, we will assume that it will not be necessary to purchase any cliff-top properties to make room for coastal recession and that the only works undertaken to defend the coastline will be beach conservation measures.

- The same may not be quite so true of properties along the Esplanade, where the council caravan park situated between the beach and the Esplanade may come under threat during a major storm. If this happens it is likely that owners of properties on the inland side of the Esplanade will campaign for sea-wall protection, even if this results in disappearance of the beach (as it already has at the launching ramps). This may create a conundrum for abatement policy: Is the beach worth more than the strip of properties? Perhaps the best way out is to assume that an expenditure of $1m on sea-wall creation, in addition to the above expenditure on beach maintenance, both protects the properties and the caravan park and maintains the beach; absence of this expenditure removes the caravan park and renders both the beach and the properties vulnerable during the big storm.

Taking these measures into account, we would seek to define two cases:

- Abatement case: investment totalling $4m over 10 years (as detailed above) is undertaken, which preserves the ambience and recreational amenity of the foreshore, even if not its precise configuration. The result would be that the foreshore survives a great storm with amenity intact and, perhaps, improved vis-à-vis alternative Victorian resorts. Costs will be incurred: $4m over the next (say) 10 years. Partial benefit will be received if the event occurs during the construction period, and complete benefit if it occurs after completion. Benefits can be modelled by keeping the tourism and retirement economic base at trend levels.
- Complacency case: No costs incurred but a dip in tourism and retirement if the event occurs.

8.2.2 Effects of high winds

In the course of a severe storm it is possible that some of the more exposed houses on the seaward edge of the town will be unroofed. The major abatement responsibility here lies with property owners, who can invest in weather-proofing their properties. An important influence here is the terms and availability of insurance. Insurers can provide strong incentives for weatherproofing and, in conjunction with the finance sector, also help to finance it, although complete coverage is unlikely due to complacency by owners and, in some cases, lack of resources. It may be possible for local government to require weatherproofing as a condition of sale and, certainly, as a condition of construction. We do not know: (i) the proportion of vulnerable dwellings already weatherproof; and (ii) the proportion that would be weatherproofed in the case of abatement action by insurers and others. Hence:

- Abatement case: significant take-up of weatherproofing followed by no more than minor damage should a big storm occur after the weatherproofing is complete. Let us estimate that average expenditure of $50,000 for each of approximately 250 properties facing the sea, plus $25,000 each for a further 2,000 properties with second-line exposure, adding up to $62.5m over (say) 10 years, all privately financed, will result in the storm being weathered with no more than incidental damage.
- Complacency case: no more than trend take-up, no additional costs, followed by significant damage during the big storm. Damage costs will include damage to property (up to complete write-off) and also the public cost of emergency assistance. Let us estimate that 10% of sea-front houses have to be demolished after the storm, a total of 25 houses. These are likely to be less sturdy than the buildings that survive, although the quirks of windstorms can result in badly-built buildings surviving while their better-built neighbours succumb. Let us assume an average written-down value for these houses of $125,000 each giving a total loss of $3.125m. Replacement cost can be estimated as $300,000 each, or $7.5m. In addition, let us assume that 40% of the sea-front houses and 20% of the second-line houses require repairs costing, on average, $50,000 each. This equates to 500 houses or $25m. Because these houses are uninhabitable pending repairs, there is also the opportunity cost of the period for which they are uninhabitable, which, given the limits to construction capacity with which to address the rebuilding program could be anything up to 2 years, say, an average delay of 9 months. The homes affected are likely to be in superior locations and a conservative estimate of their rental value would be $400 per week. This cost multiplies out to $7.8m. (If it is extended to houses which require complete replacement, the cost rises to $8.2m.) In further addition, we may assume relatively minor damage to the remaining 1,725 exposed properties, say, an average of $25,000 each, or $43m. (In actual fact expenditure would probably be greater than this as owners hasten to weatherproof their properties. If weatherproofing in the abatement case averaged $25,000 per property, weatherproofing in arrears combined with damage rectification would cost somewhat more, say $40,000 per property.)

A severe storm is also likely to disrupt electricity supply due to fallen wires. Supply could also be disrupted due to damage to the bulk transmission system inland, although, at present, this system appears to be reasonably robust. Damage to the local distribution system can be avoided by undergrounding wires, although it may be debated whether this expense is justified as an abatement measure (as distinct from a more general amenity measure). Damage to bulk transmission can be reduced by increasing the specification of the lines, which is very expensive in arrears. No estimate has been made for these costs.

8.2.3 Inundation

Inverloch is currently drained by three creeks, none of which has an extensive catchment. Increased runoff due to paved areas and increased rainfall intensity has not been matched by increased capacity in the creeks and underground drainage system. As remarked above, there is already a fairly high probability of flooding in the commercial centre of the town and in some other locations near the creeks. This could increase with climate change owing both to the increased probability of intense-rainfall events and due to the rise in sea level and onshore surges, which will hinder drainage.
When erosion affects properties the question arises as to whether the owner should bear all losses, or whether they should be shared by the public at large. There have

been precedents for public buy-back of exposed properties but the preferable policy is not to approve them in the first place. Fortunately, most of the shoreline properties in Inverloch are not expected to be threatened by cliff recession until late in the 21st century.

Under a (currently) 1-in-10-year storm event, a combined storm surge/flash flood/sea level rise of 1.85 m will affect much of Inverloch's beach east of the boat ramp. A 1-in-10-year storm event results in inundation of much of the town beach to the east of the boat ramp and there is encroachment of ocean water up the protective rock wall near the bowls club as well. The dunes and sandbanks in Anderson's Inlet are almost lost in their entirety, whilst Screw Creek fills out westward towards the outer properties of Inverloch. At a storm surge of 1.85 m, parklands in front of the main esplanade are inundated as well. However, it is apparent that a surge of 1.85 m does not pose a great threat to properties in Inverloch.

A 1-in-100 year storm event is expected to cause the sea to surge 2.35 m in Inverloch. At this level, inundation becomes a significant concern for the township, with numerous properties and roads compromised by rising water levels. East of the boat ramp, almost the entirety of the beach is lost to inundation and water begins to encroach onto the main road and into the central town. During a one-in-100-year storm surge, it is estimated that 75 properties will be affected by inundation. In addition to this, the resort under construction west of Screw Creek is at risk of being entirely inundated.

Abatement measures include:

- Investment in increasing drainage capacity. The 2012 Bass Coast Shire budget includes provision for expenditure of $120,000 to improve drainage along A'Beckett Street through the centre of the town.
- Town planning measures to prevent construction on potentially inundated areas. Current residents, as distinct from the owners of the affected land, would favour these measures, since they would restrict the length of foreshore available for development and so help to limit the size of the town and maintain the urban/rural distinction. However, the current owners of the land are likely to object to the loss of development rights, which are valuable because short-sighted individuals are frequently willing to pay big money for housing with beach access even when it is vulnerable to inundation.
- Short of measure 2, or in marginal areas, town planning could mandate the achievement of minimum floor levels through the use of stumps, piles or fill. This would be coupled with caveats on the title warning of potential for flood. Developers seeking to offload flood-prone land could be discouraged by a requirement to insure the improvements they construct on the land against inundation damage for a period after sale, maybe up to a decade.
- Areas at risk of inundation might still be developed as parks or recreation areas, or even as caravan parks where the structures can be removed at short notice, such as when a storm is impending. Onsite transportable homes that cannot be removed at short notice do not meet this criterion, even though they are currently an increasing proportion of caravan park structures. The same would apply to the transportable amenities block recently installed: there is no guarantee that it can be removed quickly when a storm threatens. However, the switches installed on the submersible sewage pumps meet the criterion.
- Insurers could complement (or conceivably replace) this list of town planning measures with equivalent refusals to insure, conditions placed on insurance and complementary insurance price differentials.

This discussion concentrates on Inverloch as vulnerable to an event such as a storm, which, in the most severe case, would not only feature high onshore winds but occur at high tide and, hence, be accompanied by a storm surge, inundating areas normally considered secure. As regards inundation, the following cases can be put forward.

- Abatement case: (1) The Council invests in drains which reduce the number of properties inundated in both the one-in-100-year and the one-in-10-year cases. The shire is already working in this area, but available funds limit the extent of works. We could assume that additional works of (say) $1m over the next 10 years would be required to guarantee all buildings against flash flooding up to one-in-100-year standards. (2) The Council also invests in levee banks and pumps to protect existing properties liable to a one-in-100-year flood. This investment would be in addition to the sea wall required to protect against direct storm damage. A cost of $1m is estimated. (3) Building construction is prevented in the most vulnerable areas and subject to minimum floor height in the moderately vulnerable areas; the latter increases costs by (say) 25%. Constrictions on the urban area push development inland, where it falters due to distance from natural attractions. The constraints on housing supply may have further effects, such as increases in the price of existing dwellings and a higher level of redevelopment, possibly at rising density. Let us assume that these measures are sufficient to ward off inundation and flash flooding in the one-in-100-year case.

- Complacency case: development proceeds by trend till inundation and flash flooding occurs. This will be in addition to the storm damage considered above. (1) Let us say that 90 existing dwellings are temporarily inundated, 15 of them by flash floods and the rest by the storm surge. Damage to floor coverings and furniture may be costed at around $20,000 per dwelling, a total of $1.8m. These dwellings are lower in value than those exposed to storms and high winds and an average rental value of $300 a week would be appropriate. If repairs take 6 months, the loss of rental value will be around $0.6m. (2) In addition, it may be assumed that a further 15 commercial properties are temporarily inundated by flash floods. At rectification costs of $40,000 each, this would come to $0.6m, with loss of business for an average 2-month closure at $9,000 per property $0.14m. (3) In addition, it may be assumed that around 100 dwellings are newly built in areas liable to inundation. These will be standard dwellings, not dwellings elevated above flood level. Some of these are likely to be low-value transportable dwellings with an installed cost of around $100,000; others are likely to be substantial constructions in brick on concrete slabs. Let us assume that 25 dwellings are written off at $100,000 each and the other 75 are refurbished at the same cost as above. This totals $2.5m for the write-offs and $1.5m for the refurbishments, plus loss of rental value of $0.6m.

Note that in both scenarios and in both cases inundation will arise from a combination of sea level rise, storms and flash floods. It may be desirable to distinguish properties affected by flash flooding (fresh water, briefly) and those inundated by storm and sea-level rise (salt water, maybe lying around a little longer).

Inverloch has piped water supply and is sewered. The sewage system may be compromised in a major storm event, but no allowance is made for this. Inverloch is not considered seriously vulnerable to drought: its urban water supplies are secured by the desalination plant. Similarly, hot weather is normally considered to increase the attractions of the seaside as compared with the hills. As Victorian towns go, it is reasonably protected against wildfire: from the north and north-west, fire would have to approach over paddocks and an approach through bushland, with its greater flammable load, is only possible from the north-east. Grass fires are a strong possibility after good seasons but are not likely to be so intense that they leap the Bass Highway and firebreaks burned before the fire season begins. It is for these reasons that the worst case scenario concentrates on storm vulnerability.

8.3 Sandy Point

The beach at Sandy Point fronts Waratah Bay, part of Bass Strait. The beach trends south-east/north-west. To the west it curves round to Cape Liptrap, while to the south, across Shallow Inlet, it curves to Wilson's Promontory. The granite hills of the promontory are clearly visible from the beach.

8.3.1 Vulnerability to onshore storms

The beach is wide and appears to have an abundant supply of sand, although it is reported to have waxed and waned over the years. On average, it would benefit from longshore drift: presumably the whole sand bar which connects the Wilsons Promontory hills to South Gippsland is from this source, Sandy Point being part of the bar. Deposition is also aided by the relative shelter from westerly winds provided by Cape Liptrap.

The beach is backed by a substantial sand dune, which is currently fixed by vegetation and is a public reserve. The township of Sandy Point is built on a dunefield behind the front dune and does not extend onto the adjacent low-lying flat. This flat, which separates the township from Shallow Inlet, is defended from storm surges by an earthen bund or sea wall and is used mainly for dairy production. The paddocks become waterlogged in wet seasons but are valuable during dry seasons: this value can only increase as climate change increases the frequency of dry seasons.

In view of its semi-sheltered location on Waratah Bay, its abundant supply of sand and its well-vegetated dunes, the foreshore at Sandy Point would seem to be in a good position to survive storms, although the threat would increase if the vegetation was damaged by bushfire or pests. Similarly, the settlement is sheltered from wind damage and rainfall damage is unlikely to go beyond the consequences of inadequate gutters and drains. Appropriate abatement action would be private investment in weather-proofing buildings, as at Inverloch.

However, storm erosion is possible and, by 2030, could eat into the present foreshore reserve. The surf lifesaving club might be vulnerable, since it is located between the beach-side berm and the dune proper, and the berm has disappeared in the past. Damage here would certainly generate a sense of vulnerability in the community and make insurers think twice about insuring properties on the dunes. The most likely response to vulnerability here would be a sea wall, which would be quite expensive in view of the distance that material would have to be carted.

A storm surge could overtop the bunds and damage the paddocks on the shores of Shallow Inlet with salt water. However, this is not considered likely until later in the

century. More likely, intensive rainfall events could flood the paddocks with fresh water, keeping them out of production for a season and severing Waratah Road.

Abatement measures to guard against storm damage include the following:

- prevention of any extension of the settlement onto the flats. (It should be noted that current residents are strongly in favour of this, not as an abatement action but because they want to limit the size of the settlement.); and
- raising the most vulnerable section of Waratah Road (approximately 1 km) above flood level, or, alternatively, rerouting Waratah road along the foot of the dunes (approximately 4 km).

The difference between the two cases would appear to be as follows:

- private expenditure on weather-proofing, as at Inverloch;
- prevention of extension of settlement (the locals are adamant that extension is not going to happen anyway, but we could include a few marginal lots treated the same way as in Inverloch); and
- in the abatement case, allow for whatever expenditure is necessary to storm-proof Waratah Road, and in the complacent case, allow for Sandy Point to be semi-isolated for a few months while the road is rebuilt at greater expense than would have been incurred had the work been done in advance. (Note that complete isolation is unlikely: even if the road remains covered, high-floor vehicles such as trucks are likely to get through, provided the culverts have not been scoured out.)

The difference between the two cases is not large and it was accordingly decided to model a different adverse event in Sandy Point: drought followed by bad fire weather.

8.3.2 Fire

For water supply, Sandy Point depends on rainwater tanks supplemented by pumping of ground water. The latter is threatened by contaminants and could also become saline, particularly during a dry spell (remembering that such spells are likely to increase in frequency and severity under climate change). In the event of drought it may be necessary to cart water, perhaps from Inverloch as the nearest point with supply piped from the desalination plant.

Sewage is by septic tanks, with approximately 20% of properties having secondary on-property treatment in the form of package sewage plants. Presumably in the event of drought, sufficient water will be carted to keep the tanks going, but it could be necessary to revert to long drops. A rising water table with sea level rise may also interfere with the septic tank systems. More seriously, the lack of piped water in Sandy Point limits water available for fire fighting, although there would be the opportunity to bore water. In time of drought, fire is a distinct possibility.

The entire township of Sandy Point is considered a high-risk fire environment, primarily due to narrow dead-end streets and elevated fuel hazards. A fire that could threaten the town has two likely trigger points, either within the township or spreading from adjacent grassland vegetation; that is, the Coastal Dune Shrub/Coastal Dune Grassland Mosaic. This surrounding vegetation is less than 20 m from dwellings, on a reasonably flat slope. Under very high fire danger conditions it is likely that a fire will be able to reach the town from the surrounding grasslands, most probably from the north. These high fire danger days typically see northerly and north-westerly winds, with a south-westerly change in the afternoon. The vegetation surrounding Sandy Point is restricted to 1–2 km, and is surrounded by pasture. As pasture is unlikely to carry a

threatening fire (particularly if firebreaks are installed) it can be assumed that any bushfire to threaten Sandy Point will originate in close proximity to (or within) the town.

There is concern about the vulnerability of Sandy Point to damage from even a moderately controllable blaze. Sandy Point itself has no major wildfire history, although half a dozen minor ignitions have taken place in recent years. The main concern for the settlement is the lack of both access and escape routes in the event of a fire. There are many dead-end streets and only one main route in and out of town (Waratah Road and Sandy Point Road). Being a holiday destination, many properties may not be well prepared, leaving residents unable to defend their property even if they are present to do so. The resort nature of the town means that a large proportion of properties may be unattended, whilst people present may be unfamiliar with the local area (being a holiday destination).

The future climate of Sandy Point and its surrounding areas is expected to become hotter and drier than it is today, with average annual temperatures projected to be approximately 0.8°C warmer by 2030. Annual rainfall for the region is expected to reduce by around 4%, with increases in evaporation and reductions in humidity also contributing to increased dryness. Growing heat stress will contribute to the increased availability of fuel.

For a fire to spread through the Coastal Dune Shrub/Coastal Dune Grassland Mosaic that surrounds Sandy Point, wind conditions are a critical factor. Typically, wind needs to be greater than 30 km/hour for a fire to take and spread through these types of vegetation. Extended dry periods are needed to dry out the fuel: a drought factor greater than eight, or 3 to 4 weeks without rainfall. Exceeding these thresholds creates the potential for a possibly uncontrollable fire in Sandy Point, where flames may move quickly and exceed the height of rooftops. Less severe weather conditions than these constitute a moderately controllable bushfire scenario for Sandy Point. More severe conditions may render the fire difficult to control or uncontrollable.

A moderately controllable bushfire, as defined for the scenario, can be expected to have the following characteristics: the fire may be difficult to control; flames may burn into the treetops; embers might blow ahead of the fire; and spot fires may occur up to 2 km ahead of the fire.

The following are potential consequences of a moderately controllable fire affecting Sandy Point:

- A fire originating in the grassland to the north of Sandy Point destroys large amounts of local native animal species. Animals can be vulnerable due to shortages of food or predation by other species.
- The grass fire leads to an increase in weed invasion, with possible increases in the pressure to survive for native plants, although exotic plants tend to be more susceptible to fire than native plants.
- The removal of vegetation during the grass fire exposes soil to water and wind, increasing susceptibility to erosion. This erosion could potentially cause soil, ash and nutrients to be transported into streams and groundwater, increasing the sediment load. This could threaten the water supply of the town with contamination (for those with bores).
- The fire is able to reach Sandy Point (or begins in Sandy Point). It is able to spread, damaging houses, property and businesses (especially those unprepared for fire, or those without owners present to defend the property).
- Loss of life is considered unlikely for this particular bushfire risk.

The following adaptations may be suggested for Sandy Point:

- The Country Fire Authority (CFA) and the shire could maximise the resistance of the community to fire threats through increased community engagement and awareness about fire safety by hosting events and information packets (e.g. pamphlet distribution). Increased information about fire danger could also see a reduction in accidental ignitions. This can be complemented with plans to assist vulnerable individuals in the community (e.g. the elderly and the sick).
- These events can be coupled with further planning for bushfire safety, both privately and community wide. Individuals can develop household bushfire survival plans, using a CFA Fire Ready Kit. Updating and implementing the Township Protection Plan for Sandy Point, in conjunction with local council updating the Shire Emergency Management Plan and Bushfire Prevention Plan can both help minimise the spread and impact on assets of a potential fire. Planning and building regulations can also be amended.
- Reducing threats to life and property by reducing available fuel to feed the fire. Individuals can prepare their own homes by removing excess overhanging vegetation, and retrofit their houses to increase resistance to heat and ember attack.
- Maintain roadside slashing along Waratah Road and Sandy Point Road, enabling for both a firebreak and safer access to Sandy Point during a bushfire.
- Build an alternate exit/access road along the foreshore. Constructing 4WD access tracks along the Waratah Bay–Shallow Inlet Coastal Reserves would enable greater access for emergency responders, reducing both the spread of fire and the loss of assets.
- Ensure an adequate water supply is available. Individuals can take steps to equip their house with further rainwater tanks, or fit solar-powered pumps on their bores to increase efficiency. Large community rainwater tanks can be installed in key locations.
- Improved emergency communications (preparation). The roll out of the National Broadband Network, combined with improved bandwidth for emergency services and improved mobile phone network coverage, would enable greater communications coordination to fight a potential fire threat to Sandy Point.
- Improved emergency communications (operation). The Bureau of Meteorology should ensure that all fire weather warnings are immediately communicated to other organisations. Timely and accurate fire warnings are vital (e.g. information on CFA and Department of Sustainability and Environment websites and designated emergency services broadcast stations) to save lives and property.
- Improved and effective fire response. This entails a wide range of actions. Individuals must ensure they enact their Bushfire Survival Plan, and decide to leave early or stay and defend (only on an appropriately prepared property). Local organisations maintaining Regional Emergency Co-ordination centres can assist in the coordination of the fire-fighting effort. Health services and hospitals need to ensure a surplus of medical supplies to treat burns and smoke inhalation. State and local government bodies should cooperate with the CFA to fight fires on both Crown and private land.

Taking these measures into account, we would seek to define the following two cases.

8.4 Abatement case

Actions are taken to combat the vulnerability of Sandy Point to a bushfire hazard, either from within the town or from the grass to the north. These adaptations include measures to increase community awareness of fire threats in Sandy Point. Community

members take steps to prepare their houses against fire, cleaning up overhanging vegetation and retrofitting radiant heat and ember defences. The Township Protection Plan, the Shire Emergency Management Plan and the Bushfire Prevention plan are all updated to minimise both the chance for and damage from a fire. Local council takes steps to cut back on the amount of available fuel, slashing fuel breaks along Waratah and Sandy Point Road. All of these are low-budget items, say $25,000 per annum indefinitely. Access to Sandy Point is improved with the addition of an alternate access/exit route along Waratah Bay–Shallow Inlet Coastal Reserves. Approximately 10 km of road will be required, not particularly costly since earthworks and bridges will be minimal, at, perhaps $100,000 per km, totalling $1m in 10 years' time. Additional rainwater tanks and solar-powered pumps are fitted on bores to increase access to water to fight fire. Allow a budget of $2,000 per lot; there are around 600 dwellings so this multiplies to $1.2m over 10 years. Emergency communications are improved, both in connectivity and information services. Responses to a fire threat are improved and individuals put to use their Bushfire Survival Plan. National/state/local governments collaborate to extinguish fires on both Crown and private land. The council invests in some/all of the above adaptations to improve the ability of Sandy Point to prevent, respond to and defend a bushfire. The benefit is that the settlement survives a 1-in-100-year drought event without damage by fire.

8.5 Complacency case

Development continues with minimal adaptation to improve the preparedness of Sandy Point for a bushfire. Either a (likely) lightning strike causes a grass fire north of the town, or a fire originates from within the town. The fire destroys native species, and exposes the soil to water and wind. It damages those buildings not already prepared for fire. Damage costs are likely to be all-or-nothing; that is, buildings will either survive (perhaps singed) or will require demolition. Let us assume 100 buildings are demolished at $150,000, each requiring repainting at $2,000 each, a total cost of $15.2m.

8.6 Balancing costs and benefits

We have now identified two extreme events, currently estimated as having probabilities of occurrence of once in 100 years: a storm event for Inverloch and a fire event for Sandy Point. We have also placed dollar values on investments aimed at reducing the impact of extreme events and have estimated the costs which these investments are expected to save should the event take place. No claim is made for the accuracy of the estimates, although it is hoped that they are of the right order of magnitude. This is but a preliminary study and no investment should be committed without greatly improving the accuracy of the business case.

Subject to this warning about accuracy, it is now possible to balance expected investment costs against expected cost savings: more conventionally, costs against benefits. We will first do so using fairly conventional cost–benefit analysis and then broaden the scope in two ways: first, by taking a more sophisticated approach to the probability of event occurrence and, second, by placing Inverloch and Sandy Point in their geographic context.

The two sets of analysis have the following simplifying assumptions in common:

- The investments to be made in each location are simplified into a single program, undertaken over the 10 years from 2015 to 2024, with equal real expenditure in each year. No attempt is made to assess project

components, although casual inspection of the above estimates shows that some parts of the program promise higher returns than others.

- If an extreme event occurs while the investment program is under construction, benefit is calculated pro-rata.
- No account is taken of benefits accruing after 2030 as a result of investments made before 2030. This assumption was adopted as part of the terms of reference of the study and reduces the rate of return to the investments.
- No value is placed on insurance benefits: the psychological return from the sense of security that arises when one's property is protected against damage.
- The effects of climate change were specified solely through the occurrence of extreme events currently estimated at a probable frequency of once in 100 years. No account was taken of events with greater or less severity. Therefore, no account was taken of benefits which the investment program might yield should less severe events affect the sites. In the same vein, more severe (and even less frequent) events were not considered.

Conventional cost–benefit analysis typically begins with an investment sequence (a run of costs) followed by benefits arising when the investment is completed. The balance is calculated year by year (although other time periods can be used) and discounted to net present value using an assumed discount rate. The present case fits within this paradigm, with the major difference that benefits are received only if an extreme event occurs. This can be dealt with in two ways:

- Via a series of cost–benefit cases. In the first case of the series an extreme event is assumed to occur in the first year in which benefits might accrue (2016), in the second case an event is assumed for 2017, and so on, with the last of the series featuring an event in 2030. To these analyses we add a case in which no extreme event occurs in the years 2016–2030, plus a sample of cases in which two or more such events occur. We calculate the net benefit or cost for each case and prepare a weighted average, using probability estimates as the weights. The result is an estimate of the mean return to investment, given the probabilities.
- A more sophisticated approach uses Monte Carlo methods to calculate a probability function for the timing of events.

The results depend on the estimates of costs and benefits, as discussed above. Given the values estimated for Inverloch, undiscounted costs and benefits are more or less balanced. In the case where investments are made but an extreme event fails to occur, the investment program of $70m fails to yield any benefits (partly due to the benefit cut-off at 2031). Where an extreme event occurs before completion of the investment program the net benefits are generally negative, but where an extreme event occurs after the investment program is substantially complete, the net benefits are positive. In the rare cases where more than one extreme event occurs, the investment of $70m is not only recovered but there can be net benefits of $100m or more. Averaging these cases according to probability produces the result that benefits more or less balance against costs on an undiscounted basis. We once again reiterate that this is merely a worked example with crudely-estimated costs and benefits and should not be taken as typical of abatement investments as a whole.

The convention in cost–benefit analysis is to discount future net benefits by an interest rate, thus reducing benefits to net present value. Two main justifications have been offered for this.

- In practical terms, investment funds are limited. Net present values are calculated in an effort to identify the most attractive investments or, alternatively, to identify investments which are attractive in that they are expected to yield returns above a hurdle rate (the discount rate). This justification assumes that all costs and benefits are correctly assessed.
- Discounting expresses a preference for meeting current demands rather than waiting for benefits to accrue in the future: a preference for benefits to the present generation rather than to future generations. Proponents of discounting have replied to the accusation that discounting panders to the selfishness of the present generation by arguing that economic growth will ensure that the desires of future generations are more than satisfied. This reply has been challenged by those who argue that it is the duty of each generation to leave the earth in as good a condition as they inherited it. It is also being challenged by those who predict that standards of living are likely to fall as a result of the selfishness of the present generation.

Because investments to reduce the impact of climate change respond to failure to provide an unblemished inheritance to the next generation, there are strong arguments for adopting the approach common in environmental work, which is to emphasise undiscounted costs and benefits. As reported above, using simple cost–benefit analysis, the net present value of the investment program is positive, if not overwhelmingly so. This is conservative. The positive value could only be increased by taking into account net benefits received after 2030 and by adding insurance benefits to those taken into account.

Although there are strong arguments for evaluating climate change adaptation investments on an undiscounted basis, it has to be admitted that funds for environmental amelioration are limited and that discounting may be appropriate in project selection. In the rest of this report net benefits are accordingly discounted at 5% a year. This has the effect of turning net benefits negative. It should be remembered that this reflects a value judgement in favour of the interests of the present generation. An alternative value judgement is to employ discounting to favour the interests of a future generation. Taking 2030 as one's point of view and discounting past costs and benefits, again at 5% a year, yields a net positive assessment. The reason for these divergent assessments is that the costs tend to precede the benefits. From a 2013 point of view, the costs loom large; from a 2030 point of view, the benefits are nearer and relatively larger. A decision not to invest in 2013 may be regarded as rational in that year but may be regretted in 2030.

These conclusions arise from the use of simple spreadsheet methodology. We now adopt a more sophisticated approach. The major differences are as follows:

- Inverloch and Sandy Point are incorporated into their respective local government areas (LGAs), Bass Coast and South Gippsland. The unit of analysis is, hence, enlarged to these two LGAs.
- Indirect effects are taken into account, including effects via commuting, trade and financial interconnections between the study LGAs and the outside world.
- The timing and number of extreme events is estimated by performing a series of Monte Carlo experiments controlled by the gradually increasing probability of occurrence of an extreme event. The main difference here is that better account is taken of the probability of multiple events occurring within the projection period.

8.7 Assessment using regional economic modelling

The next section considers analysis using the NIEIR regional model. The process is necessarily technical, involving the development of a series of cases, each of which is outlined below with its attendant assumptions.

For modelling purposes, Inverloch is embedded in Bass Coast Shire and Sandy Point in South Gippsland Shire. Dynamic input–output models of the two shires are used in the economic evaluation. Given the larger size of Inverloch, its case is covered first; the procedure for South Gippsland is similar and follows. The modelling framework is a standard dynamic input–output model for the economy of each shire. There are 49 industries in the model. There is a household income formation segment and consumer demand and investment formation equations, as outlined in the figures.

The model is used in conjunction with Monte Carlo simulation to calculate the probability density function outcome for key indicators, such as gross regional product and employment. The shocks to the model assess the impact of the risk of increased incidence of extreme weather event.

The model framework reflects the complexity of the evaluation task. The complexity starts with the fact that the occurrence of an extreme weather event in any given year has only a probability attached to it. It cannot be assumed that it will occur in a given year. All cases evaluated are in terms of comparison with a base case where the base case assumes no increase in extreme event probabilities compared to the 2011 probabilities. A number of cases are required to capture the complexity of the possible responses. The cases are used as stand-alone outcomes to show the impact compared to the base case in which there is no increase in extreme event probability. This also allows comparison between cases.

The basic comparison is between two scenarios: one without abatement investments and one in which abatement investments are made to reduce the costs incurred when an extreme weather event takes place. Abatement investments include the marginal cost of strengthening structures to withstand events and the marginal cost of forgoing construction in damage-prone locations in favour of less damage-prone locations.

Abatement investments may be made by households/business (chiefly strengthening and avoiding dangerous locations). Abatement investments by the public sector include strengthening of public buildings, increasing capacity of drains and defensive investments like sea walls. There is also public–private interaction, as when the shire prevents private construction in damage-prone locations. In the abatement scenario, real investment costs are incurred with a return in reduced event costs, should the event occur. In the no-abatement scenario, the upfront costs are not incurred but event costs are higher. Although this involves probabilities, the underlying cost analysis below is straightforward enough and similar to the spreadsheet analysis reported above. It is likely that abatement investment will pay, up to a point, but not beyond that point, as is generally the case with investments.

Costs may be borne by households, businesses, the shires and the country as a whole. The more that costs are borne by households/businesses, the greater the likelihood of permanent loss through non-replacement of assets. Real costs cannot be shifted through time. However, within limits, cost incidence may be shifted through financing mechanisms. Abatement investment costs can be shifted both geographically and over time through private finance (loans to finance marginal cost), and public sector budgets and loans. Recovery costs can also be shifted through insurance (with upfront implications), using the private budgets of geographically diverse businesses (e.g.

rebuilding a bank branch) and through public budgets, including Commonwealth grants for disaster relief. Hence, three cases are developed for each shire. One case is an abatement case while there are two non-abatement (or complacency) cases. The two non-abatement cases capture the two polar cost incidence responses. In the first case, the costs of the extreme weather event are incurred when the event occurs, as happens when households do not have insurance. In the second case costs are shifted through time (and perhaps across geography) via insurance, as happens when households have insurance.

8.8 Extreme event probability functions

The key assumption is that, by 2030, the probability of the historical one-in-100-year event increases to once in 25 years. Thus, for the years 2013 to 2030, the annual probability of a historical one-in-100-year event, hereinafter referred to as an extreme event, increases from 1.3% in 2011 to 4% by 2030. The base case is where the risk stays at 1.3% to 2030.

What this means in terms of the occurrence of extreme events is outlined in Figure 8.1. Figure 8.1 is an overlay of two probability distributions: the probability density function showing the probability of the number of extreme events between 2013 and 2030; and the upward cumulative probability function of extreme event occurrence. These two distributions are shown in Figures 8.1a and 8.1b. The probability of no extreme events occurring in the period to 2030 is 54%. This means that the probability of at least one extreme event occurring is 46%. The probability of two or more events is 2.8%. The probability of three or more events is 0.4%, while the probability of four or more events is 0.25%.

These estimated probabilities are likely to increase over the next decade as the consequences of climate change become better understood. In this context, a good planning rule of thumb will be to assume that at least one extreme event will occur in Inverloch by 2030.

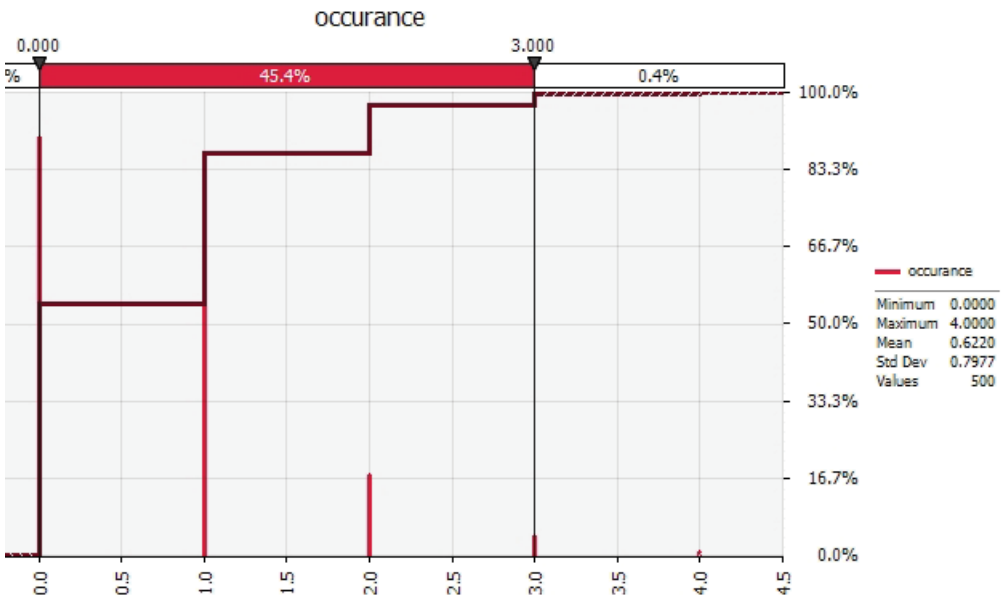


Figure 8.1: Occurrence of extreme events to 2030 in Inverloch and Sandy Point

Figure 8.1a: Cumulative probability of the number of extreme events

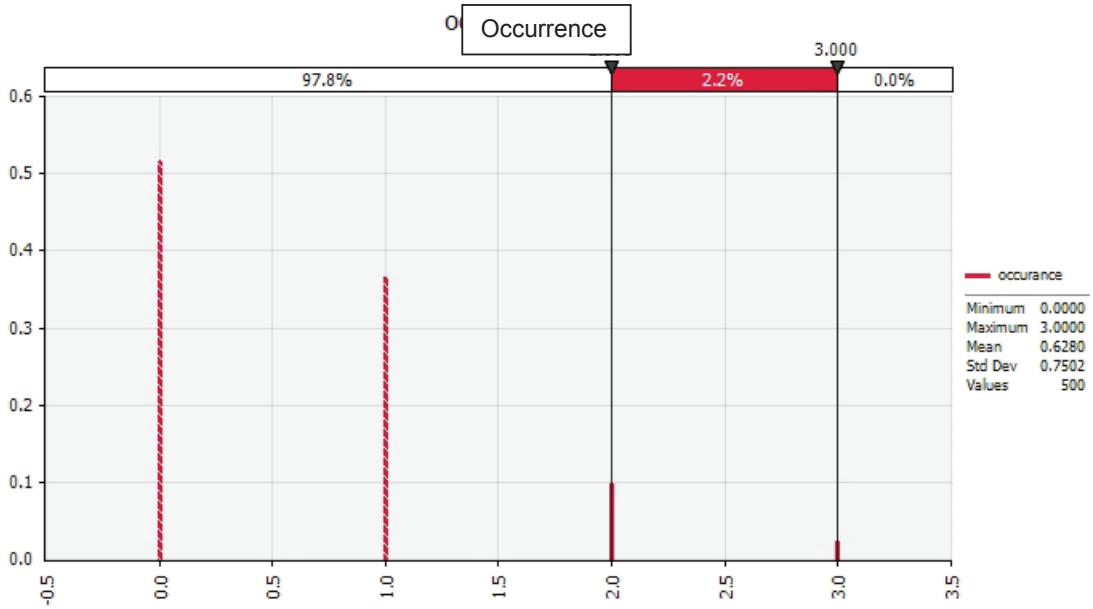


Figure 8.1b: Probability of occurrence of extreme events

The graphical presentation in Figures 8.1a and 8.1b is standard for all model results. It combines probability density functions and cumulative probability functions. The cumulative probability functions show the probability that a value will take a value less than or greater than a specific value.

8.9 How to interpret the figures

To obtain the maximum information out of the analysis, the figures need to be understood. Although time is of the essence in this study, time is not represented in the figures; all monetary values are discounted to present value using a 5% discount rate, and all probabilities refer to the probability of occurrence during the study period. In Figure 8.1, the left-side axis means the proportion out of all possible experiments at the value on the *y*-axis. The figure reflects 500 simulations, a number chosen to adequately chart the probability distribution. For a simulation for 2013–2030, 54.2%, or 0.542 on the right-hand axis (also given in the bar at the top of the figure), have a value of zero, indicating that there are no extreme weather events (as was the case in 271 out of the 500 simulations). The number of simulations that produced two events was 0.03 x 500, or 16. The number of simulations that produced three events was 0.01 x 500, or 5, and so on.

The cumulative probability function is the ascending function in Figure 8.1. It measures the probability that an outcome will be less than or greater than the selected point on the *y*-axis, with the probabilities given on the right-hand side axis. Thus, for the one event case, the probability that there will be fewer than one event is 54.2%, from the right-hand-side axis. The probability that there will be one or more events is, therefore, 45.8%. The probability that there will be more than three events is 0.4%. The probability of three or fewer than three events, including no events, is 99.6%.

8.10 The Insurance versus the non-insurance case

Households affected by an extreme event may or may not have insurance.

The non-insurance case

The non-insurance case assumes that the cost of extreme events is funded as they arise, which is the case now for non-insured households.
The assumptions of the non-insurance case are:

- 25% of the costs are funded directly out of household disposable income by reducing consumption. This applies particularly to the loss of rental incomes while houses are uninhabitable awaiting repair, but also applies to repairs financed by increasing the household savings ratio.
- The remaining 75% of costs are financed by increased borrowing. The economic cost of this will be incurred over the medium term as increased debt repayment costs force up the household savings ratio and increased interest costs reduce household disposable income.

In the non-insurance case, the cost of restoration of household assets falls on the household affected. It is assumed that, if a household cannot afford to incur debt for restoration, they will sell and leave the region and be replaced by a household that can afford the debt for restoration expenditures. It is assumed that all damage is made good. From a regional perspective, if household replacement occurs the assumption is that the new households will incur increased debt service costs in the same absolute (but not relative) manner as the households they replace.

The assumptions for debt service cost formation are a nominal interest rate of 8.5%. Each year, 8% of the debt is assumed to be repaid. The same treatment is given to public expenditures. It makes no difference if the local council or households incur the abatement costs. An increase in local council debt service costs will either flow into increased rates, reducing private consumption expenditure, or to a reduction in public

consumption expenditures, which, either, way will reduce total consumption expenditures.

The Insurance case

For the modelling analysis below, all extreme event costs are assumed to be financed by insurance. The average cost, paid per year, will be stable whatever the actual occurrence of events but is likely to trend upwards as the climate risk increases. If Bass Coast suffered climate change but no other place on Earth was affected, and provided the insurers were not aware of its being singled out for the anger of nature, the increase in insurance costs for the shire would be minimal as the increased risks could be spread over a worldwide customer base. However, the reality is that the increase in climate risks faced by Bass Coast or South Gippsland will be similar, more or less, to the increased risks of all other regions. Increased risks are assumed at the 75th percentile level, which means that insurance costs will have to increase to cover the costs of two events over a 15 to 20 year period at 2030 plus an insurance profit margin. This will make insurance costly and there is likely to be a substantial increase in the proportion of houses uninsured.

8.11 The evaluation indicators: Measures of welfare

There is a general unease with the standard gross domestic product (GDP) indicator and its regional equivalent gross regional product (GRP). The unease stems from the fact that this indicator is generally used as the measure of the general increase in welfare that results from any change to the economic structure so that the benefits of policy changes and other changes to the economic structure (e.g. building a new road) are measured in terms of the estimated increase in GDP that will result. There are many reasons why GDP is not a fully satisfactory measure of increases in welfare. For example, the GDP measure is silent on the impact in the income distribution. A GDP increase, which is associated with an increase in income inequality, can have a negative impact on measures of community wellbeing. Activities that can be detrimental to community wellbeing, such as cigarette consumption, gambling and road accidents, all result in an increase in GDP, but, more likely than not, reduce welfare as expressed by the intangible concept of community wellbeing. GDP is also notorious for excluding environmental costs and benefits.

There is no better illustration of the problem with the GDP measure than a disaster. Disasters destroy assets, which require restoration expenditures that will stimulate GDP growth. However, this growth is likely to require diversion of resources that would have otherwise been available to support consumption expenditures. Restoration expenditures do not contribute to community wellbeing, which is, in fact, less than it would have been had there been no disaster. Foregone consumption expenditure subtracts from community wellbeing.

If both indicators move in the same direction there is no problem. If, for example, both GDP and consumption increase in response to a given policy change or shock to the economy, the conclusion is that both economic activity and employment have increased along with community welfare. If, however, GDP increases and consumption expenditure falls, all that can be said is that economic activity will increase but it is likely that community welfare will fall. This case would be superior, however, to the case where both GDP and consumption fall. Accordingly, the evaluation carried out here uses both GRP (i.e. GDP at the Bass Coast and South Gippsland level) and consumption expenditure as the key model output indicators in terms of the economic evaluation. The two indicators are measured in two ways; namely, the cumulative difference to 2030 between the indicator value with increased extreme event risk to

2030 versus the case of no increase in extreme event risk; and the discounted cumulative difference to 2030. The assumed discount rate is 5%.

The cumulative difference in employment between the cases of increased risk of extreme events versus the case of no increase in risk is also selected as an output indicator. The key input indicators of restoration and abatement capital expenditures, and direct impact on household disposable income, will also be profiled in the analysis below.

8.12 Important model mechanisms

There are several important mechanisms imposed on the model which have a significant bearing on the results. Firstly, the local content of construction expenditures coming directly from a disaster is set at 0.4. This is because the recovery expenditures are generally required to be carried out relatively quickly, which gives a competitive advantage to out-of-region construction enterprises because of greater levels of capacity to control the work flow. However, for the abatement case, because the expenditures will be planned and delivered in a stable manner, local firms should be able to gain an increased share. Hence, for the abatement case, the local construction content is set at 0.6.

For Bass Coast, the negative shock to exports is set at 5% for the first year after the event (equivalent to a 30% reduction in tourism-related exports from Inverloch), trailing off to a negligible loss after 4 years. The total cumulative loss per event is 12%. For South Gippsland, there is a negligible loss in exports.

There is assumed to be a permanent 4% loss in exports (from what otherwise would have been the case) for each extreme event greater than one. This is to incorporate long-run loss of investment confidence from multiple extreme event cases. These settings are sufficient to allow for an adequate economic damage estimate from extreme weather events.

8.13 The impact on Bass Coast

There are two types of expenditures. Restoration expenditures repair the damage inflicted by an extreme event and abatement measures reduce damage inflicted when the event occurs.

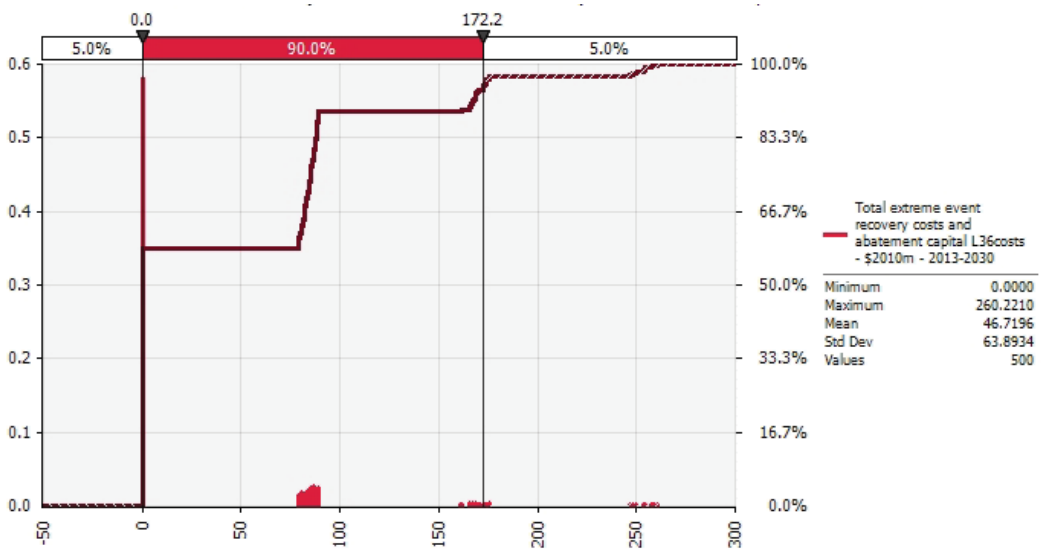


Figure 8.2.: Bass Coast – No abatement measures – Insurance case. Total extreme event recovery costs and abatement capital costs ($2010m) – 2013-2030.

By assumption, in Figure 8.2. there are no abatement expenditures. Figure 8.2 shows the distribution of restoration expenditures to be covered by insurance. If there is one extreme event, between $80m and $90m will have to be spent on recovery expenditures. If there are two events, then between $160m and $175m will have to be financed. Why is there a distribution for expenditures for a given number of events? Why, in this case, for a single event is the distribution of expenditures $80m to $90m? The answer is that the Bass Coast is a growing economy with more dwellings being subject to damage in 2030 than 2013. If a single extreme event occurs close to 2013, lower levels of restoration expenditures will be required than if the event occurs close to 2030.

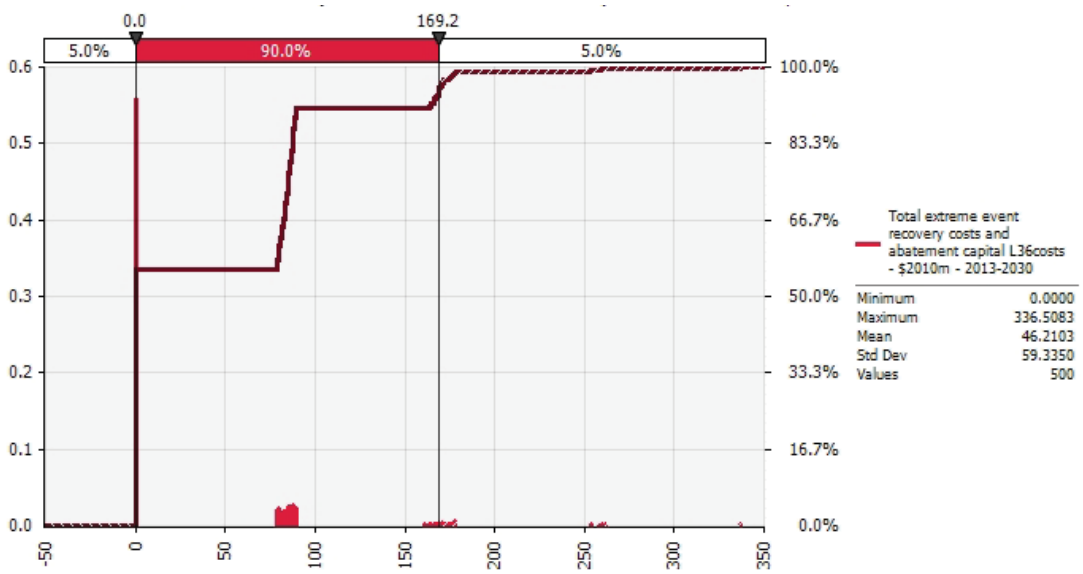


Figure 8.3: Bass Coast – No abatement measures – Non-insurance case. Total extreme event recovery costs and abatement capital costs ($2010m) – 2013-2030.

Once again, in Figure 8.3 there are no abatement expenditures. As in the insurance case, real costs are bunched in the no-event and one-event cases.

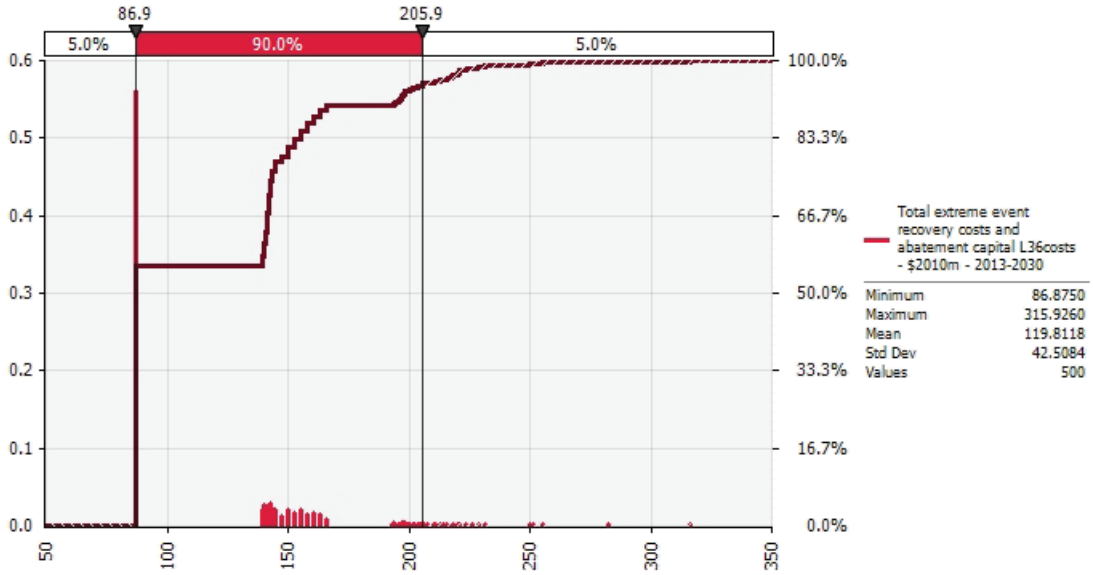


Figure 8.4: Bass Coast – Abatement measures – Non-insurance case. Total extreme event recovery costs and abatement capital costs ($2010m) – 2013-2030.

Figure 8.4 shows the outcome for both abatement and recovery expenditures. Total abatement expenditures come to $87m, with the bulk of the expenditures undertaken by 2023. However, from the figure, there is a cluster of outcomes around $150m, with the range being from $140 to $170m. This reflects the expenditure range for one extreme event. The range of outcomes reflects the fact that total expenditures will be a function of the timing of the event. The closer the timing to 2013, the greater the expenditure because the less the implementation of the abatement strategies and the greater will be the damage from any one event. Conversely, the later the extreme event, the less the damage. Even when the abatement expenditures are largely completed, there will be damage such as general house damage from high wind. For the two event case, the range is between $190m and $230m.

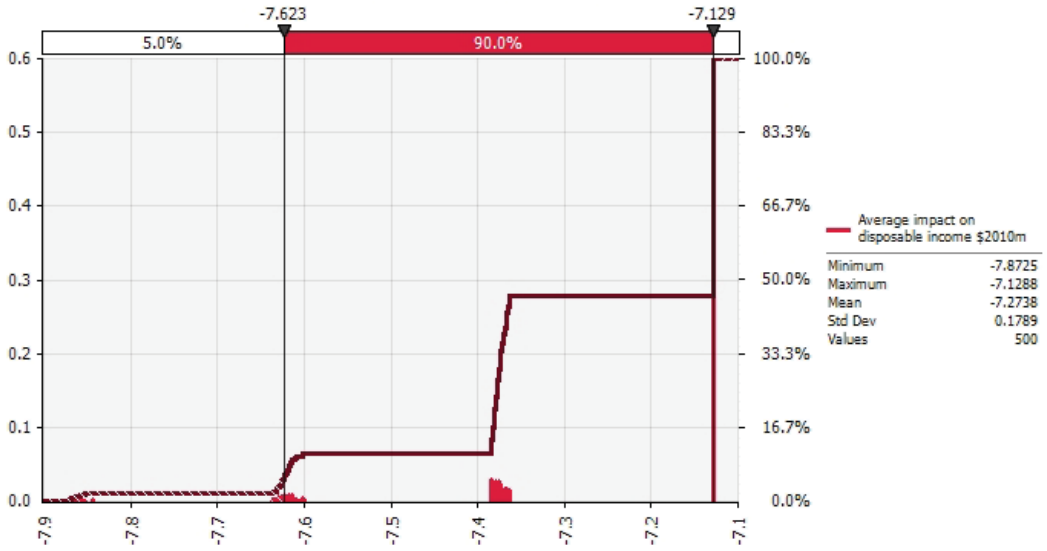


Figure 8.5: Bass Coast – No abatement measures – Insurance case. Average impact on disposable income ($2010m).

Figure 8.5 is closely related to Figure 8.2 but differs slightly because a new set of Monte Carlo simulations was used. The figure gives the average annual impact on Bass Coast household disposable income in the insurance case. There is little variation around the annual average of $7.3m per annum incurred as insurance costs. These costs are independent of the actual number of extreme events, save for uninsurable items such as additional rental costs and minor repair costs such as re-painting. Why the $7.3m? By 2030 the insurance companies will be budgeting on two extreme events over the 2030s and into the 2040s, which means that they will be expecting a direct claim cost of around $150m over 15 to 20 years. Adding a standard 40% margin gives a total annual premium approaching $14m on the impacted dwellings in Bass Coast. Since the increase in premiums ramps up from near zero in 2013 the average increase for the period to 2030 will be near seven, as indicated by Figure 8.5.

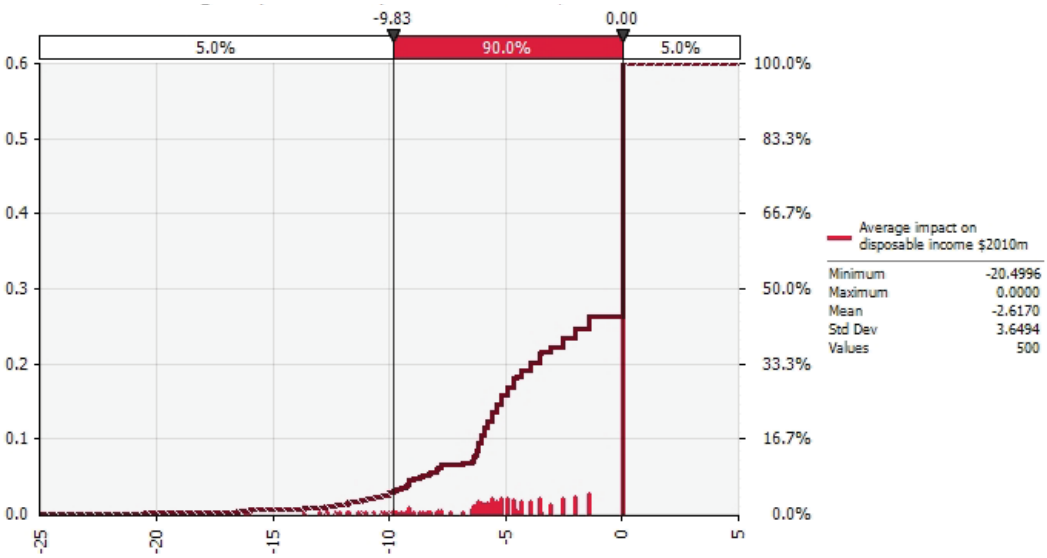


Figure 8.6: Bass Coast – No abatement measures – Non-insurance case. Average impact on disposable income ($2010m).

In the no insurance case (Figure 8.6) costs arise when the event occurs and are paid off over the decade and a half following the event. Here, the costs imposed will still vary with the number of events, although there is a wide variation in costs for each a given number of events. For example, from Figure 8.6, the average impact of a single event on household disposable income varies from −$2m when the event occurs in 2030 to up to −$7m when the event occurs in 2013: a difference which arises largely because costs beyond 2030 are out of scope. This means that the cumulative direct cost for a one-event case can vary between $30m and $120m in terms of a direct impact on household disposable income depending when the event occurs, a sum substantially less than that incurred in the insurance case. This would suggest that if the risks for Bass Coast are global (with little prospects of the insurance industry reducing costs by spreading the risks over a wider customer base), if insurance premiums have no incentive effects (such as persuading households to weatherproof their houses), if costs and benefits after 2030 are disregarded, if all costs and benefits are discounted to the present and insurance values are disregarded, an efficient policy response would raise funds for the recovery expenditures as they are required. This could include an institutional framework designed to spread the costs evenly over dwellings in the disaster catchment rather than simply the households directly affected. As can be seen from the list of caveats, the conclusion in favour of paying as events occur is by no means clear cut and an intense debate on this policy issue needs to commence.

Figure 8.6 looks a little different from Figure 8.1 but it should be read the same way. If there are no events then there are no non-abatement non-insurance case costs. Thus, from Figure 8.6, the probability that the impact on average household disposable income will be zero is 54%, and, therefore, the probability that the impact on household disposable income will be less than zero (i.e. negative) is 46%, which is consistent with the outcome in Figure 8.1. The sum of all the bars along the y axis in Figure 8.6 is 1.0, including the 0.54 bar for zero costs, which is partly overlayed with the cumulative distribution.

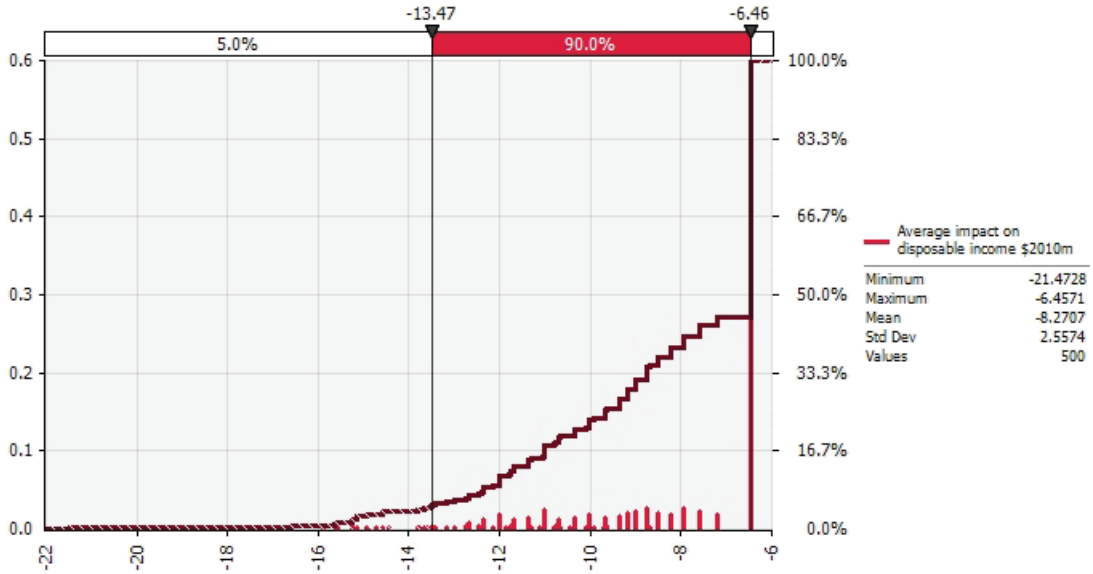


Figure 8.7: Bass Coast – Abatement measures – Non-insurance case. Average impact on disposable income ($2010m).

Figure 8.7 presents the abatement case with no insurance: admittedly, a simplification, since differential insurance premiums are a major incentive to persuade households to undertake abatement investments. It is assumed that all abatement investments are paid for by borrowing, so incurring debt servicing costs. In this simplified case, the cost of a one-event outcome varies widely from a minimum reduction in household disposable income of $7m to around $12m, or a cumulative total at a maximum of over $200m for the one event case. For up to four events it can be seen from Figure 8.7 that the average annual maximum is $21.5m in cost or a cumulative total approaching $360m. Debt-servicing costs (interest and repayments) rise from an initial level of $7m per annum to $119m for the period to 2030. The range of outcomes for the one event case depends when the event occurs. If it occurs near 2013 when there is little protection from the abatement measures, the total cost to 2030 will equal the abatement costs plus the full cost of the event, as analysed above. After 2023 the abatement measures are assumed to be fully effective if an extreme event occurs.

These effects can be illustrated through the use of calculations. If the extreme event occurs early, say in 2015, the majority of the interest costs and repayments of loans arising from this event will have been imposed on the community by 2030. In this case, from Figure 8.6, the costs will be in the vicinity of $6m for the one event case. To this has to be added the abatement costs giving the upper estimate for a single event with abatement measures. However, if the one event case the extreme event occurs in 2025, the interest and repayment costs will be small and the total average costs for the period will only be a little more than the abatement cost.

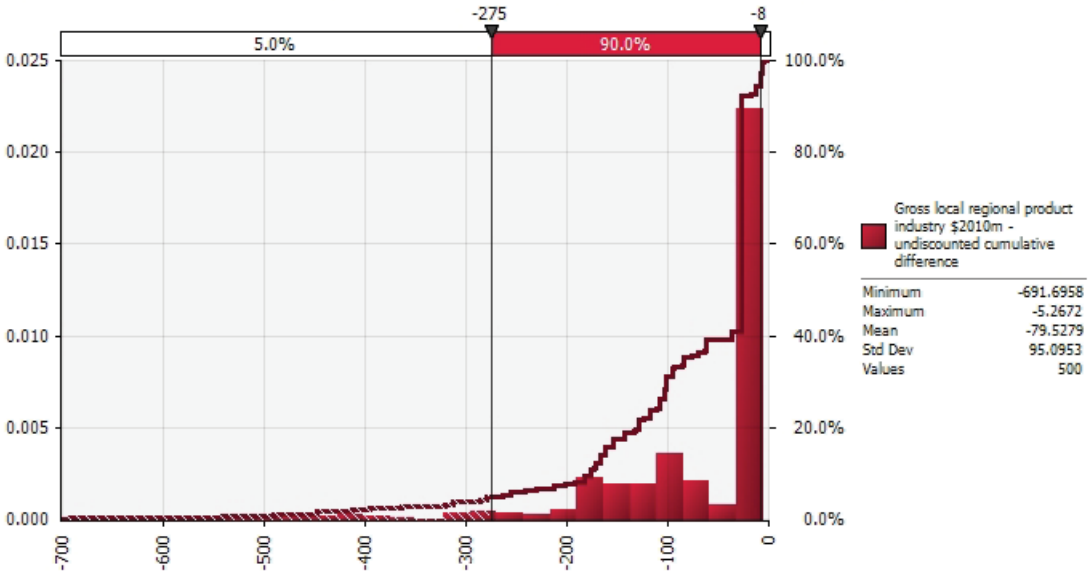


Figure 8.8: Bass Coast – No abatement measures – Insurance case. Gross local regional product industry ($2010m) – undiscounted cumulative difference.

The impact on gross local regional product is given in Figure 8.8 for the no-abatement measures insurance case. This figure shows the cumulative sum of the difference between gross local regional product with increased event risk to 2030 compared to the base case without increased risk of extreme events. For a one-event case, the difference is an average of −$115m, with an upper estimate approaching −$200m.

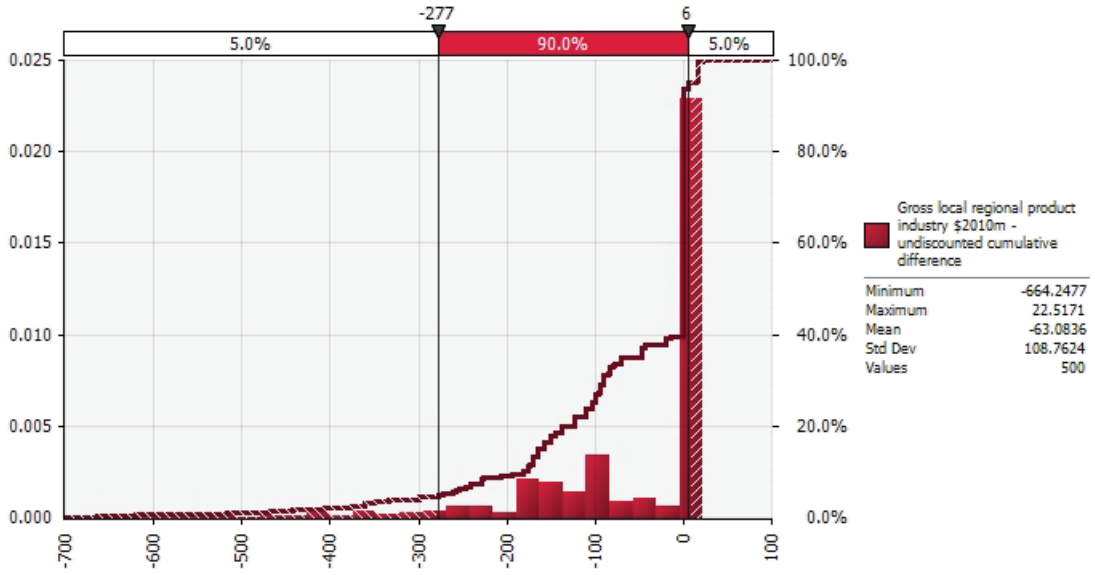


Figure 8.9: Bass Coast – No abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – undiscounted cumulative difference

For the less costly non-insurance case, the annual cost for a one event case (at both average and upper estimate levels) is around $10 to $15m under the equivalent insurance case cost. Once again, the caveats to this conclusion should be borne in mind.

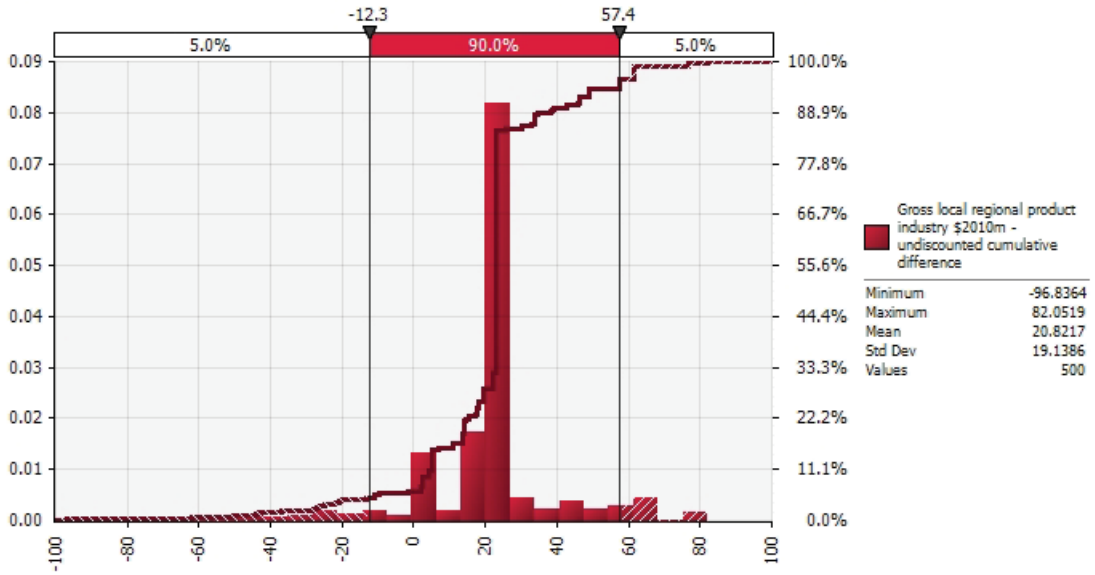


Figure 8.10: Bass Coast – Abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – undiscounted cumulative difference.

For the abatement case, Figure 8.10, there is generally an increase in cumulative gross local industry product of approximately $20m at the average benchmark. It is worth

noting how the extreme costs are reduced. From Figure 8.10, the maximum cost (called the minimum in the figure) is −$96m. From Figure 8.9, the maximum is −$664m. Thus, abatement measures will not only reduce average costs when one event occurs during the study period but also more than proportionately reduce the estimates of extreme damage when more than one event is allowed for.

The abatement case with no insurance implies a gain of $120m when compared to the no abatement case with no insurance costs.

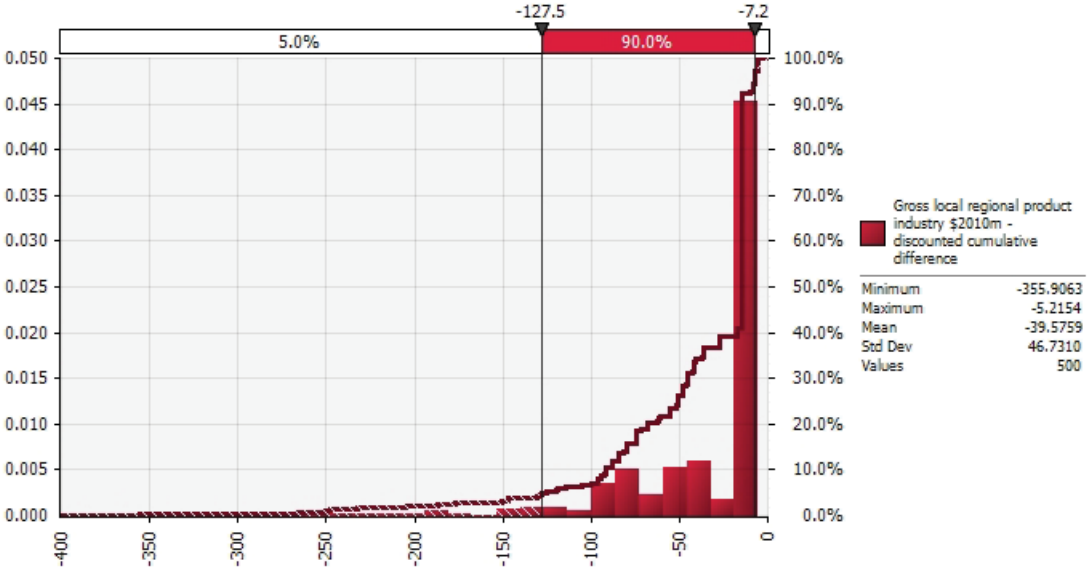


Figure 8.11: Bass Coast – No abatement measures – Insurance case. Gross local regional product industry ($2010m) – discounted cumulative difference.

Figures 8.11, 8.12 and 8.13 show the same result as Figures 8.8, 8.9 and 8.10, except in cumulative discounted terms. The benefit of the abatement case over the non-abatement case is now reduced. From Figure 8.13, the mean discounted gain for the abatement case is now $23m compared to the no insurance mean loss of −$30m. The net difference is a gain of $53m. The corresponding additional event range (including the no event case) from Figures 8.9 and 8.12 is $63m plus $20m, or $83m. The reason for this is that the abatement costs are incurred from 2013 and have a higher discounted total in the overall sum. It is also relevant that abatement benefits received after 2030 are disregarded.

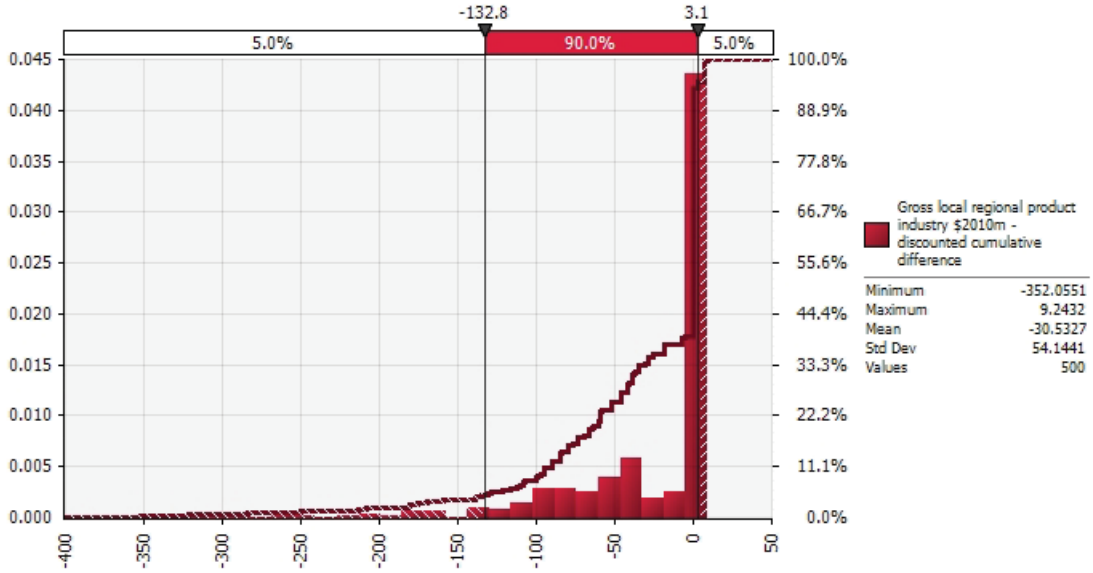


Figure 8.12: Bass Coast – No abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – discounted cumulative difference.

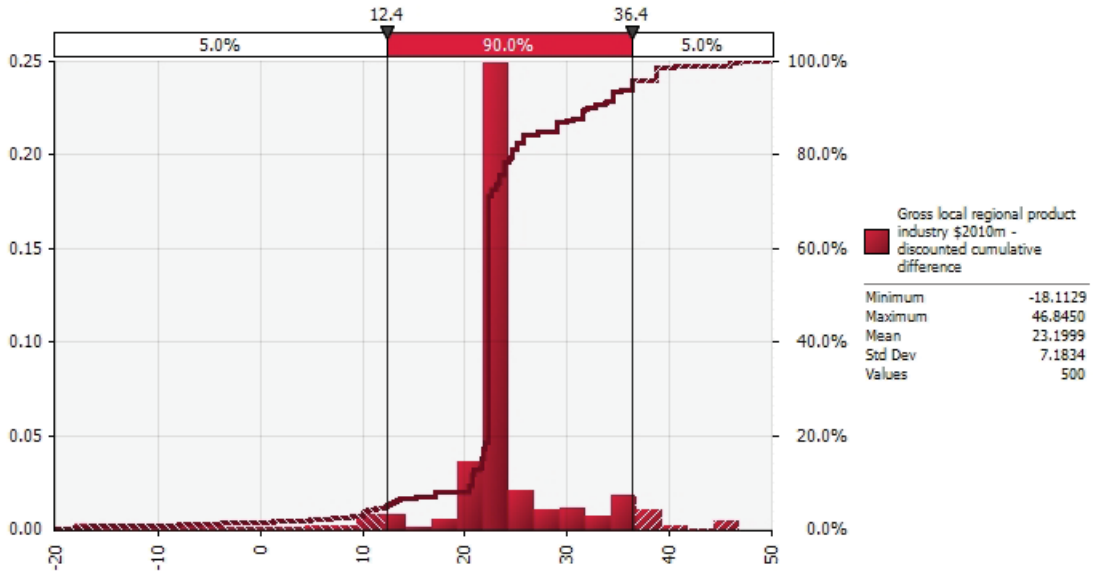


Figure 8.13: Bass Coast – Abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – discounted cumulative difference.

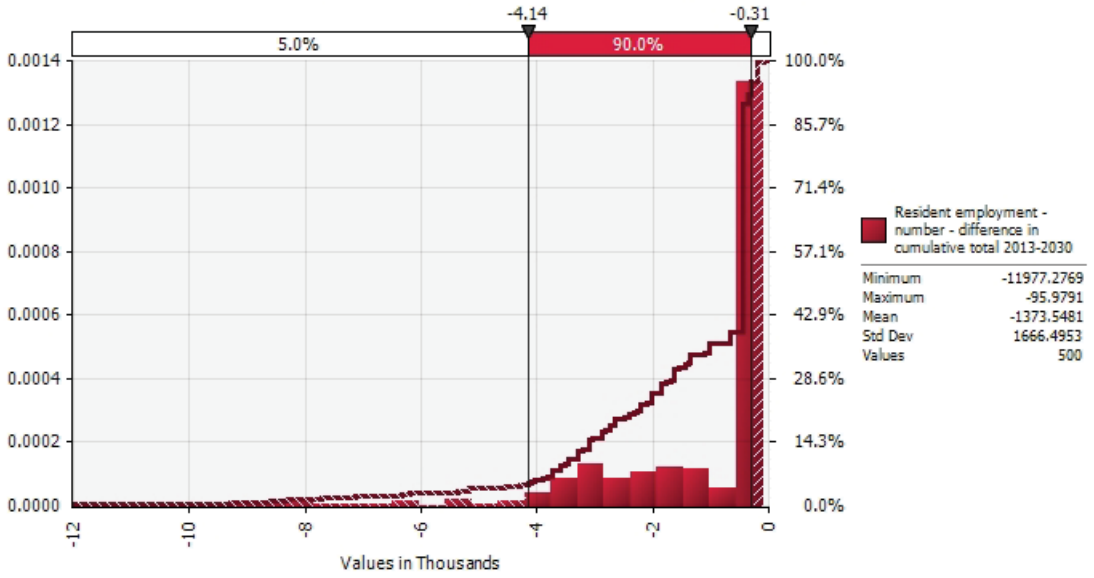


Figure 8.14: Bass Coast – No abatement measures – Insurance case. Resident employment (number) – difference in cumulative total – 2013-2030.

The cumulative impact on employment is shown in Figures 8.14, 8.15 and 8.16. The outcome for cumulative change in employment follows the gross local industry product outcomes. Thus, from Figure 8.14, the mean loss of cumulative employment is 1,373, or 81 per annum, ranging up to a maximum of 11,977 or 705 per annum for the insurance, no abatement case. From Figure 8.15, the non-insurance non-abatement case is a little less. For the abatement case, the mean employment gain is 922 or 54 per annum, with a maximum possible gain of 922 or 54 per annum.

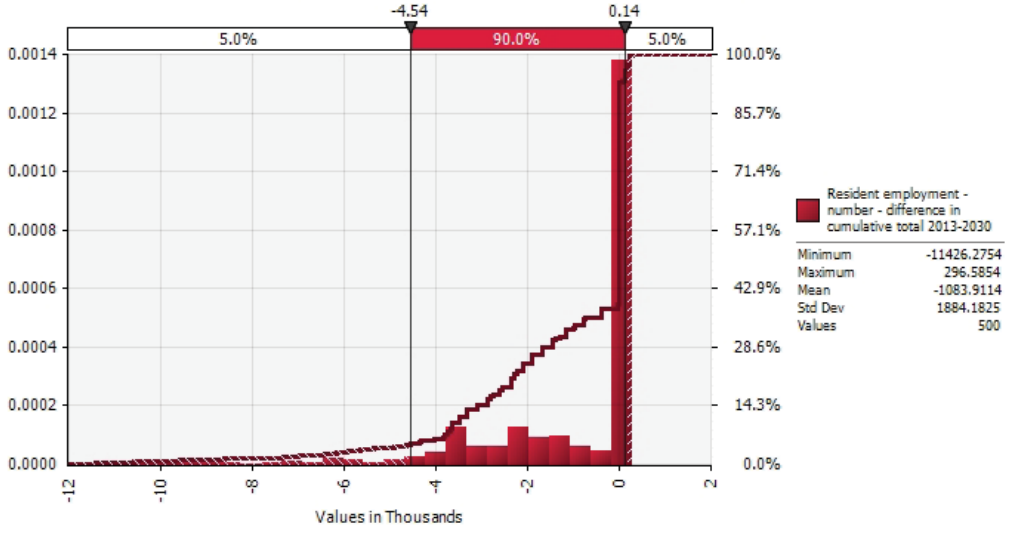


Figure 8.15: Bass Coast – No abatement measures – Non-insurance case. Resident employment (number) – difference in cumulative total – 2013-2030.

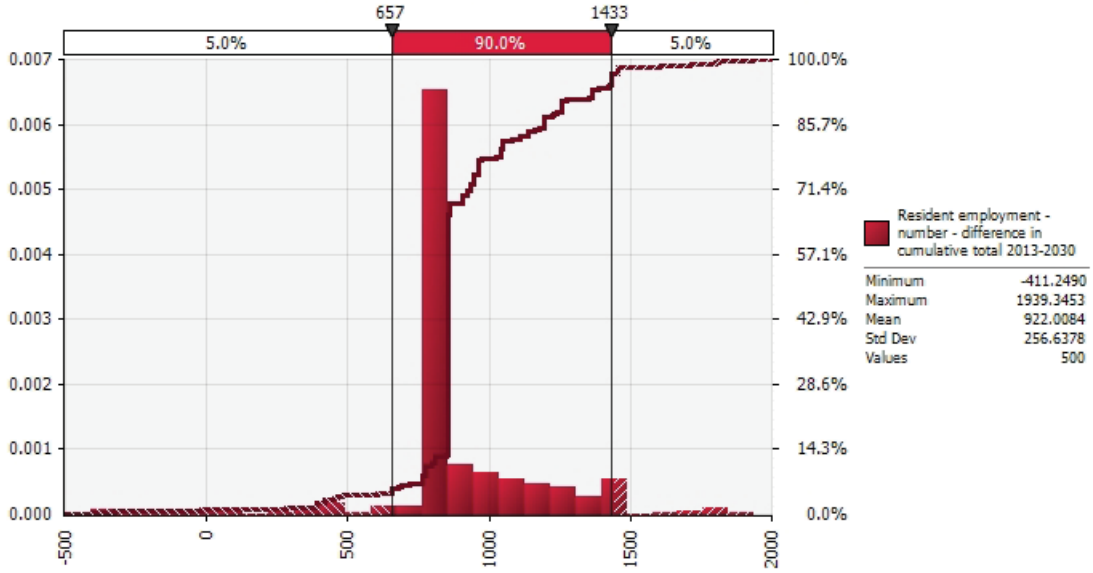


Figure 8.16: Bass Coast – Abatement measures – Non-insurance case. Resident employment (number) – difference in cumulative total – 2013-2030.

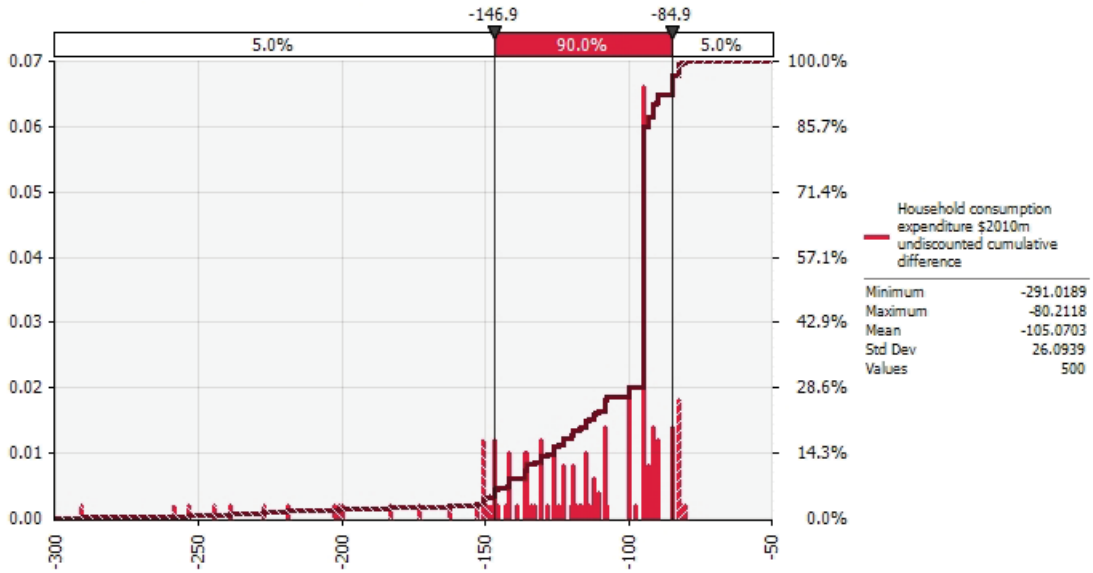


Figure 8.17: Bass Coast – No abatement measures – Insurance case. Household consumption expenditure ($2010m) – undiscounted cumulative difference.

The last two figure sets show the impact on consumption expenditures. From Figure 8.17, the mean loss in cumulative consumption expenditure is $106m for the insurance, no abatement case, which is reduced to a $44m loss for the no insurance, no abatement case. However, with abatement, the mean loss increases to a cumulative undiscounted total of $82m. In discounted terms, from Figures 8.20, 8.21 and 8.22, the corresponding totals are −$53m, −$21m and −$40m. This is because consumption has to be foregone to finance abatement, even though this yields benefits through job generation.

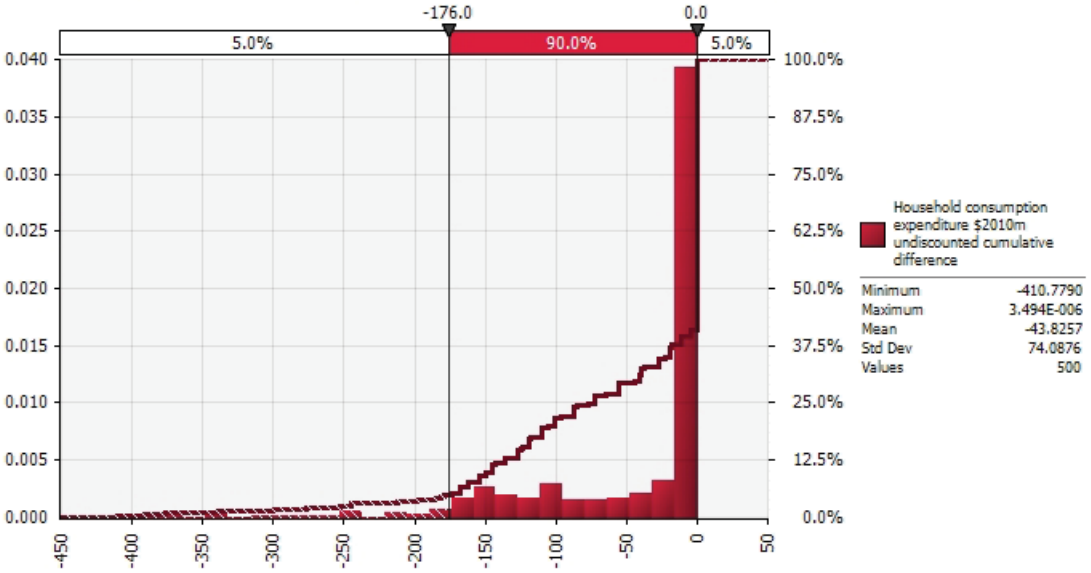


Figure 8.18: Bass Coast – No abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – undiscounted cumulative difference.

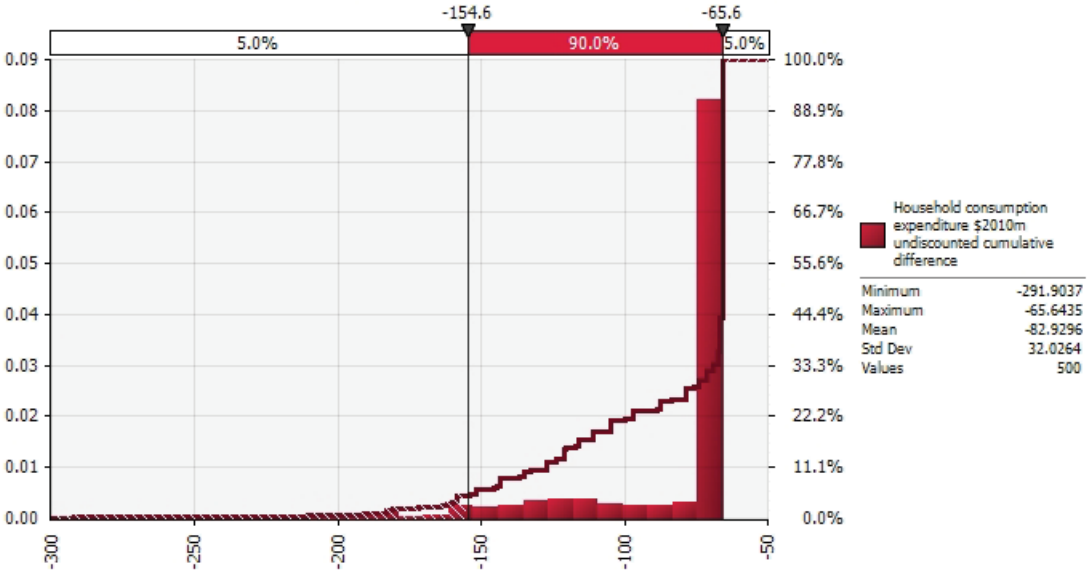


Figure 8.19: Bass Coast – Abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – undiscounted cumulative difference.

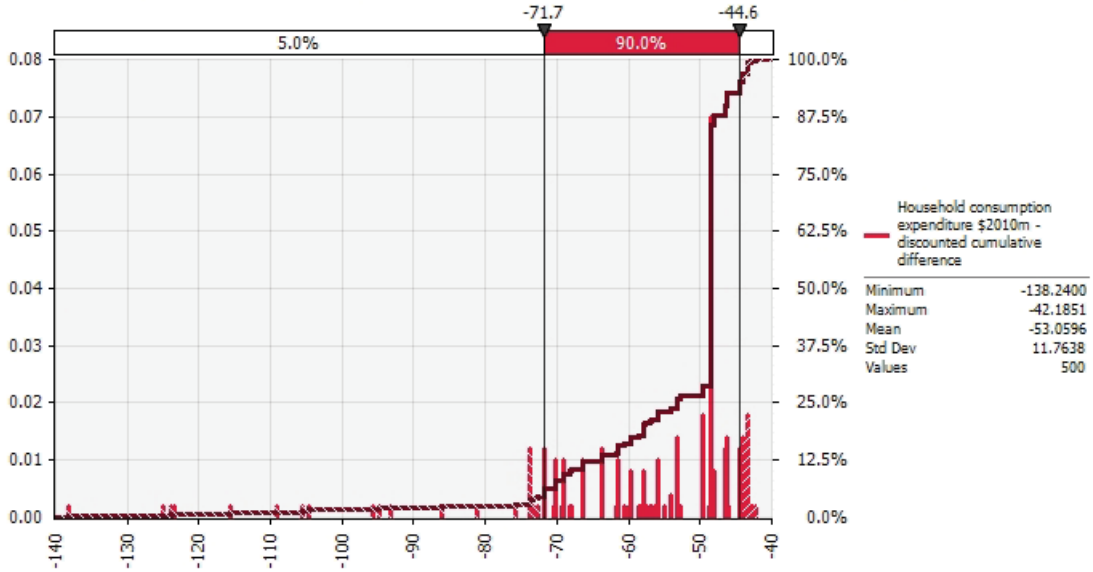


Figure 8.20: Bass Coast – No abatement measures – Insurance case. Household consumption expenditure ($2010m) – discounted cumulative difference.

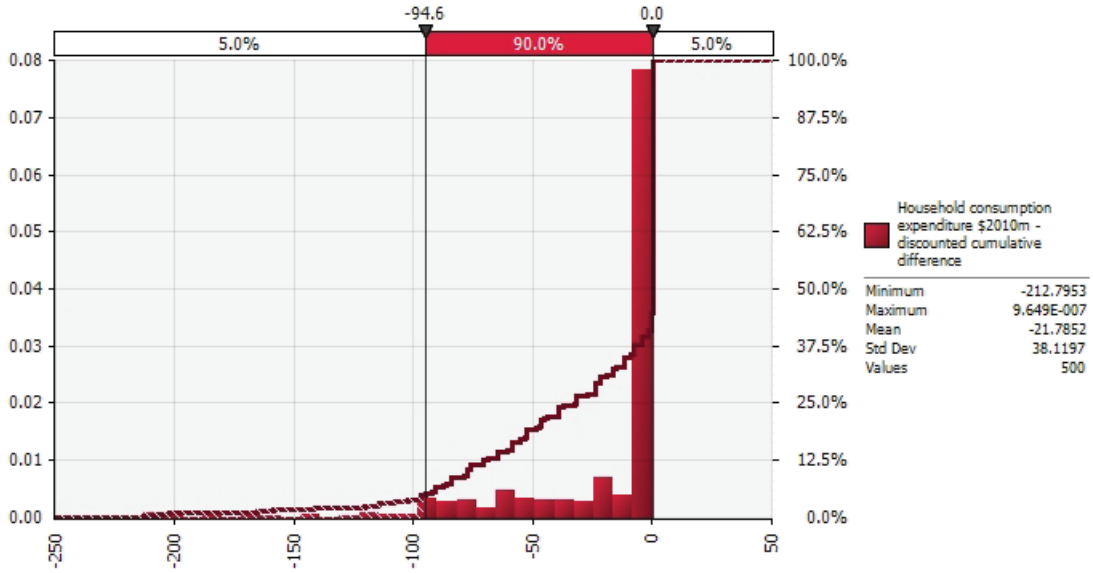


Figure 8.21: Bass Coast – No abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – discounted cumulative difference.

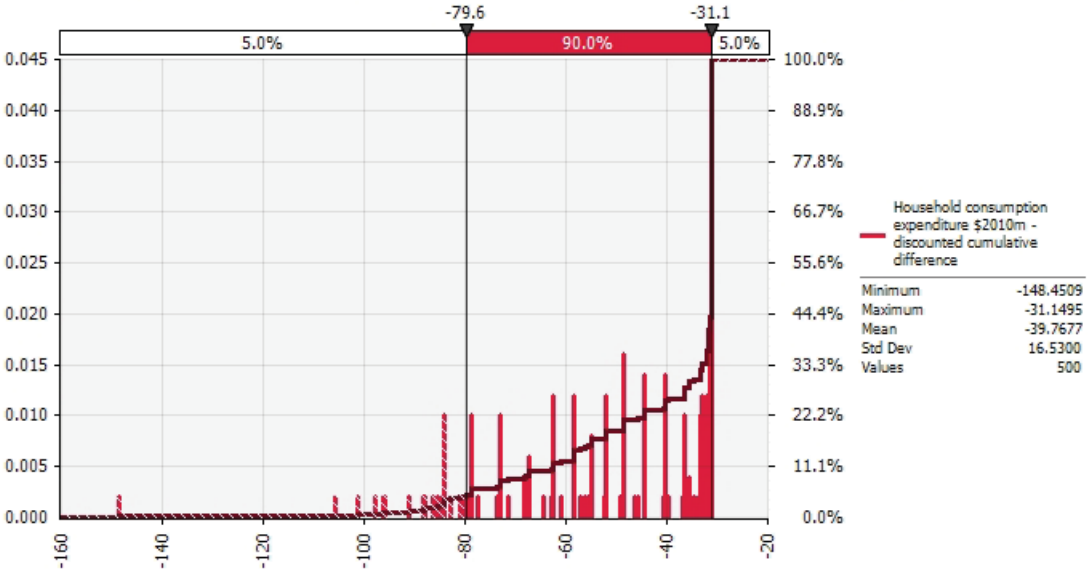


Figure 8.22: Bass Coast – Abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – discounted cumulative difference.

The question is what to conclude? On the strict consumption standard the prima facie results would be that the abatement measures should not be undertaken if the non-insurance case is an option. However, this assumes that the loss of employment due to lack of activity in abatement construction, and the loss of business sector investment because of the risk of unprotected extreme events do not subtract from community welfare.

The appropriate conclusion would be as follows. If the cost and benefit estimates are broadly accurate, a community like Inverloch, which does not want to incur loss in its welfare as a result of fear of an extreme weather event, lower employment or lower investment in the region because of business losses from the cost of extreme weather events, will have to accept loss of community welfare from foregone consumption expenditures in the short-term. This choice is for the community to make.

It is again emphasised that this dilemma is partly the result of the particular assumptions adopted in this study. In particular, if the community takes a longer-term view, to say 2040 (and beyond), the discounted values would probably favour abatement measures over the other cases (the 2030 cut-off was determined by the project specification). In this case, its choices would be more like those of South Gippsland, where, given the assumptions, abatement investment is supported by all indicators.

8.14 The impact in South Gippsland

The impact of wind and flood damage in South Gippsland from an extreme weather event at Sandy Point will be only a fraction of the impact of the Bass Coast case. The reason for this is: Sandy Point only has 16% of the dwelling stock of Inverloch, and the damage caused by any specific storm is expected to be no more than 10% of the damage per property at Inverloch because of the more sheltered position of Sandy Point. In addition, Sandy Point has a significantly higher proportion of unoccupied dwellings than Inverloch, which will result in only a third of the costs of an extreme

weather event (for the same cost) being directly imposed on the South Gippsland economy compared to Bass Coast. The costs will be imposed on other LGAs in Victoria and, in particular, the metropolitan Melbourne LGAs.

Thus, for South Gippsland, the same weather event in terms of wind and flood damage will only impose 0.16 x 0.1 x 0.33, or 0.5% of the cost imposed on Bass Coast.

The position as to fire risk is, of course, different. However, even so, only a third of the insurance/non-insurance costs will be imposed on the South Gippsland economy compared to the Bass Coast economy. This means, for example, that for the insurance costs total over 15 to 20 years of $50m resulting from damage by 2030, the increased premiums on South Gippsland residents will be approximately $1m per annum, giving, from Figure 8.26, an average annual impact of $0.5m.

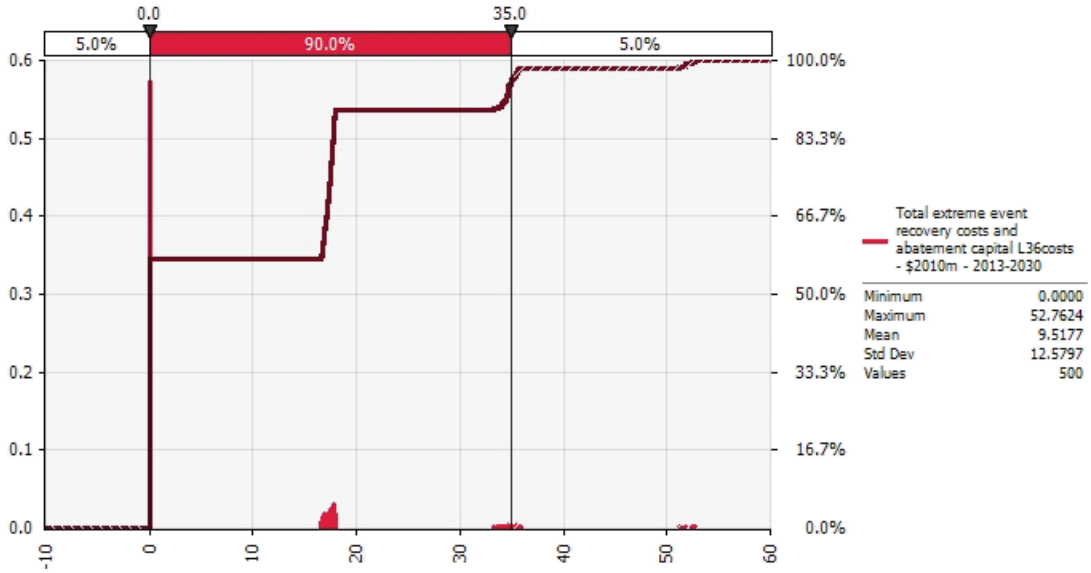


Figure 8.23: South Gippsland – No abatement – Insurance case. Total extreme event recovery costs and abatement capital costs ($2010m) – 2013-2030.

The expenditure from restoration expenditures will be applied in the South Gippsland economy, even if the majority of costs are transferred to other regions. From Figure 8.23, the cumulative restoration costs will cluster around $18m for the one event case and $35m for the two event case. With abatement measures, the mean cost is $5m. However, for early events, that is, events close to 2013, the total expenditures will range up to $20m.

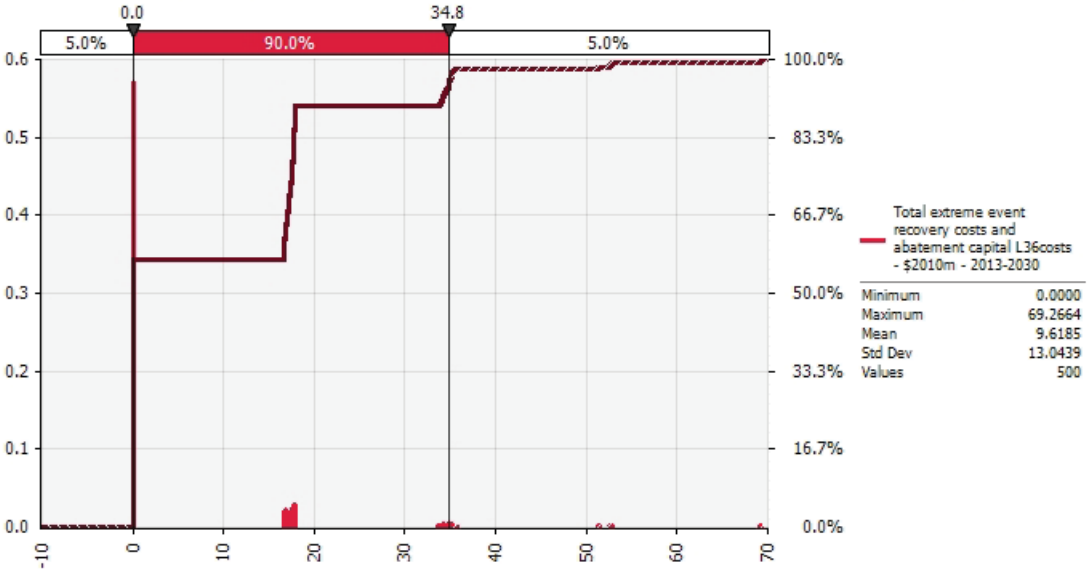


Figure 8.24: South Gippsland – No abatement measures – Non-insurance case. Total extreme event recovery costs and abatement capital costs ($2010m) – 2013-2030.

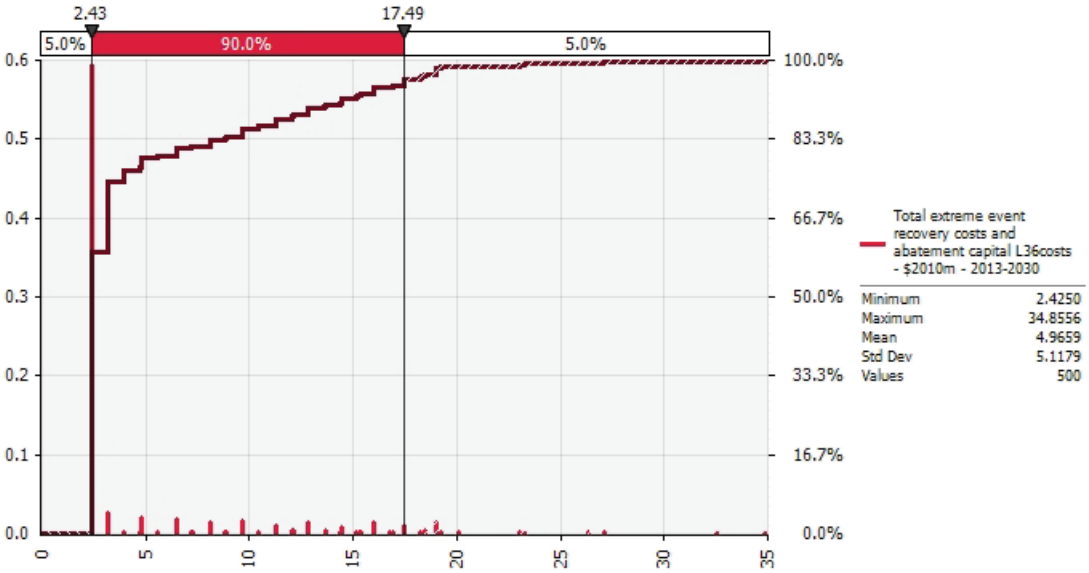


Figure 8.25: South Gippsland – Abatement measures – Non-insurance case. Total extreme event recovery costs and abatement capital costs ($2010m) – 2013-2030.

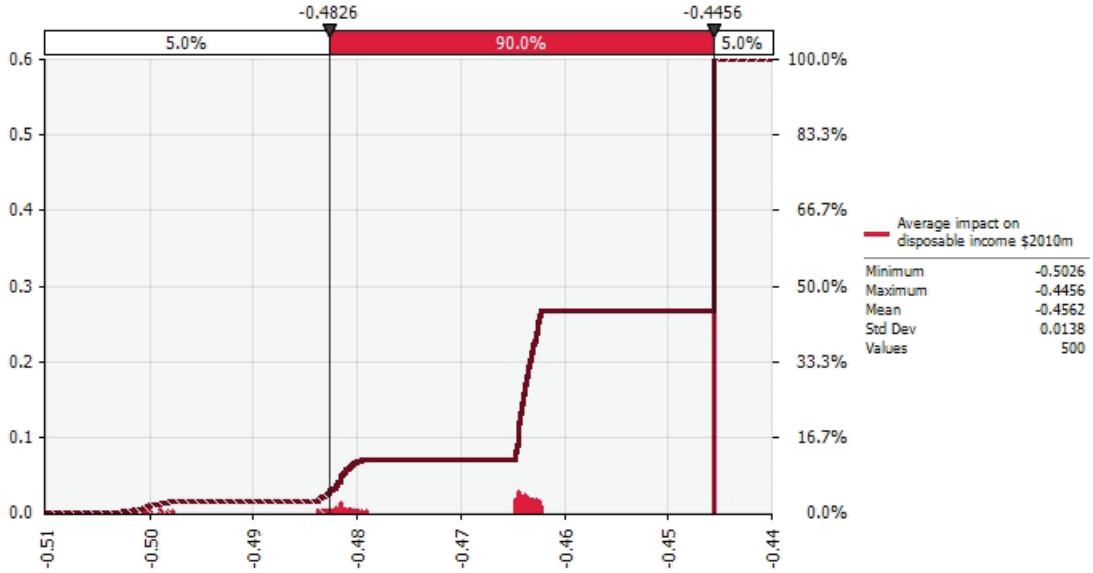


Figure 8.26: South Gippsland – No abatement measures – Insurance case. Average impact on disposable income ($2010m).

From Figures 8.26, 8.27 and 8.28, there is little variation in the mean average annual impact on household income. The cumulative undiscounted impact on gross local regional industry product ranges from a mean of −$2.4m for the non-abatement insurance case to +$0.2 for the abatement case with negligible impact on employment.

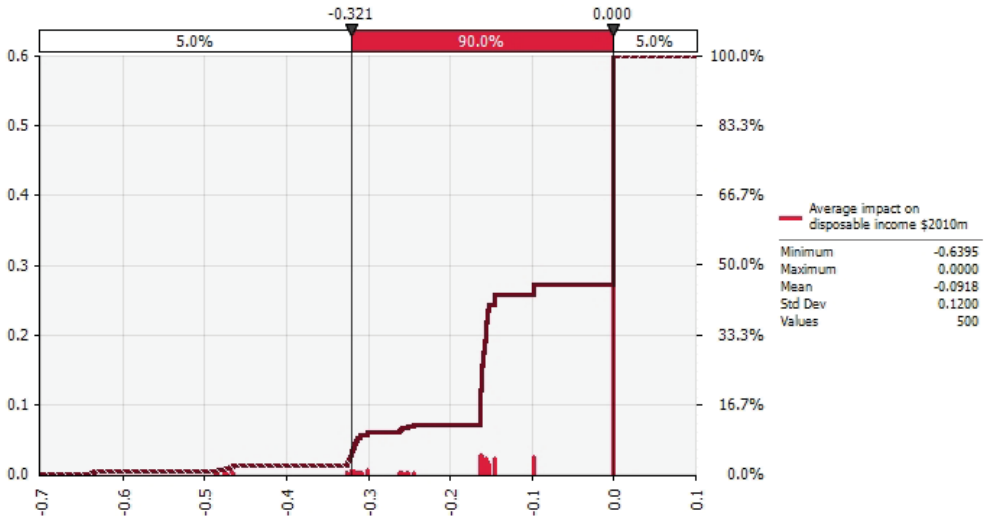


Figure 8.27: South Gippsland – No abatement measures – Non-insurance case. Average impact on disposable income ($2010m).

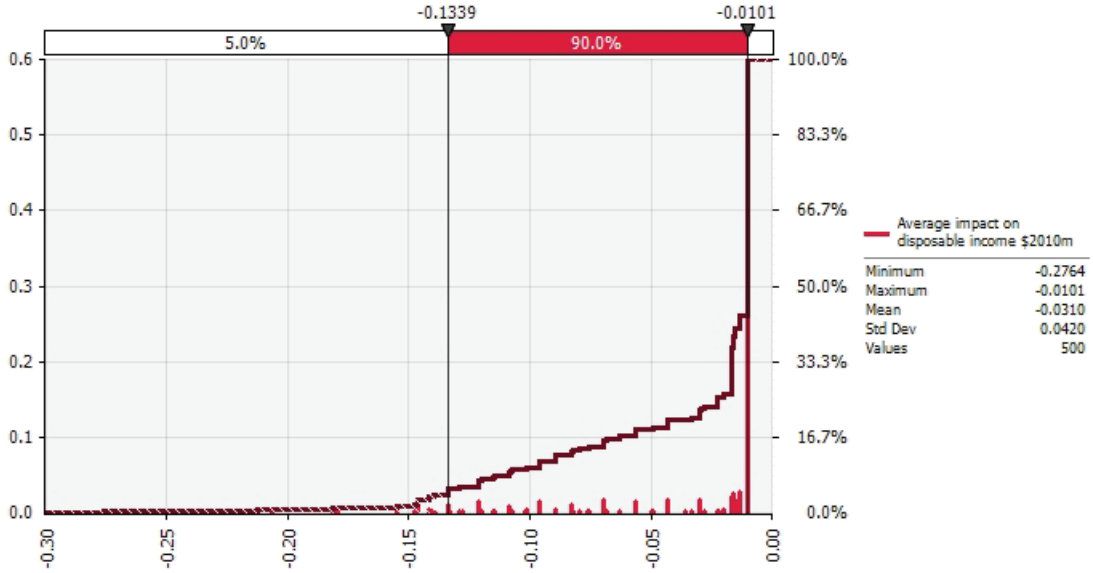


Figure 8.28: South Gippsland – Abatement measures – Non-insurance case. Average impact on disposable income ($2010m).

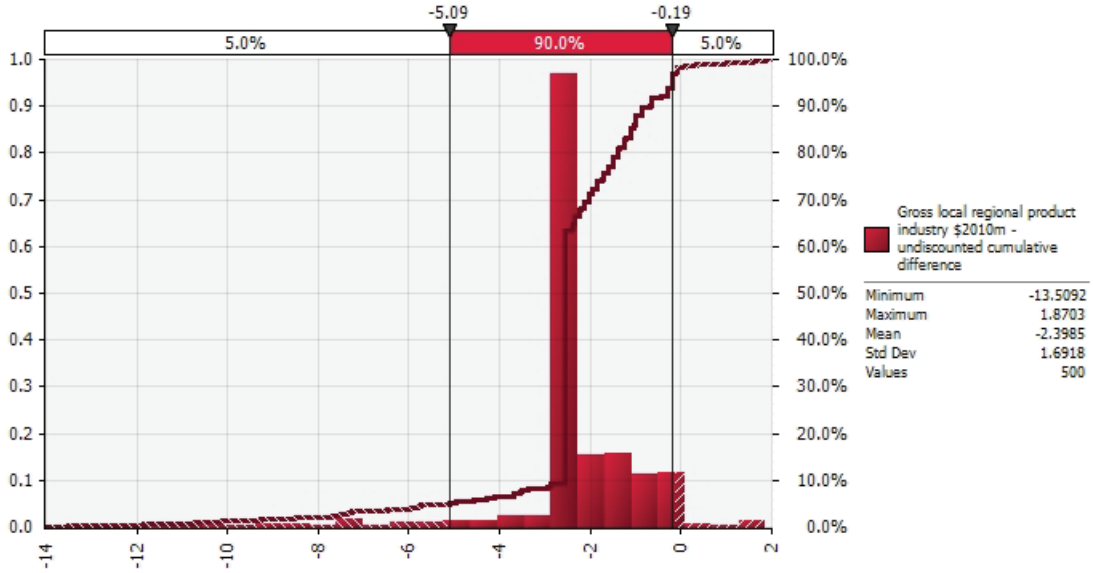


Figure 8.29: South Gippsland – No abatement measures – Insurance case. Gross local regional product industry ($2010m) – undiscounted cumulative difference.

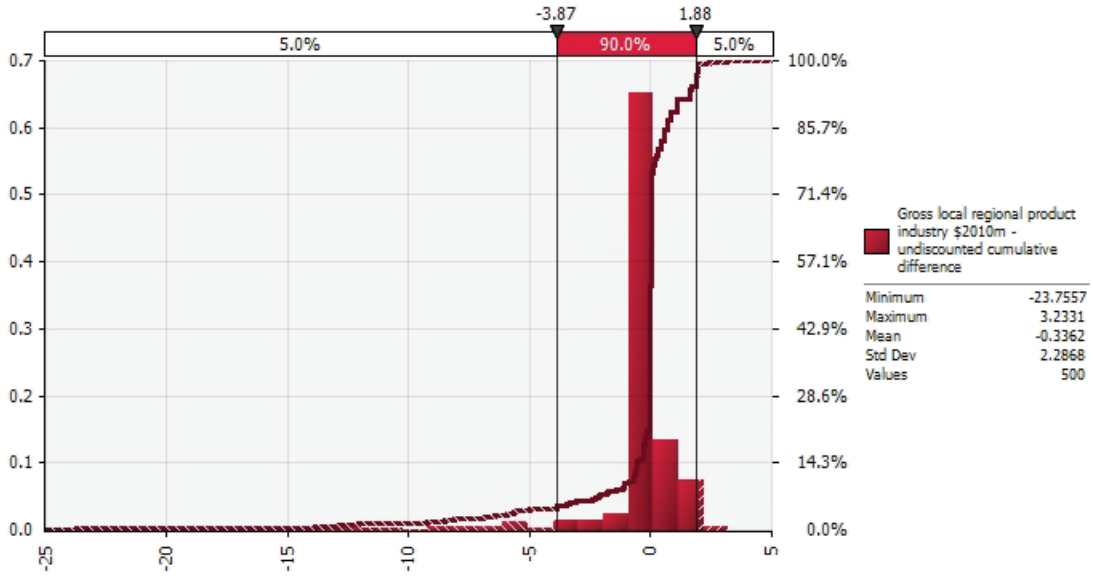


Figure 8.30: South Gippsland – No abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – undiscounted cumulative difference.

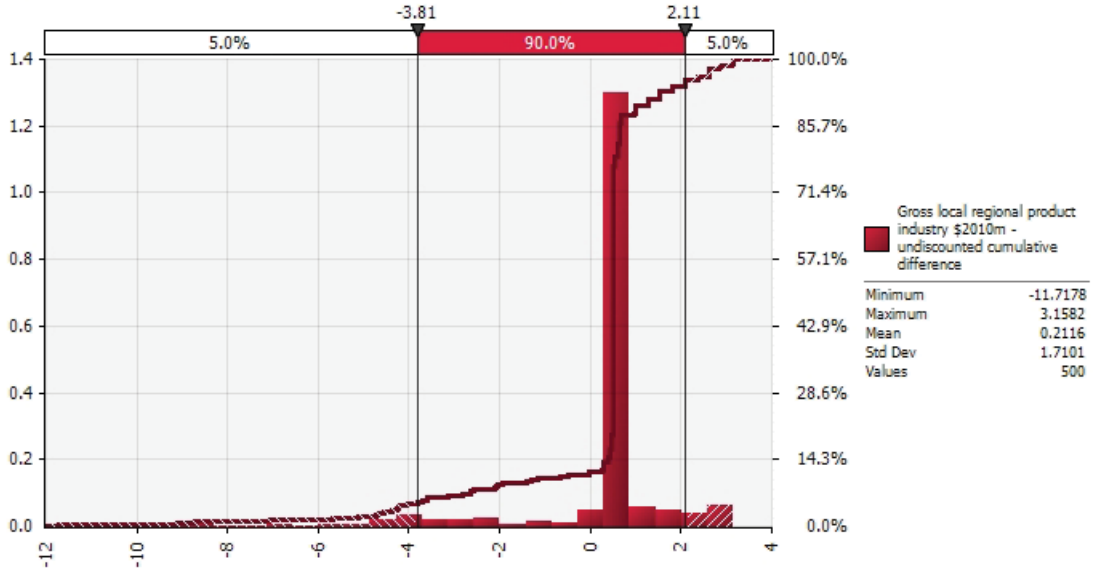


Figure 8.31: South Gippsland – Abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – undiscounted cumulative difference.

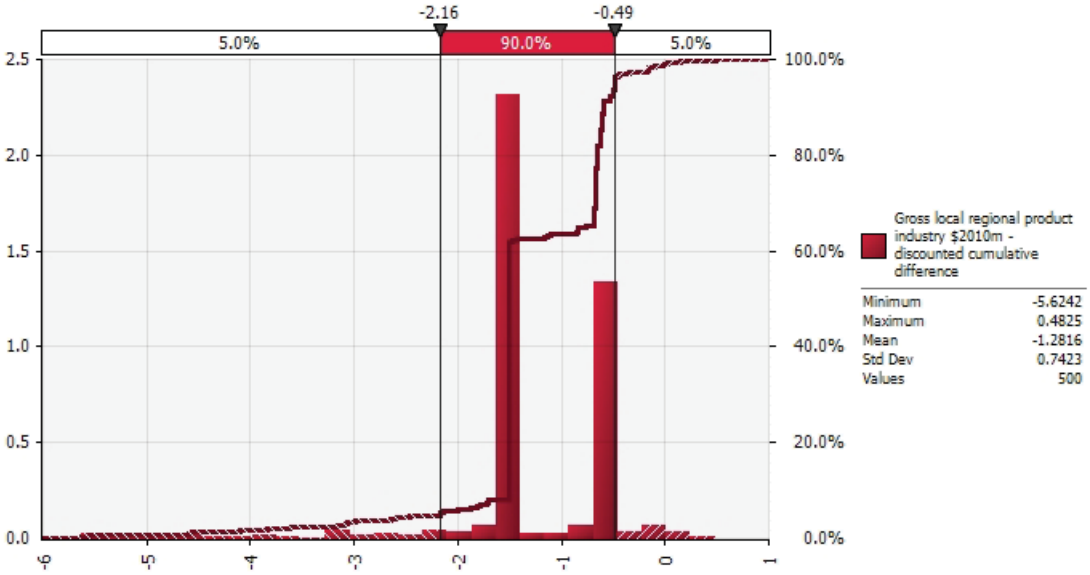


Figure 8.32: South Gippsland – No abatement measures – Insurance case. Gross local regional product industry ($2010m) – discounted cumulative difference.

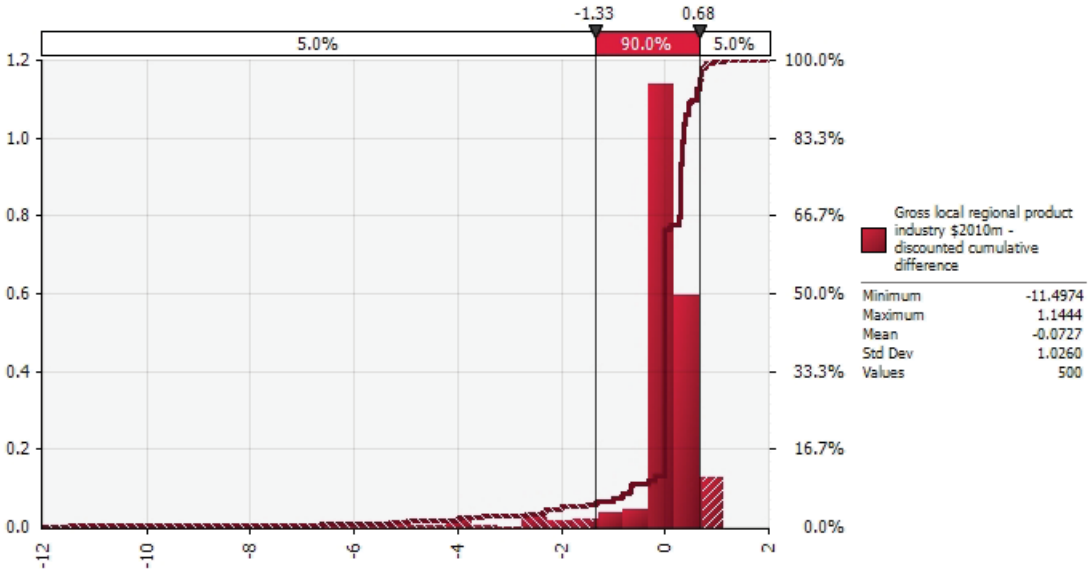


Figure 8.33: South Gippsland – No abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – discounted cumulative difference.

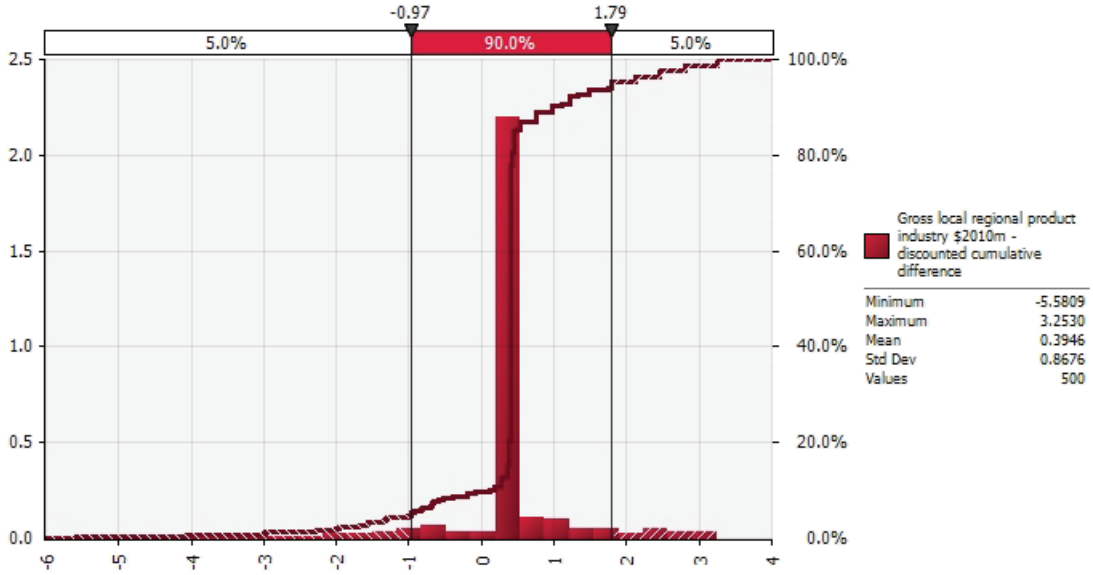


Figure 8.34: South Gippsland – Abatement measures – Non-insurance case. Gross local regional product industry ($2010m) – discounted cumulative difference.

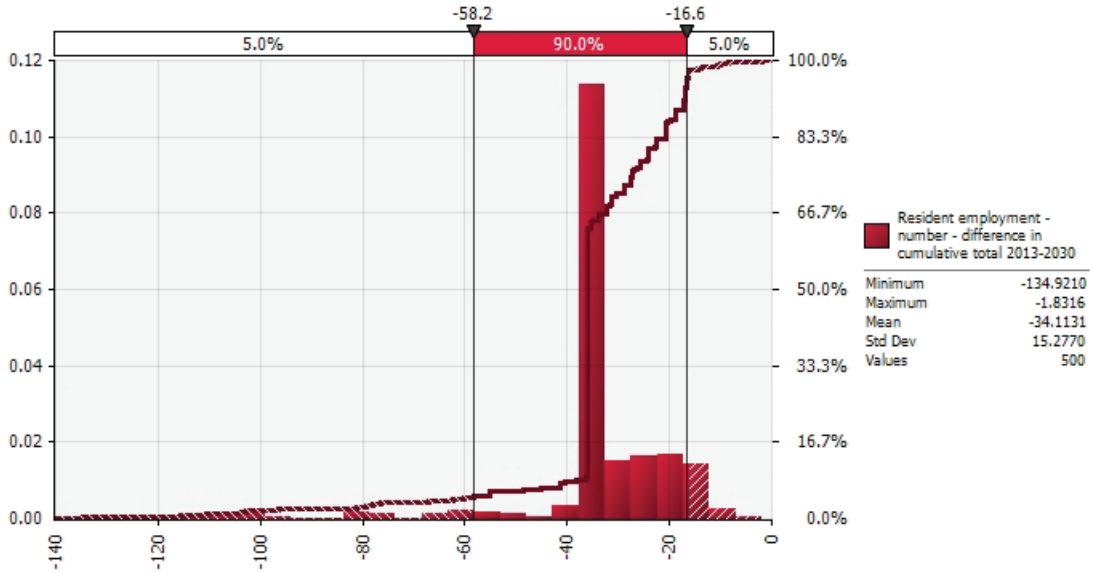


Figure 8.35: South Gippsland – No abatement measures – Insurance case. Resident employment (number) – difference in cumulative total – 2013-2030.

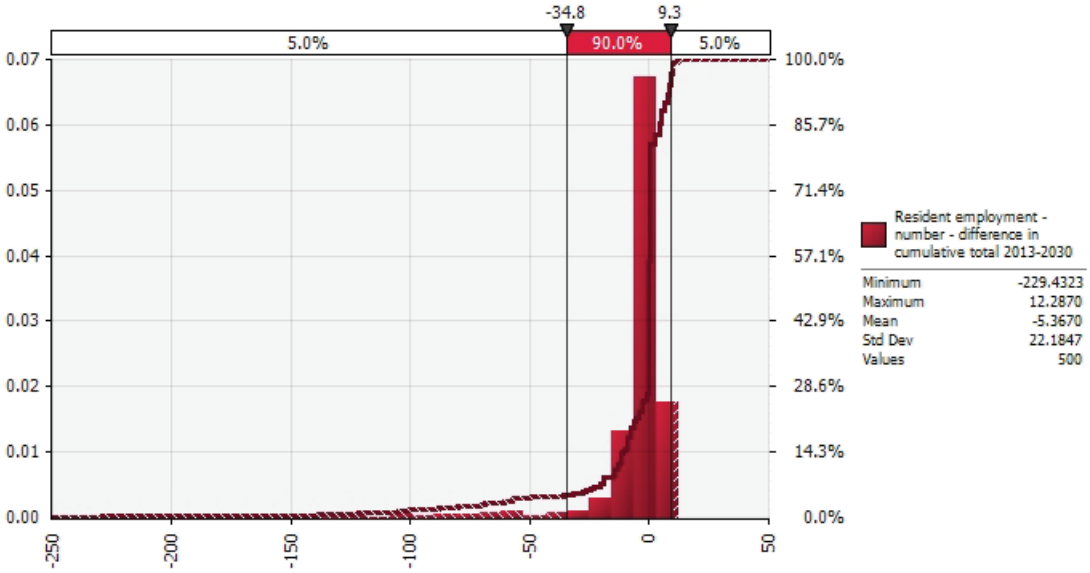


Figure 8.36: South Gippsland – No abatement measures – Non-insurance case Resident employment (number) – difference in cumulative total – 2013-2030.

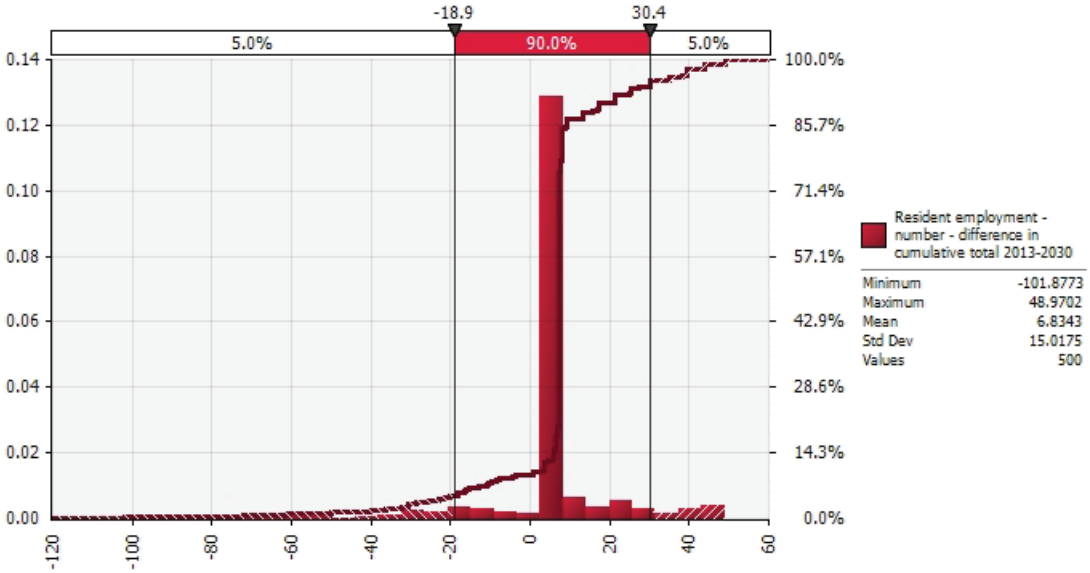


Figure 8.37: South Gippsland – Abatement measures – Non-insurance case. Resident employment (number) – difference in cumulative total – 2013-2030.

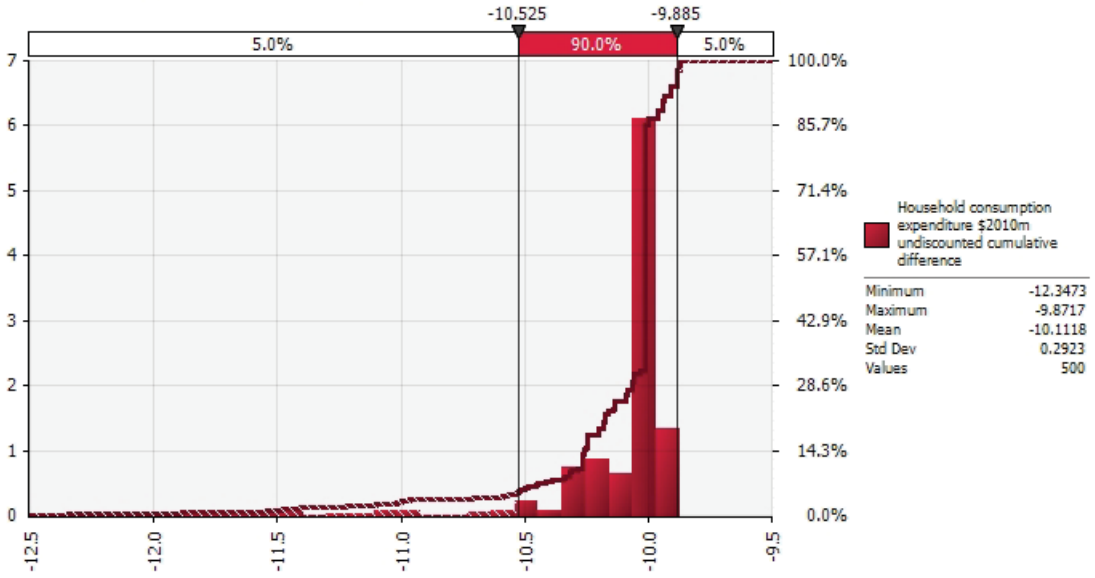


Figure 8.38: South Gippsland – No abatement measures – Insurance case. Household consumption expenditure ($2010m) – undiscounted cumulative difference.

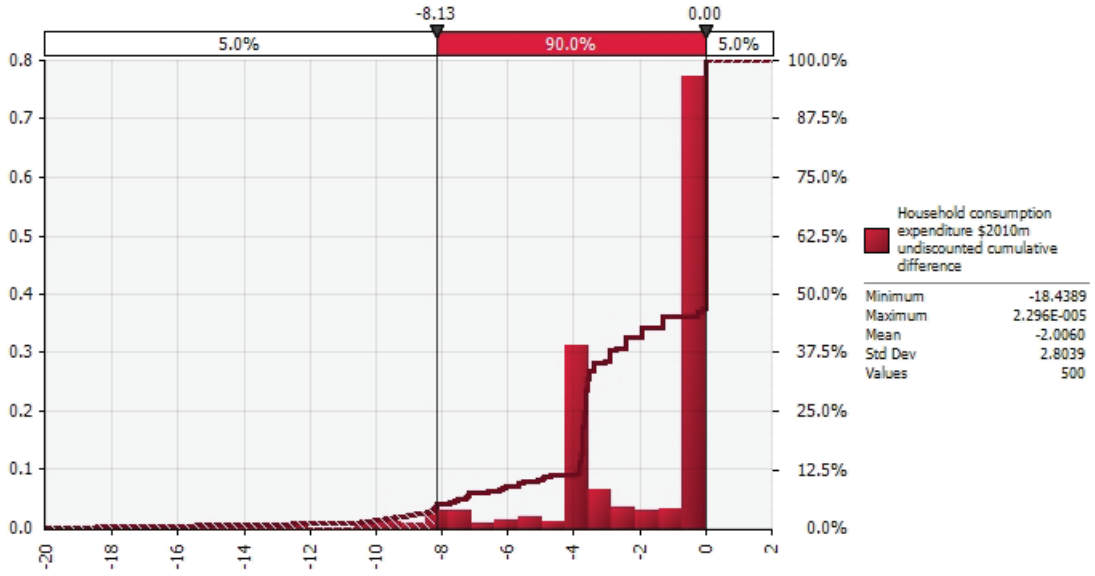


Figure 8.39: South Gippsland – No abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – undiscounted cumulative difference.

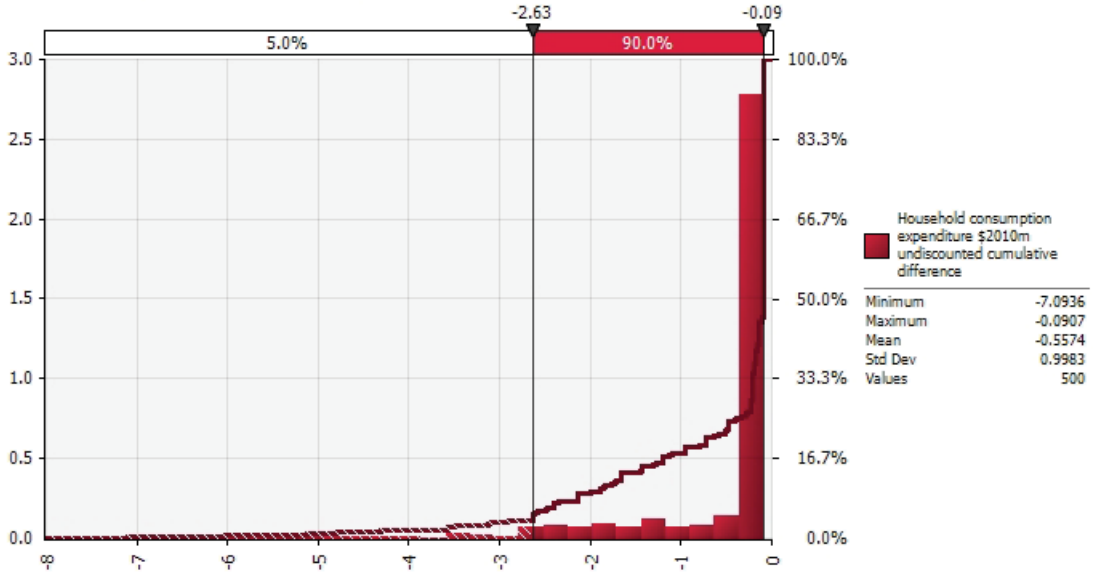


Figure 8.40: South Gippsland – Abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – undiscounted cumulative difference.

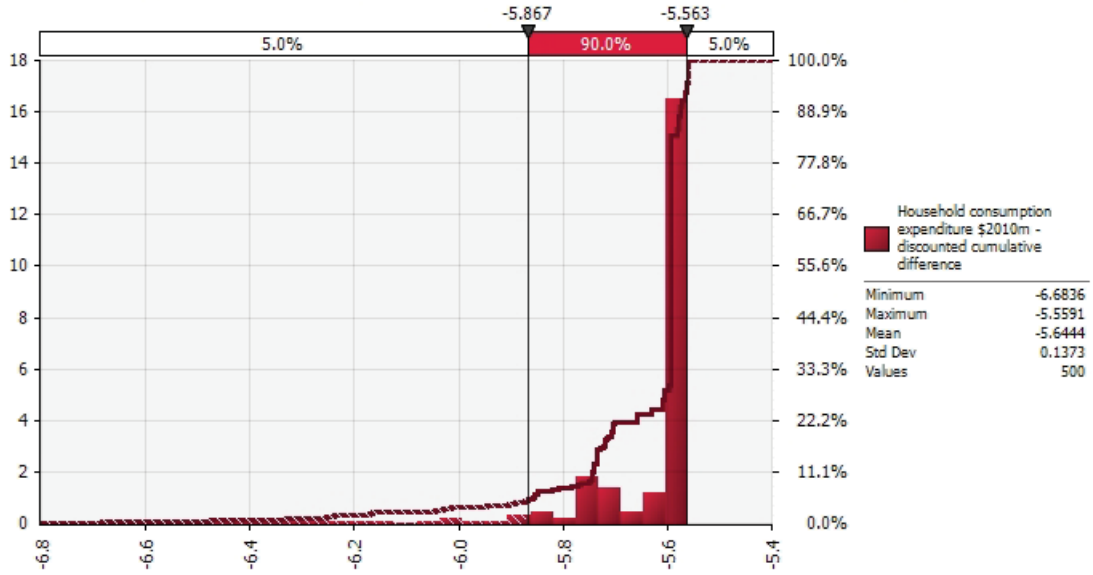


Figure 8.41: South Gippsland – No abatement measures – Insurance case. Household consumption expenditure ($2010m) – discounted cumulative difference.

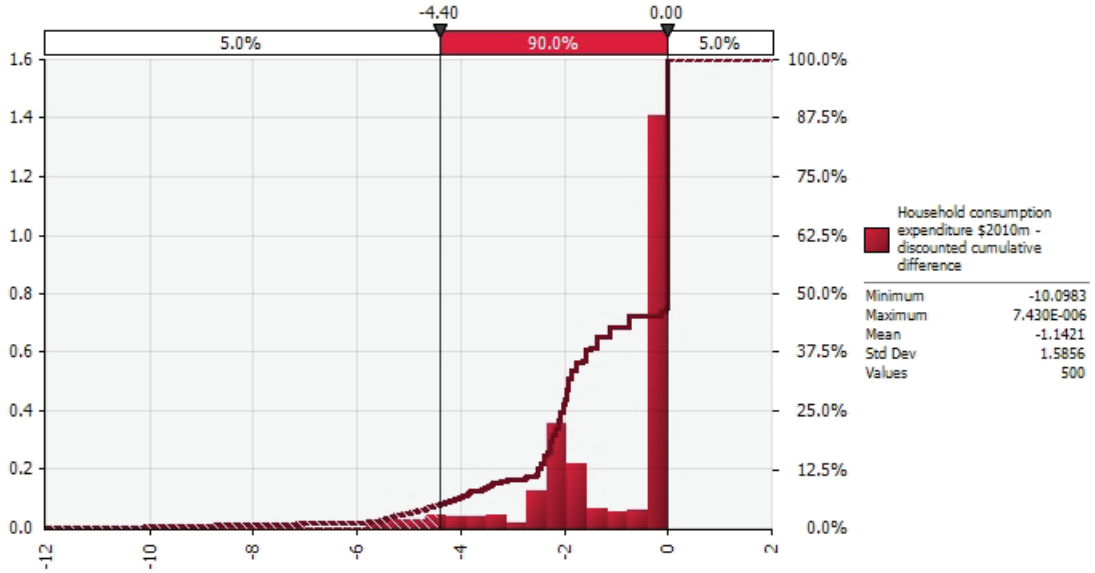


Figure 8.42: South Gippsland – No abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – discounted cumulative difference.

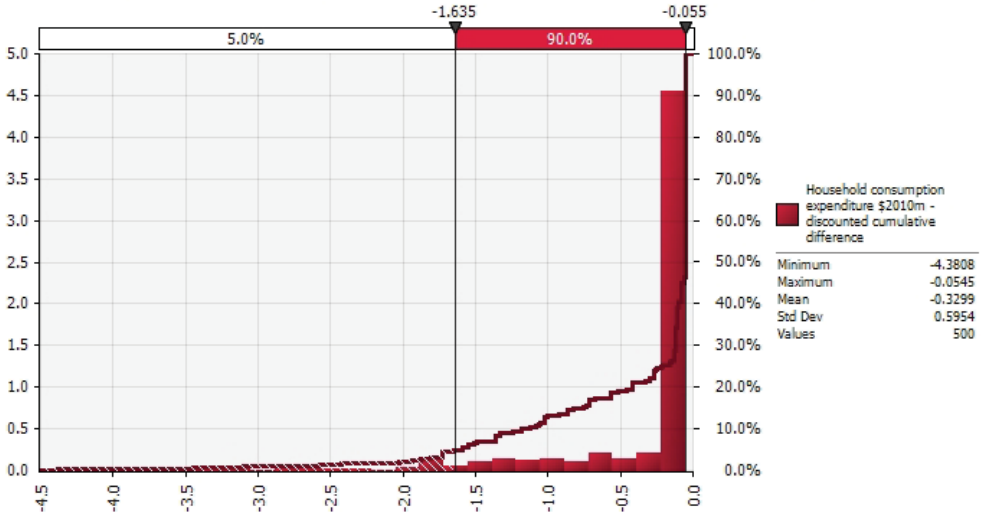


Figure 8.43: South Gippsland – Abatement measures – Non-insurance case. Household consumption expenditure ($2010m) – discounted cumulative difference.

Judged by the cumulative discounted impact on consumption, the abatement case generates a loss of $0.3m (Figure 8.43), which is less than the mean loss of −$1.1m (Figure 8.42) for the no abatement, no insurance case and the loss of −$5.6m for the no-abatement insurance case (Figure 8.41). In the case of South Gippsland, the abatement case produces a clear-cut gain in both economic activity and welfare. This is, of course, due to the majority of the costs being shifted to other LGAs.

8.15 Conclusions

Compared to daily and seasonal changes in the weather, climate change is a gradual process, which, in coastal Australia, is likely to manifest itself most dangerously in an increased probability of extreme events. These findings have provided an estimate of the increase in the probability of such events due to climate change from 2011 to 2030. It is admitted that the estimate is subject to considerable uncertainty but submitted that it reflects current trends.

The question addressed in this chapter is whether, given the increasing probability of damaging weather events, it would be worthwhile to prepare for such events using defensive (or abatement) investments. As with all investments, costs would be incurred while the relevant works are constructed but the works would deliver subsequent benefits: in this case, in the form of reduced damage costs should an extreme event occur. Conventional cost–benefit analysis can be applied to the assessment of these investments but only after it has been modified to take into account the fact that abatement investment yields returns only if a damaging weather event actually takes place.

The first step in the analysis was to describe the position in Inverloch and Sandy Point. The type of extreme event considered most likely to cause extensive damage in Inverloch is a storm accompanied by rain, an onshore gale and a high tide, resulting in a combination of wind and inundation damage. Sandy Point is at less risk of damage from such a storm but at greater risk of damage from wildfire resulting from hot, dry weather and strong offshore winds. A storm event was postulated for Inverloch, now considered as likely once a century but likely by 2030 to occur once in 25 years. The likely damage was costed along with abatement measures designed to minimise the damage. Sandy Point was assessed as liable to damage from fire and, once again, abatement measures and the resulting damage reductions were costed for an event currently considered as once a century but expected to become once a quarter-century by 2030. Although intended to be broadly accurate, neither the investment costs nor the benefits of damage reduction were costed in detail. The emphasis was on assuming realistic numbers to assist in the construction of a methodology to assess the benefits of preparedness.

The following simplifying assumptions were made:

- The investments in each location were simplified into a single program, undertaken over the 10 years from 2015 to 2024, with equal real expenditure in each year. A more realistic assessment would recognise that the investment program can be subdivided into a large number of separable investments. Each potential component of the investment program would be assessed, allowing the investments to be ranked and a better overall program constructed.
- If an extreme event occurs while the works constituting the investment program are 50% complete, it was assumed that 50% of the total-program benefits would be received, and similarly for other completion ratios.
- No account was taken of benefits accruing after 2030 as a result of investments made before 2030. This assumption was adopted as part of the terms of reference of the study and reduced the rate of return to the investments.
- No value was placed on insurance benefits: the psychological return from the sense of security which arises when one's property is protected against damage. This benefit becomes more than subjective when it

manifests as an improvement in business confidence: businesses are more likely to invest when they feel secure that their investments will not be destroyed by extreme events.

- Due to difficulties of specification and valuation, no value was placed on strictly environmental values such as preservation of species. However, a value was placed on the preservation of amenities of value to tourists and residents.
- The effects of climate change were specified solely through the occurrence of extreme events currently estimated at a probable frequency of once in 100 years. No account was taken of events with greater or less severity. No account was therefore taken of benefits which the investment program might yield should less severe events affect the sites. In the same vein, more severe (and even less frequent) events were not considered.

On this basis a simple spreadsheet cost–benefit assessment was prepared for Inverloch alone. The spreadsheet included rough allowance for the probabilities of event occurrence. This assessment found that the costs and benefits of the proposed investment program were approximately balanced on an undiscounted basis. However, if (as is conventional) the costs and benefits were discounted to 2013, costs exceeded benefits. Such conventional discounting places a premium on the interests of the present generation, so it is no surprise that reversing the premium in favour of the future generation by discounting costs and benefits to 2030 results in benefits exceeding costs.

Broadly speaking, these results were confirmed by more detailed modelling. In this work the above assumptions were maintained but the following methodological changes were made:

- Inverloch was replaced as a unit of analysis with the Shire of Bass Coast and Sandy Point with the Shire of South Gippsland. This allowed both costs and benefits to be set in the context of the rich datasets which are available at local government area level. Using these data, the assessment was broadened to take into account indirect economic effects, such as the addition to construction demand from investment in abatement and the flow-on income-generation and consumption effects of this.
- The timing and number of extreme events was estimated by performing a series of Monte Carlo experiments controlled by the gradually increasing probability of occurrence of an extreme event. The main difference here is that better account is taken of the probability of multiple events occurring within the projection period.
- Rather than relying on a simple comparison of investment and no investment cases, the methodology was revised to include a base case in which the probability of an extreme event remained at estimated 2013 levels.
- The definitions of ‘cost’ and ‘benefit’ were revised to include three major indicators: gross regional product, employment and consumption. In each case and for each indicator, a time sequence was generated and discounted to 2013 using a 5% discount rate. As expected, climate change imposes net costs which are absent in the base case so in all policy cases there were negative net returns.
- Although in real terms construction costs are incurred as and where construction takes place while damage costs are incurred as and where the storm or fire strikes, within limits, cost incidence can be shifted by financial mechanisms, either private sector (loans, insurance) or public sector (loans, inter-governmental transfers). These were taken into account.

The effects of financial transfers were analysed by defining three cases:

- A case with abatement investments and no insurance. To simplify the case, it was assumed that the abatement investments, although undertaken partly by households and partly by local government, would be financed from loans at 8.5% interest. (In practice many household abatement investments would be financed from current savings at enhanced current cost but reduced long-term cost; similarly councils often finance works from current revenue, imposing costs on current ratepayers but reducing costs on future ratepayers.) The exclusion of insurance from this case was likewise justified as a simplification even though it is unlikely in practice: at the household level insurers generally offer lower premiums to households which invest in approved methods of reducing the damage from the insured event. These reduced premiums constitute both an incentive to invest and an incentive to continue with insurance. It was further assumed that the abatement measures succeeded in avoiding damage costs after completion of the investment program. However, the program takes 10 years and if an extreme event took place before the program commenced the community was in the same position as it would have been in the no abatement, no insurance case. If an event took place during the construction period it was assumed that partial protection was afforded (as in the above general assumptions).
- A case without abatement investments but with universal insurance both by households and local government. (The case recognised that a few types of loss are uninsurable: chiefly temporary loss of accommodation and minor repairs.) In this case, financial losses from extreme events were spread over the population in general and did not surge upwards when an extreme event occurred. Instead, substantial premiums were charged in all years.
- Finally, a case without abatement investments and without insurance. In this case, it was assumed that temporary losses of accommodation and minor repairs were met by reductions in household income and consumption. In Inverloch, it was assumed that half of rental losses were suffered by resident owners and half by owners who live outside the respective shires; in Sandy Point, the non-resident proportion was higher in accordance with the pattern of dwelling ownership. Apart from these losses, it was assumed that damage was made good, with a quarter financed from reduced consumption by owners and three-quarters from loans at 8.5%. These loans reduced consumption in subsequent years as they were serviced and repaid.

As expected, each of these three cases showed an increase in costs compared to the base case in which the probability of extreme events remained at 2013 levels. However, climate change being inevitable, the chief interest of the study lay in determining which case offered the minimum increase in costs.

In both Bass Coast (Inverloch) and South Gippsland (Sandy Point) and by all three indicators employed, the highest costs were incurred in the no investment insurance case. There were several reasons for this result:

- Administrative and profit costs were higher than in the two other cases. There is nothing unexpected in this: commercial insurance is necessarily priced so as to recover the probable losses plus a profit margin. Property owners buy fire and storm insurance because they guarantee the purchaser against catastrophic loss should an extreme event occur and insurance companies are able to

charge for this service. (It is notable that property owners with large and diverse portfolios often find it cheaper to self-insure, but this is not the case for property owners in the study areas.)

- The assumptions specified for the study prevented a fair comparison in that they excluded costs and benefits incurred after 2030. In particular, the comparison between the no investment insurance case and the no investment non-insurance case is biased because in the insurance case households bear costs throughout the study period while in the latter case many of the costs are postponed until after 2030 and are, therefore, out of the scope of the present study. The comparison between the no investment insurance case and the investment case is also biased, but the other way, since the investment case generates benefits after 2030, which are not taken into account. It may be added that discounting costs and benefits to 2013 further increases assessed costs in the insurance case with its high upfront costs.
- As already pointed out, the study excluded the incentive effects of differential insurance premiums. While theoretically interesting, the no investment insurance case is internally incoherent in that insurance premiums are likely to provide a major incentive to abatement investment by households. Any case with substantial insurance coverage should, therefore, include substantial abatement investment.

Even if these caveats are taken into account, it should be remembered that storm and fire insurance have never been worth buying except as protection against loss from extreme (low-probability) events. When events move from low probability towards certainty they become uninsurable. If it is certain that a house will be destroyed next year, an insurer will quote the complete value of the house plus a profit margin. What this means is that insurers will continue to provide protection against extreme events but that the definition of extremity will be tightened with climate change. Unless their owners undertake remedial works, more properties will become uninsurable, as, indeed, fire-trap and flimsy buildings are already. It is also probable that buildings in some locations will become uninsurable.

In South Gippsland (Sandy Point), given the cost and benefit estimates, the abatement investment case yielded lower costs than the no investment, no insurance case. As already pointed out, this difference would be increased if the terms of reference were relaxed to include costs and benefits incurred after 2030: in the abatement investment case further benefits would be expected after this cut-off date, while in the no investment, no insurance case there is an expectation of further costs. It should, however, be noted that this assessment partly depends on many of the damage costs being borne by non-residents of the shire. If Sandy Point were a community of permanently-resident owner-occupiers the calculations would have to be re-run and could come to a different result.

The more interesting comparison is for Bass Coast (Inverloch). Here, the abatement investment case yielded higher employment and gross regional product than the no investment, no insurance case but lower levels of consumption. The reason for this ambiguous result is simple enough and is likely to prove to be widespread in abatement investment assessments: the construction effort involved in abatement investment yields jobs and increased gross regional product but the investment has to be financed by increased saving, which reduces consumption. An important difference between the scenarios at the end of the study period in 2030 is accordingly in their balance sheets: a community which invests in abatement will have a stronger balance sheet at this end date than one which does not. Taking balance-sheet changes into account (effectively taking more account of costs and benefits after 2030) could easily change the consumption indicator in favour of abatement. However, it remains that a

community which prefers present consumption over future security is here presented with an argument for deferment of investment, particularly if the community is also prone to add in hope factors such as disbelief in climate change and optimistic expectation of technical fixes.

Finally, it is emphasised that this is a preliminary study aimed at developing a methodology for the assessment of climate change abatement investments. The conclusions for abatement investment in Inverloch and Sandy Point are, accordingly, tentative. In a more realistic assessment where real investment money is at stake greater attention should be devoted to cost and benefit assessment in the various possible sub-programs and more attention should also be given to alternative means of financing the program. However, ultimately, the investment decisions lie with local government, local businesses and local households. Although studies like this can help to define the choices available, the responsibility to decide lies with the community.

9. DISCUSSION AND CONCLUSION

9.1 Introduction

This research explored what was happening in practice in relation to local adaptation. This was undertaken through two case study settlements in Victoria and also through an exploration of what was happening in three other Australian states. A holistic, multi-discipline approach was taken to understand social, economic and environmental adaptation needed in the context of other non-climate trends occurring. The research sought to understand what the residents of the settlements thought about their vision of an adapted settlement and how they were involved in decision-making about adaptation. It was explored as to whether there are principles which can be formed for all small adapting Australian settlements. Finally, the team looked at the adaptation task ahead for the two case-study communities.

9.2 Vision

9.2.1 Representation of community meetings

A key challenge for local governments is finding ways to involve communities in an effective way and also to engage with those who have a less direct interest or who tend to have barriers or constraints over their involvement (Leitch and Inman (2012). Despite concerted efforts to get a more representative group at the community consultations, those who attended represented those who were more aware about climate change issues. They also tended to be an older group of people who were more involved in community organisations. Hence, they may have a particular perspective which may be different from the rest of the community. However, given the wide advertisement about the consultation, it may also be that the group who attended are going to be the community leaders in adaptation and unless others are particularly opposed to a particular adaptation activity, they may be willing for this involved group to make decisions. A small but active group working, particularly those already involved in environmental issues, was also reflected in the interstate workshops. While it is desirable to have a wide range of community representation (Connors and McDonald 2010), this may not be feasible in practice. This situation was reported in the literature, where in practice active participation often only involves a minority of people (Cuthill 2004).

The risk is that social cohesion may be threatened by resentment of some taking a free-ride and not contributing (Dawes and Messick, 2000; Weber et al., 2004). Part of this may be resolved through the proper resourcing of those who are taking action. The risk is also as to whether all members of the community will be involved in a participatory process, as those experiencing disadvantage may remain invisible and their invisibility may be re-enforced by their lack of involvement in consultations (Cuthill 2004). Thus the importance of building both social capital and adaptive capacity throughout the community.

9.2.2 Nature of the vision in case-studies, consultations and interstate workshops

Those who attended the community consultations had not formed a comprehensive vision of what an adapted settlement would look like in 2030. People expressed some thoughts on the place they would like to live in, but this largely revolved around a ‘business as usual’ vision around quality of life. Sandy Point community expressed confidence that the settlement wouldn’t change too much because of geographical

barriers and the distance from Melbourne, although some community leaders felt that the population would grow. The vision of an adapted settlement presented at the community consultation at Sandy Point was remarkably similar to the vision of the future of Sandy Point which was given in 2006 as background to future planning of the area: low growth within urban boundaries, dependence on nearby larger urban centres, environmentally sustainable practices and a holiday destination (Connell Wagner 2006). In contrast, there were some concerns about how Inverloch was shaping, especially in relation to housing developments and the urbanisation of the surrounds. However, an adapted settlement was commonly viewed as one where people are living sustainably and more simply, with localised sourcing of food and remotely connected to others which reduces travel needs.

The absence of a comprehensive vision or an adaptation outcome was also found in the consultations and the interstate workshops. As the consultation in the workshops was at the local government and state official level, it would seem that a comprehensive target vision is not being sought at this level. While some states were developing scenarios of possible outcomes as a means of understanding choices that need to be made by communities, the choices were based more on values than a vision. A vision which describes what is being aimed for in an adapted settlement offers a direction for adaptation. The consultations all presented the adaptation process as more short term and incremental, dealing with issues as they presented than one moving towards a longer-term vision. Perhaps this should not be unexpected as this view of the development of a vision is found in the literature, where people rely on personal experiences, values and emotions (Trutnevyte et al. 2012).

There was recognition by a few in the individual interviews in the case study areas, of the need to think beyond physical structures and consider more than the physical responses to extreme events, such as how disadvantage individuals will cope and psychological impacts. There was also little consideration of the bigger environmental picture around natural capital, ecosystem services, habitat and biodiversity loss and intrinsic rights of other species. This is despite the fact that the settlements under consideration, especially in Victoria and Western Australia, had the natural environment as an important component of the economic base (tourism) and as a lifestyle attraction for retirees. Many settlements under consideration were based on coastal and wetland ecosystems. This suggests there is a need for information for the communities about the links between ecosystem services and wellbeing and other related issues and the building of community capacity in this area (Mills 2010). The

The general failure to give greater attention to the issue of natural capital and ecosystem services, especially in sites with high values and economic reliance tied in with a coastal and wetland environment, is concerning. This is especially so as coastal wetlands have been disappearing more quickly than other ecosystems, mainly due land development (Dasgupta, 2013). Sea-level rise from climate change will exacerbate these losses, and ‘the resulting economic losses from coastal wetland destruction will be in addition to other coastal impacts such as the forced relocation of people and infrastructure’ (Dasgupta, 2013).

Despite the absence of a comprehensive vision, individual suggestions and specific outcomes, when put in a comprehensive package for Inverloch (see Chapter 7) did add-up to an outcome that would lead to a better adapted settlement as well as one which build on lifestyle and quality living. It was the community suggestions that triggered the visual representation. In a sense the community were able to place adaptation alongside their other concerns about trends in the settlements and suggest solutions that met their desires about the settlement more generally. This suggests that given support and information, the community are able to make decisions about

adaptation that provide a viable basis for adaptation action. This supports the literature which notes the importance of involving the community in adaptation decision-making and in the process of adaptation (Barron et al. 2012; van Staden 2010). It is likely that the development of a more comprehensive vision by the community is closely linked with growth in understanding, capacity, engagement and successful involvement in the adaptation decision-making and activity process. To achieve a vision, a certain amount of control needs to be passed over to the community (Smith et al. 1999). This is especially so given the uncertainty around projections of climate change, where the adapting is not something reached in 2030, but an adapting process and knowledge and necessity becomes clearer.

9.3 The Process of adaptation

To achieve a climate-adapted settlement by 2030 requires a process for achieving this adaptation. Exploration of what is happening about adaptation at the local level found that adaptation is only at the early stages. Not all residents in the settlements appear to be involved, at present mainly those aware of environmental issues and those immediately impacted, such as through sea level rises. Listening to the community in the case-study areas and in the workshop discussions revealed a number of significant barriers to adaptation taking place. These centred around governance arrangements to manage the adaptation process and resourcing of adaptation. This is reflected on further following discussion on some of the questions discussed earlier in the report. The following questions were posed by Smit and colleagues (2000):

1. Adapt to what?
2. Who or what adapts?
3. How does adaptation occur?
4. How do we monitor and evaluate adaptation action to decide if it was successful?

9.3.1 The case study settlements

Adapt to what?
Data collected from the community consultations with Inverloch and Sandy Point suggest that these communities are relatively resilient and well-informed about the risks associated with climate change for their locations (although these were self-selecting participants, and therefore may not be representative of their communities). To some extent this appears to be the case. A member of the research team spoke about the project to a community group, who were remarkably uninformed about climate change, adaptation and other environmental issues. What the group had was a very strong social support structure for local members. In contrast again, there is another environmental organisation that extends beyond Inverloch which has been very influential in moving households to sustainable energy.

Inverloch and Sandy point are quite different coastal settlements. They have varying demographics, physical structures, levels of infrastructure and stages of development, and yet despite their differences they are facing quite similar issues with relation to climate change and planning for their future. There are likely to be many significant impacts associated with climate change on both towns at both a macro and micro level. Some of the main considerations, specifically in relation to the built environment and infrastructure centre on increased extreme weather events which may result in increased:

- deterioration of roads and services infrastructure
- threat to houses and other buildings (fire, flooding)

- reliance on energy using systems to make people comfortable
- storm surges, sea level rises, and runoff from heavy rain
- risk of inundation of low lying areas

Whilst some of these issues are more prevalent due to the coastal location of Inverloch and Sandy Point, they are issues that many settlements across to globe are facing.

While the research team raised a range of issues in relation to adaptation to climate change, few were taken up for discussion. The predominant need to adapt was seen as related to water inundation, largely sea level rises but also inland flooding and erosion of beach areas. Environmental degradation around the town was discussed in both settlements. The Sandy Point residents also gave a little consideration to the risk of fire. In large part, both settlements saw the immediate issues in terms of wishing to maintain their current lifestyle and the threats they saw to this. Their major concerns centred around inappropriate development which was, or was at risk of changing the nature of the towns.

Who or what adapts?
The community consultation saw adaptation in terms of the residents of the towns. Discussion was largely town-based and immediately localised in issues. It also was largely people-centric in content and related to issues that the community were concerned about, such as transport, over-development or inappropriate development and tree loss. However, the solutions to these issues were couched in an adaptation context, the community frequently achieving good integration between present trends and climate change adaptation.

However, while many were environmentally aware, this process tended to leave out issues such as the association between human wellbeing and the environment and loss of ecosystem services. The interface between the trend of biodiversity loss identified in this research and climate change was an issue not significantly identified in the consultations. Yet, one which will need to be placed on the agenda (NRMMC 2010). For example, the development around the inland water in Sandy Point and Inverloch is likely to lead to a loss of interface between the water and land, a space important for mangroves which hold land and wading birds etc.

How does adaptation occur?
The community consultations expressed strong reliance on government to undertake the adaptation, especially local government. Many of those at the community consultations had strong views about what was needed. Both communities took action where they could but felt they had little room to move and take action, being blocked by decisions taken elsewhere. Sandy Point was able to achieve more in outcomes that wanted around urban structure they wished than Inverloch. Both settlements had sections of the population who carried out environmental activities in the form of tree planting and improvement of the foreshore. Inverloch had active community groups one of which was successful in achieving up-take of solar energy generation in Inverloch and Wonthaggi. There was little discussion about individual responsibility of adaptation.

How do we monitor and evaluate adaptation action to decide if it was successful?
This issue was rarely raised in any of the discussions, as all three groups: the community consultations, the individual consultations and the interstate workshops were still at the stage of understanding what the task of adaptation is.

9.4 Governance and decision-making in adaptation

The process of understanding what is happening at the local level and understand the experience of adaptation at the local level revealed some barriers in relation to decision-making at the local scale. These barriers were also reflect (perhaps to a lesser extent) at the
Interface between local and state levels around adaptation decisions. Many commonalities were found in all consultations and workshops, such that it would seem to be important for these issues to be addressed in order to improve the adaptation process and outcomes.

As numerous studies have suggested, for adaptation to any form of change to be successful individuals and communities need to be actively involved in decision making processes (King, Feltey & Susel 1998; Nelson and Wright 1995; Putnam 1995). These studies maintain that governance structures emerging out of community decision making results in a more democratic and therefore more effective response, as individuals and communities take responsibility for the resolution of problems. This is especially important as adaptation is not a 'once-off' process but one that is an on-going 'adapting' process. Yet, as Irvin and Stansbury (2004) argue, incorporating citizens into decision making not only has these sorts of potential benefits but also has associated social and economic costs. With regards to climate change adaptation, a fundamental need lies with due diligence with regards to how participation and community decision making is incorporated into adaptation frameworks, as participants may assume their decisions will be implemented.

Such concern was an issue in this research. The case studies expressed the view that once the community expresses their view there is often no-where to take this to integrate this with other decision-making. The view expressed in the workshops was that there was a new governance arrangement needed to handle adaptation. Local government found that there was a great deal of information about adaption coming in, but they didn't know what to do with it, or were not allowed to use it in another situation.

There was great uncertainty about decision-making expressed by the community and in the personal view of those in the shires, both in the community consultations and the experience of those interstate. This was felt to be a barrier for action at the state government level. It was unclear who should be making the adaptation decisions, whether they should be made at the community level or by government. Integration and coordination of decision-making was seen to be important by all groups consulted. It was commonly agreed across the consultations and workshops that both a bottom up and top down approach was needed to decision-making. The lack of clarity in planning frameworks and other policy has also been reported by many Australian local governments, the matters poorly addressed, not addressed, or treated inconsistently (Gurran et al. 2012).

People were looking for leadership and helpful guidance in decision-making. At the two community consultations at Inverloch and Sandy Point, the attendees strongly felt they would like to be involved in the decision making. The Sandy Point community felt they knew how to get their voice heard – sheer persistence – but didn't always get the exact decision they wished. For example, there was a request that the new community hall be fitted with solar energy generators, but this did not happen. It is also likely that the view expressed at Sandy Point may not represent the whole community. As noted in the consultations, Sandy Point is in many ways a socially fragile community where there are divisions in perspectives and some lack of cohesion. At Inverloch, the view of the participants was that they would very much like to get their voice heard but were hampered by the fact that at times people weren't listening and they had few resources

to formulate their view and take action. Interestingly, the workshop participants, particularly those from state government, wished the community would express their views more clearly. This belief about powerlessness and of not being heard by authorities was also found in research undertaken with the community on environmental change and adaptation in Port Fairy, Victoria (Paschen and Ison 2011). The authors noted a growing sense of frustration in the community where '…locals do not feel listened to by the different levels of government nor do they feel that their own agency to act is facilitated by current practices and arrangements.' (p. 4).

Lack of clarity about who should make decisions was reflected in all the consultations and workshops. This critical issue was said to have set back adaptation in Tasmania, as there was a lack of integration between local government and state government decisions. In SA, many decisions were being made in a collaborative structure between state and local government, however where the community voice entered into this arrangement was less certain. Most people looked to Council to provide the impetus and guidance for adaptation and to resource the community. Many people in the personal consultations and the workshops saw that empowerment of the community to make and take adaptation decisions and actions, was very important.

Concern at the community meeting was expressed about development in general being inappropriate and going in the wrong locations, both for reasons of visual aesthetics and adaptation to climate change. It was felt that developers were being allowed to not make adaptive decisions. The community consultations expressed few views on where the responsibilities of individuals lie. Local Councils felt that many demands were made on them to 'fix things', an issue also strongly reflected in the interstate workshops.

Concern was expressed in the individual consultations as to whether people can handle information about climate change and adaptation or become scared and the housing market will respond negatively. This issue was also reflected in the interstate workshops, such that it meant clear information was sometimes not given to the community. The issue of an adversely impact on property prices, exposing governments to a political backlash from landholders and legal ramifications has been noted in the literature as an issue of concern (Macintosh, 2012).

Issue that some decision-making and policy is being made at the head office level, rather than at the regional level, where local issues are better understood. This is common across state government in Victoria at present, it being also reported in the transport field (Stanley and Banks 2012). Macintosh (2012) reports the stagnation of policy development at the council level and added to the uncertainty surrounding with the Victorian Baillieu government, as well as the unpredictability associated with VCAT decisions. In June 2012, the Victorian government changed the official sea level rises from 0.8 by 2100 to 0.2 by 2040, although the 0.8 by 2100 still holds for greenfield developments outside existing town boundaries (Leitch and Inman 2012).

When is the right time to make decisions in relation to the various areas and issues?

This issue was not given a lot of consideration as a lot of the earlier issues, such as what adaptation decisions should be made, had not yet been resolved. In general, it seemed as if adaptation issues were being addressed as they arose, thus the actions were largely responsive, such as repair of beach access areas which had been washed away. The issue of housing development on flood areas was in large part being side-stepped in all the consultations due to uncertainty about what approach should be taken and about the legal ramifications.

This responsive pattern was also reflected in the interstate workshops, where the Councils responded to requests from residents, such as carting in and replacing sand on beaches where it had washed away. However, the discussion in the interstate workshops around timing of adaptation decisions suggested that thought was presently being given to this issue, although the matter is far from being resolved. In general it was felt that the timing of the decision should reflect the life-time that the decision would hold. For example, if capital works were planned to last 30 years, then adaptation will need to be built into the project. However, this may be a 'wish' scenario, as there was a belief held by many that the government will pay for a rescue if capital works was not built to stand up to extreme weather which could be expected over the next 30 years. There was also uncertainty as to whether it was better to take action now, such as not build the sea wall until absolutely necessary, in order to retain the last few years of view or amenity. This view was being adopted by some councils, putting the onus of responsibility on the owner of the asset, such as a house. This issue was further considered by the research team in a modelling of the economic impact of adaptation decisions around an extreme event and is discussed below.

Such issues could be best address if the process of adaptation is not seen as a single event, but as a process of social learning and step-wise decision-making for an adapting community (Macintosh 2012 and Yuen et al. 2012).

Where does local responsibility begin and end?

This question was not given a great deal of consideration in the consultations and workshops. Leitch and Inman (2012) note that governments generally assume that residents will consider and inform themselves about risk to their own properties, however they note that consideration of natural hazards is just one factor of many considered, such as proximity to views or the beach. In line with the Inverloch's community concerns about property development, Leitch and Inman also report that developers are found to be less concerned over flooding potential than other stakeholder groups. Recent work by Beer and colleagues (2012) also found engaging with the community is an important part of the adaptation process, an issue receiving increasing attention.

In terms of comprehensiveness of an all hazards approach to adaptation, the major conversation was about sea level rises, flooding and erosion. How people will psychologically manage adaptation and the associated uncertainty, risks and the possibility of the occurrence of a catastrophic event, was largely not raised. While some people mentioned the issue that there could be a really doomed outcome in the future, there was little serious consideration about the implications of this for adaptation.

Adaptation of natural capital, the maintenance of ecosystem services and the responsibilities around this was left mainly unconsidered. Most of the discussion was person-centric and very individualised and localised. The issue of whether, and how, the local population should be making decisions for a broader perspective was not raised. For example, the sea and natural environment is a strong attraction for many tourists, many of whom use Inverloch and Sandy Point as a holiday destination. The ethical place in adaptation considerations, and the responsibility of the permanent locals in representing the interests of short term residents and day trippers, was not raised. The use of the coast as a retreat from heat may become more important as people experience temperature rises, especially those living in large urban areas wishing to escape the heat bank impact.

The coastal areas and associated estuaries are important ecological habitats. Many harbour threatened species and are an important habitat for migratory birds. Again,

little consideration was given to this issue in the consultations or workshops. Whose responsibility to make decisions about adaptation measures to maintain these habitats, whether it remains at the local, state or national level remains an important unresolved issue.

Place-based decision-making

The process of local decision-making assumes a place-based approach. The findings from this research suggest that this is an important approach. Due to the complexity of systems in which adaptation has to be made, it is necessary to devolve power downwards to the local level to draw on localised knowledge and values (Avis 2012). While the boundary of what is defined as local place is often variable – according to the sort of issues under consideration, the consultations and workshops revealed how strong identification of place would assist the process of adaptation. People felt very strongly about local issues and while there was not always cohesion, the establishment of a good decision-making process would assist in the elucidation of community values and desired outcomes. A strong sense of place would facilitate the engagement of people and draw on their local knowledge, support structures and social capital, to deal with uncertainty and risk, as well as in turn, grow this capacity.

9.5 What characteristics of a community will tend to facilitate or militate against successful adaptation?

Adaptation was seen to be hindered by the lack of urgency and interest or priority by some sectors in the community and in other cases by fear of climate change. Some community members felt that other issues had a higher priority, such as the lack of transport for many people. People did not want to engage with a 'doom and gloom' scenario that some felt was being perpetrated in relation to climate change. However, the communities were viewed as strong and resourceful by many of those in the individual consultations, which will be a resource for when adaptation is taken up more strongly.

There were very few connections made in any of the consultations in relation to the positive aspects of adaptation and how the process of adaptation could be used to improve other areas at the same time. It would be a very positive step if this message could be extended to the community, as the community themselves didn't view adaptation as something separate from the many issues which they thought about in relation to their community. They were in fact taking an integrated perspective.

The short term timeframe and more responsive approach to issues rather than a planning and prospective outlook also made adaptation more difficult to initiate. The lack of clarity about who made decisions and how they were made was a barrier to community participation. The need for the community to push their point of view very strongly was is a barrier. The lack of a structure which enables the community to express their view, apart from the community consultations, but then there is a perception by many that their views are not necessarily acted upon.

In general, the lack of resources owned by the community and local and state government, was viewed as a barrier. This included time – any community action was largely voluntary, and the Councils seemed to have many competing demands on their time and found it difficult to establish priorities. Information was also needed.

The community needs to be better informed about climate change, with personal knowledge being largely dependent on awareness and interest. The Council was also finding that they could be better informed in some areas, information coming in slowly

and not always consistency. Macintosh (2012) notes that the 2008 Victorian coastal climate hazards planning framework is often ambiguous and little guidance if offered in implementation.
Improved mapping was slowly being undertaken. In other situations, such as in relation to research about adaptation, Council seemed to be overwhelmed with information and unable to prioritise and ascertain where action could be guided. Part of the complicating issues here relate to the ideological position of the current state government which artificially divides adaptation from climate change, the latter being said to be not an issue for state government.

The lack of resources in terms of a dedicated budget for adaptation is also a very important barrier, referred to repeatedly in all consultations and workshops. Community spent considerable time applying for small amounts of money to undertake their environmental work. While there was some grants for specific tasks and research, actions around adaptation were not furnished with a clear budget. In some situations specific tasks, such as assessments and planning for adaptation undertaken at the region in SA were funded by the state government, but this was more on a case-by-case basis. In turn, state governments were seeking federal funding for specific projects. The lack of funding at the local government area was also found to be of particular concern, as well as the need for on-going seeking of funds, in other studies (Gurran et al. 2012).

Uncertainty around the legal and insurance implications around adaptation decisions was proving to be a barrier to adaptation. This particularly related to capital works, government land and the public responsibility for individual's decisions. On-going maintenance of adaption works, such as the building of sea walls, was a source of delaying action.

Selective attention in adaptation appears to be a problem. Community interest in adaptation is centred around their view of the world and self interests. Broader issues or common issues are not generally on the radar. This leaves considerable gaps and it may be that there have to be other ways of addressing these. For example, ecosystem services are fundamental to wellbeing but at present not seen as directly relevant to people by community members. Similarly, changes in agriculture, and equity issues in adaptation were being largely omitted. The comprehensiveness of adaptation needed has not yet been fully recognised. The dominating concerns associated with sea level rise, shoreline loss, storm surge, and coastal erosion, along with the perception that development is continuing to occur in vulnerable locations, exacerbating future risk, was noted in recent Australian work (Gurran et al. 2012).

Interestingly, Leitch and Inman (2012) report similar barriers to those found in this research, namely:

- Lack of local information sufficient for decision making - an absence of locally relevant, accessible and useful information to guide action.
- Lack of financial and human resources.
- Complex competing responsibilities for Council around complex issues.
- Lack of progress or support from other tiers of governance, and a lack of clear direction from state governments was found to be constraining. Leadership, collaboration and consistency from all tiers of government is needed.
- Lack of community concern or backlash from the community

This latter issue was not found to be present on any large scale in the consultations and workshop in this research.

9.6 Commonalities and differences of issues between the case study sites and interstate workshops

The key findings from the three interstate workshops can be summarised as follows:

- All three states were in the early stages of the adaptation process and in a learning phase
- None were working from a clear vision about what an adapted settlement would look like in 2030.
- All three states were approaching adaptation slightly differently although there was commonalities in many of the issues they were facing
- Two of the states lacked a governance structure on which to build adaptation and this was creating difficulties in relation to understanding job tasks and decision-making. One of these states was building a localised structure in cooperation with the state government. The third state was using a structure already established for a slightly different purpose, although this structure did not incorporate the community level.
- While there was a budget associated with the state with the pre-existing structure, additional resources for understanding adaptation was more ad hoc. There did not appear to be a resourcing structure for adaptation in the other states, funding and information resources being more ad hoc and opportunistic.
- The importance of consulting with the community was understood, but there was a lot of uncertainty around this, particularly around take-up of community ideas.
- 'Lifestyle' decisions seem to have dominance in relation to urban structure
- Considerable uncertainty was present in much of the adaptation processes around decision-making, legal liability and resources.
- Knowledge about adaptation is growing but better use needs to be made of this through a structured and coordinated process of knowledge development.
- Sea level rises was the predominant issue in all three states, rather than an all hazards approach – this seemingly being too much to take on at this stage.
- Environmental destruction and ecosystem services are almost not on the agenda yet.
- Similarly, little attention is given to adaptation of the economy or the psychological and social process of adaptation, although one state acknowledged the need to consider these issues.

Thus, it could be said that the two case study sites and the three states are finding the task of adaptation a considerable task where more guidance and support is needed. The way to conduct the adaptation process and priorities is really being learned along the way by each site. In all locations engagement in adaptation is being undertaken by an active group of citizens who could be said to be more aware about climate change, and possibly have more time to be involved. The method of engagement with the community is not clearly defined other than holding community meetings. All three venues struggled with a top down and bottom up approach to decision-making as there lacked a governance framework to facilitate this process. The most advanced in this area was SA where they were able to build on a state structure they had been put in place around the environment, a number of years ago. However, SA was yet to build stronger connections with local communities. They also had resources. An regional governance structure was being built in WA. The link between wellbeing and natural

capital was not commonly made in the community consultations nor the workshops. This is despite the case study settlements being dependent on holiday residents and tourism, drawn to the seaside and natural environment. This was also particularly reflected in Tasmania and WA.

9.7 Can general principles be established?

Part of the task of this research was to understand if the principles of adaptation can be generalised to other settlements. This would encompass settlements of differing sizes; urban settlements beyond the coastal fringe; settlements with varying characteristics, such as infrastructure provisions, economic base, demographic structures and rate and nature of change

In general it was felt that adaptation was a location specific task. Decisions about how to adapt needed to reflect local values as each settlement is unique. However, people reflected that they would like to be able to share ideas, actions and learnings about how people addressed and resolved issues. There were some common characteristics of smaller settlements, such as their isolation and strength under adversity. At present, while there was considerable information on aspects of adaptation, this was hard to access and hard to dissect for the usable components. Some areas were successfully resolving some issues, yet their experience was not generally available for others to use.

What was found to be clearly lacking was a governance structure on which to frame decisions and actions. The process and means to take decisions and initiate actions and understand the varying roles and responsibilities was not available. The WA workshop reported that in the Mandurah area they were beginning to address this through the formation of a regional cooperative structure and the level of local government. Similarly, SA was using a structure for adaptation and climate change that had been established to address issues around the natural environment. This provided a regional network across the state and a regional structure for knowledge building and decision-making. In both the incorporation of the community perspective was less clear, as was the position of an action-orientated approach and associated resourcing.

Policy goals usually target economic, environmental or social needs. Local government already manages a range of natural hazards such as landslips, flooding, bushfires, extreme weather events, coastal erosion and earthquakes. State legislation requires local Councils to manage current and future risk of natural hazards through a range of policies and action including land use planning, disaster management planning and response, and management of Council assets and resources (Leitch and Inman 2012).

Over the past few decades economics and growth has dominated policy goals, being viewed as the means of providing the solution to society's needs. Market failure is the fundamental basis for policy intervention, with applied welfare economics, and the related area of public choice, providing an integrating framework for approaching policy development to tackle such market failure (Stopher and Stanley 2013). Rifkin (2011) argues that much of our current thinking is based on an historical paradigm which served industrialised nations well in moving people to and through the industrial revolution with coal generated electricity providing the energy for this change. However, Rifkin also notes that this model is based on individualised self-interest, competitiveness, and in recent decades, rampant consumerism. Howe notes that social policy concentrates on raising people's skill level in order to be more competitive in the labour market:

> *Governments tend to focus on limiting spending rather than on finding ways of investing in people… they are our society's human capital and their unrealised potential can contribute to the community* (Howe, 2007, p.21).

Such a statement could also be made a about the natural environment.

There was a strong movement arising from the UK about the turn of this century for government departments to move towards integrated governance models, rather than only operating as functional departments. However, little practical success was achieved with wonderful silo heaven continuing to be the major way of working. There is a revitalised interest in integrated policy at present. The decisions around climate change mitigation and adaptation have inherent complexity, are of considerable importance and suffer from the inadequacy of the traditional economic solutions, inefficiencies as well as resource constraints (Stopher and Stanley 2013). Much of the decision-making rests around distributional consequences and values – many of which are intangibles with inherent measurement difficulties. Especially in climate change and adaptation, information is needed for good policy and decision-making, the tradition 'facts', but also values and beliefs.

This emphasis on values suggests approaches that include extensive open consultative processes, Etzioni's (1994) 'communitarian' solutions. Etzioni argues that policy should seek to promote institutions that stand between the individual and the state (e.g. family, voluntary organisations, schools, churches, neighbourhoods and communities), an idea that resonates with that of the Big Society in UK (Blond 2010).

9.8 What are the principles?

There are a number of principles that can apply to decision-making in relation to policy – decisions to assist with the issues as outlined above. These principles are based on social justice and equity ideas, they are based on decision-making which is removed from politically created limitations and competing demands, and based on a belief that communities are able to make 'correct' decisions, given the opportunity (Stanley 2013). Berke (2002, p.33) offers the following principles:

- *Harmony with nature* where land use and development minics or follows ecological systems rather than alters them
- *Liveable build environment* where all elements – location, shape, density, mix, proportion and quality - should enhance the interface between people and urban form
- *Place-based economy* where the local economy operates within natural system limits of operation and renewal, including the assimilation of waste
- *Equity* where land use patterns improve the conditions of low income people and equal access to resources
- *Polluters pay* where the costs of their adverse impacts
- *Responsible regionalism,* where communities consider the consequences of their actions within a broader setting.

To this should be added, recognition of the intrinsic rights of other species.

9.9 The operating environment for these principles

The literature gives many examples of how to undertake adaptation planning and agencies are attuned about the need for this. However, there seems to be a gap between what needs to be done and achieving action on the ground. Adaptation will require a move from 'business as usual' and the use of planning models based on past experience. Policy and planning is grounded in a method of incremental changes but it is unlikely that this will achieve the desired outcomes of response to climate change. The new operating environment will need a rethinking of past practices. The following ideas offer some thoughts on new ways of approaching the business of adaptation.

The community consultations illustrate that there are strong community strengths which can be used to facilitate the adaptation process but there are also barriers which limit the opportunities for community participation. It is likely a similar situation can be found in other sectors. The following ideas are drawn from a number of sources, including a paper by Skinner (2010):

1. Resources and other services, such as electricity, water, transport and urban form will not remain in the form as has been customary over the past few decades. Past practices will not reflect future practices. Uncertainty of supply needs to be accounted for in the transition to new systems. This may also mean a need for diversity of supply in order to maintain capacity during and after extreme and/or unexpected climate events. The process of adaptation is an iterative task needing flexibility to respond to the most important issues and encompassing the ability to respond to new information. This is likely to involve both larger scale solutions and smaller localised solutions. The assumptions about maintaining low cost in the supply of many basic services will need to be reviewed.

2. Changes in the provision of services may bear other environmental costs. These need to be understood and monitored to reduce growing environmental destruction and biodiversity loss from human impacts beyond climate change. Skinner gives the example of ensuring minimal environmental flows of water are maintained to preserve priority species and ecosystems. Another example could relate to the use of battery cars to reduce greenhouse gas emissions without addressing pollution arising from large-scale disposal of batteries.

3. Integrated adaptation planning is needed to deal with the complexity of solutions which exceed traditional sectors. For example, urban structure, transport, housing, water and energy generation, as well as health and wellbeing need to be planned together as solutions are linked. For example, firm urban boundaries to protect local environmental assets may necessitate two or three storey houses, which in turn improves accessibility and reduces the need for cars. However urban space and tree cover is needed to protect people against urban heat. Room for services such as water tanks, renewable energy generation and local food growing needs to be part of the picture. Integration is needed across sectors (government, non-government, community, business etc.), across fields (water, energy, urban structure etc.), across units of organization (individuals/ households, communities, organisations, government entities etc) and across policy options (taxation, programs, infrastructure, demand management etc.).

4. The adaptation task is large and requires involvement from individuals to large organisations and government. Skinner notes that the public want to be involved in adaptation, a message confirmed from this project's community consultations. While meaningful engagement and a well-informed community debate are needed, the process also needs to be able to empower communities to inform decisions taken elsewhere and to take actions themselves.

5. Skinner talks of creating an appropriate culture to enable the innovation needed to enable the complex processes required by adaptation. A collaborative environment is needed where people are both encouraged to take risks and supported if the risks they took doesn't prove to be successful.

9.9.1 The essential ingredients to achieve these outcomes

The essential ingredients to achieve these outcomes could be viewed as (1) resources (2) vision and lateral thinking, and (3) structures in place to undertake this new agenda and integrative work. It would seem that new and additional ways of operating are being undertaken under structures and circumstances that reflect past ways of thinking. Adaptation is being treated as 'an added task' with much of the burden falling on Local Government, a view also followed by the consultations in Inverloch and Sandy Point. As Skinner notes (referring particularly to water):

a) *A much wider range of water authorities, government bodies (federal, state and local), and private businesses will be involved in developing and delivering solutions*
b) *We will need to work with others in undertaking significant research and development to better understand the risks, opportunities and barriers to better utilization of non-traditional and often decentralized solutions…* (2010, p.14).

Resources

The role of the community

The community consultations in Sandy Point and Inverloch highlighted many issues for the research team about the role and ability of the community to facilitate the form and direction of adaptation that maintains their values about the community in which they live. There is presently an important conversation about the role of community, particularly in a the light of the recent international economic downturn and banking failures, market failures and the growth of welfare recipients and inequality in industralised countries, but also to a lesser extent it is being connected in the literature to climate change. Much of this conversation comes from the UK under the title of 'Big Society'.

In Australia, as with many other post-industralised countries, the management and facilitation of quality of life, wellbeing, social support and care, and assisting those experiencing disadvantage, as well as environmental preservation, particularly local environmental issues, is largely viewed and practiced as the task of the community. This takes place through individual actions, through informal structures and local not-for-profit organisations, as well as more established broader, state, regional or national organisations. Much of this critical life quality and values activity is undertaken through voluntary labour, supported at times through, what are usually small funding grants, and other forms of support from state governments. A recent trend is for the operation of social services to be tendered to NGOs, tasks previously undertaken by government, the latter's role now being a contract manager of closely defined tasks to be

undertaken by the NGO. However, the task of adaptation requires a considerable up-scaling of required responses.

Recent authors, such as Jordon (2010) and Blond (2010), argue that there has been an erosion of civil society. The emphasis on handing out money and contracting for specific services with targets and outcomes to conform to business models and economic markets, has overlooked one of the major gains in social services, which is the building of social capital, associational organisations and community links.

> *…social interactions produce and distribute social value… because the need to communicate and co-operate in groups and communities requires emotional support, interpersonal esteem (or respect) and the sense of belonging (or membership)* (Jordan, 2010, p.78).

It is just this that is needed if the community is going to be a participant in the task of adaptation, and adaptation that maintains wellbeing is not going to occur without community participation. It is only by understanding local context that good policy will be formed, as citizens need to be empowered so that they have more choice and control over decisions (Avis 2009). Thus, the first resource is the strength of the community. The second resource relates to an adequate level of financial support to enable the community to do this work. This is critical to a good outcome and is not there at present. While voluntary labour will always be important in community work, the absence of base level, secure and on-going funding is short-sighted and counter-productive as the value-add to this funding is likely to multiple many times over.

Vision

The second essential ingredient to achievement of good adaptation outcomes is, as noted above, vision and lateral thinking. The community consultations have revealed that the community can provide this. However, the NGO sector and the community need greater empowerment and an ability to offer a greater contribution to decision-making, especially in relation to their local community. Thus, especially in the case of social programs, NGOs need to be able to have arrangements that allow the flexibility of building relationships, belonging and local support systems. As Skinner notes above, organisations need a supportive and collaborative culture that allows new ways of thinking and perhaps even failure at times. It is only when the social structures are healthy and strong that issues such as adaptation can be attended to. A person or household with unaddressed social vulnerabilities understandably fails to see the importance of adaptation, as immediate pressing problems will take priority over future concerns. A strong cohesive community has higher capabilities to will deal with future challenges.

9.9.2 Structures to support action

Finally, the third essential ingredient are new structures to facilitate adaptation, rather than trying to use old, dated methods and simply adding on extra tasks to these past processes.

The need for robust decision-making is stressed as the key to adaptation. This cannot be argued against, but it leaves out some critical issues. The research findings outlined in this report suggests just how this decision-making process takes place. Who makes what decisions, when? Secondly, who carries out these decisions, who monitors the impact of these decisions and who makes adjustments to these decisions when either the situation changes or new evidence comes to light? delete The very nature of adaptation is that the response needs to be iterative, with on-going adjustments. This failure to specify the decision-makers becomes more complex with the recognition that the decisions are value-laden (VCCCAR, 2011) as it needs to be agreed as to who has

the right to make these value decisions and in what circumstances. The whole question of how this major is undertaken becomes critical.

Such a large and complex task needs specific purpose structures to be put in place. There is a need for connections between the governance structure where the general direction is set and people are empowered to act (Avis 2012). This requires orientation towards a core set of goals and building a shared vision by bringing together shared perspectives and putting together strategies (O'Leary and Craig 2007, in Avis 2007). The following structure (Figure 9.1) is suggested:

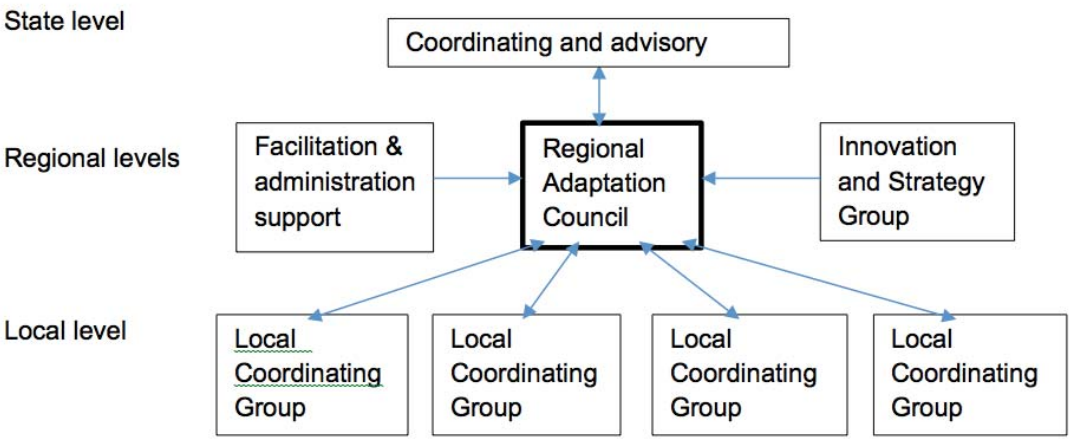


Figure 9.1: Structures to facilitate adaptation

Source: Derived from Stanley (2009)

It is suggested that representatives from each of the sectors (government, non-government and community sectors) form a Regional Adaptation Council. Based on the requirement of the Climate Change Act which requires a state adaptation plan, this Council would set priorities, co-ordinate approaches, secure resources and oversee progress on adaptation. A number of Adaptation Councils could be established across regional areas in Victoria. These Adaptation Councils across Victoria could be overseen by a Coordinating and Advisory Group. This Coordinating and Advisory Group would comprise representation from state government departments, business, and the research sector. The Group would collect key learnings from the Adaptation Councils and feed these back to the state and federal government departments to facilitate adoption of this knowledge into policy and government programs. A facilitatory administration and information collection group would act as a Secretariat for the Regional Adaptation Councils. This group would manage a website, gather and present information for the Regional Councils, organise workshops and generally facilitate their operations on a group basis. An Innovation and Strategy Group of climate change experts, researchers, NGO, business and government representatives would bring forward new knowledge, technologies and developments and innovation and encourage transformational thinking which will impact on, and facilitate the adaptation process.

Each local area would have a Local Coordinating Group for adaptation led by the community sector. This Group would provide information, resources and a central organising and coordinating point for the community. The group would have its own office and resourced administrative support as well as a secure operational budget. It would initiate and support adaptation projects and provide input into other points of

decision-making in relation to adaptation. This would be a point of community capacity building, a knowledge centre and provide a means of addressing specific vulnerabilities to adaptation, due to social or environmental vulnerabilities. Examples of activities include organising group purchasing of low energy products; linking people with microfinance and non-interest loan schemes; development of community gardens; food cooperatives for localised wholesale food buying and purchase of excess home grown food; local kitchens to increase knowledge on low cost/low carbon intensive food; a car pooling and car sharing scheme….

The role of the community

The community consultations in Sandy Point and Inverloch highlighted many issues for the research team about the role and ability of the community to facilitate the form and direction of adaptation that maintains their values about the community in which they live. There is presently an important conversation about the role of community, particularly in a the light of the recent international economic downturn and banking failures, market failures and the growth of welfare recipients and inequality in industralised countries, but also to a lesser extent it is being connected in the literature to climate change. Much of this conversation comes from the UK under the title of 'Big Society'.

Social Enterprise

It is suggested that the model for this Local Coordinating Group should be a social enterprise. A social enterprise is a business with mainly social objectives whose surpluses are primarily re-invested for those objectives in the business or community. The social enterprise is owned by shareholders who are members of the local community and local community organisations. The shareholders would select the Board when the entity is established as an on-going business. The Board should include a balance of people with requisite directorial skills and representation of key stakeholder groups. The social enterprise offers an adaptation hub, which will:

- Coordinate a local adaptation plan and program
- Raise, distribute and coordinate adaptation resources.
- provide an information service to advise regional residents/visitors of adaptation needs and options
- Provide assistance around adaptation
- Monitor adaption progress in the local community
- Represent the community in other sector decision-making on adaptation
- Understand particular vulnerabilities to climate change and coordinate an approach to address these vulnerabilities
- provide volunteering opportunities
- possibly provide job training.

The social enterprise will need a small organization to perform its roles. This task could be undertaken via a management contract with a suitably skilled local entity. The need for this organization was strongly voiced at the Inverloch community consultation. It was even given a name: "Voice of Inverloch". It was envisioned as a group of local people to come together, evaluate and synthesise information from state and local government and other agencies and own the action and do what is best for Inverloch. It was felt that there should be a body/group that takes responsibility to find solutions through consultation - a group that takes these issues on board and speaks on behalf of the community. This would give the community a sense of empowerment.

Amongst the first challenges of the social enterprise will be to:

- Define a vision for Inverloch so there is a standard or outcome for the community to work towards. This will involve establishing a set of adaptation targets and prioritizing these targets.
- Understand the task in hand to achieve these targets and plan a process for achievement
- Set up a monitoring system to understand progress towards these targets.

Establishing these structures will take time and a structured and ordered process. It is suggested that the first step is to use Inverloch to pilot a Local Coordinating Group. Indeed, in some senses the community has already started this process by identifying such a need and with volunteers to begin the process. A multi-sector committee could initiate a two year pilot of such a social enterprise and secure funding for its establishment and trial. The establishment of a social enterprise is a first important step in achieving resources, vision and structure to achieve adaptation that facilitates the wellbeing of human and other species.

9.10 The task ahead

Based on a possible structure outlined above, the adaptation tasks ahead were suggested in Chapter 7. In addition, an example was given of the place of adaptation for an extreme event, floods and fire (Chapter 8).

Extreme weather events have 'dominated' the 2012/2013 Australian summer, including heatwaves, bushfires, intense rainfall and flooding (Steffen 2013, p. 2). How best to adapt to these events was the subject of discussion in both the community consultations and the workshops. Consideration was given by communities as to whether it is best to live with the risk and physical changes (especially sea level rises) and defer adaptation to enjoy the environment while possible, or adapt early, such as build a sea wall or move housing. Chapter 8 of the report reported on economic modelling to begin to examine the benefits of preparedness or adaptation. Three options were modelled in relation to water inundation in Inverloch and fire at Sandy Point. These options were: adaptation investments and no insurance; no adaptation and insurance by households and local government; and no adaptation and no insurance.

In essence, the outcome was dependent on factors such as timing of the extreme event, which cannot be predicted, and the discount rate - whether costs will be met by this generation or the next. While early adaptation involving construction of infrastructure in Inverloch will provide jobs and investment during the construction stage, this will be at the cost of future consumption. The insurance cost in the modelling was spread over the national population. This may be so for some situations, but there may be a significant rise in risk in some locations, such as housing on flood prone land or in a high fire risk area. The rise in extreme events are likely to raise the overall cost of insurance. The reinsurance industry, which takes on some of the risks underwritten by insurers, faced its second-costliest natural catastrophe year on record in 2011 after a spate of disasters generated a claims bill of $116 billion (Mortimer 2012). Those on a low income may op out of insurance payments and experience higher rates of disadvantage after an extreme event. In the recent Queensland floods, the lack of affordability of flood insurance was found to extend to 'most home owners' (Schlesinger 2013). Nearly 40% of Queenslanders are without insurance against flooding (Goodall 2013). For those that have insurance, the average costs of flood cover in Queensland offered by one insurance company is $A8,200 but can be as high as $A19,000 (Schlesinger 2013). These figures are for flood cover only, all other

insurance averaging at $A1,250 in Queensland. Such costs will reduce the asset value and therefore sale value of vulnerable location sites, again those with a lower income will have less capacity to absorb this loss. This is likely to include those sites vulnerable to sea inundation, to drought and to bushfire.

Ultimately many of these decisions are value judgements – choices to be made about what is valued in the local community and how to understand risk and what is the value to people of avoiding an emergency event. Leitch and Inman (2012) note that traditional risk communication emphasised scientific and expert knowledge and one way communication, while contemporary risk communication emphasises balancing a range of knowledge from different sources and creating opportunities for shared learning and innovation. These decisions need to be based on the best information possible (Hales et al. 2012). As noted earlier, these decisions need to be made on a case-by case basis by the local households, businesses and council. This will be based in the inclusive involvement of the local community and local leaders in decision-making which incorporates local preferences with proven strategies from other areas (Hales et al. 2012). This should extend to the recovery process when an extreme event occurs. Thus both a governance structure is needed and an integration of local knowledge from local government and the community to assist in decision-making with insurance companies and those with specialist knowledge about likely outcomes of extreme events (Goodall 2013).

This said, it is important to note that some decisions, especially around the environment, not only impact on the local community. Decisions around the commons where they impact on Australians generally and indeed wider than Australia, such as loss of a wetland which may be of international importance, add considerable complexity. This research found that environmental loss and loss of ecosystem services did not feature strongly in community deliberations and decision-making. The economic modelling did not factor in the cost of loss of ecosystem services, just infrastructure related to tourism. There may be a different outcome if this was included. The true cost is social and psychological and environmental, in terms of trauma, loss of life and injury experienced and also those particularly vulnerable who may not be able to fully recover due to additional vulnerabilities, the loss of ecosystem values and services and damage to other species, water and air quality and the environmental experience. The cost of all these are yet to be measured.

9.11 Conclusions

The research examined what is happening with climate change adaptation in the field, an issue not adequately covered to date in the literature. More specifically, this research involved a critical examination of two case study sites within the Gippsland region - Inverloch and Sandy Point in Victoria. The case study sites were carefully considered in order that the research findings address the concerns of local communities as well as the concerns of adaptation more broadly. Therefore, while the Gippsland region presents particular sets of economic, social and ecological challenges, it is not unique in facing new governance challenges associated with climate change, and the findings made here are relevant to other regions across Australia. Hence, the approach that underpins this project recognises that it is crucial to develop place-based understandings of urban planning principles and practices that respond to the specificities of local and regional differences within the broader context of regional and national adaptation strategies.

9.11.1 Findings and recommendations

The research findings and consequent recommendations about future work are now summarised. The first research question or objective is now re-phrased from how it was expressed at the beginning of this project, to better reflect the research findings.

What is the present economic, social, environmental and governance arrangements in each of the settlements and what are the capacity restraints external to climate change?

While Inverloch and Sandy Point, in common with similar settlements interstate, are attractive to those seeking to move to a more relaxed lifestyle following retirement, there is also a significant seasonal influx of summer holiday makers taking advantage of these townships' proximity to the capital city. The findings suggest that the permanent residents consulted are relatively resilient and well-informed about the risks associated with climate change. However, the concerns in these communities are that seasonal residents are less prepared and informed about risks associated with climate change such as extreme weather events that result in wildfire and flooding.

Participants valued the natural beauty of their town and its surrounds and expressed a clear wish to retain and enhance this into the future. They were concerned about the loss of green space and damage to ecosystems associated with urban development and identified loss of funding for state government agencies (DSE, Parks Vic) as additional threats which may affect the protection of these assets. Participants were particularly concerned about new developments along the coast and recognise that the main public spaces in Inverloch are along the foreshore which is under threat from sea level rise.

Recommendation

The project findings demonstrate the importance of local knowledge in understanding the impact of climate change on specific environments and communities, and therefore how a community can be involved in adaptation, on a personal and community basis. The importance and need for well-informed communication about climate change adaptation and responses appropriate to particular areas and regions is necessary. Therefore this report recommends that clear and relevant channels of communication must be established and maintained in order to adequately respond to community needs and values.

What climate changes will be present in each of these settlements in 2030 and what trends will be in place for 2050?

The general trends with regard to climate change in the case study locations include an increased number of hot days and a fewer number of cold nights. While rainfall projection is uncertain, there is likely to be a lower rainfall but more intense events. The sea levels will rise and flood low lying areas, especially where associated with a storm event. Extreme events will occur more often.

Recommendation

Greater knowledge and preparation is needed to both understand the impact on infrastructure and the urban environment, on business and farming and on the environment, on which much of the regional economy is based. Such knowledge is needed to enable the community to establish their values, priorities, trade-offs and costs, and overview how action will be instigated and maintained. This adaptive process will continue in response to uncertainty and changing priorities.

What is the community's vision of a climate-adapted settlement?
While the communities lacked a comprehensive vision for an adapted future, ideas expressed in the consultations added up to many good practice adaptive ideas. The lack of an agreed outcome was also absent in the interstate consultations, many people only looking a few years ahead and considering only a few of the implications associated with the need to adapt to climate change.

Recommendation
The community needs assistance with a visioning process in relation to the implications of climate change and the areas where adaptation will be needed. While local government is increasingly able to access better quality data, there is a need for a process to better convey this information to the community in general.

How can this preferred settlement be achieved? Who makes what decisions about adaptation and where does responsibility lie?
The research found that local communities are able to make adaptation decisions when given a structure in which to operate and a process to adopt these decisions, as well as resources to undertake this work. However, the risk is that if the community feels they are not being listened to, then they will feel disempowered and reluctant to be engaged in the process. A good adaptation process will enable the community and local voices to further engage and strengthen the community, perhaps widening engagement as social capital grows, enabling the community to better meet the task. This includes the adaptation actions which need to be taken at an individual or household level, such as installation of renewable energy. It also includes the ability to involve those who may be isolated in the community. Such a community will be better able to manage uncertainty and extreme events, such as flooding and fire and make important decisions about values, risk and the extent of adaptation and at what point of time should action be taken.

Recommendation
Despite the lack of an integrated approach the settlements in this study were able to express their ideas and wishes about their urban environment, this being strength on which to build the adaptation process while at the same time maintaining local values and addressing local challenges. However, their perspective was fairly narrow. The need to adapt to environmental loss and the climate change threats (and trends of biodiversity loss outside of climate change) was an issue where few links were made in all locations. This is despite the strong lifestyle and economic basis for most of the studied locations, where people move to the areas on retirement due to the attractive location and the tourism economic base of the settlements. This suggests that this is an area which needs knowledge building and more community consideration, as well as more work at a strategic level.

What are the commonalities and differences of issues between the case study sites and can experiences be drawn from the interstate workshops?
The workshops reported similar issues relating to complications of the newness, complexity and uncertainty of the adaptation process. All locations were in the very early stages of moving towards comprehensive adaptation. Each site presented as learning the process of adaptation in their own way. One state is addressing the question of the process to use to undertake adaptation, another is experimenting with coordinating their activities in a region within the state, and the third was using an existing governance structure designed for a different purpose.

Recommendation
The workshops proved to be highly valuable to those involved suggesting the value of a national linking organisation which can facilitate the sharing of experiences and best practice between local government areas.

What are the principles which can be generalised from this research to small urban settlements throughout Australia?
The project drew on broad principles for small settlements as there were many commonalities between the case study and interstate sites in relation to the issues being faced and the stage of adaptation. The importance of place-based and community decision-making was revealed, and the capacity of the community to make good decisions was clear. What is seen as important is the establishment of an integrative governance structure to disseminate knowledge, facilitate local decision-making and enable the decisions to be enacted. It is vital to support this process through the adequate provision of resources.

Recommendation
There is a need to establish a place-based governance structure and provide this with resources to enable the capacity of the community to be utilised and enhanced, as well as engaged with the extensive task of adaptation.

What have the research team learned about the adaptation tasks needed for Inverloch and Sandy Point to be adapted in 2030? What would be the economic, social and environmental impacts of an extreme event on Inverloch and Sandy Point?
The participants wanted a balance between wise and well-considered community decisions that take into account sustainable development, a concept participants defined in terms of 'green attitudes', a balanced approach with regards to change, and notions of an *adapting* (not adapted) community. At present, local adaptation appears to be narrowly viewed and hard decisions are not being made. For example, in Inverloch, the loss of public space will be exacerbated by the loss of the foreshore due to sea level rise. In Sandy Point, making places more publically available may mean compulsory acquisition. There is a dominance of discussion around sea level rises, although generally not many decisions are being taken about the best adaptation process around this. The researchers offered an adaptation framework for both settlements to facilitate the adaptation process. They also provided an example of an economic model of the cost of two extreme events, where the extent of adaptation undertaken and the impact on insurance costs, were taken into consideration. While such a process enables costs to be explicit, again the decision about when to adapt needs to be based on local values and the local impact of climate change.

Recommendation
Given the differing views held by individuals in the broader Australian community with regards to acknowledging climate change and its impacts, a clear sense of what is important to each town's various communities is necessary. Individuals and groups need to be able to clearly communicate concerns and issues and come to some agreement on what is happening and what needs to happen. Therefore there needs to be in place:

- open and ongoing communication that includes all stakeholders in decision-making processes
- clear implementation processes at local and state levels

9.11.2 Unresolved for the future

A great deal needs to take place if a settlement is going to successfully adapt by 2030 and maintain this adaptation to climate changes into the future. This research suggest that small rural settlements, particularly ones based on the coast have commenced this journey but considerable assistance will be needed in the form of the establishment of a framework or process for community involvement, as well as the provision of adequate resourcing for both the process and the adaptation actions. The adaptation task needs the involvement of the community if a good outcome is to be achieved. Thus, various options to achieve this should be tried and tested, together with coordination and integration with more strategic planning and policy, as well as data and communication management, at the regional, state and national levels.

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APPENDIX 1. NIEIR'S REGIONAL MODELLING SYSTEM

An overview of the r-imp econometric model

NIEIR's regional modelling system consists of two model segments, namely:

- R-IMP; and
- RHIS.

The RHIS system is a modelling and data base system which generates detailed household socio-demographic and expenditure structure down to the CCD (a Census Collector District contains on average 180 households) level.
The R-IMP model for each region has an integrated econometric model combining industry and household segments. The household segments consist of both data and equations. The maximum level of disaggregation from the R-IMP model is the Statistical Local Area (SLA) level (very approximately 16,000 households). This means that the household sector of R-IMP is obtained by aggregating the RHIS data base into the appropriate R-IMP regional dimension.
Below the SLA level the use of RHIS is restricted to a stand-alone mode which, in turn, means restriction to household sector analysis. Regional wide analysis (that is taking into account both household with industry interaction) is restricted to the R-IMP geographical dimension. That is, full model interaction is restricted to the SLA level.

General model description

The model is a traditional, annual, multi-sector, dynamic (distributed lags), demand focused (national, state and regional accounts identities and balances) econometric model with strong supply influence and interaction. The model is anchored in real time projections of the national, state and regional economies.

Geographical dimension

In the country areas the model is currently restricted to the Statistical Sub-Division (SSD) and Statistical Division (SD) level.

The industry data base

For a number of series there is a good time series dimension, especially in relation to the building industry indicators.
The business register is the basic source of data for industry activity at the SLA level, which is used to interpolate between Census employment benchmarks. The employment benchmarks are converted to output estimates by using Industry Census information (output per employee) adjusted by firm size.
The industry data benchmarks (employment and output) are developed at the Australian Bureau of Statistics Input-Output Table 107 industry classification. The industry definitions are shown in Table A1.1.

The freight flow framework

The freight flow framework between regions (that is SLAs or SSDs) is estimated by updating AustRoads' 1988-89 origin-destination benchmarks. Given:

- industry output by region;
- port (and airport) exports and imports by industry/commodity; and
- freight flow annual control totals by road, rail, sea and air,

the inter-regional freight flows are estimated by interactive adjustment (RAS) techniques. The adjustment is continued until balance is achieved with the control totals.

Input-output framework

Given the regional trade estimates input-output relationships are developed for each region (SLA, etc.). The starting point for estimation is the latest National Technological (that is indirect allocation of imports) matrix. The key constraints used in the estimation of the input-output relationships are:

- industry output;
- trade flows; and
- consumer demand from the SpendInfo data base (the 400 expenditure estimates are aggregated into the 107 industry input-output classification).

Imports are the residual to derive input-output balance by industry.

Table A1: Regional industry output definitions

1	Sheep	55	Basic non-ferrous metals etc
2	Grains	56	Structural metal products
3	Beef cattle	57	Sheet metal products
4	Dairy cattle	58	Fabricated metal products
5	Pigs	59	Motor vehicles and parts etc
6	Poultry	60	Ships and boats
7	Other agriculture	61	Railway equipment
8	Services to agric.; hunting	62	Aircraft
9	Forestry and logging	63	Scientific etc equipment
10	Commercial fishing	64	Electronic equipment
11	Coal; oil and gas	65	Household appliances
12	Iron ores	66	Other electrical equipment
13	Non-ferrous metal ores	67	Agricultural, mining etc machinery
14	Other mining	68	Other machinery and equipment
15	Services to mining	69	Prefabricated buildings
16	Meat and meat products	70	Furniture
17	Dairy products	71	Other manufacturing
18	Fruit and vegetable products	72	Electricity
19	Oils and fats	73	Gas
20	Flour and cereal foods	74	Water, sewerage and drainage
21	Bakery products	75	Residential building
22	Confectionery	76	Other construction
23	Other food products	77	Wholesale trade
24	Soft drinks, cordials, syrups	78	Retail trade
25	Beer and malt	79	Mechanical repairs
26	Wine and spirits	80	Other repairs
27	Tobacco products	81	Accommodation, cafes & restaurants
28	Textile fibres, yarns etc	82	Road transport
29	Textile products	83	Rail, pipeline, other transport
30	Knitting mill products	84	Water transport
31	Clothing	85	Air and space transport
32	Footwear	86	Services to transport; storage
33	Leather and leather products	87	Communication services
34	Sawmill products	88	Banking
35	Other wood products	89	Non-bank finance

36	Pulp, paper and paperboard	90	Financial asset investors
37	Paper bags and products	91	Insurance
38	Printing; services to printing	92	Services to finance etc
39	Publishing; recorded media etc	93	Ownership of dwellings
40	Petroleum and coal products	94	Other property services
41	Basic chemicals	95	Scientific research etc
42	Paints	96	Legal, accounting etc services
43	Pharmaceuticals etc	97	Other business services
44	Soap and detergents	98	Government administration
45	Cosmetics and toiletries	99	Defence
46	Other chemical products	100	Education
47	Rubber products	101	Health services
48	Plastic products	102	Community services
49	Glass and glass products	103	Motion picture, radio etc
50	Ceramic products	104	Libraries, museums, arts
51	Cement, lime and concrete slurry	105	Sport, gambling etc
52	Plaster; other concrete products	106	Personal services
53	Non-metallic min. products nec	107	Other services
54	Iron and steel		

Parameter estimation: Industry level

The annual national and state IMP model has a wide range of estimated econometric functions, covering:

- price formation;
- investment formation;
- employment;
- imports;
- exports;
- wage generation, etc.,

at the three- and four-digit industry level.

The parameters from the national and state econometric formations are carried down to the appropriate industry and the regional level. The parameter/elasticities are generated by direct aggregation or model simulation exercises.
The data benchmarks are used to calibrate the constant terms, or overall elasticity correction factors, of the indirectly estimated functions.

Household modelling

The expenditure equations for the household sector are estimated from cross-section data from the RHIS system and time series estimates. The RHIS data base allows these functions to include a wide variety of socio-demographic magnitudes as independent variables.

The data base

A summary of the data series for the regional model are shown in Chart 1. The data base is used to estimate, inter alia:

- population and other demographic series;
- dwelling commencements;
- housing stock;

- employment;
- gross output by industry;
- exports and imports by industry;
- gross regional product;
- industry supply;
- private consumption expenditure by category; and
- tourist expenditure.

Microsimulation techniques are used to interpolate between Census benchmarks. The industry structure of the data base, which is equivalent to the model industry structure and input and output framework, is given in Table A1.2.

Table A2: Regional modelling – data sources

Data source (periodicity)	Type of data
Census of population and housing (every five years)	Population, income distribution, employment/occupation data, labour force and industry data.
Business register (irregular approximately every two years)	Establishments and employment by industry, establishment size data.
Manufacturing census and surveys (annual)	Establishments, employment and turnover (irregular).
Agricultural census (annual)	Establishments, gross value of production by commodity, area data.
Mining census (annual)	Not available below state level in some states. Data available on establishments, turnover, employment.
Retail census (irregular)	Irregular (every five years). Establishments, employment, turnover and floorspace.
Labour force survey (annual)	Labour force aggregates (employment, unemployment) for "labour force survey defined" regions.
Tourist accommodation (annual)	Establishments, bed spaces, takings, employment for selected SLAs.
Building activity/approvals (annual)	Number and value of dwelling approvals. Value and floorspace of non-residential building approvals by type.
Income tax data by postcode	Household income by type
Government departments	Education, health/hospital, data.
Survey of motor vehicle use	Motor vehicle use, goods carried etc.
Local government	Rateable properties, planning information.
Housing income and expenditure survey*	Household income and expenditure by disaggregated consumption type.

Note: * NE (NIEIR) uses its Regional and Household Information System (RHIS) to estimate this down to the CCD level. NE (NIEIR) can then aggregate upwards to get household consumption for any metropolitan region. Much of this data is now only available by purchase from the ABS.

The causal structure

The causal structure of the regional model is straight forward. The major 'bottom-up' interaction with the national and State models is via the export demand function by industry at the regional level.
The regional industry structure is anchored in the input-output framework, with exports from the region together with:

- regional household consumption expenditure;
- dwelling expenditure;
- non-dwelling construction investment;
- equipment investment; and
- public sector expenditures, determining industry supply.

This means that the regional model contains information for:

- population and demographic status;
- dwelling stock;
- dwelling investment expenditures;
- capital stock by industry;
- regional imports; and
- employment.

Historical data of exports and imports into the region are estimated from the freight flow data. Two different estimates of total employment in a region are generated. One is the total number of employment positions generated in the region. The other is the number of the residents in the region that are employed. Journey to work data is used to estimate the propensity of the local residents to obtain employment positions in their own region and in other regions and the propensity of residents in other regions to obtain employment within the area. If appropriate, this aspect of the model's structure can be used to determine how a road or other transport project can influence the propensity of residents to obtain employment outside the region. As noted earlier (with the exclusion of the household sector) many of the key industry response parameters are taken from time series parameter estimates included in NE's (NIEIR's) State and national models. How NE's (NIEIR's) suite of models input into the regional model is depicted in Figure A1.

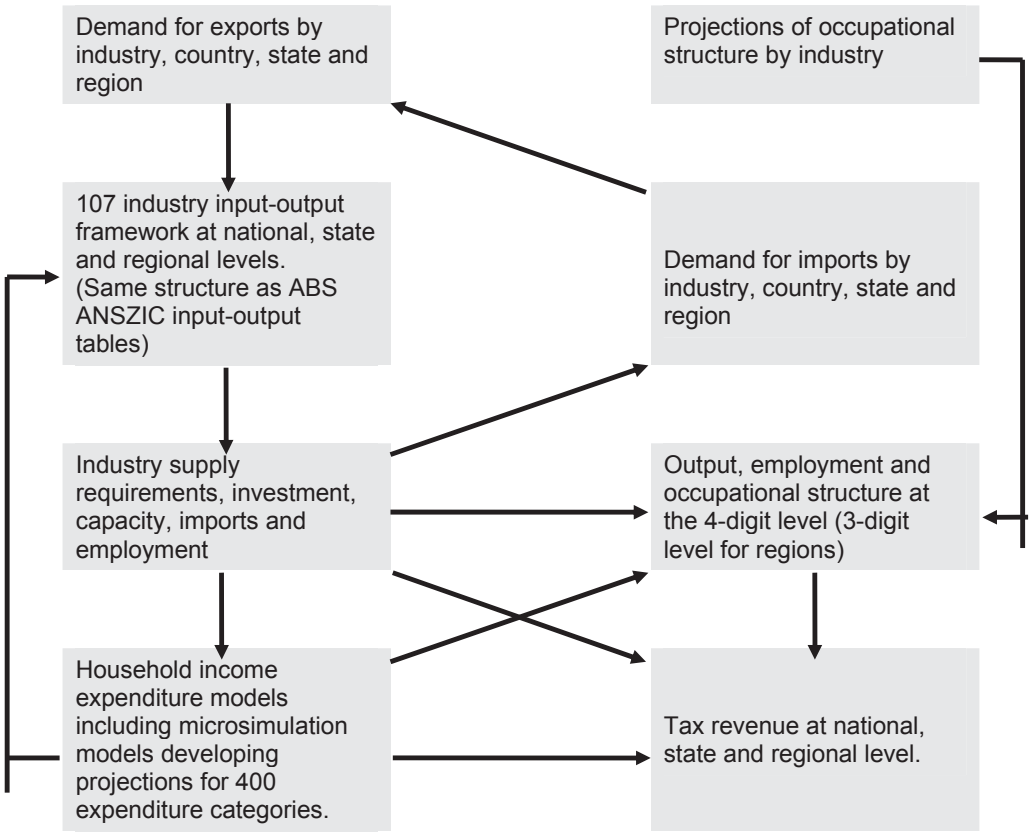


Figure A1: The core causal structure of National Economics' (NIEIR's regional modelling system

The regional and household information system (rhis)

The RHIS/SPENDINFO system forms the household/consumption at the heart of the regional modelling system. The RHIS system consists of an integrated household micro data base. This micro data base contains, for each household/person:

- their socioeconomic characteristics such as age, sex, marital status, labour force status, number of children, number of cars, income from various sources, etc.;
- detailed expenditure (down to 400 expenditure categories) information, including spending on bus/tram, train, various motor vehicle operating expenses, taxi, holiday travel etc.

The RHIS system has been developed from the 1991, 2001 and 2006 Population Census, the Labour Force Survey, the Australian Bureau of Statistics (ABS) Income and Expenditure Survey and additional data sources, using microsimulation techniques.

The RHIS system can be made an even more powerful tool for normal analysis by combining it with Urban Travel Survey data collected by state transport research bodies. This allows a very sophisticated approach to be taken to estimating the impact of household time savings.

The microsimulation system not only provides the latest demand estimates for the calculation of regional freight and input-output relationships, it also provides the

equations (linked to the appropriate socio-demographic drivers, income, age, household structure, etc.) to form the expenditure equations in the regional model structure.

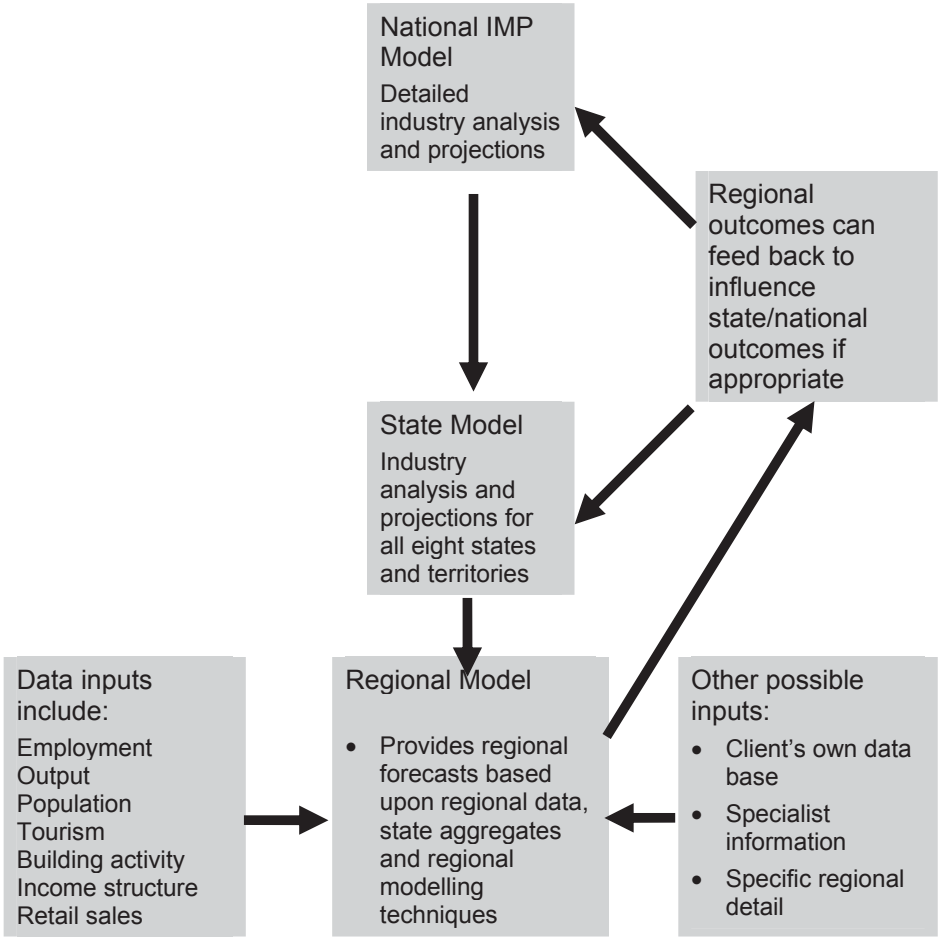


Figure A2: Inputs into the regional model

APPENDIX 2. LOCAL POLICY CONTEXT GIPPSLAND, VICTORIA

Victoria

The principal Victorian legislation dealing with adaptation to climate change is the *Climate Change Act 2010*:

- One objective is: *to provide for a strategic response by the Government of Victoria to climate change through a Climate Change Adaptation Plan.*
- Section 14 requires decision makers to have regard to climate change in preparing or approving a range of strategies and plans under various Acts (as specified in Schedule 1).
- Section 1 requires the Minister to prepare a Climate Change Adaptation Plan. Section 16 sets out the requirements for the Plan and provides that it should contain an outline and risk assessment of the potential impacts of climate change on various regions of Victoria (as specified in the plan) and a statement of the Government's state-wide priorities and strategic responses for adaptation.
- Plans are to be reviewed every four years and subsequent plans must include a report on the implementation and effectiveness of the previous plan.
- The first Adaptation Plan tabled in the Victorian Parliament on the 19th March 2013.

Other relevant legislation includes those specified Acts in Schedule 1 of the Climate Change Act: *Catchment and Land Protection Act 1994*; *Coastal Management Act 1995; Environment Protection Act 1970; Flora and Fauna Guarantee Act 1988; Public Health and Wellbeing Act 2008;* and *Water Act 1989*. The *Planning and Environment Act 1987*, although not listed in the Schedule, covers matters directly related to climate change adaptation. The *Emergency Management Act 1986* and the *Country Fire Authority Act 1956* contain provisions for planning to reduce exposure to natural hazards that may be exacerbated by climate change, as well as for response, relief and recovery from natural disasters.

Victorian strategies, policies and research programs relevant to adaptation to coastal climate change include:

Victorian Coastal Strategy (VCS) 2008

The VCS considers the potential impacts of climate change on the Victorian coast and sets a planning benchmark of not less than 0.8 metres of sea level rise by 2100 (based on the IPCC 2007 and including an allowance for the effects of storm surge). It advocates adopting the precautionary principle in decision making on coastal planning and management and recommends completing a coastal vulnerability study as a matter of urgency, then incorporating the findings into relevant policy, planning and management frameworks. The strategy sets other policy directions related to climate change on the coast, including prioritising adaptation strategies for vulnerable areas, such as protect, redesign, rebuild, elevate or relocate or retreat. It also states that new development that may be at risk from future sea level rise and storm surge will not be protected by the expenditure of public money.

State Planning Policy Framework

The State Planning Policy Framework (SPPF) included in all municipal planning schemes in Victoria contains provisions relating to planning for coastal climate change. These reflect the policies in the VCS, in that there is a requirement to plan for possible sea level rise of 0.8 meters by 2100. In addition to this a figure of 0.2 metres above 1 in

100 year flood levels by 2040 may be used for new development in close proximity to existing development (urban infill). The SPPF also includes directions for planning to avoid or manage other coastal hazards.
The Government provided no explanation of the change. However, it is generally held to reflect a belief that it is unfair to constrain owners of undeveloped lots when the quantum of development in existing townships that are potentially vulnerable to inundation from sea level rise and storm surge (combined in some cases with catchment flooding) is already so great that collective responses such as seawalls will be required in future to protect the whole settlement or substantial parts of it.

Future Coasts

Future Coasts is a major research program undertaken by the Victorian Department of Sustainability and Environment (DSE) since 2009.

The program has included detailed digital elevation modelling of the Victorian coast, including the nearshore zone, as well as research by CSIRO and others on the likely impacts of climate change on sea level rise, rainfall, storms and storm surge. The digital elevation modelling is designed for use in predicting potential inundation at a regional scale, rather than at the local or property level. It utilises what is know as a 'bathtub' model, which assumes a uniform level of inundation as a result of a given amount of sea level rise. It does not consider the effects of existing protective structures or take account of natural flood reservoirs, such as major estuarine wetlands, which might attenuate inundation in some areas. It also does incorporate long-term coastal recession that may result from successive episodes of coastal erosion due to sea level rise and increased storminess.

The digital elevation modelling has now been made available to local government to form the basis for more detailed planning. The maps are intended to be viewed and used at catchment to regional scale. They are not suitable for assessing the impacts on individual properties.

DSE is also sponsoring four local assessments across the State, at varying scales. These areas were selected to represent a range of different environments and adaptation challenges. The case study towns for this project – Inverloch and Sandy Point – are outside the areas being covered by the local assessments.

Funding for Adaptation Planning

State Government funding has been made available on an *ad hoc* basis to at least one Gippsland local government (East Gippsland Shire) to develop an adaptation plan for a vulnerable settlement.

The State Government has announced investment of $6m, delivered under the Victorian Adaptation and Sustainability Partnership, to provide real and practical support to local government through funding, mentoring and a range of partnership projects.

The $6 million funding will deliver support to local government and their communities through:

- $4 million in grants for individual and partnership projects to enhance sustainability and climate resilience locally. The first round will open in mid-2013;
- a new, two-year, state-wide mentoring initiative that provides skilled mentors to work together with councils, supported by a training package and an interactive adaptation knowledge hub; and
- partnership projects to progress key adaptation and sustainability issues between state and local government and information sharing between councils.

Planning for the health impacts of climate change has also been a major focus in Victoria:

Victorian Health and Wellbeing Plan 2011-2015

The Victorian Public Health and Wellbeing Plan (prepared under the *Public Health and Wellbeing Act 2008*) recognises that severe weather events present environmental, economic and health challenges. Some people will be at higher risk of health problems related to weather and climate change impacts, including children, older people, people with existing medical conditions, people who work outdoors, and those who live in areas most likely to be affected, such as rural and coastal communities.

Victorian Heatwave Framework

The main components of the Victorian heatwave framework are:

- The 2011 *Heatwave Plan for Victoria: Protecting health and reducing harm from heatwaves*, which guides the state-wide response to heatwaves. It sets out the roles and responsibilities of the Victorian Government, local councils, emergency management and the health and community service sector.
- The Heat Health Alert System (HHAS) which monitors climate conditions and notifies councils, departmental program areas, hospitals and health and community service providers of impending heatwaves and to activate their heatwave plans and responses.
- Local council heatwave plans. Thirteen pilot projects were conducted in 2008, involving 22 councils and funding was provided to support the remaining 57 councils to develop and implement a heatwave plan.
- The Heatwave Planning Guide assists councils to plan for heatwaves at a community level using existing municipal planning frameworks. It provides councils with templates, strategies and background information with an emphasis on identifying and protecting vulnerable or at risk populations.

Planning for the effects of climate change on the natural environment and natural resources in Victoria has included:

Sustainable Water Strategies

Sustainable Water Strategies have been prepared for all Victorian regions. Amongst other things, they consider the likely impacts of climate change on waterways, wetlands and water supplies for urban, industrial and agricultural use.

Reducing the impacts of natural disasters (mitigation, response, relief & recovery)

Two recent major public reviews have examined the adequacy of State provisions for reducing exposure of people and property to natural disasters and have taken into account in the likely effects of climate change. The inquiries covered the 2009 bushfires in central Victoria and Gippsland and the 2011 floods in northern Victoria. They made recommendations on improving planning arrangements, warning systems, emergency management and support for community recovery. Many of these recommendations have been implemented through the planning system and by other means.

Local Government

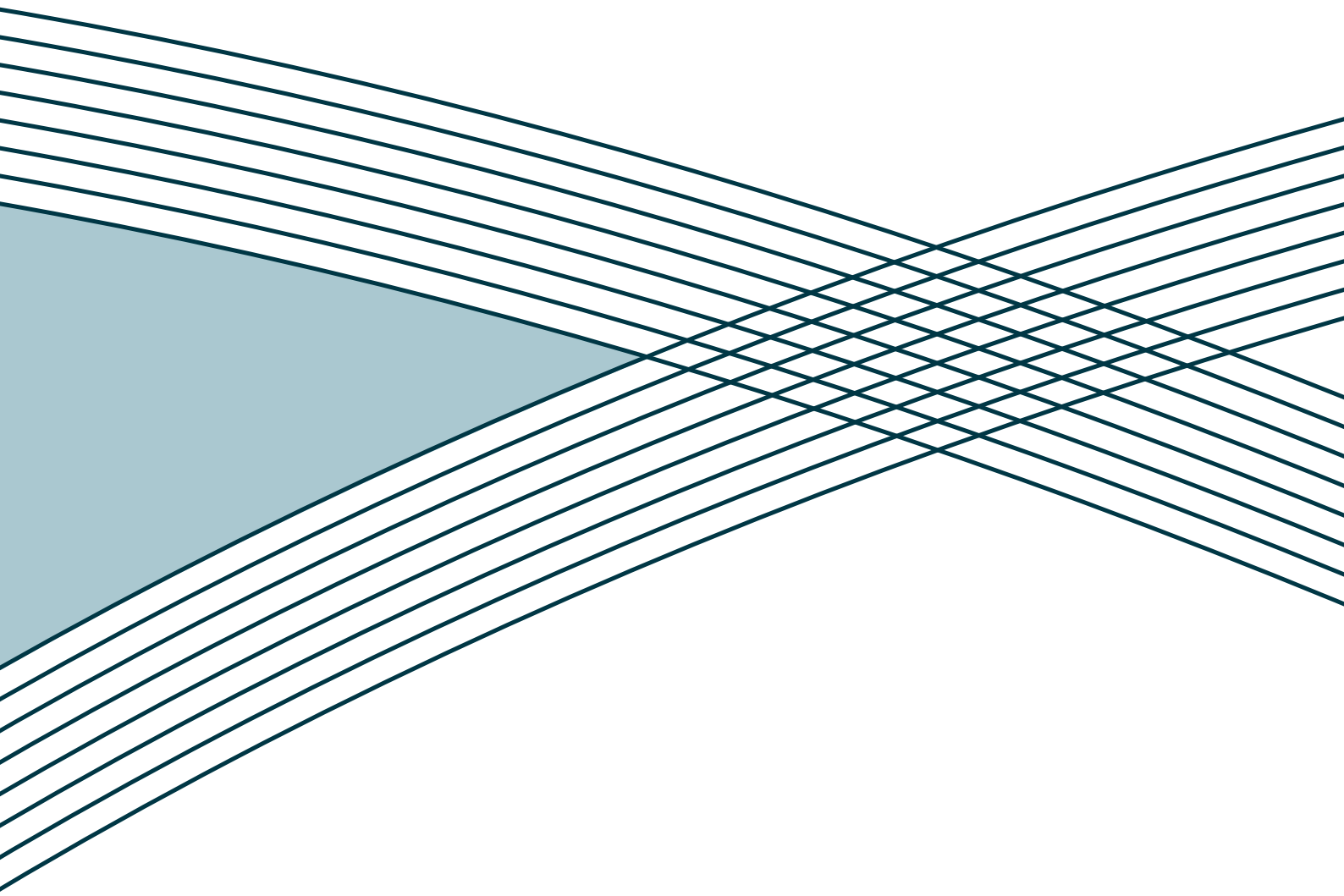
Bass Coast and South Gippsland Shires have undertaken a range of land use and health planning activities to assist with adaptation to climate change in coastal settlements. These include:

Bass Coast

- Active participation in the work of the South East Climate Change Alliance (formerly Western Port Greenhouse Alliance).
- Amending the Municipal Strategic Statement to include references to the need to plan for the potential impacts of climate change.
- Preparing strategic framework plans or urban development frameworks for all coastal settlements, to identify land for future growth in areas not vulnerable to sea level rise and to introduce coastal settlement boundaries and incorporating them in the planning scheme.
- Requiring coastal hazard vulnerability assessments in specific areas potentially at risk.
- Hosting a workshop in 2009 for key stakeholders, including emergency services agencies, to discuss the implications of climate change data for the Shire.
- Mapping using the Future Coasts dataset and the Shire's geographical information system to identify areas of existing settlements that may be at risk of inundation in the future.
- Mapping of overland flow paths for stormwater and mapping for new flood overlays, incorporating a provision for sea level rise.
- Mapping of potential coastal recession as a result of long-term erosion.
- Preparing a Heatwave Plan for the municipality (2011), to be incorporated into the Bass Coast Shire Council Municipal Emergency Management Plan
- Preparatory work on a whole-of-Council Climate Change Adaptation Strategy, which will cover mitigation as well as adaptation, emergency management and community engagement. It will focus first on impacts on council assets and services, then foreshores and communities and will also cover planning advice to owners of private infrastructure.

South Gippsland Shire

- Amending the Municipal Strategic Statement to include references to the need to plan for the potential impacts of climate change on the environment of the municipality, including coastal locations.
- Requiring, as a condition of approving a planning permit in areas located below 5m AHD, that owners enter into a Section 173 Agreement (under the *Planning & Environment Act 1987*) acknowledging that the land may be affected by future climate change impacts and agreeing, amongst other things, to remove buildings and works if the land becomes uninhabitable. The agreement is registered on the title to the land.
- For larger developments in potentially vulnerable areas, requiring a coastal hazard vulnerability assessment as part of the planning application.
- Preparing a Heatwave Plan for the municipality (2009), to be incorporated into the South Gippsland Shire Council Municipal Emergency Management Plan
- Holding four free climate change forums across the Shire, in conjunction with the Sustainability Network, to assist older people and younger people with a disability to understand the likely effects of climate change and learn how to adapt to it



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