



Adapting to the Impacts of Climate Change in the Western Port Region:

Part 3 – Strategic Directions

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Adapting to the Impacts of Climate Change in the Western Port Region:

Part 1 – Needs Analysis

Part 2 – Climate Change Impacts in Western Port

Part 3 – Strategic Directions

TABLE OF CONTENTS

Page

Executive Summary	i
1. Introduction.....	1
1.1.Study overview	1
1.2.Scope and structure of report.....	2
2. Adapting to Climate Change in the Western Port Region.....	4
2.1.Adapting to global climate change	4
2.2.Climate change in Western Port: the importance of a regional response.....	5
2.3.Strategic directions	7
3. Key Sectoral Issues	11
3.1.Overview.....	11
3.2.Environment and natural resources domain	12
3.3.Social and community domain	17
3.4.Economy and infrastructure domain	21
4. Priority Cross-Sectoral Issues	25
4.1.Overview.....	25
4.2.Opportunities	27
4.3.Information gaps and research requirements	28
5. Next steps	29
5.1.Regional adaptation	29
5.2.Priority projects.....	30
5.3.Conclusion.....	31

Executive Summary

Introduction

1. Climate change is emerging as a vital issue for Victorian communities. Even with international action to reduce greenhouse gas emissions, the global climate is projected to undergo significant change in the 21st century, with the potential to create many risks as well as opportunities.
2. It is important that the impacts of climate change are examined at the regional and local scale, since regional attributes including socio-economic characteristics and the physical environment will significantly determine the extent of the risks and opportunities, as well as the nature of community response.
3. A scoping study on climate change impacts and adaptation opportunities in the Western Port region was undertaken in 2005-2006 to assist key stakeholders in the Western Port region prepare for and adapt to the impacts of climate change. The study was funded by the Victorian Department of Sustainability and Environment (DSE) and coordinated by the Western Port Greenhouse Alliance (WPGA).
4. The scoping study was undertaken in three major stages (see Figure 1). Information gained through these stages has been used to establish strategic directions for adapting to climate change in the Western Port Region. The framework is outlined and discussed in this report.

Adapting to climate change in the Western Port region

5. The Western Port region is not immune to climate changes occurring at the international and national levels. As detailed in *Climate Change Impacts in Western Port*, climate change has the potential to impact on a wide range of activities, services and systems in Western Port, cutting across natural, social and economic domains.
6. Climate change will continue to add to, merge and in some cases, change existing sources of risk and opportunity for the Western Port region.
7. Given the long lead time of many planning and investment decisions and projections on future on-going climate change, the Western Port community needs to establish adaptation priorities and opportunities now.
8. Strategic directions for adaptation to the impacts of climate change in the Western Port region are set out in Figure 2. The strategic directions reflect priorities and concerns of regional stakeholders, whose involvement was fundamental to the outcomes of the scoping study.
9. Central to the strategic directions are a series of eight 'priority cross-sectoral issues' (see Box ES 2). The priority cross-sectoral issues have been derived from a wider list of 'key sectoral issues' identified by stakeholders at a series of workshops. The priority status of these issues stems from the fact that they are particularly vulnerable to climate change and cut across a range of economic, environmental and social issues.

10. Community engagement has been identified as another key aspect of regional response to climate change. Stakeholders should be engaged at all future stages in the ongoing process of adaptation. Engagement also needs to be extended to the broader community of the Western Port region.
11. Implementation of a regional response to climate change also requires effective coordination and integration. Regional coordination is best achieved at the local level, with the Western Port Greenhouse Alliance already providing a working model of how regional coordination on climate change issues can be achieved. Integration is needed to align policies and programs between agencies and different levels of government and to ensure consistency between adaptation responses and initiatives driven by other community objectives.

Key sectoral issues

12. Western Port Region stakeholders participated in a series of workshops to prioritise risks and opportunities from climate change in relation to their sectors. More than 100 stakeholders from one of three broadly defined domains participated. The three 'domains' were:
 - environment and natural resources;
 - social and community; and
 - economy and infrastructure.
13. The major task for workshop participants was to prioritise issues. A prioritisation process is needed to ensure that, in developing a future regional response to the impacts of climate change, the best use of resources and time are focussed on the most pressing issues.
14. Approximately 100 issues were discussed by stakeholders, across 12 sectors from the three domains. Stakeholders qualitatively rated each issue according to its 'vulnerability' to climate change. From this list, 35 issues that are especially vulnerable to climate change have been identified. These 'key sectoral issues' warrant priority attention **at the sectoral level** when responding to the impacts of climate change in the Western Port Region.
15. The key sectoral issues are listed in Table ES.1.

Table ES.1: Key Sectoral Issues	
Environment & natural resources domain	
<p>Agriculture & fisheries</p> <ul style="list-style-type: none"> ▪ Aquaculture ▪ Wild fisheries ▪ Farm forestry ▪ Viticulture <p>Catchment management & planning</p> <ul style="list-style-type: none"> ▪ Acid sulphate soils ▪ Groundwater and salinity ▪ Waterways and stream flow 	<p>Biodiversity</p> <ul style="list-style-type: none"> ▪ Coastal habitat (e.g. mudflats, salt marsh, sea grass) ▪ Cool temperate rainforest ▪ Wetlands <p>Coastal management & planning</p> <ul style="list-style-type: none"> ▪ Coastal communities/built environment ▪ Coastal and marine biodiversity ▪ Coastal processes (e.g. erosion, sedimentation)
Social & community domain	
<p>Community services</p> <ul style="list-style-type: none"> ▪ Low socio-economic groups ▪ Multiple disadvantaged <p>Emergency services</p> <ul style="list-style-type: none"> ▪ Heat waves ▪ Storm damage ▪ Water and waste water (short term, emergency) 	<p>Health</p> <ul style="list-style-type: none"> ▪ Emergency management ▪ Heat exposure/radiation ▪ Water availability/quality (non-mains) <p>Recreation</p> <ul style="list-style-type: none"> ▪ Fish habitat and stocks ▪ Marine infrastructure
Economy & infrastructure domain	
<p>Water infrastructure & services</p> <ul style="list-style-type: none"> ▪ Groundwater ▪ Stormwater & drainage ▪ Coastal impacts (water infrastructure) <p>Other infrastructure & services</p> <ul style="list-style-type: none"> ▪ Existing building stock (performance) ▪ Location of buildings (existing & new) ▪ Road construction & maintenance ▪ Transport efficiency (business) 	<p>Regional development & tourism</p> <ul style="list-style-type: none"> ▪ Beaches ▪ Tourist attractions <p>Urban planning</p> <ul style="list-style-type: none"> ▪ Coastal planning ▪ Residential design (existing stock) ▪ Stormwater infrastructure

Priority cross-sectoral issues

16. As noted, central to the proposed framework for responding to the impacts of climate change in Western Port are a series of eight 'priority cross-sectoral issues', so designated because each of the issues is relevant to a number of sectors in the Western Port region.
17. When setting strategic directions for a regional response to the impacts of climate change, the priority cross-sectoral issues assume particular significance. This is because cross-sectoral issues:
 - require an integrated and coordinated response if they are to be effectively addressed (see section 2.2);
 - encompass a range of economic, environmental and social objectives that are important to the community;

- provide a focus for capturing opportunities presented by climate change (see section 4.2); and
- provide a focus for establishing regional partnerships on climate change response, especially in relation to further research (see section 4.3).

18. The priority cross-sectoral issues are listed in Table ES.2.

Table ES.2: Priority cross-sectoral issues
<ul style="list-style-type: none">▪ Coastal and marine biodiversity and habitats▪ Groundwater▪ Housing and accommodation▪ Infrastructure siting and planning▪ Potable water supply▪ Storms (emergency response)▪ Stormwater▪ Waterways and streamflow

19. Climate change in the Western Port region has the potential to create many opportunities, as well as risks and threats. A range of opportunities relevant to the priority cross-sectoral issues have been identified by stakeholders. These are listed in Table 2.

Next steps

20. Options for adaptation are wide-ranging. Adaptation need not be limited to reactive technological and infrastructure measures but can also include proactive measures such as community engagement & capacity building, further research and planning and regulatory measures. Capacity building is likely to be a key first step towards adaptation for groups, assets or industries that have been rated as highly vulnerable to climate change.
21. An initial step towards implementing regional adaptation measures has been taken with identification and by stakeholders of adaptation project opportunities, at a workshop held to discuss the priority-cross sectoral issues
22. Five 'partnership projects' were identified by stakeholders at the workshop:
- A. Design a monitoring regime to track impacts of climate change and identify triggers for action
 - B. Strengthen community groups and volunteer organisations to develop responses to climate change through a series of community strengthening workshops
 - C. Develop climate change adaptations to existing emergency management strategies

- D. Investigate viability of additional water treatment and recycling options in the region (linked project: regional water use mapping)
 - E. Develop climate change scenarios for the region
23. These projects provide an opportunity for concrete steps to now be taken towards regional adaptation to climate change in the Western Port region. However, stakeholders should also consider other specific adaptation measures, to be initiated either individually or through regional partnerships.
24. However, continued momentum on regional adaptation will ultimately depend on the long term commitment of stakeholders.

1. Introduction

1.1. Study overview

Climate change is emerging as a vital issue for Victorian communities. Even with international action to reduce greenhouse gas emissions the global climate is projected to undergo significant change in the 21st century, with the potential to create many risks as well as opportunities. It is important that the impacts of climate change are examined at the regional and local scale, since regional attributes including socio-economic characteristics and the physical environment will significantly determine the extent of the risks and opportunities, as well as the nature of community response.

A scoping study on climate change impacts and adaptation opportunities in the Western Port region was undertaken in 2005-2006 to assist key stakeholders in the Western Port Region prepare for and adapt to the impacts of climate change by:

- raising awareness of the potential impacts of climate change in the region with the stakeholders;
- engaging the stakeholders to assess natural and human vulnerabilities to climate change impacts in the region; and
- exploring with them possible adaptation opportunities.

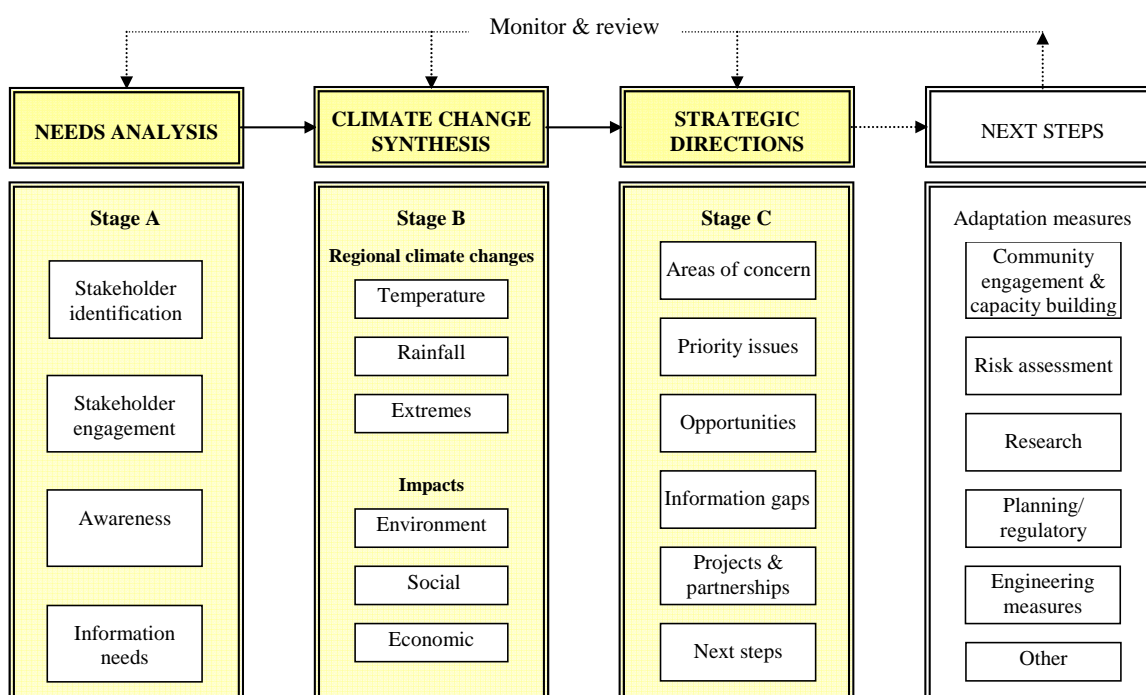
The study was funded by the Victorian Department of Sustainability and Environment (DSE) and coordinated by the Western Port Greenhouse Alliance (WPGA). The WPGA was established in June 2004 to provide a regional framework for local stakeholders to work together on climate change and greenhouse gas projects in the Western Port region. It comprises a management committee, including representatives from: City of Casey; Cardinia Shire Council; Bass Coast Shire Council; Frankston City Council; Mornington Peninsula Shire Council; DSE; and the International Council for Local Environmental Initiatives.

The scoping study was undertaken in three major stages (see Figure 1):

- In Stage A of the study, a number of regional stakeholders were identified and interviewed about their information needs in relation to the impacts of climate change on their sectors/areas. The results of Stage A are presented in a *Needs Analysis* report.
- In Stage B, current knowledge and information on the impacts of climate change in Western Port were pulled together into a 'synthesis report', *Climate Change Impacts in Western Port*.
- In Stage C of the study, key stakeholders participated in a series of four workshops to prioritise risks and opportunities from climate change in relation to their sectors and to help set directions for responding to climate change in the region, including through regional partnerships.

Information gained through these stages has been used to establish strategic directions for adapting to climate change in the Western Port Region, which are outlined and discussed in this report.

Figure 1: Adapting to Climate Change in Western Port – The Scoping Study



1.2. Scope and structure of report

This scoping report presents strategic directions for responding to climate change in the Western Port region. Priorities, opportunities and other directions discussed in the report draw directly on outcomes of the stakeholder engagement process undertaken in Stage C of the study.

The report is not intended to provide a detailed plan of action for climate change response. Response measures such as research, community awareness, planning and infrastructure initiatives will be key aspects of an integrated response to climate change in Western Port. These measures will need to be assessed and implemented as further steps in the evolving process of responding to climate change in the Western Port Region (see Figure 1, 'Next Steps').

The remainder of the report is structured as follows.

Chapter 2 discusses why it is important to develop a regional response to the impacts of climate change and provides a broad framework for that response.

Chapters 3 and 4 examine in more detail the sectoral and cross-sectoral issues that form the basis of the framework.

Chapter 3 looks at key sectoral issues - industries, activities and assets across a range of sectors in the Western Port region, rated by stakeholders as being vulnerable to climate change.

Chapter 4 examines and discusses a smaller number of priority cross-sectoral issues – identified by stakeholders from a range of sectors as being especially vulnerable to climate change. ‘Opportunities’ and ‘projects’ relevant to the cross-sectoral issues are also discussed.

Finally, Chapter 5 examines next steps that should be taken for the strategic framework outlined in this report to be effectively carried forward.

The report also contains a number of appendices including:

- an outline of the methodology applied to identifying key sectoral issues and priority cross-sectoral issues;
- an inventory of workshop output including issues identified by participants, together with their vulnerability assessment scores, and project ideas linked to the cross-sectoral issues; and
- complete lists of workshop participants.

This report is the third and final part in a series of reports that have been produced for the scoping study. The first two parts are:

Part 1 - *Needs Analysis Report*, which reports on stakeholder information requirements in relation to the impacts of climate change in Western Port.

Part 2 - *Climate Change Impacts in Western Port*, which provides a synthesis of available information on climate change and its potential impacts in Western Port.

Parts 1 and 2 should be read in conjunction with this report.

2. Adapting to Climate Change in the Western Port Region

2.1. Adapting to global climate change

The global climate is changing. In 2001, the Intergovernmental Panel on Climate Change (IPCC)¹, acknowledged as the definitive source of information on most aspects of global climate change, concluded that:

- the present global climate is significantly warmer than at the beginning of the 20th Century, with global temperatures having increased by around 0.6°C;
- it is likely that 1990-1999 was the warmest decade in the last 1,000 years, at least in the Northern Hemisphere;
- most of the observed warming is attributable to human activities – notably the release of so-called greenhouse gases, such as carbon dioxide, methane and nitrous oxide, into the atmosphere; and
- due to the long atmospheric lifetime of major greenhouse gases and time lags in the ocean-atmosphere system, global warming will continue for decades or even centuries to come, even if large scale action to mitigate greenhouse gases is taken in the near future.

An IPCC special report, *The Regional Impacts of Climate Change: An Assessment of Vulnerability*² indicates that Australia is one of the most vulnerable of all industrialised countries to the impacts of climate change. This reflects Australia's already variable climate, poor soils, vulnerable ecosystems and high proportion of population living in coastal areas.

In response to these threats, the Council of Australian Governments (COAG) has agreed to develop a *National Adaptation Framework* to assist effective risk management by business and community decision-makers³. Adaptation refers to 'actions in response to climate change and impacts that lead to a reduction in risks or a realisation of opportunities'. Working within the national framework, it is crucial that regional and local adaptation strategies are developed and implemented because:

- regional differences in terms of socio-economic characteristics and physical environment will significantly determine the extent of the risks and opportunities; and

¹ Houghton, J. T., Ding, Y., Griggs, D.J., Noguera, M., van der Linden, P.J., Dai, X., Maskell, K. and Johnson, C.A., (eds.) 2001. *Climate Change 2001: The Scientific Basis*. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge

² Watson, R.T., Zinyowera, M.C. and Moss, R.H. (Eds.) (1997), *The Regional Impacts of Climate Change: An Assessment of Vulnerability*, A Special Report of IPCC Working group II, Cambridge University Press, Cambridge

³ Council of Australian Governments, 2006. *Council of Australian Governments' Plan for Collaborative Action on Climate Change*, Attachment C, COAG Meeting, 10 February 2006.

- provided they have access to adequate information and resources, local communities are well placed to determine the most appropriate adaptation measures and to ensure that these measures are effectively integrated with other (non-climate) local and regional programs and strategies.

The Victorian Government launched the Victorian Greenhouse Strategy (VGS) in 2002. One of the stated goals of the strategy was to develop a greater understanding of climate change impacts, and where appropriate, initiate adaptation actions. However, the focus of VGS action was largely on programs to reduce greenhouse emissions so as to limit the extent and severity of climate change.

Since 2002, the Victorian Government's responses to climate change issues have evolved, especially with respect to adaptation to climate change. While reducing greenhouse gas emissions remains a priority, attention is now also being given to how Victoria can best prepare for and adapt to climate change. Section 4.2 of the *VGS Action Plan Update (2005)* committed funding to three adaptation projects in Western Port, Central Victoria and West Gippsland to identify local climate change impacts and raise community awareness. The knowledge gained from these three projects will assist the development of regional responses to climate change in other communities across Victoria.

2.2. Climate change in Western Port: the importance of a regional response

The Western Port region is not immune to changes occurring nationally and internationally. Climate changes in Western Port are discussed in the report *Climate Change Impacts in Western Port* and summarised in Box 1. As detailed in the report, climate change has the potential to impact on a wide range of activities, services and systems in Western Port, cutting across natural, social and economic domains. Climate change will continue to add to, merge and in some cases, change existing sources of risk and opportunity for the Western Port region.

Given the long lead time of many planning and investment decisions and projections on future on-going climate change, the Western Port community needs to establish adaptation priorities and opportunities now.

Information from *Climate Change Impacts in Western Port* was used to inform the stakeholder engagement process for this study which, in turn, was the basis for setting strategic directions for regional adaptation to climate change.

Box 1: Summary of projected climate changes for Western Port

Temperature

- annual warming of 0.2 to 1.4°C by 2030 and 0.7 to 4.3°C by 2070
- day time maximum temperatures and night time minimum temperatures will rise at a similar rate
- warming will be similar throughout the seasons
- a 10 to 40% increase in the number of hot summer days (over 35°C) by 2030 and a 20 to 300% increase by 2070
- a substantial reduction in the number of frost days by 2030 and a possible loss of all frost days by 2070

Precipitation

- annual precipitation decreases likely (changes of +3 to -9% by 2030 and +9 to -25% by 2070)
- extreme heavy rainfall events may become more intense

Drought

- droughts are likely to become more frequent and longer
- dry conditions that currently occur on average one in every four years may increase to up to one in three years by 2030
- due to hotter conditions, droughts are also likely to become more intense

Water Resources

- increased evaporation rates
- drier soil likely, even if precipitation increases
- decreased average run-off in streams
- hotter, drier conditions likely to increase bushfire risk

Winds, storms and sea level rise

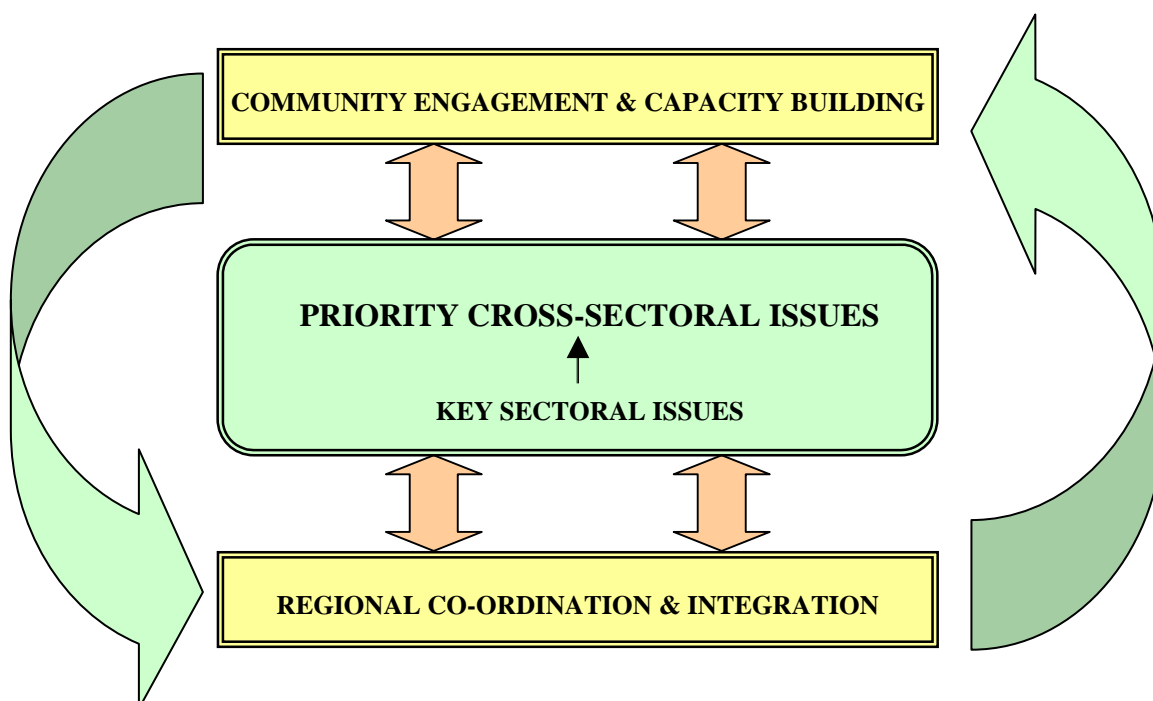
- winds are likely to intensify in coastal regions of Victoria, particularly in winter as a result of more intense low pressure systems. Low pressure systems off the east coast of Australia may become more frequent
- sea level rise of 7 to 49cm by 2070

2.3. Strategic directions

2.3.1. Overview

Strategic directions for adapting to the impacts of climate change in the Western Port Region are set out in Figure 2. As noted, the strategic directions reflect priorities and concerns of regional stakeholders, whose involvement was fundamental to the outcomes of the scoping study.

Figure 2: Climate change adaptation in Western Port - strategic directions



Central to the strategic directions are a series of eight 'priority cross-sectoral issues'. The priority status of these issues stems from the fact that (in the view of a wide range of stakeholders) they are particularly vulnerable to climate change and cut across a range of economic, social and environmental issues. As well, coordination across a number of sectors and responsibilities is needed if they are to be effectively addressed. The eight priority cross-sectoral issues are outlined in Box 1 below and discussed further in Chapter 4. The priority cross-sectoral issues have been derived from a wider list of 'key sectoral issues' that were assessed as being vulnerable to climate change by people with knowledge of these areas (see Chapter 3).

Box 2: Priority cross-sectoral issues

Over the course of the scoping study stakeholders identified almost 100 'areas of concern' or issues. By qualitatively assessing the vulnerability of these areas of concern to climate change it has been possible to establish:

- 35 'key sectoral issues'; and
- Eight 'priority cross-sectoral issues' – areas or sectors that are highly vulnerable to climate change (as identified by stakeholders), and which require an integrated and co-ordinated regional response.

The eight priority cross-sectoral issues are:

- **Coastal and marine biodiversity and habitats**
- **Groundwater**
- **Housing and accommodation**
- **Infrastructure siting and planning**
- **Potable water supply**
- **Storms (emergency response)**
- **Stormwater**
- **Waterways and streamflow**

Note, the priority cross-sectoral issues reflect the collective concerns and priorities of stakeholders who participated in the scoping study. The nature of the engagement process and potential gaps in the list of participants means that the priorities do not necessarily reflect those of any single organisation or of the broader community.

The other major aspects of the strategic framework are:

- community engagement and capacity building; and
- regional integration and coordination.

These are overarching issues; their importance to an effective regional response to climate change has been stressed by a large number of stakeholders from across all domains and sectors. These two issues are discussed further below.

2.3.2. Community engagement and capacity building

Stakeholder engagement was a key aspect of the scoping study, with nearly 70 organisations and 200 individuals participating at different stages of the study. An effective regional response to climate change requires that existing and new stakeholders are engaged at all future stages in the ongoing process of adaptation. Engagement also needs to be extended to the broader community of the Western Port Region.

A particular aspect of engagement to be addressed is 'capacity building'. Adaptive capacity refers to 'the ability of an affected system, region, industry or community to cope with the impacts and risks of climate change and to take advantage of opportunities'. Improving knowledge and understanding of the potential local and regional impacts of climate change will be a key initial step in the process of building community capacity to cope with change (see Box 2).

Box 3: Community engagement and capacity building

Building capacity in Western Port to cope with climate change is likely to involve the following initial steps.

Building capacity for public awareness and response

- Provide accessible public information on:
 - the potential impacts of climate change in the Western Port region; and
 - local, state and national plans for dealing with the impacts of climate change.
- Strengthen community groups and other organisations to develop responses to climate change (see section 4.3).

Building capacity for decision making

- Provide decision makers with information that will assist with decision making processes on adaptation including through:
 - local and regional monitoring, projections and research programs;
 - training programs and guides (e.g. risk assessment⁴, economic and financial assessment of options)

Building capacity for regional coordination and integration

- Improve networking and information exchange between local and regional governments and agencies on climate change impacts and response options.
- Align climate change adaptation with existing plans and strategies (see section 2.2.3).

2.3.3. Regional coordination and integration

Implementation of a regional response to climate change requires effective coordination and integration. Regional coordination is best achieved at the local level, with the Western Port Greenhouse Alliance already providing a working model of how regional coordination on climate change issues can be achieved.

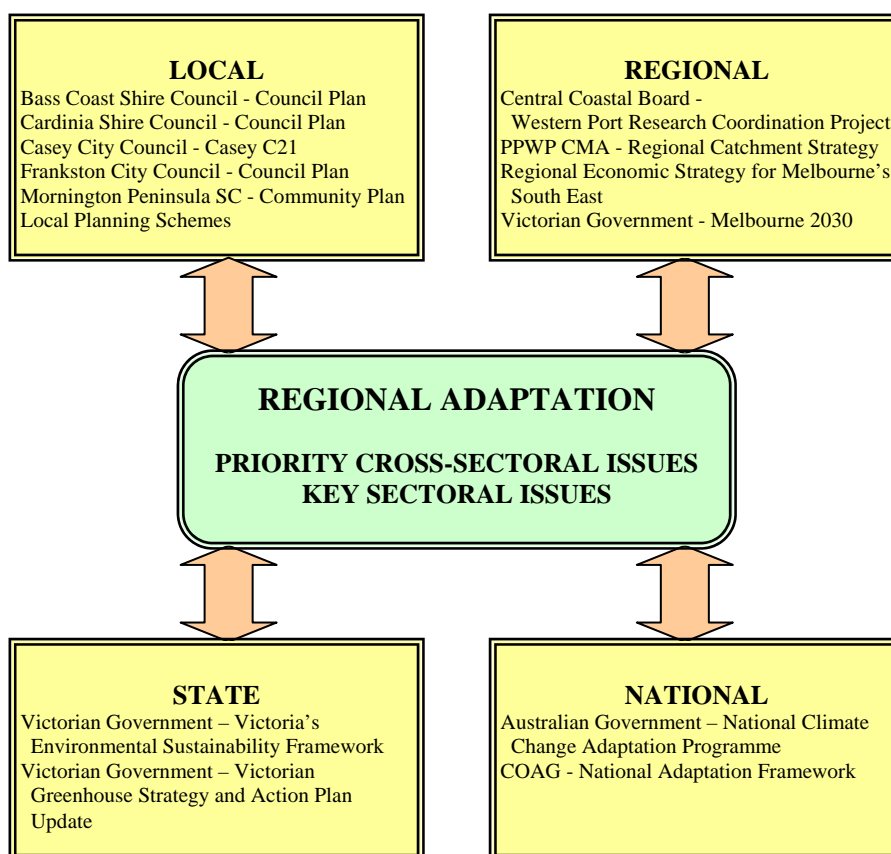
An effective regional response also requires integration of regional climate change adaptation with other strategies, plans and programmes at the local, regional, state,

⁴ Note, some relevant information is now available nationally through the Australian Greenhouse Office, including *Climate Change Impacts & Risk management: A Guide for Business and Government* – see <http://www.greenhouse.gov.au/impacts/>

and national. Integration is needed to avoid conflicting objectives between agencies and different levels of government and to ensure consistency between adaptation responses and initiatives driven by other community objectives – for example, sustainable building design, water conservation and biodiversity protection. Figure 3 provides a sample of just some of the strategies and programmes that will need to be linked into climate change response in Western Port if effective adaptation is to be achieved. The figure highlights the importance of stakeholder engagement at all steps in the adaptation process.

The need for regional coordination and integration is especially true for the priority cross-sectoral issues.

Figure 3: Integrating regional adaptation with other strategies and programmes



3. Key Sectoral Issues

3.1. Overview

In Stage C of the scoping study, Western Port region stakeholders participated in a series of workshops to prioritise risks and opportunities from climate change in relation to their sectors. More than 100 stakeholders from one of three broadly defined domains participated. The three 'domains' were:

- environment and natural resources;
- social and community; and
- economy and infrastructure.

The major task for workshop participants was to prioritise issues. A prioritisation process is needed to ensure that, in developing a future regional response to the impacts of climate change, scarce resources and time are focussed the most pressing issues. The process used to determine priority issues was essentially a 'screening' one. It involved getting stakeholders to generate lists of issues that are relevant to their sector and then qualitatively rating each issue according to its 'vulnerability' to climate change - with vulnerability assessed as a function of 'climate sensitivity' and 'capacity to adapt to climate variability and change'. The process is described in more detail in Appendix 1.

Approximately 100 issues were identified and discussed by stakeholders, across 12 sectors from the three domains. A full list of the issues and their vulnerability assessment ratings is provided in Appendix 2. From this list, 35 'key sectoral issues' (at least 2 issues from each sector) have been selected, using the following general criteria:

- all issues were assessed by stakeholders as being highly sensitive or extremely sensitive to climate and climate variability; and
- all issues were assessed by stakeholders as having only low or moderate capacity to adapt to climate variability and change;

The 35 issues are spread across the three domains (environment & natural resources -13; social & community -10; economy & infrastructure – 12).

It is important to note that these issues do not necessarily have the highest vulnerability ratings of the 100 issues examined overall. Furthermore, consideration of key issues relevant to some sectors may have been affected by a limited range of sectoral stakeholders participating in the workshops⁵. Nevertheless, the key sectoral issues clearly warrant priority attention **at the sectoral level** when responding to the impacts of climate change in the Western Port region.

However, simply because an issue is not listed as a key sectoral issue does not mean that it warrants no further attention as part of future adaptation responses for the region.

⁵ This statement applies especially to the 'recreation' and 'tourism & regional development' sectors,

The key sectoral issues are now discussed.

3.2. Environment and natural resources domain

Coastal and marine biodiversity and habitat often suffers from the 'out of sight, out of mind' syndrome – their loss often goes largely unnoticed. Climate change could add to the substantial pressures already faced by many of these systems in the region.

At a workshop held on 1 March 2006, stakeholders from relevant state government departments, local government, industry associations, research bodies and non-governmental organisations examined and assessed the potential impacts of climate change on four sectors:

- agriculture and fisheries;
- biodiversity;
- catchment management & planning; and
- coastal management & planning.

Each of these sectors is discussed in turn below, with an overview provided of the industries and activities discussed by stakeholders and the vulnerability assessment ratings which they attached to each of the issues. These ratings were used as the basis for identifying the 'key sectoral issues'.

3.2.1. Agriculture and fisheries sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Aquaculture	water temperature, storms, rainfall	pests and diseases: change in population dynamics, viability
Wild fisheries	sea temperature, wind and waves	competition from introduced species, loss of habitat, low margins for some fisheries, lack of information
Farm forestry	groundwater, soil moisture, fire, winds	long lead times for species selection, margins
Viticulture	temperature, rainfall, humidity, hail	reduced quality ,viability of existing plants, expense of changing crops

As discussed in *Climate Change Impacts in Western Port* (section 5.1), the agriculture and fisheries sector is important to local economies in the Western Port region, especially in Bass Coast and Cardinia shires.

Stakeholders considered and assessed the vulnerability of the following industries and activities to climate change:

- Wild fisheries
- Aquaculture
- Perennial horticulture (berries, stone, pome)
- Farm forestry and plantations
- Nursery/flowers
- Grazing
- Intensive livestock, poultry
- Asparagus
- Intensive horticulture (vegetables, potatoes)
- Viticulture

With the exception of intensive livestock and flowers, stakeholders rated most of these industries as climate sensitive, reflecting the climate-dependent nature of the sector. Stakeholders rated a more limited number of the industries as having limited capacity to adapt to future climate changes. Due to their climate sensitivity and limited capacity to adapt, stakeholders rated the following industries as being particularly vulnerable to climate variability and change:

- Aquaculture
- Wild fisheries
- Farm forestry
- Viticulture

Factors influencing the capacity of these industries to adapt to climate change include: a generally limited range of viability for crops and species; limited flexibility in terms of ability to change to alternative strains or species; often low profit margins; and other market pressures. In the case of wild fisheries, adaptive capacity is affected by a distinct lack of available information on climate change impacts.

An important response measure identified by stakeholders in relation to the vulnerable industries is the need for regionally specific research and information to examine the impacts of changed climate conditions on industry viability.

3.2.2. Biodiversity sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Coastal habitat (mudflats, salt marsh, sea grass)	sea level, wind/waves, water quality	rate of change, migration constraints, community values
Cool temperate rainforest	extreme temp., humidity, rainfall, fire	lack of information, existing pressures
Wetlands	sea level/salinity, soil moisture	lack of resources, information
Coastal habitat (mudflats, salt marsh, sea grass)	sea level, wind/waves, water quality	rate of change, migration constraints, community values

Climate change has the potential to have profound impacts on biodiversity, but as noted in *Climate Change Impacts in Western Port* (section 4.3), there is currently limited information on the impacts of climate change on biodiversity in the Western Port region. Nevertheless, stakeholders identified a range of ecosystems and issues that are significant to the region and examined their vulnerability to climate change:

- Wild fisheries⁶
- Coastal habitats, salt marsh
- Mud flats
- Sea grass
- Remnant vegetation
- Cool temperate rainforest
- Weeds/pests
- Revegetation planning
- Wetlands

At the workshops, it was clear to stakeholders that many if not most of the major ecosystem types in the region are vulnerable to climate change, reflecting both a high sensitivity to climate variability and a limited capacity to adapt to future changes. However, the following are considered by stakeholders to be especially vulnerable to climate change:

- Coastal habitat (including salt marsh, mudflats and seagrass)
- Cool temperate rainforest
- Wetlands

These ecosystems are highly sensitive to a range of climate drivers and to climate variability. Further, they have limited capacity to adapt to future climate change due to factors such as significant fragmentation and limited availability of land/habitat for future migration and a lack of information and resources for effective management.

Stakeholders identified the need for research and other information on coastal habitat and wetlands threatened by climate change in the region.

⁶ Some issues, such as wild fisheries, were identified and assessed by more than one stakeholder group.

3.2.3. Catchment management and planning sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Acid sulphate soils	rainfall, soil moisture	lack of research, information
Groundwater and salinity	rainfall, soil moisture	information not disseminated, increasing demand
Waterways and streamflow	rainfall (average, extreme)	significant existing pressures, lack of resources

In recent years, catchment and land management issues have been at the forefront of the national environmental agenda. Stakeholders considered and assessed the vulnerability of a range of catchment issues to climate change:

- Acid sulphate soils
- Biodiversity
- Waterways and streamflow
- Water quality
- Groundwater and salinity
- Soil erosion, sediments
- Land use capability/changes
- Wetlands
- Estuaries, coastal wetlands
- Changes in fire regimes

Of these issues, the following were considered by stakeholders to be particularly vulnerable to climate change:

- Acid sulphate soils
- Groundwater and salinity
- Waterways and streamflow

All of these issues are highly sensitive to a number of climate drivers and climate variability, especially to reduced rainfall and soil moisture. Their capacity to adapt to future climate change is only low to moderate. In the case of waterways and streamflow, climate change appears likely to compound existing stresses already faced by many waterways in the region, a point noted in *Climate Change Impacts in Western Port* (section 4.1). Substantial research and public information about the issue, strong networks and significant resources devoted to remediation programmes may only partially offset the compounding effects of climate change on the problem. In the case of acid sulphate soils and groundwater, capacity to adapt to climate change is greatly limited by just how little is known about the issues, especially in relation to the effects of climate change.

3.2.4. Coastal management and planning sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Coastal communities/built environment	sea level, storm surge, waves, floods	limited guidance in planning processes, particularly on disaster planning
Coastal and marine biodiversity	sea level, waves, water quality	'out of sight, out of mind', lack of research/monitoring
Coastal processes (e.g. erosion, sedimentation)	storm surge, sea level, waves, rainfall	lack of risk assessment, lack of resources, lack of data/monitoring

Coastal impacts of climate change have particular resonance for communities, such as inhabitants of the Western Port region, who live on or near the coast.

Stakeholders considered and assessed the following coastal issues and the implications of climate change for them:

- Coastal and marine biodiversity
- Coastal processes (e.g. erosion, sedimentation)
- Coastal communities/built environment
- Coastal infrastructure
- Water quality

Stakeholders assessed all of these issues as being highly sensitive to climate drivers and climate variability, in particular to sea level, storm surge and waves. Of the coastal management issues, three were considered by stakeholders to be particularly vulnerable to climate change:

- Coastal and marine biodiversity
- Coastal processes
- Coastal communities/built environment

The high vulnerability of these issues reflects their limited capacity to adapt to future climate change. Factors affecting adaptive capacity include, in relation to the built environment, often poor coastal planning processes and disaster planning, although these deficiencies may be offset, to some extent, by the availability of good regional volunteer networks to deal with natural disasters. Adaptive capacity, in relation to both coastal processes and coastal and marine biodiversity, suffers from a general lack of research and monitoring and a lack of community understanding ('out of sight, out of mind') contributing, in the case of coastal biodiversity, to substantial existing pressures.

3.3. Social and community domain

Many groups in the community are potentially vulnerable to the impacts of climate change. Most vulnerable though, are low-socio-economic groups and groups who have multiple disadvantages. An important aspect of a regional adaptation strategy will be measures that build the capacity of these groups to respond to the impacts of climate change.

At a workshop held on 2 March 2006, stakeholders from relevant state government departments and agencies, local government, emergency service authorities, welfare organisations and non-governmental recreation organisations examined and assessed the potential impacts of climate change on four sectors:

- community services;
- emergency services;
- health; and
- recreation.

Each of these sectors is discussed in turn below, with an overview provided of the industries and activities discussed by stakeholders and the vulnerability assessment ratings which they attached to each of the issues. These ratings were used as the basis for identifying the 'key sectoral issues'.

3.3.1. Community services sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Low socio-economic groups	extreme temperatures, storms, fire	skills base, lack of information and networks, other more immediate pressures
Multiple disadvantaged	extreme temperatures, storms, fire	skills base, lack of information and networks

Relatively little research has been undertaken on the social impacts of climate change. Nevertheless, workshop participants identified a number of groups who rely in some way on the provision of community services (aged care, disability services, children's services, welfare) and considered the challenges that they face from climate variability and change. The groups considered were:

- Low socio-economic groups (including low income, homeless)
- Disadvantaged (culturally, educationally)
- Elderly
- Young parents
- Infants
- People with special needs/disabilities
- Commuters
- Volunteers
- Pet owners
- Stock owners

- Geographically vulnerable groups (rural and remote areas, low lying areas)

Of these groups, stakeholders assessed the following to be particularly vulnerable to climate change:

- Low socio-economic groups (including low income and homeless)
- Multiple disadvantaged (people falling into a number of categories of need – e.g. elderly living in remote areas)

These two groups are sensitive to climate drivers and climate variability already, especially to extreme temperatures, storms and fire (in particular, geographically remote households). Further, their capacity to adapt to climate variability and change is often severely limited due to their skills base, lack of resources, skills, access to information and/or access to community networks.

Stakeholders identified a number of response measures, linked to building the capacity of the broader community and of the groups themselves to respond to the impacts of climate change. These include improved institutional support generally, provision of early information (for example on potential extreme weather events) and improved regional planning for extreme events.

3.3.2. Emergency services sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Heat waves	temperature - daily extreme, seasonal temperature	good information but relies on volunteer resources
Storm damage	winds, extreme rainfall	communications & volunteer constraints, retrofit costs
Water and waste water supply (short term)	extreme rainfall, seasonal rainfall, fire	infrastructure dependence, long term planning

Extreme weather events already pose significant challenges to the emergency services sector. Stakeholders considered the impacts of climate change on a range of related issues including:

- Storm damage
- Bushfires
- Disease outbreaks (human)
- Marine safety (disasters)
- Heatwaves
- Water and waste water (short term, emergency provision)

Unsurprisingly perhaps, all of the above issues were assessed as being highly sensitive to climate drivers, notably to extreme weather events such as intense rainfall, high winds and extreme temperatures. However, three issues were assessed as being particularly vulnerable to climate change:

- Heatwaves
- Storm damage
- Water and waste water (short term, emergency)

The vulnerability of these issues stems from a generally low to moderate adaptive capacity - of the sector and of the broader community - to an increase in the frequency or intensity of extreme weather events relevant to these issues. The region is blessed by having a large, committed and well-trained volunteer network that can respond to weather-related emergencies. Nevertheless, the sector faces resource constraints, which could expose the community in the event of an increase in the frequency or severity of emergencies.

Improved emergency planning and resourcing are potential response measures that were identified by stakeholders.

3.3.3. Health sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Emergency management	extreme winds, intense rainfall	availability of resources, rapid population growth
Heat exposure/radiation	extreme temperature, radiation	relies on volunteer support
Water availability/quality (areas not connected to mains)	average/seasonal rainfall	information gaps, resource constraints

As outlined in *Climate Change Impacts in Western Port* (section 5.3), climate change poses a number of potential health risks in the region. Stakeholders considered the impacts of climate change on a range of issues relevant to health in the Western Port region including:

- Physical activity
- Social health
- Vector borne diseases
- Non-vector borne diseases
- Food security
- Emergency management
- Heat exposure/radiation
- Water availability/quality (non-mains)
- Mental health

Of these issues, stakeholders rated the following as being particularly vulnerable to climate change:

- Emergency management
- Heat exposure/radiation
- Water availability/quality (non-mains)

The vulnerable status of these issues reflects their sensitivity to climate drivers:

- emergency management, to climate extremes such as extreme temperatures and floods;
- heat exposure to extreme temperatures; and
- water availability, to reduced average and seasonal rainfall.

The issues also have a moderate to low capacity to adapt to future climate change, reflecting resource constraints, gaps in available information on the impacts of climate change and pressures posed by rapid population growth in the region.

3.3.4. Recreation sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Fish habitat and stocks	sea temperature, water quality, currents	lack of knowledge, other pressures, resources
Marine infrastructure	sea level, storm surge, winds	planning & approval processes, design standards, investment

As with social issues generally, relatively little work has been undertaken into the impacts of climate change on the recreational sector. Stakeholders considered the impacts of climate change on a range of issues relevant to recreation in the Western Port region, notably connected to boating and fishing. Issues considered by stakeholders included:

- Fish habitats & stocks
- Introduced species
- Quality of fishing experience
- Changes in type of fishing - pressure on region
- Fish types and changing numbers
- Inland waterways
- Marine infrastructure
- Boating safety
- Pressures on existing boating infrastructure

Stakeholders rated most of these issues as being very sensitive to major climate drivers including water temperature and quality, currents (fish habitat & stocks, introduced species, fish types) and sea level, storm surge and winds (marine infrastructure, boating safety, boating infrastructure). However, two issues were rated as being particularly vulnerable to climate change:

- Fish habitat & stocks
- Marine infrastructure

The vulnerable status of these issues reflects their low capacity to adapt to future climate change. In the case of fish habitat & stock low capacity reflects lack of knowledge and other pressures, issues that were also raised by stakeholders from the coastal management and biodiversity sectors. In the case of marine infrastructure, problems with design standards and planning processes were cited as factors that severely limit the adaptive capacity in relation to the issue.

3.4. Economy and infrastructure domain

Planning for urban growth is a key issue facing decision-makers in the Western Port region. The impacts of climate change could well merge with and compound existing pressures.

At a workshop held on 3 March 2006, stakeholders from energy, transport and water utilities, regional planning authorities, industry bodies, local government and relevant state government departments and agencies, examined and assessed the potential impacts of climate change on four sectors:

- water infrastructure & services;
- other infrastructure & services (e.g. energy, transport);
- regional development & tourism; and
- urban planning.

Each of these sectors is discussed in turn below, with an overview provided of the industries and activities discussed by stakeholders and the vulnerability assessment ratings which they attached to each of the issues. These ratings were used as the basis for identifying the 'key sectoral issues'.

3.4.1. Water infrastructure & services sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Groundwater	average/seasonal rainfall, soil moisture	increased demand, lack of information, salinity
Stormwater & drainage	storm surge, sea level, average/extreme rainfall	lack of flexibility in older areas, limited resources
Coastal infrastructure (water and wastewater)	storm surge, sea level, extreme winds	costs, lack of information

Climate change has the potential to have major impacts on water resources in Australia. Significant research has already been undertaken on the issue, including research that is relevant to the Western Port region (see *Climate Change Impacts in Western Port*, section 4.1). Stakeholders considered the impacts of climate change on a range of issues relevant to water infrastructure & services in the Western Port region including:

- Waterways and estuaries
- Coastal infrastructure
- Potable water supply
- Stormwater and drainage
- Effluent & greywater
- Waste water
- Reuse

- Groundwater

With the exception of effluent & greywater and reuse, all of the issues listed above were assessed as being highly sensitive to climate, notably to reduced average annual or seasonal rainfall (groundwater, waterways, potable water supply) and increased rainfall intensity (stormwater, waste water, coastal impacts). However, three issues were assessed as being particularly vulnerable to climate change:

- Groundwater
- Stormwater & drainage
- Coastal infrastructure (water and wastewater)

The vulnerability of these issues stems from a generally low to moderate capacity to adapt to climate change. Groundwater resources in the region are facing significant pressures already. These are likely to increase. Unlike other water issues facing pressures (e.g. waterways and potable water supply), there is a comparative lack of information available on groundwater and few resources are being devoted to the issue. Low adaptive capacity of stormwater & drainage systems and of coastal infrastructure reflects resource constraints and a lack of flexibility.

3.4.2. Other infrastructure & services sectors

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Existing building stock (performance)	extreme temperatures, humidity, winds	resources/income constraints
Location of buildings (existing and new)	storm surge, sea level, groundwater	land availability, resources/value of real estate
Road construction and maintenance	temperature, rainfall, soil, groundwater, storm surge, sea level	resource intensive but new technologies and political will/support
Transport efficiency (business)	extreme rainfall, temperature	cost of roads and new transport technologies and planning systems

Relative to the water sector, information on the impacts of climate change on other infrastructure & services (buildings, electricity, transport) is quite scant. Nevertheless, participants in the stakeholder workshops were able to use the workshop processes to effectively and efficiently consider the impacts of climate change on a wide range of infrastructure & services in the Western Port region including:

- Electricity demand
- Electricity distribution network (capacity, damage, design)
- Electricity supply (generation)
- Building design
- Building construction and maintenance
- Existing building stock (performance)
- Location of buildings (existing, new)
- Transport costs - householders
- Traffic pressures
- Transport efficiency (business)
- Road maintenance and construction

Of these issues, stakeholders rated the following as being particularly vulnerable to climate change:

- Existing building stock (performance)
- Location of buildings (existing, new)
- Transport efficiency (business)
- Road maintenance and construction

The vulnerable status of these issues reflects their sensitivity to a range of climate drivers including extreme temperatures, rainfall and wind (building stock, transport efficiency, road construction & maintenance) and sea level, storm surge and groundwater (location of buildings, road construction & maintenance). Those sectors identified as vulnerable also have a moderate to low capacity to adapt to future climate change, reflecting resource and income constraints in particular (building stock, road construction & maintenance, transport efficiency) and constraints on land availability (location of buildings).

3.4.3. Regional development & tourism sectors

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Beaches	ambient temperature, storm surge, weather extremes, water temperature & quality	limited flexibility, existing pressures
Tourist attractions (nature-based)	ambient temperature, weather extremes, water temperature & quality	slow responses/limited flexibility, existing pressures

Tourism is a major employer in parts of the Western Port region, and a major driver of regional development (see *Climate Change Impacts in Western Port*, section 5.1). Other industries and infrastructure are also important to the economic development of the region, especially coastal infrastructure. Stakeholders examined the impacts of climate change on a range of issues relevant to tourism and regional development in the western Port region including:

- Port infrastructure
- Industry planning and management
- Investment in major projects
- Tourist attractions (nature-based)
- Beaches
- Agritourism

Of these issues, stakeholders rated the following as being particularly vulnerable to climate change:

- Beaches
- Tourist attractions (nature-based)

Stakeholders rated both issues as being very sensitive to climate and having very limited adaptive capacity. Ambient temperature, weather extremes and water temperature and quality were identified as key climate drivers for both issues. Given some of these drivers (ambient temperature, water temperature), climate change could conceivably generate opportunities, especially for beach-based tourism. Working against these opportunities are the threats posed to beaches and natural

attractions by climate change (sea level rise, storm surge, water quality) and the limited adaptive capacity of the natural systems that underpin beach- and nature-based tourism. Poor adaptive capacity of these issues stems from significant existing pressures, and limited flexibility to respond to change.

3.4.4. Urban planning sector

Key sectoral issue	Major climate drivers	Factors influencing capacity to adapt
Coastal planning	sea level, storm surge, sea temperature	lack of data/information, rate of coastal development/land values/unwillingness to move
Residential design (existing stock)	extreme/seasonal temperature, winds, extreme rainfall	cost of retrofitting, communication issues
Stormwater infrastructure & management	extreme rainfall, storm surge, sea level	cost of upgrading – already at capacity

Planning for urban growth is a key issue facing decision-makers in the Western Port region. The impacts of climate change could well merge with and in some cases compound existing pressures (see *Climate Change Impacts in Western Port*, Box 6). Stakeholders considered the impacts of climate change on a number of issues relevant to urban planning in the Western Port region including:

- Residential design (existing stock)
- Commercial design, siting
- Stormwater infrastructure
- Transport planning/urban design
- Demographic pressures
- Coastal planning

Of these issues, stakeholders rated the following as being particularly vulnerable to climate change:

- Coastal planning
- Residential design (existing stock)
- Stormwater infrastructure

Stakeholders rated all three issues as being very sensitive to climate. Key climate drivers include sea level rise and storm surge (coastal planning, storm water management) and extreme temperatures and winds (residential design, coastal planning) and extreme rainfall (residential design, stormwater management).

Stakeholders also rated all three issues as having very limited capacity to adapt to future climate change. Factors limiting adaptive capacity include (perceived) high capital costs of retrofitting/upgrading (residential design, stormwater infrastructure), and the current rate of coastal development and a lack of specific data relating to areas that could be impacted by sea level rise and storm surge (coastal planning). It is worth noting that this last issue was also raised by stakeholders from other sectors, including 'biodiversity', 'coastal management and planning' and 'other infrastructure & services'.

4. Priority Cross-Sectoral Issues

4.1. Overview

Priority cross-sectoral issues:	<ul style="list-style-type: none">▪ Coastal and marine biodiversity and habitats▪ Groundwater▪ Housing and accommodation▪ Infrastructure siting and planning▪ Potable water supply▪ Storms (emergency response)▪ Stormwater▪ Waterways and streamflow
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Central to the strategic directions for responding to the impacts of climate change in Western Port are a series of eight 'priority cross-sectoral issues', so-designated because each of the issues is relevant to a number of sectors in the Western Port region. Their priority status stems from the fact that the issues have been rated by a wide range of stakeholders as highly vulnerable to climate change.

The priority cross-sectoral issues were selected by:

- examining the key sectoral issues; and
- identifying issues that are rated as particularly vulnerable by stakeholders from two or more sectors.

The high priority cross-sectoral issues are outlined in Table 1, detailing the major elements of each issue and the relevant sectors. In some cases, wording of a cross-sectoral issue has been amended or expanded to reflect a number of major elements within the issue and different emphasis placed by stakeholders from different sectors on these elements.

When setting strategic directions for a regional response to the impacts of climate change, the priority cross-sectoral issues assume particular significance. This is because cross-sectoral issues:

- require an integrated and coordinated response if they are to be effectively addressed (see section 2.2);
- encompass a range of economic, environmental and social objectives that are important to the community;
- provide a focus for capturing opportunities presented by climate change (see section 4.2); and
- provide a focus for establishing regional partnerships on climate change response, especially in relation to further research (see section 4.3).

Table 1 : Priority cross-sectoral issues

Priority cross-sectoral issue	Major elements	Sectors*
Coastal and marine biodiversity and habitats	Loss of mudflats, salt marsh, sea grass, fish breeding habitat, bay water quality, beaches	Biodiversity, coastal management, recreation, fisheries, regional development & tourism
Groundwater	Groundwater recharge, salinity, surface water interaction, ecosystem dependence (e.g. wetlands), agricultural industries (farm forestry, asparagus, perennial horticulture)	Catchment management, water infrastructure & services, biodiversity, agriculture
Housing and accommodation	Quality and performance of existing housing stock (thermal comfort, storm worthiness, energy and water use), especially in low income groups.	Community services, emergency services, health, other infrastructure & services; urban planning, water infrastructure & services
Infrastructure siting and planning	Siting of infrastructure in coastal and low-lying areas, especially existing and proposed housing and associated residential infrastructure.	Coastal management, other infrastructure & services, urban planning, community services, recreation
Potable water supply	Access to potable water, particularly short term, emergency supplies. Low income groups and rural areas especially.	Community services, emergency services, health, water infrastructure & services
Storms (emergency response)	Emergency response to storms and flooding. Damage to infrastructure, injuries, energy and water supply, traffic management, other health issues.	Emergency services, health, other infrastructure & services, community services, urban planning, water infrastructure & services
Stormwater	Infrastructure planning and management of stormwater and drainage. Issues include flooding and bay water quality.	Water infrastructure & services, urban planning, emergency services, coastal management, catchment management, regional development & tourism
Waterways and streamflow	Reduced environmental flows - impacts on freshwater biodiversity, riparian vegetation, water quality. Reduced water supply – agriculture.	Catchment management, water infrastructure & services, recreation, biodiversity

* Sectors listed are those which rated an issue (or one of its major elements) as a key sectoral issue. The issue may also be relevant to other sectors.

4.2. Opportunities

Climate change in the Western Port region has the potential to create many opportunities, as well as risks and threats.

At workshops held in March 2006, regional stakeholders were asked to identify opportunities arising from climate change in the region. A large number of responses were received, some of which are relevant to framing a regional response to climate change. Set out in Table 2 below are opportunities identified by stakeholders that are relevant to the priority cross-sectoral issues.

Table 2 : Opportunities relevant to priority cross-sectoral issues

Priority issue	Opportunities
Coastal and marine biodiversity and habitats	<ul style="list-style-type: none"> ▪ Improved monitoring of coastal ecosystems and processes.
Groundwater	<ul style="list-style-type: none"> ▪ Improved understanding of links between hydrological processes and ecosystems.
Housing and accommodation	<ul style="list-style-type: none"> ▪ More efficient, comfortable and storm resistant house design. ▪ No regrets water efficiency audits and implementation. ▪ Markets for water saving devices. ▪ Links with energy efficiency
Infrastructure siting and planning	<ul style="list-style-type: none"> ▪ Improve community understanding of the costs associated with providing coastal infrastructure. ▪ Redesign of coastal housing areas. ▪ Enhanced land use planning and controls in coastal areas.
Potable water access	<ul style="list-style-type: none"> ▪ Investment in alternative water supply options. ▪ Grey and black water recycling.
Storms (emergency response)	<ul style="list-style-type: none"> ▪ Better training for volunteers in fields of emergency response and pre planning.
Stormwater	<ul style="list-style-type: none"> ▪ Reduced effluent and pollutants to bays and ocean. ▪ Improved stormwater design. ▪ Increased local/stormwater storage = mitigation of flash flooding. ▪ Stormwater reuse for recreational areas.
Waterways and streamflow	<ul style="list-style-type: none"> ▪ Improved long term monitoring of waterways.
Community engagement and capacity building	<ul style="list-style-type: none"> ▪ Improved community understanding of sustainability through information, education and demonstration programs. ▪ Strengthen local communities.
Regional integration and coordination	<ul style="list-style-type: none"> ▪ Utilise existing community infrastructure, resources, networks. ▪ Natural and built asset registers. ▪ Improved local government and/or regional agency strategic planning risk management.

4.3. Information gaps and research requirements

At workshops conducted in March 2006, stakeholders were asked to identify information gaps and areas requiring further research. A large number of responses were received, nearly all of which are relevant to one or more of the key sectoral issues discussed in Chapter 3. A complete list of the research requirements identified by workshop participants is provided in Appendix 2. The items listed in Table 3 below are selected from that list. They represent the research and information requirements identified by workshop participants that are relevant to the priority cross-sectoral issues.

Table 3 : Research requirements relevant to priority cross-sectoral issues

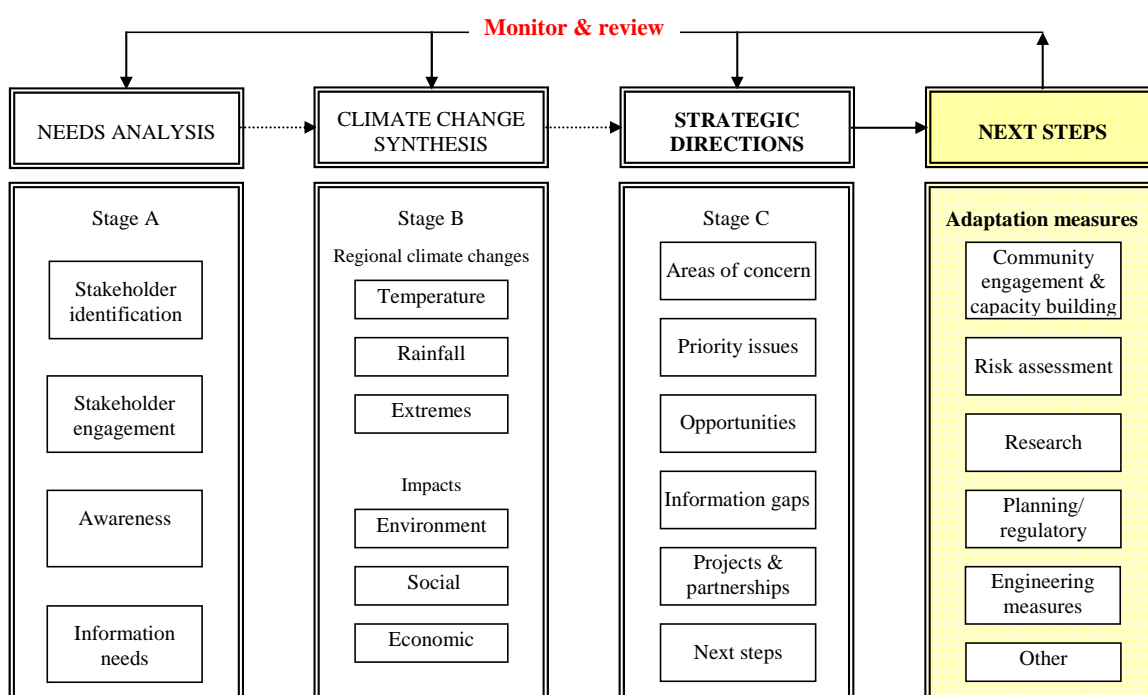
Priority issue	Research/information requirements
Coastal and marine biodiversity & habitats	<ul style="list-style-type: none"> ▪ The implications of climate change for vulnerable coastal and marine habitats and communities (various). ▪ The implications of climate change for the distribution and movement of fish stocks. ▪ Impacts of increased water temperatures on fish stocks and habitat. ▪ The implications of climate change for mangrove/salt marsh communities. ▪ The impacts of sea level rise on sea grass. ▪ Changes to sea temperatures and currents – implications for exotic marine pests.
Groundwater	<ul style="list-style-type: none"> ▪ Catchment scale hydrological modelling. ▪ Information gaps on wetlands.
Housing and accommodation	<ul style="list-style-type: none"> ▪ Potential to modify existing housing stock to make it more sustainable. ▪ Demonstration projects – water and energy efficient housing. ▪ Wind damage thresholds, housing and other infrastructure.
Infrastructure siting and planning	<ul style="list-style-type: none"> ▪ Regional population projections - implications for coastal and urban planning. ▪ The impacts of sea level rise and increased storm surge on coastal settlements. ▪ Flood frequency changes under future climate scenarios. ▪ Areas and infrastructure vulnerable to increased sea level and storm surge. ▪ How can governments and planning authorities factor climate change into land use planning and decision-making?
Potable water access	<ul style="list-style-type: none"> ▪ Cost and availability of potable water under future climate scenarios, especially in rural areas. Implications for low income groups. ▪ Feasibility of alternative supply options for the region. ▪ Long term regional water requirements, given population and economic projections.
Storms (emergency response)	<ul style="list-style-type: none"> ▪ Frequency and severity of storms under future climate scenarios. ▪ Are roads capable of meeting small-scale evacuation needs?
Stormwater	<ul style="list-style-type: none"> ▪ Intense rainfall scenarios - implications for stormwater management and infrastructure.
Waterways and streamflow	<ul style="list-style-type: none"> ▪ Likely streamflow changes. ▪ Catchment scale hydrological modelling.

5. Next steps

5.1. Regional adaptation

The scoping study has focussed on establishing strategic directions for responding to climate change in the Western Port region. As outlined in Figure 4, next steps in a regional response will include specific adaptation measures, initiated by regional stakeholders either individually or through regional partnerships.

Figure 4 : Adapting to Climate Change in Western Port – Next Steps



Options for adaptation are wide-ranging. Adaptation need not be limited to reactive technological and infrastructure measures but can also include proactive measures such as on-going community engagement and capacity building, further research and planning and regulatory measures. As previously discussed, capacity building is likely to be a key first step towards adaptation for groups, assets or industries that have been rated as highly vulnerable to climate change (for example, low socio-economic groups - see Chapter 3).

When considering adaptation measures however, stakeholder organisations will need to be wary of not needlessly spending time and resources on adaptation measures (referred to as 'over-adaptation'). To avoid that possibility, stakeholders should keep in mind principles of 'good climate adaptation' as outlined in Box 4. Stakeholder organisations should also consider further prioritisation of issues. This can be achieved through risk assessments applied to the priority cross-sectoral issues and key sectoral issues.

Box 4: Principles of 'good climate change adaptation'

- Work in partnership where possible
- Be clear on your objectives before you start
- Take a balanced approach to managing climate and non-climate risks and opportunities
- Focus on actions aimed at addressing priority risks and opportunities
- Use adaptive management to cope with uncertainty, i.e. small, incremental changes that can be redirected or reversed if information changes
- Try to find 'no-regret' and/or 'win-win' measures
- Avoid actions and measures that will make it more difficult to adapt to climate change in the future
- Monitor your strategy and review it regularly

5.2. Partnership projects

An initial step towards implementing regional adaptation measures has already been taken, with identification by stakeholders of adaptation project opportunities. At a workshop held in April 2006, stakeholders discussed the priority-cross sectoral issues, as well as the other major aspects of the strategic directions outlined in Chapter 2 - 'community engagement & capacity building' and 'regional coordination & integration'. A series of exercises was then used to enable stakeholders to:

- identify possible projects linked to the strategic directions;
- prioritise those projects; and
- to begin establishing partnerships around the projects.⁷

Five 'partnership projects' were identified by stakeholders. These are:

- A. Design a monitoring regime to track impacts of climate change and identify triggers for action
- B. Strengthen community groups and volunteer organisations to develop responses to climate change through a series of community strengthening workshops
- C. Develop climate change adaptations to existing emergency management strategies
- D. Investigate viability of additional water treatment and recycling options in the region (linked project: regional water use mapping)
- E. Develop climate change scenarios for the region

⁷ This process is described in more detail in Appendix 1.

The partnership projects provide an opportunity for concrete steps to now be taken towards regional adaptation to climate change in the Western Port region. However, stakeholders should also consider other specific adaptation measures, to be initiated either individually or through regional partnerships.

Further information on the partnership projects and on other adaptation project ideas discussed by stakeholders is provided in Appendix 2.

At the time of writing, funding to undertake an integrated assessment of the impacts of climate change on settlements in the Western Port region has been obtained from the Department of Environment and Heritage (Australian Government) and the Department of Sustainability and Environment (Victorian Government). The new project, to be undertaken over two years from July 2006, will enable a number of aspects of the partnership projects to be initiated, as well as other adaptation opportunities that have been explored by stakeholders.

5.3. Conclusion

The strategic directions outlined in this report, and the regional partnerships that are coalescing around the key cross-sectoral issues, represent the first tentative steps towards adapting to climate change in the Western Port region. The Western Port Greenhouse Alliance (WPGA) provides a focal point for moving the adaptation process forward, especially on priority projects and other aspects of the priority cross-sectoral issues. To that end, the WPGA is actively seeking opportunities and additional resources. However, continued momentum will ultimately depend on the long term commitment of regional stakeholders, not only those with an interest in the priority projects, but all stakeholders concerned about effective and efficient adaptation to climate change in the Western Port region.