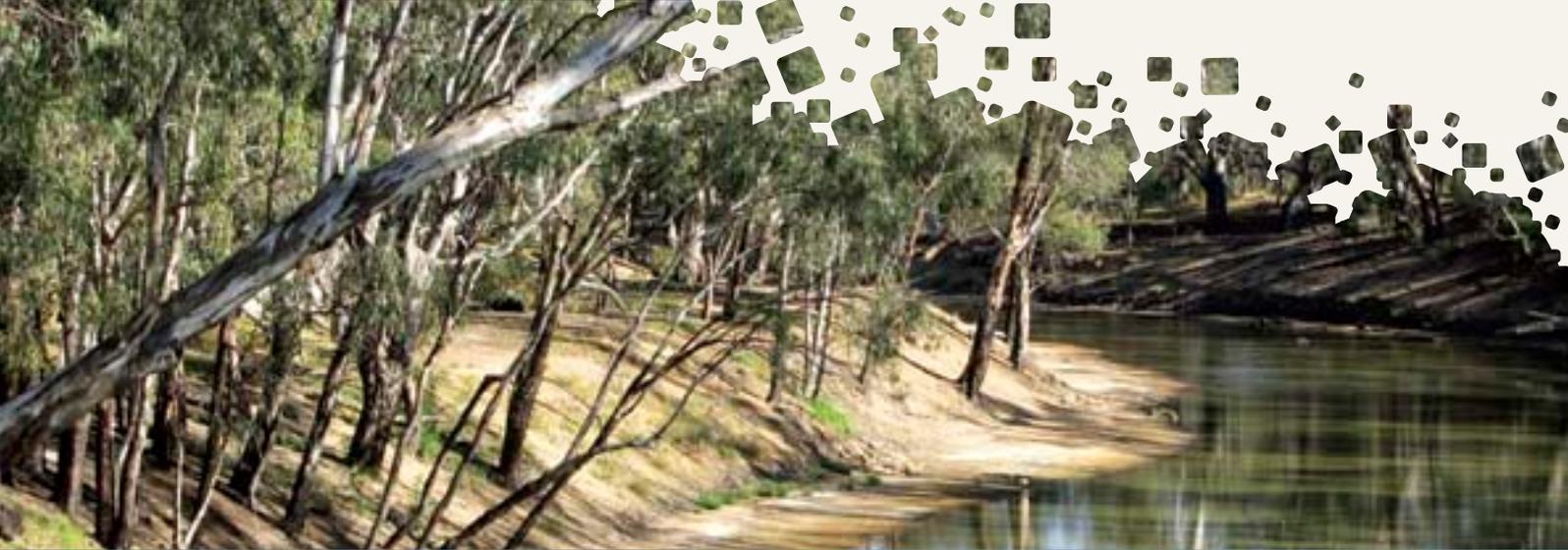


Summary



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Introduction

Victoria's Commissioner for Environmental Sustainability was established to promote environmental sustainability. One of the Commissioner's statutory functions is to prepare reports on the state of Victoria's environment at least every five years. These reports must be tabled in Parliament and followed by a Government response to any recommendations within 12 months. This is the first comprehensive State of Environment report for Victoria.

The report describes the current state of Victoria's environment, how and why it has changed over time, and how it is expected to change in the future. Driving the condition of Victoria's natural environment is a set of overarching forces - population and settlements, consumption and climate change. These drivers are seen in our use of water, energy and materials. An analysis of the condition of the natural environment is presented in four chapters - the atmosphere; land and biodiversity; inland waters; and coasts, estuaries and the sea. A final chapter explores how Victorians can live well within the environment, rather than at its expense.

The report brings together information from a wide range of sources and sets that information in the context of society and the economy. It sets a baseline of environmental condition which can be used to measure the success of future government policies and actions. Recommendations are provided to help Victoria take the actions needed to ensure a healthy environment which is vital for Victoria's future prosperity and wellbeing.

This summary is presented in two parts. The first provides highlights from the report and the second provides a list of the key findings and recommendations by chapter.

Our wellbeing relies on a robust, healthy environment. Healthy environments provide a range of services such as clean water, a stable climate, productive land, and fisheries. Energy and material resources, which come from the environment, contribute to our health, wealth and wellbeing. The environment is also used for recreation, and many places throughout the State have cultural importance to our communities. We have dramatic alpine areas, spectacular coastlines, ancient forests, wild deserts, stunning rivers and wetlands. Our State is a unique place with plants and animals found nowhere else on Earth. Over the last 200 years, Victorians have radically changed the environment through land clearing and settlement, but enjoyment of our environment has remained ingrained in our culture. Our natural environment, the bush and beaches, and our native plants and animals form part of our identity and shape who we are, and what we present to the world.

In developed countries across the world, population growth, urbanisation, affluence and consumption have created unsustainable pressures on the environment. In developed states like Victoria we enjoy a high standard of living. As a result of improvements in the efficiency of primary production and technology, and with so many people living in cities and towns, a disconnection has been created between people and their natural environments. Victoria's prosperity is masking the environmental damage caused by our modern society and our lifestyles. We believe that we can manage environmental degradation for a price, but we don't know enough about environmental systems or their thresholds to have certainty that we will be able to act in time to avoid catastrophic changes. Some types of environmental degradation can be reversed for a price. Others, such as species extinction, cannot.

Our way of life continues to be maintained and enhanced through the gradual degradation of our natural environment. Most environmental indicators in this report show that the environment is degraded, and is getting worse. The environmental services we rely on are already damaged by human activities and past management, and will further degrade if we continue with current approaches.

Victoria strives for economic growth and improved wellbeing but these come at an environmental cost. Our waterways and biodiversity are stressed and we have very high per capita greenhouse gas emissions. It might seem that the natural environment is in a good condition, but it can be very difficult to notice changes which happen slowly but cumulatively. It is often not until significant damage has occurred that we realise that it is too late to easily, or if at all, fix the problem. This lack of understanding or acknowledgement has resulted in policies and actions that have been insufficient to protect and restore the environment, which reduces the value of our natural systems and therefore devalues the State.

All Victorians have a role to play in deciding what kind of future we will have. There are hard decisions ahead. These decisions must be based on what we value and what kind of environment we want to have and leave for the future. For the wellbeing of Victorians to continue to improve without damaging the environment at the same time, the value of environmental services will need to be brought more comprehensively, transparently and explicitly into decision-making. This will mean changes, but the sooner we act to improve the health of our environment, the less dramatic the changes will need to be.

Transparent engagement between Government and the community is needed. To do this, high quality, accessible information about the environmental issues at stake, the options available to address these, and their relative merits, must be provided to our communities. Decisions will have environmental, social, economic and potentially political consequences. Society must inform the strategic decisions that need to be taken while understanding what is at stake, and what values are in play.

The future cannot be an extension of the past – major changes are needed and a real commitment to improving the environment is required. It is not just the future that is under threat; we are already experiencing the impacts of environmental degradation. Victoria needs a healthy and robust environment that can withstand and adapt to environmental shocks such as fire, drought, floods and the additional stresses that will come with climate change. A better future is available if we have the will to approach the future along a different path.

A culture of consumption - drivers of change

Our society and economy rely on the environment, but the way we use resources, and the amounts we use are damaging it.

The most obvious links between our economy and the environment are the natural resource and primary industries, such as agriculture, forestry, fishing and mining. Natural resource industries provide us with food, products to export and inputs to other sectors such as manufacturing, transport and building.

Partly due to significant exports, Australia's total material requirements are increasing and are more than twice that of other OECD countries. The energy sector is critical to the Victorian economy. The availability of abundant, cheap electricity has driven industrial development in the State and increased our prosperity. As consumers, we buy goods and services which have large impacts on the natural environment. Together, these factors create risks and pressures but also opportunities for better management of the environment and behaviour change.

Population growth, settlement and consumption patterns, and climate change are the key drivers of environmental degradation in Victoria.

Population growth and settlements

Victoria's population growth, increasing affluence and the expansion of our cities and towns, have contributed to unsustainable levels of resource consumption and waste production. This has direct environmental impacts through changes in land use, from conservation and agriculture to cities and towns. To supply our cities and towns, we harvest water for residential and manufacturing purposes, change river flows, discharge wastes to land and sea, remove native vegetation and send damaging gases into the atmosphere.

Lifestyle factors, such as the demand for larger homes and the rising cost of city living, are increasing the demand for development on Melbourne's edges. These areas are poorly serviced by public transport due to low urban density and a focus on motor vehicle dominated urban design rather than transport systems which have the least environment impact, and which reduce our vulnerability to future economic shocks.

Changing social patterns have led to a reduction in the number of people per household. At the same time there has been an increase in the size of houses which are often poorly designed for the local climate with low thermal and water efficiencies. These trends, combined with a growing population means we need more houses than ever before. This drives demand for household furniture and appliances, as well as heating and cooling and has led to an increase in the consumption of raw materials, water and energy.

Economic growth and consumption

The cost of environmental degradation is not integrated into our economic systems. Modern society uses material consumption as a measure of human wellbeing. However, the goods and services we buy and use are not currently priced to include the costs associated with the environmental degradation that they create. This means that the costs of environmental degradation are being 'externalised'.

It is cheaper to protect the environment than to restore it, but it is even cheaper to degrade it, externalising the costs.

Current measures of economic growth, such as gross domestic product or gross state product, do not adequately capture changes in the state of the environment or social wellbeing. For example, the cost of environmental degradation is counted towards gross domestic product, when in reality, this continues to mask environmental degradation. To ensure that the environment is properly accounted for, we need to change the way we measure wellbeing and break the link between environmental degradation and economic growth. This will enable Victorians to maintain a high standard of living as well as protect the environment.

Victoria's Ecological Footprint is three times larger than the world average. Our footprint is larger than the Australian footprint and those of other developed countries such as the United Kingdom, France and New Zealand. If everyone lived like Victorians, almost four planets would be needed. There is only one available. This indicates that in the global context, Victorians' way of life is not sustainable.

Victoria is becoming more efficient in the use of energy and water, but resource consumption continues to increase. Recycling, for example, has increased, with 60% of waste now diverted from landfill. However, this major achievement is undermined by the fact that between 1993 and 2006, total waste produced (waste and recycling) per person doubled. While a certain level of waste may be unavoidable and has been historically absorbed by the environment, the sheer level of resource use is now threatening the health of the environment. Victoria's increasing population requires us to urgently confront such issues and reduce these inefficiencies with a view to reducing total resource use.

Increasing efficiency is essential but it is not enough unless absolute environmental pressures also reduce. This has not yet occurred.

To achieve sustainable consumption and production we will need significant technological research and development, industry partnerships, and governments that are prepared to make difficult decisions to ensure current and future community wellbeing. The sooner we take decisive action, the lower the environmental, social and economic costs will be.

Climate change

The potential impacts of climate change on natural systems may well eclipse all other causes of environmental degradation. Climate change has the potential to overwhelm our environment leading to the extinction of plants and animals, and threatens agricultural productivity which would in turn, have huge impacts on our social and economic wellbeing. The current degraded state of our environment is not a result of climate change, rather past actions which have assumed that the natural environment could bear any impact from human activities. This assumption and the continuation of current approaches is not sustainable. Climate change is a crosscutting theme throughout this report because of its potential to cause dramatic changes to our living standards and environment in the short to medium term, not just in the distant future.

The drivers of environmental damage must be tackled while also continuing to improve efficiency. The good news is that Victorians have a history of finding innovative solutions to environmental problems, such as the internationally successful Landcare movement. We are well placed to lead the development of solutions to many environmental issues that could make a difference well beyond our state borders.

The climate is changing - we must act now

There is now overwhelming evidence that the earth's climate is changing because of higher concentrations of greenhouse gases in the atmosphere. The United Nations Intergovernmental Panel on Climate Change (IPCC) has declared that **climate change is 'unequivocal' and due, with a probability of greater than 90%, to human activity.**

Australia's already hot, dry, and highly variable climate is more vulnerable to climate change than other developed countries. Australia has large natural year-to-year variations in climate. At short time scales, natural variability can offset global warming and cause short-term cooling, but the long-term warming trend is clear.

Globally, greenhouse gas emissions increased by 70% between 1970 and 2004. Carbon dioxide emissions, trends in global temperatures and sea levels are continuing to track at the upper limit of IPCC projections for climate change. This indicates that the speed and severity of the changes forecast may be significantly underestimated. The greater the warming, the greater the risk is of tipping into irreversible climate change. **Climate change confronts humanity with the possibility of catastrophic change to life on Earth.**

Climate change is affecting us already. Victoria has warmed by 0.6°C since the 1950s. Six out of the ten hottest years on record in Victoria have occurred since 1990, with 2007 being the hottest year of all. Rainfall during the last ten years has also been much lower than the historical long-term average.

Climate change projections for Victoria include:

- higher temperatures of 0.6°C to 1.2°C by 2030 with increases between 0.9°C and 3.8°C by 2070
- very high or extreme fire danger days across south-eastern Australia expected to increase by up to 25% by 2020 and up to 230% by 2050
- flows in rivers and streams reduced by half across much of the State by 2070
- drought frequency is likely to increase between 10% and 80% in the southern half of the State and by between 10% and 60% in the north by 2070
- storm surges of over two metres above sea level could be expected around once every five years by 2070 threatening the coast and coastal infrastructure.

Natural systems can only tolerate small changes in average temperatures. Based on current projections of climate change in Victoria, **it is very likely that many species won't be able to adapt.** Small and fragmented populations of flora and fauna, and those at the limits of their range, are at particular risk and little is known about the adaptation responses of individual species. Climate change will further threaten the survival of a number of species in Victoria, including the Mountain Pygmy-possum and a State emblem, the Helmeted Honeyeater.

Climate change will affect natural systems locally and globally. If climate change continues, many of the world's poorest nations, including some of our neighbouring countries, will be hit hardest by the changing environment. Many millions of people will be at risk from extreme weather such as heat waves, drought, fire, floods and storms. Coasts and cities will be threatened by rising sea levels. Plant and animal species will be in serious danger of extinction and some of Australia's most famous sites such as the Great Barrier Reef, Kakadu and the Australian Alps areas would be irreparably damaged.

The global nature of climate change requires a global response. Developed nations have produced most of the greenhouse gases that are changing the climate. Australia and other developed countries have committed to leading climate change mitigation actions. Developing countries are looking to developed nations to take responsibility for their historical emissions, and to take the lead in global emissions reduction efforts. The fast growing economies of China, India and Brazil are seeking to lift the living standards of their societies and will soon become some of the largest greenhouse gas emitting countries in the world. This means that developing countries must be brought into the post-Kyoto agreement for any chance of success. Without global mitigation, developing countries could account for about 90% of the emissions growth over the next decade and beyond.

In 2007, the IPCC indicated the need, and the potential, for developed countries (including Australia) to reduce their emissions (from 1990 levels) by 25-40% by 2020 and by 80-95% by 2050. However, both Australia and Victoria currently have a target of 60% reduction from 2000 levels. This target neither fully reflects the expectation of developing countries that developed countries should provide leadership on mitigating climate change nor the financial ability of wealthier countries to make deeper cuts.

The Garnaut Climate Change Review showed that if there is an international agreement, the economic impact of deep cuts in emissions, compared with the proposed 60% reduction, would be negligible in Australia. It suggested that if no international agreement is achieved, Australia should revert to a target of 5% emissions reduction by 2020 and maintain the 60% target for 2050. This is Australia's existing unconditional offer for emissions reductions. Failure of the world to act now will leave Australians with a legacy of economic, environmental, social and health which far outweighs the costs of acting now.

Australia is well placed for a transformation to a low carbon economy. A significant reduction in Australia's greenhouse gas emissions is achievable now, but it requires rapid action from governments, business and the community. A recent report by McKinsey and Company estimated that a 30% reduction in Australia's greenhouse gas emissions below 1990 levels can be achieved by 2020 and 60% by 2030 without major technological breakthroughs or lifestyle changes. Recent Commonwealth Government Treasury modelling shows that the economic impact on Australia of early greenhouse gas emission reductions is negligible.

Australia is the second highest on a per capita scale of the top 25 emitting countries. Our country is the 14th largest emitter of greenhouse gases in the world, but responsible for only 1.5% of total global emissions. Victoria is responsible for one fifth of Australia's greenhouse pollution and our State's emissions have increased by some 12% since 1990.

95% of Victoria's electricity is supplied from brown coal, the most greenhouse-polluting energy source in Australia. Energy consumption in Victoria increased by more than 80% over the last 30 years. In 2006, over 85% of greenhouse pollution generated in Victoria was produced by the energy and transport sectors. Electricity from brown coal is almost six times more polluting than natural gas per unit of energy created in Victoria. **Only 4% of Victoria's electricity comes from renewable energy sources with solar contributing just 0.006%.** Transport contributes 17% of total greenhouse gas pollution largely due to our vehicle dominated urban design and freight. Agriculture adds a further 13%. Victoria's heavy reliance on fossil fuels for both transport energy and electricity generation will be sustainable only if those sectors can adapt quickly to a low carbon economy.

The state of flux in Australia's and Victoria's climate change policy and programs is reflected in the number of key initiatives in development. Recent initiatives include the Commonwealth Government's response to the final report of the Garnaut Climate Change Review, the announcement of a national Carbon Pollution Reduction Scheme (CPRS), the Victorian Climate Change Green Paper and subsequent climate change legislation, and research and development of low emissions technologies including carbon capture and storage technology for electricity generation and research into renewable energy. The current

uncertain state of policy and technology development is not yet driving the changes required to achieve low carbon systems for energy, transport and urban form.

Critical decisions on Australia's and the world's commitment to reduce greenhouse gas emissions will be made in 2009. Australia will decide its contribution to reducing global greenhouse gas emissions which will impact on all Australians and on all sectors of our economy. Decisions will also be made about how hard Australia will push for an international agreement between developed and developing countries to reduce greenhouse gas pollution.

Victoria's greenhouse gas pollution reduction efforts will largely depend on the Commonwealth Government's aspirations for greenhouse mitigation, including long and short-term targets, and the design and coverage of the CPRS. The CPRS will drive Australia towards lower emissions while allowing the market to find the most cost effective ways of achieving the emission reductions. A range of State-based mitigation activities will be needed to complement the CPRS.

Victoria is largely banking on carbon capture and storage to deliver major reductions in our State's emissions. Reliance on a technology that may not be ready until 2030 or later risks emissions continuing to rise for some time. This uncertainty makes it essential that all governments continue to support the development of renewable energy. It will be important to ensure that renewable technologies continue to improve and costs come down, so that they can deliver a significant proportion of future energy needs.

It is clear that economic transformation is needed, particularly for the energy sector, as we prepare to face the challenges of climate change. **Business as usual isn't going to work.** The time for much stronger action on climate change has arrived. Many policies and programs have been put in place at both the Commonwealth and State Government level, however, they have been largely peripheral in the absence of: putting a price on carbon; driving energy efficiency from low-hanging fruit; and being clear as to the magnitude of change required. We must take strong action, not just make further aspirational policy commitments.

Urgent action is required if both Australia and Victoria wish to make a contribution to reduce global emissions with a view to avoiding dangerous climate change. This will require the involvement of all sectors of the Victorian community, Government, industry and the general public. Public awareness and support for Government action on climate change have gained momentum; however, in light of the current global economic instability and ongoing industry concerns about international economic competitiveness, strong and **continued community support for government leadership is needed.**

We all need to support governments to make the hard choices ahead, while also continuing to do what we can to reduce our own impacts such as switching to green power, using more energy efficient appliances and reducing our transport related emissions by avoiding private car use.

Achieving international agreement for deep cuts in global emissions of greenhouse pollution to mitigate climate change should be the primary focus for our governments; however, the amount of greenhouse gases in the atmosphere has already locked us into some climate change. Victoria's portfolio of responses to climate change incorporates both actions to mitigate climate change and adaptation initiatives. The Victorian Government should build on its existing Victorian Climate Change Adaptation Program to develop and publicly report on a strong and ongoing adaptation research program and suite of actions.

Unless the world can reach global agreement and achieve deep cuts in greenhouse gas emissions within the next decade, climate change will forever alter natural systems and the structure of societies and economies. **There is an urgent need for the global community to commit resources and actions at a scale not previously considered.**

Victoria must continue to support leadership in national aspirations, and Australia must do everything possible to promote international agreement. Action on climate change is required to hold global atmospheric greenhouse gas concentrations to a level which prevents dangerous climate change.

Summary

Water – supply, demand and survival

Cities and towns in Victoria were established alongside freshwater rivers, streams and lakes for the most basic of human needs, drinking water. We value waterways as places to enjoy nature, and for recreational activities such as boating and swimming. Our inland waters also provide us with water for drinking, agriculture and industry.

Our inland waters, surface and ground waters, are all interlinked as parts of a water cycle that cannot be separated from the land, or the plants, animals and people that live in and around them. This makes river health is an important indicator of overall environmental health.

Rivers in eastern Victoria are generally in good condition but many of the rivers in the centre and west of the State are environmentally degraded. The last assessment of river health in 2004 found that **only one fifth of major rivers and tributaries in Victoria were in good or excellent condition.** In 2008 nine out of ten Victorian basins in the Murray Darling Basin were found to be very poor health.

The plants and animals which depend on our inland waters also indicate the health of rivers and wetlands. Unfortunately the news is not good. 21 fish species, 11 frog species and 29 species of waterbirds are threatened, and only 14% of riverside vegetation along major rivers and streams in Victoria was found to be in good condition, with most being patchy and interspersed with weeds.

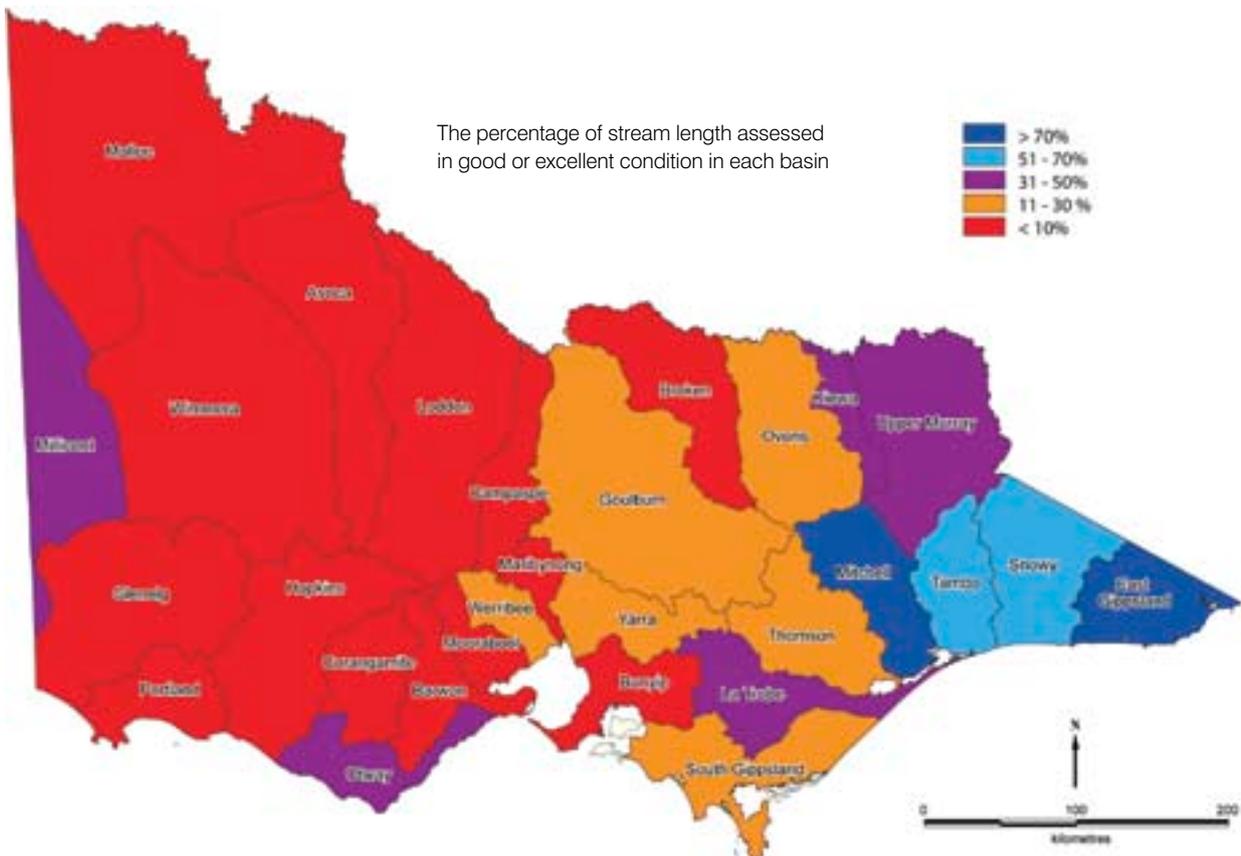
Wetlands are also very important for environmental health, but **no statewide study of the extent of our wetlands has been undertaken since 1994.** At that time, more than a third of our naturally occurring wetland area had already been lost and over 90% of the wetlands on private land had vanished – often drained for agriculture or housing developments. **In August 2008, groundwater levels in half of the most highly developed or potentially stressed groundwater areas were the lowest on record.**

In most years, rivers only receive a fraction of their average flow due to Victoria's highly variable climate, however the past decade of low rainfall has caused water shortages across the State, stressed our environment and caused hardship to

regional communities. This dry period, or 'drought', has reduced inflows to water storages to 30–60% below long-term averages with record lows in 2006. The drought has contributed to the pressures on our inland waters, but **many of our rivers, streams, wetlands and groundwater were environmentally damaged before the current drought.**

The way we have developed our State has drastically changed our inland waters and the way they interact with the land. Building dams for water storages, removing water for consumption, creating channels and building levees have altered the flows in our inland waters. Wetlands throughout the State have been converted for agriculture; riverside vegetation has been cleared, and stock access to streams causes damage to riverside vegetation, erosion and water pollution.

Condition of major rivers and tributaries in Victoria's river basins



Consumption drives the modification of our waterways and is an environmental pressure in itself. As a result of low water availability, farmers are doing it tough. However, irrigated agriculture is the single biggest user and is responsible for about three quarters of water consumed in Victoria. Melbourne uses about 10% of the State's water.

Victorians have been successful in reducing their personal water use in response to education programs, restrictions and a lack of water. Improvements in irrigation practices are improving water use efficiency and helping to reduce salinity impacts and nutrient discharges. Melbourne's per capita water consumption decreased by one third in 2006-07 compared to the average of the 1990s. There has also been a six-fold increase in the consumption of recycled wastewater in Victoria over the past decade. Despite these efforts, over the past four years more than three quarters of all the water in a quarter of our rivers was removed for consumption by people, agriculture and industry. Many rivers are simply not getting enough water to maintain their condition.

Changing our landscape and removing water for consumption are important causes of degradation but the way we manage our inland waters also has an impact. In 2005-06, about one-quarter of the water harvested in Victoria (about three times the water consumed in Melbourne) was lost or unaccounted for due largely to evaporation, seepage, leakage and metering error. Water management in Victoria is rapidly increasing in sophistication and accountability, and Victoria is recognised for its leadership in water management. However, the degraded state of many of our rivers shows that **the way we manage our water resources has not secured the health of our inland waters.**

Water resources management in Victoria has historically focussed on providing reliability and protecting the rights of water consumers. The focus has now broadened to include the protection of the environment. This can be seen in several important policies such as the National Water Initiative at the Commonwealth level, Victoria's Our Water Our Future (2004) and the Victorian River Health Strategy (2002). The actual sharing of water between competing users, however, occurs through the Victorian Allocation Framework. The Allocation Framework protects private rights but it also recognises the environment's right to water.

Allocation of water for rivers and streams for the purpose of environmental health is called providing 'environmental flows'. Flows in rivers are naturally variable and the timing, frequency, volume and duration are all important aspects of environmental flows. Providing and protecting adequate environmental flows continues to be a central management issue. Commitments to provide environmental water were not fully achieved in 40 locations across Victoria in 2006-07, as part of drought contingency measures. **During times of low rainfall, the current allocation system reduces environmental flows more than it reduces water for consumption.** Adequate flows and environmental water reserves have not yet been agreed for many rivers and aquifers across Victoria.

The Victorian Government has responded to Melbourne's water shortages and uncertainty about future supply with commitments to expand supply capacity by about 60% of 2006-07 consumption by 2011. This will be done by building a desalination plant, the Tarago Reservoir Reconnection, and the Northern Victoria Irrigation Renewal Project, and the Sugarloaf Pipeline Project. There are also plans to produce 100GL a year of recycled water from the Eastern Treatment Plant.

These projects aim to provide Melbourne with insurance against running out of water. To minimise the high costs of providing this insurance and developing and using the new supplies of water, **we must continue to save water.**

Significant water savings, environmental and financial benefits, can be achieved through efficiency improvements such as installing rainwater tanks, introducing stormwater harvesting and 'third pipe' uses of recycled water.

The current degraded state of many inland waters makes them vulnerable to the impacts of climate change.

Current projections suggest that Victoria's future climate will be warmer and drier. By 2020, a 10-40% reduction in snow cover would reduce the flows into downstream inland waters. By 2030, streamflow may vary from no change or slight increases in East Gippsland to 25-40% decreases in western and north-western Victoria. **By 2070, the flow in rivers and streams may be reduced by half across much of the State.** This would seriously endanger environmental health. For example, climate change is likely to reduce the frequency of significant flooding in the Barmah Forest to once in 17 years, but River Red Gums need significant flooding every five to 10 years. Unless action is taken to ensure adequate flooding, these world-renowned forests are unlikely to survive.

Millions of dollars are being spent on efficiency and securing supply, but the impact of climate change means that water allocated to the environment may not be enough to secure environmental health.

Sharing water between competing uses ultimately involves social and therefore political choices. To date, the environment has been the loser. Difficult decisions must be made as water availability declines and pressures on our environment increase. Many inland waters are in poor condition and in the context of ongoing drought and climate change, their future health is uncertain.

Summary

Caring for our land and biodiversity?

Victoria's land is intimately connected to the rivers and streams that flow through it and from it into to coastal areas and marine environments. Not surprisingly, the condition of our land mirrors the state of our inland waters. There is relatively good environmental health in the east of the State where natural systems are least disturbed and are large enough to cope with shocks, but the centre and west of the State are generally in poor condition.

Victoria is Australia's most cleared and most densely populated State.

More than half of our land has already been cleared and we are continuing to lose native vegetation at a rate of some 4,000 ha per year, mostly from endangered grasslands. **Our State has the highest proportion (48%) of sub-bioregions in Australia in poor condition, with four out of Australia's five most cleared bioregions found in western Victoria.**

Land clearing for cities, towns and farmland has contributed to a biodiversity crisis in Victoria. Most of our high quality native vegetation is found on Victoria's public land in National and State parks and forests. Native vegetation remnants on private land are often small, patchy, isolated and degraded by human activities. 12% of Victoria's remaining native vegetation is found on privately owned land but it supports 30% of our threatened species populations, and up to 60% of the native plants on private land are threatened vegetation types.

Biodiversity is a critical part of overall environmental health.

Losing biodiversity or 'species richness' makes environments vulnerable and less able to cope with existing and future pressures. We have 157 species of native animals and 778 native plant species that are rare or threatened with extinction. 51 native plant species and 24 animal species have already become extinct in Victoria.

Trends in the fate of individual threatened species are variable. Some threatened species continue to decline but a small number of others are increasing in number in response to management activities. However, **the number of threatened species in Victoria increased between 2002 and 2007.** Many species have unknown or variable population trends and require ongoing monitoring. Loss of native vegetation, weed invasions, inappropriate grazing and too much or too little fire are the biggest threats to plants and animals in Victoria. Climate change is likely to add to these pressures.

Weeds affect all Victorian landscapes.

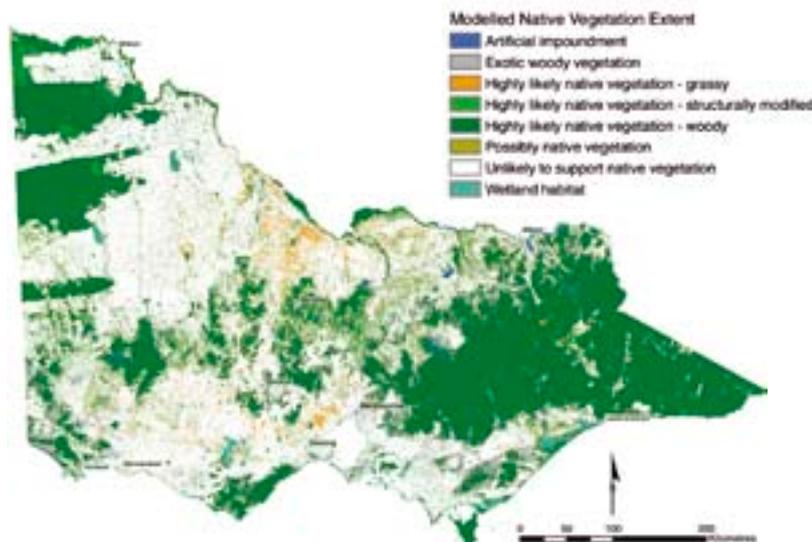
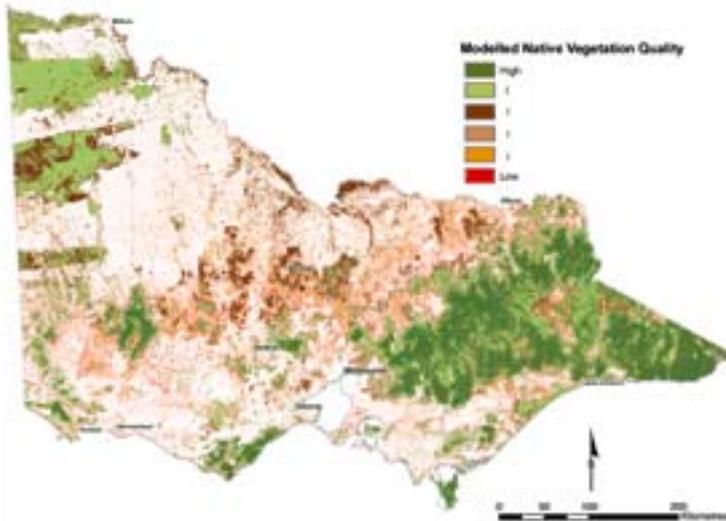
Weeds are continuing to establish in Victoria posing a major threat to biodiversity, farming and the beauty of natural landscapes. Almost all of the native bushland in Melbourne is badly affected by weeds and over half is considered severely degraded. Most new weeds in Victoria are introduced species from gardens. Weeds and pests are difficult and expensive to manage. The economic impact of invasive species is high. The total cost of pest species in Victoria is estimated at \$900 million per year.

Degradation of our land and biodiversity can also have significant economic impacts.

Salinity costs Victoria \$50 million annually in lost agricultural production and the direct costs of salinity are expected to reach \$77-166 million by 2050. The cost of lost productivity due to soil acidification to Victoria is almost ten times more and is estimated at \$470 million per year. Lost productivity of farmland also reduces the amount of land that could be used for biodiversity conservation in agricultural landscapes. The global cost of environmental damage and lost species has been estimated at US\$2.1-4.8 trillion annually.

Whilst farm productivity continues to be high, this is made possible by application of artificial fertilisers, pesticides and irrigation which come at an environmental and economic cost. This continued management of the land for high productivity, which supports our high standard of living, masks the incremental and cumulative environmental degradation that is occurring.

Extent and quality of native vegetation in Victoria



We have had some successes in maintaining and/or enhancing the quality of our land and biodiversity.

Increasing awareness of environmental issues and advances in farming systems and have helped to reduce erosion and protect soil structure in some areas. Community groups have improved areas of the environment and promoted sustainability, for example, land-holders who participate in Landcare are more likely to use sustainable agricultural management practices and protect native bushland.

Almost 40% of Victoria's land is publicly owned and is used for biodiversity conservation purposes, timber harvesting, recreation and water catchment. Public land reserved for nature conservation occupies some 17% of Victoria, mostly in National and State Parks, Wilderness Areas and Nature Conservation Reserves. Vegetation in these areas is largely intact and generally in good condition, particularly where the reserved area is extensive.

Laws and policies for managing our natural environment have been developed over many years but need to be reformed.

Victoria is committed to a joined-up approach to catchment, land and biodiversity management. Current management arrangements are complex and involve all levels of government, as well as public and private land managers. This has resulted in an extensive and complex range of regulations and legal requirements for land managers, and variable compliance and enforcement. Reform is needed to simplify environmental legislation and to align the environmental objectives of all levels of government to drive improvements in environmental condition.

The *Flora and Fauna Guarantee Act 1988* is failing to meet its stated objectives and needs to be reviewed to address Victoria's natural environments and their vulnerabilities to climate change. It also needs an adequate long-term allocation of resources to ensure effective achievement of its objectives.

While improvements are needed for environmental laws and management arrangements, laws and decisions not normally thought of as 'environmental' can have a big impact on our environment. For example, town planning requirements limit the number of dwellings permitted on an area of land which encourages the expansion of the outer suburbs, rather than increasing housing density in new and existing suburbs. With Victoria's population expected to reach 6 million people by 2020, 10 years earlier than previously anticipated, further development to accommodate this growing population is likely to be especially hard on threatened species in Melbourne's urban fringe areas.

Climate change will compound existing environmental pressures and could radically change our landscapes.

Natural environments can only cope with small average temperature changes, and the rate of climate change is very likely to exceed the ability of many species to adapt. Vulnerability of natural systems becomes significant at 1.5–2°C of global warming. This degree of warming may happen in Victoria by 2070, even under the Intergovernmental Panel on Climate Change's (IPCC) low-emissions scenario. Some species are sensitive to even smaller increases in temperature.

Climate change will further stress native plants through more frequent drought and fire, and increased competition from weeds. Some of Victoria's most threatened species are at risk of completely losing their habitats as climate change progresses. Climate change is also likely to threaten the adequacy of Victoria's current conservation reserve system as suitable habitats shrink and/or move within the landscape, e.g. towards the coast or to higher altitudes. It will be important to build connections between existing areas of native bushland to allow plants and animals to move within the environment. Native bushland on private land will become important as the basis for corridors between existing conservation reserves. Research and investment is needed to minimise biodiversity loss and maximise our environment's ability to adapt to a warmer, drier climate. This must be undertaken on a statewide scale.

Bushfires will become more frequent and severe due to climate change. Fire is a natural and necessary part of Victorian environments as many plants rely on fire to reproduce, but fire that is too frequent can prevent regeneration. **The number of very high or extreme fire danger days across south-eastern Australia is expected to increase by up to 25%**

by 2020 and up to 230% by 2050. Fire threatens human life and infrastructure, and provides opportunities for weeds to establish in forests. Soil left bare of vegetation by fire is vulnerable to erosion, especially if the fire is followed by heavy rain or flooding, as is often the case.

Victoria is one of the highest bushfire risk areas in the world. Victoria has experienced a high frequency and severity of fires in the last decade, including major bushfires in 2003 and 2007 that each burnt in excess of 1 million ha. Some animal species have lost large amounts of habitat due to these massive fires and their numbers have fallen.

Future decisions will reflect choices about what Victorians value.

Climate change will drive changes in land use which require environmental and political decisions about the relative values of our biodiversity and land. Victorians must make decisions about the trade-offs we are willing to accept, acknowledging that it is difficult and sometimes impossible to restore degraded environments. To do this, transparent engagement between Government and the community is needed. It is important that Victorians understand the issues, the options available to us, and the reasons for the choices that are eventually made. Part of this process should include setting, monitoring and reporting on short-, medium- and long-term targets for managing natural resources, biodiversity and threatened species in Victoria – managing them as an asset. Our environment is an asset that requires careful management. Just like financial assets, we need to protect our 'natural capital' – our environment.

The Victorian Government is reviewing land and biodiversity resources and management in response to the threats posed by climate change. The *White Paper Land and biodiversity in a time of climate change* will direct land and biodiversity policy for the next 50 years. This process provides the opportunity to strengthen and simplify legislation and management of land and biodiversity, to address the current causes of environmental degradation and put in place systems to maximise the health of our land and enhance our biodiversity into the future.

Victoria's coasts and the sea – a destructive relationship

Victoria's coast is made up of some 120 bays, inlets and estuaries and includes spectacular cliff and rock formations and lengthy sand features such as the 90 mile beach. It is one of the richest and most diverse environments in Australia, with 90-95% of species found in southern Australian waters living nowhere else on earth.

Like much of Victoria, our coasts are highly modified. Urban development and industry continue to put pressure on our coasts, estuaries and the sea. By 2004, 16.5% of Victoria's total coastline was urbanised. Since then, the rates of development in coastal areas have been much higher than the State average. Without active and close management, the projected growth in houses along our coasts could significantly reduce the amount of coastal vegetation we have, with serious consequences for biodiversity.

What we do on the land affects the sea. Victoria's estuaries receive nutrients and other pollutants from rivers and streams and they often have poorer water quality than the open sea. Sites in estuaries close to the urban areas, industries and agriculture such as Long Reef and Hobson's Bay in Port Phillip Bay, and Corinella in Western Port, have some of the poorest environmental quality.

Prevention is better than cure. Introduced species are a constant threat to Victoria's marine systems. There are now 161 introduced species in Port Phillip Bay, one of the most invaded marine environments in the southern hemisphere. Preventing the introduction of marine pests is invariably cheaper and more practical than removing them once they are established. Marine pests are a threat to biodiversity as invasive species can often out-compete native marine flora and fauna and reduce Victoria's fish stocks.

Preventing further damage to Victoria's coast is being undertaken in a number of ways. **Establishing marine parks and reserves covering almost 12% of Victorian waters has been an important step towards protecting Victoria's marine environments.** However, due to the interactions between coasts and the oceans, even these protected marine areas continue to be at risk from external pressures. On land, most of the coast is publicly owned in parks and reserves. Around coastal towns, improved planning processes have been developed with the intention of creating clear guidelines for protecting coastal township character and surrounding environments.

Tourism is a major source of income for many local communities along our coasts. Victorians make 70 million visits to the coast each year, more than any other recreational area in the State. Marine and coastal environments also contribute to Victoria's economy through natural resource industries such as fishing, oil and gas extraction. These sectors depend on a healthy and relatively predictable environment.

We have more information about our coastal areas where it relates to industry, demographics and tourism than natural systems. Data on the condition of coastal land and water resources is not gathered in a comprehensive way, making it difficult to assess the condition of coastal and marine systems.

Climate change further threatens the health and viability of our coastal environments. For example, coastal biodiversity is already under threat from human uses of land and the sea; climate change will intensify these threats.

Projected increases in ocean acidity resulting from climate change could have devastating consequences for marine environments and the industries that rely on them. Acidification will reduce the ability of many sea creatures (such as molluscs) to make their shells. This would cause declines in their populations and the populations of species that feed on them, leading to changes in the function of marine environments. This would have flow-on effects, putting pressure on coastal communities that rely on marine environments for tourism, recreation and fishing. Acidification would not be reversible in human time scales.

There is also evidence that increasing sea surface temperatures brought about by climate change is causing reductions in the ability of the oceans to continue absorbing carbon dioxide. Oceans currently provide a buffer against climate change, but this capability is starting to decrease. Decreasing carbon dioxide absorption by the oceans would increase the speed of climate change.

Coastal settlements will be increasingly vulnerable to damaging weather due to climate change.

Since 1961 there has been a global average sea level rise of approximately 10 cm. The IPCC projects that global sea levels will rise between 18 and 79 cm above the 1990 baseline levels by 2100, and increases on the east coast of Australia may be greater than the global mean sea level rise. Global sea level rises may be higher still if there are significant increases in the melting rate of glaciers and the polar ice caps. Sea level rise is now tracking at the upper limit of recent projections, indicating that both existing and new policy must be more responsive to the most recent data.

In addition to higher sea levels; climate change modelling shows that damaging storm surges of over two metres above sea level could be expected around once every five years by 2070. To prepare for such a future, the Victorian Government should ensure that all new and upgraded coastal infrastructure can withstand these impacts.

Good news - our air quality is good and the hole in the ozone layer is smaller

Air quality

Despite increased pressures from a growing population and economy, Melbourne's air quality has improved significantly since the 1970s and 1980s. Emission reduction requirements for industry and motor vehicles, and the banning of backyard burning are key reasons for this success.

Melbourne's air quality is now relatively good by international standards, although even current levels of air pollution can reduce our enjoyment of the environment. While regional Victoria experiences poor air quality at times, air pollution is greater in Victoria's cities due to higher population densities, transport and industrial activities.

Victoria's common air pollutants from cars, wood heaters and industry are associated with a range of health effects. Our current air pollution levels contribute to premature mortality, increased hospital admissions and emergency room attendances, doctors' visits, use of medication, and reduced lung function. Other toxic pollutants in our air have been associated with cancer, respiratory irritation, and developmental and reproductive problems.

Bushfires and dust storms resulting from a prolonged drought have recently affected air quality across Victoria because they create high levels of fine particles. Air quality was poor in 2003 and 2006 due to severe bushfires. **Climate change is likely to increase the frequency and severity of bushfires, dust storms and smog.**

Stratospheric ozone

Ozone is an important part of our upper atmosphere because it absorbs most of the ultraviolet radiation from the sun, preventing it from reaching the Earth's surface and causing harm to plants and animals, including humans.

The atmosphere over Melbourne suffered major ozone losses between the 1970s and early 1990s (7-8% per decade). Ozone levels over Melbourne are now at least 10% lower than they were in the late 1950s. Worldwide ozone losses of 4% per decade occurred from the late 1970s until the late 1990s. Global ozone depletion also led to a hole in the ozone layer which was discovered over Antarctica in the 1980s. At its maximum, about the year 2000, the hole was almost four times the size of Australia. The Antarctic hole allowed 50-130% more ultraviolet-B radiation to reach the Earth's surface. It has since stabilised in size. **Despite this longer-term stabilisation, the lowest ozone level recorded over Melbourne since 1956 was seen in 2007.**

Global action to combat environmental issues can be successful. A full recovery of stratospheric ozone is possible but, relies on developed and developing countries complying with international agreements to end emissions of ozone depleting substances. **While ozone recovery is expected over the next five years, an enhanced greenhouse effect and increases in atmospheric concentrations of some gases could prevent, or even, reverse the expected ozone recovery.**

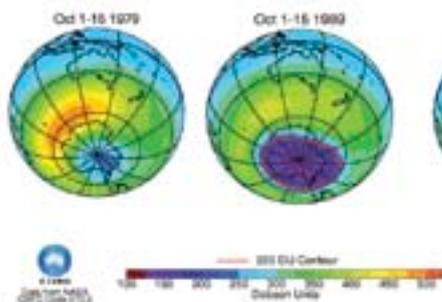
Living well within our environment

Victorians are living well, but beyond their environmental means. The environmental services we depend on have been, and under business-as-usual scenarios will continue to be degraded. Population growth, settlement patterns, growing consumption and climate change combined with past and current management practices are driving this degradation. These issues are reflected in the challenges we face with river and land health, biodiversity decline, vulnerable coastlines and acute climate change risks.

Environmental degradation makes our environment and our wellbeing vulnerable because it causes social and economic exposure. The economy, a component of society, provides money and wealth. The social structures that Victorians have built over the past 200 years also provide valuable services. For example, personal health and safety, sophisticated medical care and a sense of community are services provided by society that enable us to live well. Underpinning these, the natural environment provides services, such as clean air and water and a stable climate. There is wide recognition of the services that the economy and our society provide to us, but environmental services are not valued in the same way. Understanding, valuing and pricing the services that the environment provides is a vital step towards achieving sustainability.

In order to live within the limits of our environment we need to focus on both current and future patterns and actions. We need to invest in the environment if we want to maintain Victoria's world renowned liveability. This will mean doing things differently. We need a healthy environment that is resilient enough to weather shocks such as floods, drought, fire, and pest invasions. We must dramatically increase our efforts to bolster the health of our environment to ensure it is robust enough to cope with the added future pressures of climate change.

Total ozone levels over the southern hemisphere October 1979, 1989 & 2007. The edge of the ozone hole is shown as a red line.



Victorians are talented and innovative.

We can make a difference. Victorians are willing and capable of tackling environmental problems. Ours was the first state to establish an Environment Protection Authority and to achieve improvements in urban air quality. Victoria has led the country in pushing for a carbon emissions trading scheme and has been ahead of other States in managing water resources, even under conditions of ongoing drought. The Environmental Sustainability Framework 2005 was a pioneering decision taken by the Victorian Government, and the review of the Biodiversity Strategy is providing a fresh look at how natural systems can gain full recognition in the economy. We have strong policy commitments, but resourcing for environmental improvements has to compete with other government priorities and actions haven't always been forcefully followed through. The degraded state of large parts of Victoria shows that we are not doing enough.

Governments need to become more strategic and future focussed. The sooner serious action is taken to improve the state of the environment, the more likely it is to succeed and the cheaper it will be. All Victorians will play a part in deciding what kind of future we will have. Government must lead and ensure that the information needed to make the necessary changes is made available. **Transparent engagement between Government and the community is essential** and it is important that Victorians understand the issues, the options available, and the reasons for the choices that are eventually made.

Our future wellbeing and economic success cannot continue at the expense of environmental health. **Economic and social planning must include consideration of the environment.** The Victorian Government should ensure that the value of all environmental services is factored into its decision-making, as water and climate are starting to be. Agencies should become as adept at valuing and accounting for environmental services as they are for economic and social services.

The technique of strategic environmental assessment could help the Victorian Government to examine the long term and wider implications of planning and policy for traditional 'environmental' policy areas, such as water and biodiversity management. It should also be used for other areas of policy such as planning and major projects, which can also have large impacts on our environment. Ministerial portfolios not generally considered environmental, such as Treasury, Energy, Planning and Roads and Ports, have significant environmental impacts. All Ministers should consider potential environmental impacts during, and not after, decision making processes.

Sustainability can become a reality when we increase wellbeing while simultaneously reducing environmental pressures. Improving efficiency is an important step. Technology has a significant role to play in reducing environmental pressures by increasing resource efficiencies in business and within communities. However, technology alone must not be seen as a 'silver bullet'.

Increasing efficiency is essential, but reducing overall environmental degradation is what ultimately matters.

On their own we have seen that markets fail to protect the environment. However, market-based instruments – a way of rationally pricing the environmental impact of goods and services – can be a powerful tool. Provided that environmental services are adequately valued and are supported by legislation, market-based instruments are a cost effective, efficient way of internalising environmental pressures within our economic framework.

Victorians recognise their ability to influence the environment through their actions as consumers. To help consumers buy greener products and services, the Victorian Government should provide information about programs such as eco-labelling, and promote public education campaigns that raise awareness of the environmental impacts of all consumable services.

Victorians have a responsibility to act as stewards of the environment with a duty to protect environmental services for current and future generations. In order to do this we need to understand the needs of the environment so that it can thrive along with us. This report uses sets of verified, valid and statistically reliable indicators to evaluate many aspects of one key part of sustainability: the environment. It provides information about the state and quality of major elements of Victoria's environment. Improving long-term and consistent data collection and reporting at a statewide

level would help us to better understand and report on the current state and future environmental trends.

We also need to monitor our progress towards a more sustainable way of life.

Several methods for measuring and tracking progress towards environmental sustainability have been proposed in this report. Triple bottom line reporting adds social and economic indicators to complement environmental indicators in order to assess the degree to which we are living well within the environment and moving towards sustainability. By combining indicators of environmental, social and economic values into single indices, comparisons with traditional measures such as gross domestic product can be made. The Index of Social Economic Welfare and the Genuine Progress Indicator are two such indices which could be used to measure our sustainability and wellbeing, not just our economy. For measures of sustainability such as these to have influence, they would need refinement and ownership at the highest levels of government.

On a global scale, Victoria's level of responsibility for environmental problems is small in absolute terms. The experience gained from good, innovative environmental management in Victoria can provide business opportunities globally and locally. It makes good environmental, social and economic sense to manage the environment so that it is protected and enhanced.

As a first-world State with one of the largest ecological footprints and a heavily degraded natural environment, **Victoria has an obligation and an ability to restore the health of its natural environment. It also has an opportunity to become recognised as an international environmental leader and take advantage of the business opportunities leadership presents.**

If we have the will, Victorians can live well within, and not at the expense of, our environment.

Key findings and recommendations

PART 1 Introduction

Key findings

None in this section

Recommendations

I1 That a strategic review of environmental data collection, monitoring and access be conducted to assess the needs for government environmental reporting requirements.

I2 That better data collection, monitoring and reporting regimes be implemented to enable more accurate, integrated and long-term reporting and an up-to-date understanding of environmental health and pressures.

PART 2 Driving forces

Key findings

- Climate change, population growth and settlements, and consumption associated with economic growth are the overarching driving forces of environmental degradation.
- The Victorian community has a history of finding innovative solutions to environmental problems and is well placed to lead innovative solutions that may make a difference well beyond its borders.
- Climate change provides a defining context for this report because of the extent to which it is affecting and is projected to affect ecosystems. Significant environmental and economic policy changes are required to ensure the Victorian community lives well within a healthy environment.
- Trends in greenhouse gas emissions, insufficient and uncertain policy and uncertain technological development pathways highlight the current policy and technology gap between business as usual and emission reduction targets. Victoria, with its high energy and emissions intensive economy has a leading role to play.
- Continuing growth of Victoria's population will increase demand for land, energy and other resources, as well as housing and transport services, potentially leading to more waste and pollution. Extra demand for water is particularly pertinent given the predicted effects of climate change on already depleted water storages.
- Development in peri-urban regions is driving loss of natural habitat and biodiversity, as well as agricultural land.

The challenge is to ensure development does not put undue stress on the environment; uses resources such as land, water, materials and energy efficiently; and allows replenishment of the natural resource base.

- As household sizes have declined and the number of rooms per house has increased there has also been a marked rise in floor area per house. The trend to larger and more luxurious housing is a driver of consumption. Further, as this trend is most evident on the urban fringes there are implications for biodiversity, food production and infrastructure as land use changes from rural to urban.
- Melbourne is an energy intensive city in international terms, and in common with other Australian cities, has a low-density urban form with high levels of car use.
- The cost of environmental degradation is not integrated into economic systems. Current measures of growth such as GDP or GSP do not adequately capture environmental degradation or social wellbeing.
- Victoria's economy has been growing at a faster rate than population, an indication of an affluent society. This affluence comes with increased consumption of goods and services that place pressure on the environment.
- The resource intensity of the economy is improving, however total (absolute) resource use and associated environmental pressures are increasing, with the exception of water which has decreased due to a combination of resource scarcity and demand management.
- The environment does not care how resource efficient the economy is if absolute environmental pressures continue to increase.
- Improvements in human wellbeing and economic development have been achieved at the expense of ecosystem services essential to life.
- It is currently cheaper to protect the environment than it is to attempt restoration, but it is even cheaper to degrade the environment, externalising the costs.

Recommendations

None in this section

PART 3 Production, Consumption and Waste

Part 3.0 Introduction

Key findings

- Current patterns of resource use in Victoria are unsustainable. The way many resources are used, and the amount that is used, is placing stress on natural systems.
- The Victorian Ecological Footprint is three times larger than the world average. Energy generation and consumption has the single biggest impact on Victoria's ecological footprint.
- To date resource efficiency gains have generally fed into higher economic productivity, not environmental benefits. Increasing the efficiency of resource use is essential but insufficient unless it can demonstrate a reduction in absolute environmental impacts/pressures.
- To address sustainable consumption and production requires significant technological research and development with an increased emphasis on appropriate governance frameworks, industry partnerships and behavioural change.

Recommendation

PCW1 The Victorian Government should form and implement the Sustainable Production and Consumption Taskforce, as detailed within the Environmental Sustainability Action Statement (ESAS), 2006.

Part 3.1 Energy

Key findings

- Energy generation and consumption is the single largest component of Victoria's ecological footprint.
- Victoria's final energy consumption has increased by over 80% within the last 30 years, and business as usual consumption will increase by almost 40% by 2030.
- Between 1990 and 2006, Victoria's total greenhouse gas emissions increased by 12% but energy-related emissions increased by 27%.
- There was a slight decrease in total greenhouse gas emissions in 2006, the most recent year for which data is available, and slight decreases in emissions from energy in 2005 and 2006, but it is not known whether this signifies a long-term downward trend.

Summary

- In 2006, over 85% of greenhouse gas emissions generated in Victoria were produced by the energy sector.
- Stationary energy consumption accounts for only 20% of final energy consumption but 69% of total greenhouse gas emissions.
- Transport is the greatest contributor to final energy consumption (36%) but contributes only 17% of total greenhouse gas emissions.
- 95% of Victoria's electricity is supplied from brown coal, the most greenhouse intensive source in Australia. Electricity is almost six times more polluting than natural gas per unit of energy delivered in Victoria.
- 4% of electricity comes from renewable energy sources.
- Victorian efforts to reduce emissions from energy are largely dependent upon the design of the Commonwealth's Carbon Pollution Reduction Scheme (CPRS), the associated emissions reduction trajectories, and the viability of technology development pathways including carbon capture and storage and non-intermittent base-load renewable energy, which as yet are not known.
- Electricity generators extract approximately 100,000 million litres of surface water per annum, which is approximately one quarter of the total water consumption of metropolitan Melbourne in 2006–07. A further 120,000 million litres of groundwater is extracted per annum for the mining of coal, oil and gas.
- Low-density urban design and high motor vehicle dependency make metropolitan Melbourne vulnerable to oil affordability and carbon price shocks.

Recommendations

E1 The Victorian Government conduct a study to identify and address regulatory and other barriers to the development of a network of distributed renewable and gas-fired electricity generators to meet growing energy demand and delay the need for further augmentation of brown coal generators.

E2 The Victorian Government conduct scenario modelling to consider fundamental future restructuring of Victoria's energy supply industry, including the potential for a significant shift towards distributed energy, co-generation and renewables.

E3 The Victorian Government should conduct a review that identifies and makes public any existing energy subsidies to industry, including the metal products sector. It should include proper assessment of impacts of subsidies on greenhouse gas emissions and an evaluation of net strategic benefits.

E4 The Victorian Government increase the energy efficiency of the 5 Star Standard to international best practice levels and extend it to include fixed appliances including hot water systems and lighting.

E5 The Victorian Government, through the Essential Services Commission, mandate disclosure of all large energy contracts offered by Victorian energy retailers and Vicpower Trading to create transparency of energy prices and therefore incentives and disincentives for energy efficiency on offer.

E6 The Victorian Government establish a process to collect and disclose energy consumption data from energy retailers at a local scale, including at local government level, to encourage local energy efficiency initiatives and allow assessment of the social and economic impacts of increased energy prices.

E7 Through COAG, the Victorian Government should support increased energy efficiency and thermal performance within the Building Code of Australia.

E8 A step change increase in the provision of public transport services is required, particularly in outer suburbs, to actively drive a shift from private vehicles.

E9 The Victorian Government continue to encourage mode-shifting from cars to cycling and walking through the further provision of appropriate infrastructure.

E10 The Victorian Government should ensure that future commercial assistance provided to the automotive industry is tied to demonstrable improvements in vehicle fuel efficiency and should seek to achieve this through COAG.

E11 The Victorian Government should ensure that any support to the biofuels industry is directed at technologies that deliver positive environmental benefits including reductions in greenhouse gas emissions.

E12 Through COAG, the Victorian Government should continue to encourage the Commonwealth Government to provide funding for public transport infrastructure.

E13 The Victorian Government should encourage the Commonwealth Government to abolish the current FBT concession for private use of company cars as part of its current review of the Australian tax system.

E14 The Victorian Government should develop a strong program of complementary measures – including measures which are required in the lead-up to the CPRS, support renewable energy, support research and development of low-carbon technology, address market failures, and reduce the cost of abatement in covered sectors or related sectors not covered by the CPRS.

E15 The Victorian Government influence the design of the CPRS to ensure that it is comprehensive in coverage, contains minimal concessions to carbon-intensive sectors (such as free allocation of permits), and that emissions caps are established that reflect the urgency of the science and lead to rapid and significant emissions reductions.

E16 The Victorian Government establish long-term energy efficiency reduction initiatives and targets across the residential, commercial and industrial sectors beyond 2011 to complement the national Carbon Pollution Reduction Scheme.

E17 The Victorian Government should introduce measures to significantly improve the energy efficiency of existing residential buildings by requiring, for example:

- compulsory disclosure of energy efficiency at point of sale.
- mandatory roof insulation before sale.
- subsidies to convert electric water heaters to zero or low-emissions alternatives.

E18 The Victorian Government, through COAG, support measures to reduce regulatory barriers to energy efficiency improvements and improve financial incentives for energy efficiency improvements, including green depreciation.

E19 The Victorian Government increase the funding and resources to MEPS development to allow greater and faster roll out.

E20 The Victorian Government modify the MEPS program such that minimum energy efficiency standards are based on the performance of the most efficient products available.

E21 The Victorian Government should review the purpose and design of the feed-in tariff in the context of the CPRS, accounting for the full range of potential costs and benefits.

E22 The Victorian Government release the detailed calculations used in designing the on-going solar feed-in tariff scheme to better communicate the policy objectives.

E23 The Victorian Government consider the Eddington Report as part of a long-term transport plan for Melbourne which has key objectives of reducing greenhouse gas emissions and building resilience to future oil and carbon price increases.

E24 The Victorian Government should incorporate strong environmental objectives, including the reduction of greenhouse gas emissions, into new transport legislation through the Transport Legislation Review.

E25 The Victorian Government ensure that effective minimum standard levels of public transport services are required for new developments.

E26 The Victorian Government, through COAG, should support the introduction of aggressive mandatory fuel efficiency targets for new passenger vehicles to significantly drive down emissions.

E27 The Victorian Government should continue to work on or implement programs, in consultation with industry, to reduce potable water use in electricity generation.

Part 3.2 Water resources

Key findings

- Serious rainfall deficiencies over the past 11 years have reduced inflows to storages 30–60% below long-term averages. Water scarcity has been statewide in extent, exacerbated by high temperatures, and has worsened over time, with flow in the Murray and Melbourne storages reaching record lows in 2006.
- The harvesting of water from rivers and aquifers, altered flow regimes, loss of habitat connectivity and water pollution are key pressures on the environment arising from the State's water management. Drought and climate change compound these pressures.
- With climate change, streamflow may decrease by up to 50% across much of Victoria by 2070 compared to long-term average streamflow, further increasing competition for water resources.
- Victoria is heavily reliant on surface water (84% of water harvested), despite the increasing use of groundwater (13%) and recycled water (3%). The total volume of water harvested in 2006–07 was 4,094,030 ML.
- In the past four years, over 75% of the total flow was harvested for consumptive use from a quarter of Victoria's river basins. These were also the basins experiencing the greatest reductions in flow.
- In August 2008, groundwater levels in half of the most highly developed or potentially stressed groundwater management units (Water Supply Protection Areas) were at their lowest on record.
- Approximately one-quarter of water harvested in Victoria was lost or unaccounted in 2005-06, which equates to about three times the water consumed in metropolitan Melbourne. The Victorian Government is making significant investments to reduce unaccounted water in rural water supply systems.
- Irrigated agriculture is the largest single sector of water consumption and accounts for about 74% of surface water consumed in Victoria. Allocations have been markedly reduced due to water scarcity in the past few years.
- Melbourne accounts for about 10% total water harvested for consumption. *Per capita* water consumption has decreased by 34% in 2006-07 compared to the average of the 1990s.
- A six-fold increase in the consumption of recycled wastewater in Victoria has occurred over the past decade. In 2006-07, 95,500 ML or about 1/4 of the total wastewater produced across Victoria was recycled.
- A water conservation ethos has emerged in response to water scarcity, which in combination with restrictions, and a range of demand management measures, has resulted in significant decreases in residential and non-residential water consumption, both in Melbourne and regional Victoria.
- The Victorian Allocation Framework is fundamental to the management of water resources in Victoria. The principle of protecting private rights to water is central to the allocation framework.
- Significant improvements in the way water is managed for the environment have occurred in the past decade, including the recognition of the environment's right to water in the allocation framework, commitments to improve flow regimes; better water accounting and scientific understanding.
- During times of low streamflow, the current allocation system reduces environmental flows more than it reduces water for consumptive uses.
- The urgency for government action has been accelerated by the reality of irretrievable ecological damage caused by past and current management practices, prolonged water scarcity leading to reduced security of supply and climate change projections.
- Providing and protecting adequate flow regimes and water levels in rivers and aquifers remains a central issue. Adequate flow regimes and environmental water reserves are yet to be agreed for many rivers and aquifers across Victoria. These are being developed through Regional Sustainable Water Strategies and other government programs.
- Rivers are mostly connected to groundwater, yet they are currently managed separately. An integrated management approach is being trialled through the Upper Ovens Stream Flow Management Plan.

Summary

- The Victorian Government and water corporations have implemented demand management strategies and commenced major infrastructure programs, such as the desalination plant for Melbourne and pipelines to connect water supply systems, in response to current and projected risks to the security of urban water supply.
- The implementation of a diverse range of water use efficiency and conservation strategies, and decentralised water systems, should continue in conjunction with major source augmentation projects to minimise the cost and environmental impact of improved urban water supply security.
- Urban water resources planning now accounts for the possibility that the historically low streamflows recorded over the last three years may continue into the future.
- Victoria is recognised for its leadership in water resources management, which is rapidly increasing in sophistication and accountability, but to date this has not been enough to secure the health of inland waters.
- The sharing of water between competing consumptive and environmental uses ultimately involves social and therefore political choices. Traditionally the environment has been the loser. Difficult decisions will need to be made in future, as water availability declines, and pressures on natural resources, and the need to maintain healthy and productive ecosystems, increases.

Recommendations

WR1 The Victorian Government should assess the merit of removing logging from Melbourne's water supply catchments, to maximise catchment yield and water quality.

WR2 Investment in water infrastructure and water recovery by the Victorian Government, as well as other states and the Commonwealth, needs to be coordinated at the highest level, to avoid policies and projects with conflicting outcomes.

WR3 The Victorian Government should review policy on farm dams to control their cumulative impact on streamflow, particularly in peri-urban areas.

WR4 The practice of managing surface and groundwater as a single inter-connected system needs to be implemented over Victoria. The scientific

rigour of groundwater management and implementation of Council of Australian Government Policy commitments should be improved as part of achieving this objective.

WR5 The Victorian Government should engage with the community to get a better understanding of values, aspirations and fears related to urban water supply, including drinking purified recycled water supplied through indirect potable re-use.

WR6 The Victorian Government should support research to develop technologies which improve the cost-effectiveness and viability of alternative sources of water such as solar desalination and indirect potable use of recycled water.

WR7 The Victorian Government should continue to work on or implement programs, in consultation with industry, to reduce potable water use in electricity generation.

WR8 The Victorian Government should continue to pursue decentralised supply options to minimise economic and environmental impacts associated with improving urban water security.

WR9 The Victorian Government should make information on the ownership of water entitlements publicly accessible.

WR10 The Victorian Government should carefully consider its food and fibre export target of \$12 billion in light of external economic factors, current knowledge regarding current and future water availability, river health implications, and potential to achieve higher levels of irrigated production through improved water use efficiency.

WR11 The Victorian Government should advocate for the establishment of a set of national, mandatory minimum standards for water use efficiency in new appliances, homes, commercial and government premises and subdivision design.

WR12 The Victorian Government should increase the water efficiency performance thresholds expected from the 5 star building standard, which may include the mandatory installation of rainwater tanks where third pipe systems are not available, and include stormwater quality objectives.

WR13 The Victorian Government should support increased water use efficiency within current commercial building standards.

WR14 The Victorian Government should introduce measures to significantly improve the water efficiency of existing buildings, for example by requiring: compulsory disclosure of water efficiency at point of sale or lease; and ensuring minimum standards for water use at point of sale or lease.

WR15 The Victorian Government should maintain efforts to improve water literacy in the community.

WR16 The Victorian Government, in partnership with local government, should develop programs to overcome recognised barriers to demand management.

WR17 The Victorian Government should ensure return flows captured by water recovery projects are accounted for and the implications of removing them understood, so there is no overall loss in benefits received by the environment.

WR18 Research should be directed towards gaining a better, integrated understanding of the ecological, hydrological, social and economic impacts of long term droughts.

WR19 The Victorian Government should finalise Sustainable Water Strategies for the Eastern and Western regions as soon as possible.

WR20 The Victorian Government should provide regular, consolidated reports on progress against the actions and outcomes within Our Water Our Future and Regional Sustainable Water Strategies, including compliance with environmental flow obligations.

WR21 The contract for the proposed desalination plant should allow the volume of water the plant supplies to be varied, so as not to provide disincentives to the implementation of beneficial water conservation and decentralised water supply projects, and to avoid paying for water that is not required.

WR22 The Victorian Government ensure that the proposed greenhouse gas offset purchase of renewable energy credits is additional and beyond the level proposed by either the VRET or MRET schemes.

Part 3.3 Materials

Key findings

- There is a level of material dependence to the Australian economy that is as high as at any time in history. This is despite the technological advances that have disassociated a large proportion of the world's population from direct involvement in the primary industries—the industries from which all material products originate.
- While monetary flows in the economy are well accounted for, most physical flows are poorly understood. Accounting for the physical dimension of material flows would enable greater appreciation of the fundamental dependence of the economy on materials and of the opportunities for reducing their environmental impact.
- Partly due to significant exports, Australia's total material requirement is increasing, and is currently estimated at 180 tonnes per person per year. This is more than twice that of other OECD countries.
- Over the last quarter century, material flows in the minerals, forestry and agricultural industries have continued to increase, while material flows from fisheries have declined.
- In Victoria, material flows in construction have grown by an estimated 600% between 1946 and 2004 and by 19% between 1984 and 2004. The size of houses has grown throughout the 20th century, while the number of people per house has declined by 40%.
- The increasing production of materials can have an impact on natural systems. For example, previous fishing regimes have reduced the population of Southern Rock Lobster to approximately 20% of the 1951 level.
- Increasing material flows requires significant investments of energy and water. Transporting a kilogram of bananas to Melbourne emits over half a kilogram of CO₂ and the manufacture of approximately half a litre of milk requires 795 litres of water.
- It is estimated that in 2005–06, 32% of the total streamflow in Victoria was harvested. Of this harvested water, around 40% (2,000 GL) is 'exported' out of the state as embodied water, mainly in food products.
- Recycling of material has increased, with 60% of waste diverted from landfill. However, in the period 1993–2006, total material outputs (waste and recycling) per person doubled. The main reason

for the increase is the increase in total material consumption, driven primarily by economic factors (including higher incomes).

- 77,000 tonnes of prescribed manufacturing waste were generated in Victoria in 2007–08, a 37% reduction from the 2000 level.
- Increasing the efficiency of materials use is widely accepted as a necessary step in reducing environmental impact. In contrast, levels of absolute material consumption remain largely unchallenged, yet if increasing the efficiency of material use is not sufficient to reduce environmental pressures, then reducing overall consumption may be necessary.

Recommendations

- M1** Establish a framework for coherent State and Commonwealth materials flow reporting systems using recognised materials flow analysis methodologies.
- M2** The Victorian Government analyse the feasibility of undertaking consistent and replicable materials flow reporting for the primary industries to complement the extensive economic reporting already in place.
- M3** The Victorian Government encourage primary industries to use materials flow reporting systems for all major 'hidden' flows, and investigate the economic and environmental benefit of internalising their full environmental cost into industry operating costs.
- M4** The Victorian Government establish comprehensive materials flow reporting systems for manufacturing, and for imports and exports, in order to aid decision-making and regulatory approaches for reducing the environmental pressures of materials.
- M5** The Victorian Government encourage the wider use of tools such as ISO standardised methodologies for measuring the environmental pressure of materials in manufacturing and construction.
- M6** The Victorian Government provide further incentives via the Environment Protection Act 1970 to manufacturing industries to add value to all products, while increasing materials efficiency.
- M7** The Victorian Government consider the establishment of pilot programs targeted to reduce material consumption for key, high impact consumables via demand management programs such as those that have

already been initiated for energy and water.

M8 The Victorian Government set a stretch target of zero waste by 2020 and implement annual increases to the landfill levy to:

- provide disincentives to the use of this as a waste management option.
- raise funds to provide incentives to industry for R&D for increased materials efficiency.

M9 The Victorian Government encourage product manufacturers to use accredited environmental evaluation programs (such as LCA) to assess the level of resource depletion attributable to the manufacture of products.

M10 Governments in Australia continue to explore environmental labelling programs for high profile commodities that includes the use of resources throughout the entire manufacturing process.

M11 The Victorian Government encourage industry to use accredited environmental evaluation programs (such as LCA) to assess the level of embodied energy and embodied water in products and to develop more efficient processes.

M12 Governments in Australia continue to explore environmental labelling programs, for high profile commodities, that includes energy and water embodied into the products during the manufacturing process.

M13 The Government explore opportunities for systematically raising the standard of environmental management of landfills. The government consider banning the landfilling of materials for which resource recovery systems currently exist. The government provide incentives to resource recovery industries to explore further market opportunities for increasing the utility and value of recyclable materials.

M14 The Victorian Government investigate ways to further apply extended producer responsibility programs (EPR) with the long-term goal of programs that cover all material products.

M15 The Victorian Government expand analyses of waste to landfill to identify opportunities for increasing material recovery rates in order to reach the stretch target.

M16 The Victorian Government annually increase the prescribed waste levy with funds raised targeted towards resource recovery and clean industry programs.

M17 The Victorian Government investigate further opportunities to actively enforce current anti-littering legislation and review the effectiveness of current anti-littering legislation.

M18 The Victorian Government review the viability of container deposit legislation and other EPR programs, including the recently successful plastic bag levy trial.

M19 The Victorian Government encourage product manufacturers to use accredited environmental evaluation programs (e.g. LCA) to assess the level of environmental pressure attributable to waste flows of products.

M20 Governments in Australia continue to explore environmental labelling programs for high profile commodities that includes information on the level of environmental impact due to waste outputs attributable to each product.

M21 The Victorian Government work with the Commonwealth Government to enhance the scope of the Australian Lifecycle Inventory Initiative (AusLCLi.com) to a level that enables it to be applied to a wide range of high profile products.

M22 Governments in Australia lead industry in continuing to explore the development of robust eco-labelling programs to enable consumers to use sound environmental criteria to choose between products that provide the same or a similar service.

PART 4 The State of the Environment

Part 4.0 Introduction

Key findings

- The wellbeing of Victorians is ultimately dependent upon the health of the natural environment. The ecosystem services upon which we depend have been compromised through a long history of management actions taken for short term benefits that have left a legacy of poor environmental condition.
- Despite improved understanding of environmental issues and processes, the policies and initiatives implemented in recent decades, and extensive investment in the environment, the condition of Victoria's natural environment has continued to decline.
- Society is dependent on the natural environment which is characterised by the interconnectedness of air, land, biodiversity, inland waters, coasts and the sea. Actions of society, and in any of these natural systems, are likely to have consequences in another, so it is essential that they be managed as interlinked environmental systems.
- Climate change will exacerbate existing pressures on Victoria's natural environment. It has significant implications not only for a stable climate but also for biodiversity, river health, coastal integrity and air quality as well as the social and economic implications as activities such as agriculture are forced to change due reduced rainfall and new temperature regimes.
- A lack of consistent, co-ordinated and repeated data collection and reporting limits the ability to assess and report on the condition of Victoria's environments at the statewide level.

Recommendations

SoE1 The Victorian Government should reinforce its commitment to significantly improving the health of Victoria's land, biodiversity, rivers, coasts, and other environments as set out in *Our Environment, Our Future, Our Water Our Future*, and other initiatives, and take urgent action to reverse the poor trends in environmental health.

SoE2 Ecosystem services should be recognised as a component of the value of the landscape, so that landholders are supported in taking active stewardship of Victoria's landscape. Knowledge of the interaction between ecosystems and the services they provide to human settlements should be improved.

SoE3 The *Flora and Fauna Guarantee Act 1988* has failed and should be reviewed. Future management frameworks for Victoria's natural environment should be funded for long-term improvement in the condition of Victoria's unique flora and fauna.

Part 4.1 Atmosphere

A0 Introduction

Key findings

- Victoria has warmed by 0.6°C since the 1950s; a faster rate of warming than the Australian average and the last ten years have been hotter than average in Victoria, with 2007 being the hottest year on record.
- Since 1990, changes to both global temperature and sea level have tracked at the upper limit of projections, indicating that projections may be underestimates of likely climate change scenarios.
- Victoria's greenhouse emissions have increased by approximately 12% since 1990.
- Full recovery of stratospheric ozone is possible but is highly dependent upon adherence of both developed and developing countries to international agreements. In addition, an enhanced greenhouse effect and future atmospheric concentration of nitrous oxide and methane may reverse anticipated ozone recovery.
- By international standards, Victoria has good air quality. Increased frequency and severity of bushfires, and low rainfall attributed to climate change, will produce added pressures on air quality. The higher temperatures may also lead to a greater potential for ozone formation leading to increased incidence of smog.
- Australia has particular vulnerabilities to climate change and environmental degradation, but these should not act as a constraint on its environmental policy responses, rather they increase the risk of not acting strongly and urgently to climate change risks.
- The window of opportunity to stabilise levels of greenhouse gas emissions is rapidly diminishing.

Recommendations

A0.1 Encourage an Australian program of action on climate change which sees effective multilateral and bilateral action and develop a strong program of state-based mitigation policy measures including building a climate change "test" into all major policy, infrastructure and expenditure decisions.

A0.2 Continue to support CSIRO monitoring and reporting of atmospheric ozone concentrations and review developments that may lead to suitable greenhouse neutral replacements for ozone depleting substances that are still in use.

A0.3 Continue to support the EPA in monitoring and reporting air quality and actively seek solutions to managing air quality in light of the increased pressures predicted from a growing population and climate change.

A1 Climate change

Key findings

- Global atmospheric concentrations of greenhouse gases have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values. Impacts of climate change on stratospheric ozone; air quality; land and biodiversity; inland waters; and coasts, estuaries and the sea are addressed throughout this report.
- There are large natural year to year variations in climate. Natural climate variability will influence actual warming values in any single year or decade. The global warming influence due to increasing greenhouse gases is at global scales and cumulative over many years. At short time scales, natural variability can offset that warming influence and cause short term cooling. The long-term warming trend is unequivocal.
- Australia naturally has a highly variable climate. Because of its geography, Australia has further vulnerability to damage through variations induced by climate change than most other developed countries.

Observed changes

- Victoria has warmed by 0.6°C since the 1950s - a faster rate of warming than the Australian average. The last ten years have been hotter than average in Victoria, with 2007 being the hottest year on record. Six out of Victoria's ten hottest years on record have occurred since 1990.
- Rainfall during the last ten years has been markedly lower than the long-term average, with 2007 being one of the three driest years since 1900.
- Serious rainfall deficiencies over the past 11 years have reduced inflows to storages 30–60% below long-term averages. Water scarcity has been statewide in extent, exacerbated by high temperatures, and has worsened over time, with flow in the Murray and Melbourne storages reaching record lows in 2006
- Since 1961 global average sea level rose approximately 10 cm. Williamstown has registered a sea level rise of 18 cm over the last hundred years.
- Victoria's greenhouse gas emissions have increased by approximately 12% since 1990.
- In 2007, the IPCC declared that climate change is 'unequivocal' and, with a probability over 90%, this change is due to post-industrial human activity.

- Since 1990, carbon dioxide emissions, global mean temperatures and sea levels have tracked at the upper limit of projections, indicating that projections may be underestimates of likely climate change scenarios. The greater the warming, the greater the risk of tipping into irreversible climate change. Climate change feedback loops further increase these risks.

Projections

- Projections indicate that by 2030 warming in Victoria is likely to range from 0.6°C to 1.2°C on 1990 temperatures and by 2070 from 0.9°C to 3.8°C. The 2030 rise is largely locked in by the current level of emissions, with the 2070 projections dependent on rates of global growth and measures put in place to reduce greenhouse gas emissions.
- In most Victorian catchments, runoff into waterways is projected to decrease between 5% and 45% by 2030 and between 5% and 50% by 2070.

Summary

- Fire risk is forecast to increase substantially in Victoria, with the number of very high or extreme fire danger days across south-eastern Australia expected to increase by up to 25% by 2020 and up to 230% by 2050.
- By 2070 drought frequency is likely to increase by between 10% and 80% in the southern half of the State and by between 10% and 60% in the northern half.
- More frequent extreme weather events are predicted, with increasing damage from flooding, high winds and coastal storm surges and inundation; a current 1 in 100 year extreme storm surge could occur around every 5 years by 2070. Projected sea level rises will further exacerbate these problems.

Context and policy responses

- Globally, between 1970 and 2004, greenhouse gas emissions covered by the Kyoto Protocol have increased by 70% (24% since 1990).
- Without additional policies, global greenhouse gas emissions are projected to increase by 25-90% by 2030, relative to 2000.
- In its 2007 report, the United Nations Intergovernmental Panel on Climate Change (IPCC) found that carbon dioxide emissions need to peak no later than 2015 and be reduced by 50-85% by 2050 (from 2000 levels) to limit global average temperature increases to 2.0 - 2.4° C.
- The 2007 United Nations Framework Convention on Climate Change (UNFCCC) Bali Roadmap and IPCC Working Group Reports indicated potential greenhouse gas emissions reductions by developed countries of 25-40% by 2020 and 80-95% by 2050 (from 1990 levels).
- Australia, and Victoria, have committed to reducing emissions by 60% by 2050 from 2000 levels, with interim targets yet to be announced.
- Early global action to reduce greenhouse gas emissions reduces the risks associated with climate change, reduces long term costs and provides greater flexibility should emerging science cause mitigation responses to be adjusted over time.
- While being responsible for only 1.5% of total global emissions, Australia is the 14th largest emitter of greenhouse gases in the world. On a per capita scale of the top 25 emitting countries, Australia is the second highest.
- In 2006, approximately one fifth of Australia's greenhouse gas emissions came from Victoria. Between 1990 and 2006, Victoria's emissions grew by 12% and could increase 40% above 2000 levels by 2050 in the absence of effective mitigation.
- The Australian Garnaut Climate Change Review has proposed that Australia should offer to play its full, proportionate part in a global agreement designed to achieve a 450 ppm CO₂-e concentration. However, it further proposes not to focus on a single trajectory, but to have a set of options available during the negotiations for the international post Kyoto Protocol arrangements.
- Momentum has built rapidly in terms of public awareness and support for Government action, however, in the context of current global economic instability and ongoing concerns about international economic competitiveness, strong community support will continue to be required.
- Critical decisions on Australia's and the world's commitment to reduce greenhouse gas emissions will be made in 2009.

Recommendations

- A1.1** The Victorian Government should ensure that the data and information required to measure progress against the indicators in this chapter is collected in an ongoing and regular manner and made publicly available.
- A1.2** The Victorian Government should sponsor ongoing refinement and development of modelling (by BoM/CSIRO and others) to provide statewide, regional and local climate projection data which is sufficiently precise to underpin policy and capital project decision making with limited risk.
- A1.3** The Victorian Government should encourage, through CoAG and relevant bodies such as the Standing Committee on Treaties, an Australian program of action on climate change which sees effective multilateral and bilateral action and a strong theme of climate ethics and social justice.
- A1.4** The Victorian Government should incorporate in the Climate Change White Paper a strong program of state-based mitigation policy measures which either are required in the lead-up to the CPRS, complement the CPRS (addressing market failures) or relate to sectors not covered by the CPRS.
- A1.5** The Victorian Government should build a climate change "test" into all major policy, infrastructure and expenditure decisions, including:
 - Development of appropriate assessment tools, methodologies and processes, including consideration of the essential components of strategic environmental assessment methodologies.
 - Assessment of climate mitigation and adaptation impacts of budget and Cabinet decisions.
 - Assessment of the impact of current policies and programs on Victoria's emissions profile and reduction target.
 - Regular public reporting against this measure including building climate assessment and greenhouse gas and water use reduction performance requirements into all Victorian Government department and agency heads performance plans.
- A1.6** The Victorian Government should develop strong medium-term greenhouse gas emission reduction targets and a long-term goal of carbon neutrality for its own operations.

A1.7 The Victorian Government monitor and report its own greenhouse gas emissions and water use in annual budget papers and its performance against set targets. A detailed whole of government entity by entity listing of greenhouse gas emissions and water consumption should also be reported.

A1.8 The Victorian Government should build on the existing Victorian Climate Adaptation Program to develop and publicly report on a strong and ongoing adaptation research program and suite of actions. Key areas of focus should include long term planning for human systems including electricity infrastructure, and the resilience of agriculture and natural systems, and there should be a clear commitment to business, local government and community engagement and delivery of public good outcomes in the protection of natural systems and resources.

A1.9 The Victorian Government should ensure that Victoria's adaptation and research program supports national and international efforts, through CoAG and relevant Ministerial Councils and CSIRO/BoM.

A1.10 That the Victorian Government should conduct and present publicly a regular risk assessment related to climate change within five yearly cycles – looking at risks to both the natural environment and human systems and infrastructure; and its progress in achieving its stated greenhouse gas emissions reduction and climate change adaptation goals.

A1.11 The Victorian Government should incorporate the elements of Recommendations A1.4, A1.5, A1.6, A1.7, A1.8 and A1.10 within its proposed Climate Change legislation.

A1.12 The Victorian Government should support, through CoAG, the adoption of national greenhouse gas emission reduction targets consistent with achieving an initial global 450 ppm CO₂-e concentration. This would require greenhouse gas emission reductions of 25% by 2020 and 90% by 2050.

A2 Stratospheric ozone

Key findings

- The anthropogenic emission of chemicals such as chlorofluorocarbons (CFCs) leads to the depletion of stratospheric ozone, exposing both marine and terrestrial life to additional harmful amounts of ultraviolet radiation.
- Global emission of substances that deplete stratospheric ozone peaked in the late 1980s to early 1990s at 2.1 million tonnes per year, and by 2005 had declined by 70% to 0.5 million tonnes.
- Worldwide ozone losses of 4% per decade occurred from the late 1970s until the late 1990s.
- The Antarctic ozone hole reached a maximum area (approximately 30 million km²) and depth (60% ozone losses since the late 1970s) about the year 2000, resulting in 50% to 130% more ultraviolet-B radiation reaching the Earth's surface. It has since stabilised.
- Major ozone losses over Melbourne from the late 1970s until the early 1990s have been 7% - 8% per decade. Ultraviolet levels under clear-sky conditions increased by 10% per decade over southern Australia from the late 1970s to the late 1990s. Since the late 1990s ultraviolet levels have declined by 5%.
- Ozone depletion halted in the late 1990s leaving ozone levels over Melbourne relatively stable, but at a level at least 10% lower than they were in the late 1950s.
- Within this longer-term stabilisation, the lowest ozone level recorded over Melbourne since 1956 was seen last summer (267 DU, 2006/2007). It is believed that this was influenced by solar cycles.
- Stratospheric ozone recovery may have commenced in 2000, but is currently masked by solar cycle effects. Significant ozone recovery is expected over the next five years.
- Full recovery of stratospheric ozone is possible but highly dependent upon adherence of both developed and developing countries to international agreements. In addition, an enhanced greenhouse effect and future atmospheric concentration of nitrous oxide and methane may reverse anticipated ozone recovery.

Recommendations

A2.1 That the Government monitor emissions of HCFCs and methyl bromide to inform a management strategy to reduce emissions.

A2.2 That a strategy be developed to ensure that methyl bromide used for quarantine purposes in shipping ports be recaptured from freight containers then recycled or destroyed.

A2.3 That the Government further encourages the processes that are currently in place to recall equipment currently in use and reclaim the ozone-depleting substances they contain, including CFCs and HCFCs, from refrigeration and air conditioning systems and halons from fire-fighting equipment.

A2.4 That the Victorian Government continues with its control and limitation on the use of ozone-depleting substances and assists in further reduction of emissions from industrial sectors of particular importance, specifically the strawberry runner industry and grain handling facilities at Melbourne and Geelong ports.

A2.5 That the Australian or Victorian Government further investigate the feasibility of salvaging refrigeration systems currently discarded in landfills so that the ozone-depleting substances they contain can be reclaimed.

A3 Air quality

Key findings

- By international standards, Victoria has good air quality.
- Air quality has been relatively stable over the last decade despite increased pressures from a growing population and economy.
- Levels of fine particles and ozone do not always meet the objectives set out in Victoria's ambient air quality policy.
- Bushfires and dust storms resulting from a prolonged drought have recently affected air quality across Victoria.
- Air quality was poor in 2003 and 2006 due to the impact of severe bushfires.
- Increased frequency and severity of bushfires and drought associated with climate change will compound existing air quality pressures. The higher temperatures may also lead to a greater potential for ozone formation.
- Current air pollution levels are associated with adverse health impacts.

Recommendations

A3.1 To reduce emissions of greenhouse gas and pollutants from motor vehicles, Government should shift transport investment priorities towards less energy intensive modes such as public transport, walking and cycling.

A3.2 Government should investigate the best means by which to improve community awareness of the impacts of transport and heating choices on air quality which might include an eco-labelling system whereby passenger cars and heaters or heating systems are supplied with a label stating the potential pollutants that will be produced through their use.

A3.3 Government should consider the findings of the Environment and Natural Resources Committee Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria and revise the Code of Fire Management on Public Land if necessary to better manage air quality in relation to bushfires and planned burns.

A3.4 Government should investigate how alternative fuels (including diesel) will affect air quality whilst continuing to support improved emissions standards for motor vehicles.

A3.5 The Victorian Government should continue to work through the Environment Protection and Heritage Council to develop a National Environment Protection Policy to set goals and objectives for very small particles (PM2.5).

A3.6 The Victorian Government should continue to assess and understand how Victoria's air quality may be impacted by pressures from urban growth and climate change

A3.7 EPA should continue to issue smog and pollution alerts (including smoke and dust alerts) and work with the media to improve community access to practical information and advice on what to do on days when air quality is poor.

A3.8 Government should investigate options to further reduce the impacts of wood heaters on air quality, especially in the areas of Victoria where alternatives are readily available (e.g. metropolitan Melbourne). The impacts of restricting or phasing out the sale and use of wood heaters and encouraging householders to switch to alternative and more sustainable heating options, such as natural gas should be investigated.

Part 4.2 Land & Biodiversity

LB0 Introduction

Key findings

- Despite improved understanding of environmental issues and processes, the policies and initiatives implemented in recent decades, and extensive investment in the environment, the condition of Victoria's land and biodiversity has continued to decline – Victoria has the highest proportion of sub-regions in Australia considered to be in poor condition. A lack of co-ordinated data collection and reporting arrangements limit the ability to report on individual land and biodiversity resources at a statewide level.
- The study of climate change impacts on Victorian land and biodiversity is in its infancy and there is a high level of uncertainty about both the nature of climate change and its likely effects on Victoria's flora and fauna. Natural ecosystems are highly vulnerable to 1.5–2°C of warming. Climate change is likely to drive changes in land use that will require political and managerial decisions about the relative values of terrestrial systems and uses of land.
- Victoria's historic use of land has left a legacy of highly cleared and fragmented native vegetation over much of the State. Good quality, relatively intact native vegetation only remains in areas that have not been extensively modified. Native grasslands are Victoria's most depleted and most endangered vegetation classes; however, Victorians continue to develop and modify grassland ecosystems. High levels of vegetation clearing may constitute the crossing of an ecological threshold, beyond which rapid change occurs and ecosystems may not recover.
- Human activities continue to cause declines in the condition of native flora and fauna. Future decisions will reflect the choices of Victorians about the attributes of land and biodiversity that they most value. Continuing population growth, urbanisation and consumption may hinder achievement of land and biodiversity management objectives. The high degree of urbanisation of the Victorian population means that the environmental impacts of societal lifestyle patterns may go largely unrecognised.
- A lack of co-ordinated data collection and reporting arrangements limits the ability to assess and report on the condition of Victoria's land and biodiversity at statewide level.

- Victoria's current legislative and institutional framework for land and biodiversity conservation has been developed over many years and is in need of reform and consolidation. However, Victoria has in place a range of structures and processes that will form the basis of future responses to land and biodiversity concerns.
- A range of policy options, including regulation and enforcement, market-based instruments, education and research, is needed to engage a broad spectrum of Victorians in management and protection of land and biodiversity resources.

Recommendations

LB0.1 The Victorian Government should prioritise investment in incentives for enhanced vegetation and biodiversity management on private land. For example, the Government should allocate funding for priority development and expansion of the ecoMarkets programs, which encourage multiple environmental outcomes from improved vegetation management and deliver a reliable alternative income stream to landholders for provision of vegetation management services. Future expansions of ecoMarkets programs should be targeted to threatened ecosystems such as grassy plains ecosystems and to sites identified as having priority for revegetation or natural regeneration and with the ability to improve connectivity at the landscape scale.

LB0.2 Through the *Land and Biodiversity in a Time of Climate Change* White Paper, the Victorian Government should develop an overarching institutional and legislative framework for management, protection, restoration and enhancement of the environment to integrate existing legislation and clarify institutional responsibilities. Investment should be articulated in the Land and Biodiversity White Paper process.

LB0.3 The setting, monitoring and reporting of short-, medium- and long-term resource condition targets should form an integral component of management of natural resources, biodiversity and threatened species in Victoria.

LB0.4 Transparency of policy decisions and accountability of management should be improved by implementing a program of independent auditing and monitoring of land and biodiversity management across tenures; for example, in a way similar to auditing of forest management by the EPA.

LB0.5 The Victorian Government should work with the Commonwealth Government to ensure maximum alignment between Commonwealth, State and regional investment priorities under the new Commonwealth natural resource management investment program, Caring for our Country.

LB0.6 The Victorian Government should work with the other States and Territories and the Commonwealth to develop a nationwide program of environmental monitoring focusing on biodiversity, the carbon cycle and water resources, for example by adopting reporting against agreed National Land and Water Resources Audit indicators.

LB1 Vegetation loss and modification

Key findings

- At least half of Victoria's native vegetation has been cleared, including 80% of the original vegetation cover on private land, whereas public land retains over 80% of its original vegetation cover. Victoria is losing native vegetation at a rate of approximately 4,000 ha per year, mostly from endangered grasslands.
- Victoria has developed a native vegetation accounting approach to monitoring gains and losses of native vegetation which provides the basis for assessment of progress towards the State's goal of a Net Gain of native vegetation. On public land, vegetation losses have been offset by gains but on private land, gains have been outweighed by losses.
- Victorian native vegetation is fragmented over much of the State and is declining in quality. Loss of quality is now a key driver of native vegetation decline in Victoria, especially on agricultural and urban land, which has been the most severely impacted through incremental clearing, and suffers significant ongoing threats.
- Twelve per cent of Victoria's remaining native vegetation is on private land; of this vegetation, 60% is of a threatened vegetation type. Native vegetation on private land supports 30% of Victoria's threatened species populations.

- Ongoing clearing and conversion to cropping is still the major pressure for native grasslands and Victoria's native grasslands retain less than 1% of their original extent in good condition.
- Climate change is likely to compound existing pressures on native vegetation due to greater incidence of drought and fire and increased competition from weeds and pathogens. Climate change is also likely to threaten the adequacy of Victoria's current reserve system.
- The ecosystems and biodiversity attributes of cleared vegetation are not necessarily reconstructed in revegetated offset areas and are not provided on the same timescale due to the lag between clearing of remnant vegetation and the establishment and maturation of planted offset vegetation.
- Victoria's undisturbed native forests store much more carbon in forest biomass and soil than estimated by the IPCC, meaning that the importance of undisturbed native forests in mitigating climate change may be greater than previously thought.
- Restructuring of the Victorian timber harvesting industry in response to a review of its sustainability in 2001 has resulted in substantial reductions in the area logged and volume of sawlogs harvested.

Recommendations

LB1.1 The Victorian Government should give greater recognition to the threats to grassy ecosystems and ensure that the Native Vegetation Management Framework is enforced in relation to these ecosystems.

LB1.2 The Victorian Government should ensure that future expansions of BushTender and related programs are targeted towards threatened ecosystems, such as grassy plains ecosystems, and should investigate options for encouraging stewardship of grassy plains ecosystems on private land.

LB1.3 The Victorian Government should re-state the role of natural forests in climate change mitigation in light of recent findings that undisturbed forests are more efficient in carbon sequestration than harvested forests, and encourage the conservation of undisturbed forests. Production of timber products from Victoria's maturing plantation estate should also be encouraged.

LB1.4 The Victorian Government should urge improved implementation of the Native Vegetation Management Framework at the local government level. This could be achieved by supporting training for local government vegetation officers and ensuring that DSE has adequate resources to assess the additional vegetation clearing permit applications being referred by local governments.

LB1.5 All vegetation clearing activities should be recorded and monitored – not just those for which permits are required. This could be achieved by expanding the Native Vegetation Tracking tool to accommodate a register of permit-exempt clearing and encouraging voluntary registration of exempt clearing by landholders.

LB1.6 The Victorian Government should specify interim targets for the achievement of Net Gain of native vegetation on private land and allocate adequate funding to achieve the desired targets. This could be achieved by expansion of BushTender and other programs intended to encourage improved management of native vegetation.

LB1.7 The Victorian Government should allocate funds for and undertake five-yearly estimates of native vegetation cover in Victoria, based on high quality aerial photography or satellite imagery, with the aim of publicly reporting on progress towards the achievement of Net Gain of native vegetation.

LB1.8 There should be an increased allocation of funds for large scale, ongoing, active management of the existing public land estate for biodiversity conservation as the return on investment is significant when the range of services provided is considered.

LB1.9 The Victorian Government should review the applicability and adequacy of current reservation targets in light of the threats posed by climate change and explore ways of ensuring that Victoria's reserve system is as resilient as possible to climate change.

LB1.10 The Victorian Government should strongly support the Commonwealth Government's program to build the National Reserve System, with a focus on under-reserved Victorian bioregions and EVCs.

LB1.11 There should be a significant increase in the allocation of funds for land acquisition to ensure that ecologically significant private land can be secured to address gaps in Victoria's reserve system. This could be achieved by making a contribution to the Trust for Nature's Revolving Fund. Funding should also be allocated for ongoing management of private land acquired for conservation purposes.

LB1.12 The Victorian Government should undertake a study evaluating the contributions of conservation on private land to biodiversity retention, and develop an integrated portfolio of strategies for improving the status of native vegetation and biodiversity on private land that targets a broad spectrum of private landholders. Such a portfolio could include: expansion of existing market-based instruments with mechanisms to ensure that vegetation remains protected beyond the life of management agreements; increased allocation of funding for acquisition and management of highly significant private land; and development of new tools to engage the full spectrum of landholders in native vegetation management, including Victoria's growing corporate farming sector.

LB2 Contemporary land use change

Key findings

- Victorian bioregions are under high levels of landscape stress and four of Australia's five most cleared bioregions occur in western Victoria. Climate change is producing and will continue to produce extreme pressure on land use and biodiversity.
- Victoria's land economy has traditionally been dominated by agriculture; however other land uses such as forestry and housing are driving change in some parts of Victoria. Water trading is driving the distribution of irrigation water towards highest value uses, which is producing significant land use change in irrigation areas. Land use change creates both threats and opportunities for biodiversity conservation.
- Victoria's population is expected to reach 6 million people by 2020, 10 years earlier than anticipated. The resulting growth of peri-urban and rural populations is driving land use changes and producing strong pressure on biodiversity.
- Housing density in Melbourne is low by global standards, producing demand for housing development at the urban fringes. Requirements of the planning system can work against the objectives of a more sustainable Melbourne, for example preventing increased housing density by limiting the number of dwellings permitted on a parcel of land.
- There is a trend towards greater corporate ownership and management of agricultural land in Victoria, and fewer family farms. New mechanisms for encouraging land stewardship among corporate land managers are required.
- Valuable information about environmental assets is gathered during catchment management activities but could be better integrated into strategic planning processes and statutory planning decisions. The barriers to integration of information between catchment planning and local land use planning are unclear and in need of further investigation.

Recommendations

LB2.1 The impact of urban and peri-urban development on remnant vegetation should be minimised. This could be achieved by developing a biodiversity management strategy to be applied to a planning scheme for urban and peri-urban areas. The development of such a strategy could arise from the current review of Victoria's Biodiversity Strategy.

LB2.2 The Victorian Government should investigate options for preventing the loss of significant elements of rural vegetation, including mature paddock trees. Investigations should recognise that the habitat value of mature trees may not be replicated in offset plantings and that existing patches of remnant vegetation form a cost-effective basis for revegetation efforts.

LB2.3 The Victorian Government should investigate policy options to ensure that investment in carbon offsets provides maximum benefits to biodiversity and native vegetation; for example, by purchasing biodiverse plantings to offset government greenhouse gas emissions and by targeting tender-based schemes at biodiverse plantings.

LB2.4 The Victorian Government should expand existing investment in public education to enhance Victorians' understanding of their impacts on the environment, and to promote behaviour change. For example, the 'black balloons' advertising campaign has been effective in raising the level of climate change understanding in the community. A similar public education approach could be adopted for broader environmental concerns and could be targeted to various population sectors; for example, urban and peri-urban residents.

LB2.5 As part of policy development resulting from the *Land and biodiversity at a time of climate change* Green Paper/White Paper process, the Victorian Government should undertake a study to identify parts of the agricultural landscape suited to natural regeneration processes, as well as highly fertile sites requiring active revegetation, and instigate ecologically defensible large-scale restoration projects, for example through targeting of BushTender or related projects to areas of high regeneration potential.

LB2.6 Options for developing a 'Biolinks' strategy are outlined in the Green Paper and the development of such a strategy should be considered an urgent priority, given the opportunities that currently exist for regeneration from existing vegetation.

LB2.7 The Victorian Government should expand the scope of Action 2.20 of *Our Water, Our Future* to develop a regulatory framework to control the water resource pressures exerted by the full range of potential surface water diversions including plantation forestry, restoration of riparian vegetation and farm dams (see also Part 4.3: Inland Waters). Development of such a framework should involve a full investigation of the impacts of all potential sources of water interception and extensive policy analysis to assess the impact of the proposed regulation on water users and the environment.

LB2.8 The Victorian Government should ensure that Regional Catchment Strategies are underpinned by the best available scientific and technical information.

LB2.9 Regional Catchment Strategies should include measurable resource condition targets as a means of improving evaluation of outcomes.

LB2.10 CMA reporting against Regional Catchment Strategy objectives should include public reporting against an agreed set of key environmental performance indicators.

LB2.11 The Victorian Government should explore options for improving linkages between catchment planning objectives and local planning schemes. Regional catchment strategies should contain implementation strategies with specific advice for planning authorities.

LB2.12 The Victorian Government should undertake a study to identify the most significant barriers to effective protection of environmental assets. This investigation should include relationships between CMAs and planning authorities, alignment between catchment planning and land use planning processes and objectives, resourcing of strategic and statutory planning in relation to environmental assets, and flow of information between State Government departments and planning authorities.

LB2.13 Where clearing is approved by local governments, it should be recorded by DSE in the Native Vegetation Tracking tool.

LB2.14 The Victorian Government should continue to support the development and application of a land health index. Analysis of the relationship between land use and land health should inform Victorian land use planning decisions at statutory and strategic levels to achieve better alignment between planning decisions and biodiversity or conservation objectives.

LB3 Threatened species

Key findings

- The number of threatened species in Victoria increased between 2002 and 2007, yet Action Statements to improve their status under the Flora and Fauna Guarantee Act 1988 have not been developed. 157 native vertebrate species and 778 native plant species are considered rare or are threatened with extinction.
- The Flora and Fauna Guarantee Act 1988 is failing to meet its stated objectives and is in need of review. It requires a change in focus to facilitate improved understanding of Victoria's natural ecosystems and their vulnerabilities to climate change and an adequate allocation of resources to ensure effective achievement of objectives.
- Climate change is likely to exceed the evolutionary adaptive capacity of some species, compounding existing threats to native species and increasing the number of threatened species.
- There are significant knowledge gaps with respect to Victoria's threatened species. For example, survey effort for native species has declined significantly over the last 5–10 years, limiting the ability to track population trends. Knowledge of the status of invertebrates is particularly poor, hampering assessments of conservation needs.
- Trends in populations of individual threatened species are variable. While some populations of threatened species continue to decline, a small number of threatened species populations are increasing in number in response to management activities. There are many species whose population trends are inconclusive or variable and which require ongoing monitoring.
- The impact on ecological processes of the extinction of 24 species of vertebrates from Victoria (18 of which are mammals) and 51 species of plants is largely unknown.

Recommendations

LB3.1 The Victorian Government should allocate funding for the ongoing maintenance of advisory lists for all taxa, including invertebrates.

LB3.2 The Victorian Government nominate a central data agency to integrate existing species distribution datasets, facilitate the integration of future datasets and make all data available to the agencies with responsibility for managing threatened species.

LB3.3 The Victorian Government should support an enhanced strategic, co-ordinated and ongoing survey effort for Victoria's flora and fauna. To enhance the availability and utility of data to relevant agencies, the Government should nominate a central data agency to co-ordinate collection, storage and distribution of survey data.

LB3.4 The Victorian Government should ensure that current Action Statements are prepared for all species listed under the *Flora and Fauna Guarantee Act*, and that all Action Statements include an assessment of threats from climate change.

LB3.5 The Victorian Government should review the *Flora and Fauna Guarantee Act* and resources allocated to it to ensure maximum effectiveness in protecting Victoria's biodiversity within the constraints of unavoidable and projected climate change. This process should include a review of the Act's objectives, the interactions between the FFG Act and other legislation to protect a maximum number of species across all land tenures, and extensive consultation with the Victorian community about the biodiversity implications of any proposed changes. Climate change should be declared a threatening process under the *Flora and Fauna Guarantee Act*.

LB3.6 The Victorian Government should provide sufficient resources to implement a suite of tools to achieve biodiversity conservation.

LB3.7 The Victorian Government should work with the Commonwealth Government to ensure adequate maintenance of lists of threatened species and ecological communities, and consistency of such lists between State and Commonwealth threatened species legislation.

LB3.8 The Victorian Government should prioritise incentives to improve the status of biodiversity on private land. This could be achieved by expanding market-based incentive programs such as BushTender and EcoTender, which provide biodiversity benefits from vegetation management and deliver a reliable alternative income stream to land holders.

LB4 Pest plants & animals

Key findings

- Pest species continue to establish in Victoria and pose a major threat to biodiversity, primary production and the aesthetics of natural landscapes.
- Weeds affect all Victorian landscapes. Approximately 90% of the native bushland in Melbourne is badly affected by weeds, with more than 50% considered severely degraded. Almost 80% of recently recorded plant naturalisations in Victoria are of garden origin.
- The economic impact of invasive species is high. The total cost of pest species in Victoria is estimated at \$900 million per year. Costs associated with control of pest species compromise resources available for other resource management activities.

Recommendations

LB4.1 The Victorian Government should allocate resources for a regular review of the Noxious Weeds list to ensure that the Catchment and Land Protection Act is informed by accurate and up-to-date listings of weed species threatening Victoria's environment and economic productivity.

LB4.2 The Victorian Government should investigate mechanisms for raising Victorians' awareness of the weed potential of garden plants sold in nurseries and should continue to consult with the nursery industry to limit the sale of weedy plants.

LB4.3 The Victorian Government should investigate options for developing further partnerships with the broader community to achieve weed and pest animal control, since these problems occur across tenures.

LB4.4 The Victorian Government should continue to support long-term regional scale projects to protect biodiversity from exotic predators; for example, the Southern Ark and Glenelg Ark projects.

LB5 Soil structure & erosion

Key findings

- The extent of soil structure decline in Victoria is not clear because there is no single measure of soil structure condition and there is no program in Victoria to monitor indicators of soil structure. In 1991, 30% of Victoria's agricultural land was considered to be severely degraded due to soil structure decline. There is no update on this estimate.
- At least 13.4 million ha of Victoria (approximately 60%), including 73.4% of the State's agricultural land, has sodic soils, which are prone to erosion and soil structure decline. Soil type, land form and land management practice also contribute to risks of erosion and soil structure decline.
- Advances in farming systems and awareness of the issues have reduced erosion and may have reduced soil structure decline in some areas. Reduced tillage, precision agriculture and controlled traffic are innovations that can assist in improving soil structure and lessening the likelihood of erosion. Management of soil organic matter also has a major influence on soil structure and erosion.
- The extent of gully erosion in Victoria was mapped in detail in the 1970s and early 1980s but has not been comprehensively mapped since 1982. Erosion has been better controlled since the end of broadscale clearing, but significant episodes still occur during severe weather events.

Recommendations

LB5.1 The Victorian Government should incorporate, within current soil health initiatives, a program to ascertain the significance of soil structure decline as a threat to soil health in Victoria.

LB5.2 Victoria has existing strength in soil biology and biotechnology research. The Victorian Government should continue to support this research for the purpose of filling the knowledge gap surrounding the roles of soil biological populations in ecological processes and production systems. The Government should also continue to support farming systems research, in collaboration with regional industry groups, with the aim of developing 'conservation' farming systems suitable for all applications. This research could be supported under the *Land and*

biodiversity in a time of climate change Green Paper objective of 'Expanding our knowledge base'.

LB5.3 The Victorian Government should co-ordinate with other States to have land management practice monitored in the annual ABS agricultural survey for the purpose of supporting soil health risk assessment and public reporting of these risks.

LB5.4 The Victorian Government should support a 'community engagement' framework for soil health data collection and management at the point that it is most influential in affecting management change in soil health. The Government should co-invest with regional communities and organisations such as cropping groups to benchmark their soil conditions and management regimes against a set of agreed indicators for the purposes of knowledge exchange, learning, target setting and action implementation within stakeholder groups. The investment program could be designed to deliver robust and reliable data about condition and performance over time for public review, assessment and evaluation.

LB5.5 Within the context of a soil health community engagement framework, a key outcome is development of guidelines relating soil type, soil management and crop type to desirable soil health outcomes. The Victorian Government should co-invest with regional communities to develop such guidelines based on data collected within the framework.

LB5.6 The Victorian Government should work with regional cropping groups to identify barriers to adoption of current best cropping practice. Research partnerships should develop and demonstrate alternative farming systems to facilitate uptake of new cropping technology.

LB6 Salinity

Key findings

- Salinity costs Victoria \$50 million annually in lost agricultural production and direct costs of salinity are expected to reach \$77–166 million by 2050.
- Approximately 240,000 ha of land in Victoria are known to be affected by discharge of saline groundwater; however, mapping of salinity in Victoria is inadequate to provide a comprehensive statewide picture of areas affected.
- Since the late 1990s groundwater depths have stabilised or retreated in response to salinity management and a prolonged period of below-average rainfall. The extent of salinity is also considered unlikely to extend beyond current limits because of reductions in groundwater recharge; however salinity persists and requires ongoing management.

Recommendations

LB6.1 The Victorian Government should invest in salinity mapping methods research and mapping activity in order to better quantify the area and severity of salt-affected land in Victoria and enable change to be tracked over time. The Government should also invest in research to better understand the hydrological characteristics of Victorian groundwater, so as to reliably define future salinity risk for Victoria.

LB6.2 The Victorian Government should ensure that ongoing management of salinity is incorporated into asset-based approaches to land and natural resource management.

LB6.3 The Victorian Government should continue to invest in the development of readily adoptable and cost-effective perennial-based farming systems to deliver multiple benefits for salinity, acidification, soil health and carbon storage.

LB7 Soil acidification

Key findings

- The cost of lost productivity due to soil acidification to Victoria is estimated at \$470 million per year. Productivity declines due to soil acidification also reduce the amount of land that could be used for biodiversity conservation in agricultural landscapes.
- Soil acidification is accelerated by some land management practices and the area of acid soil is increasing; however, Victoria has large areas of naturally acidic soils that can't be distinguished from soils acidified by agriculture.
- The use of acidifying fertiliser is increasing to support the increasing cropping intensity in Victorian agriculture.
- Only 5.5% of the area requiring treatment to restore critical pH levels is sufficiently treated with lime. Current lime use in Victoria is only 7% of the level required for soils to reach pH 4.8 and 2% of that required to reach pH 5.5 on a statewide basis.
- The last statewide assessment of soil pH was made in 1994.

Recommendations

LB7.1 The Victorian Government should allocate funding for a comprehensive statewide pH benchmarking program and establishment of long-term monitoring sites in key areas. The findings of such a program should be made widely available to land managers to encourage optimal management and remediation for each soil type.

LB7.2 The Victorian Government should update the soil surface pH map layer to indicate the current soil pH status. This information should be made widely available to land managers to encourage optimal fertiliser management and lime application.

LB7.3 The Victorian Government should continue to support the development and adoption of farming systems based on perennial plants in order to address acidification and salinity, and to capture benefits for biodiversity and soil carbon sequestration.

LB8 Fire in the Victorian environment

Key findings

- Climate change is forecast to substantially increase the fire risk in Victoria, with the number of very high or extreme fire danger days across south-eastern Australia expected to increase by up to 25% by 2020 and up to 230% by 2050.
- Victoria has experienced a high frequency and severity of fires in the last decade, including major bushfires in 2003 and 2007 that each burnt in excess of 1 million ha. Some species have undergone marked declines and have large amounts of habitat have been lost following these large-scale fires.
- Fire regimes in Victoria have been altered in response to demand for fire suppression to protect human life and property. Inappropriate fire regimes (too much or too little fire) threaten the persistence and condition of some species and ecosystems. Human sources of ignition account for at least 70% of individual fires on public land in Victoria.
- Uncertainty exists over optimal levels of planned burning in Victoria for ecological benefits and protection from wildfire.

Recommendations

LB8.1 The Victorian Government should formulate a response in preparation for the increased risk of fire that is arising from climate change.

LB8.2 The Victorian Government should expand research on ecological burning to develop an ecologically based program of planned burning that accounts for the regeneration requirements of plant communities and the habitat needs of fauna that is applicable to public and private land tenures and to small peri-urban vegetation remnants. Funding should also be allocated for the extension of Tolerable Fire Interval analysis to all Victorian Bioregions.

LB8.3 The Victorian Government should review current ecological burning guidelines to account for the limitations on burning of small remnant vegetation patches in peri-urban areas, especially in light of rapid peri-urban development in Victoria.

LB8.4 The Victorian Government should investigate options to limit further housing development in fire-prone areas to reduce the potential for loss and damage as Victoria's fire risk increases. This should be achieved by altering planning policy for fire-prone areas.

LB8.5 The Victorian Government should include in its response to the increased risk of fire, review of key fire management documents such as the *Code of Practice for Fire Management on Public Land* to consider and incorporate the potential impacts of climate change on fire.

LB8.6 That DSE continue to work with the community and other stakeholders such as the CFA and Department of Human Services in rural Victoria and urban centres to manage fire and educate the public about the risks of bushfire and the benefits of planned burns.

LB9 Impacts of climate change on land & biodiversity

Key findings

- Climate change is progressing faster than expected and will exacerbate existing pressures on Victoria's native vegetation resulting from past clearing and current land uses, altering the distribution and structure of vegetation communities and habitats. Efforts to reduce greenhouse gas emissions may have both positive and negative impacts on biodiversity.
 - Ecosystems have a narrow coping range for temperature and projected rates of climate change are very likely to exceed rates of evolutionary adaptation in many species. Vulnerability becomes significant for 1.5–2°C of global warming. Globally, 20–30% of species assessed to date will be at increasingly high risk of extinction as warming exceeds 2–3°C, which is likely given current trends in greenhouse gas emissions.
 - The key impacts of climate change on terrestrial systems will be increased incidence and severity of drought and fire, declining water availability, alteration of habitats and interactions between species, and increased frequency of extreme climatic events.
- Climate change further threatens the survival of a number of threatened species, such as the Mountain Pygmy-possum and Helmeted Honeyeater. Small and fragmented populations of flora and fauna and those at the limits of their range are at particular risk but little is known about the adaptation responses of individual species. Modelling to predict impacts on ecological systems is in its infancy.
 - Climate change is likely to facilitate the establishment of pest plants and animals and pathogens in areas that previously were relatively unaffected.
 - Agriculture contributes 12.9% of Victoria's greenhouse gas emissions and agricultural production is vulnerable to climate change impacts.

Recommendations

LB9.1 The Victorian Government should recognise soil carbon as an important asset and should contribute to the national research effort to understand the behaviour of organic carbon in a range of soils, agricultural systems and environmental conditions with a view to incorporating soil carbon in the Carbon Pollution Reduction Scheme at some future time.

LB9.2 The Victorian Government should support the future inclusion of agriculture in the Carbon Pollution Reduction Scheme.

LB9.3 The Victorian Government should continue to invest in research aimed at understanding the responses of species to climate change and the requirements for biodiversity conservation in a changing climate. Research findings should inform future responses to climate change but lack of scientific certainty should not be a barrier to implementing broad-scale strategies to improve landscape connectivity in Victoria.

LB9.4 The Victorian Government should undertake a review of current agricultural practices in the State and, based on current climate projections, develop a sustainable, long-term agricultural strategy. This could be supported by extended regional modelling of climate suitability for new and existing enterprises.

LB9.5 The Victorian Government should undertake a comprehensive risk assessment of the impacts of climate change on Victoria's land and biodiversity assets, including agricultural and urban land.

LB9.6 The Victorian Government should ensure that investment in carbon offsets (vegetation planted for permanent biosequestration) provides benefits to biodiversity and native vegetation, for example, by developing mechanisms to encourage biodiverse indigenous plantings rather than monoculture plantings. This could be achieved by broad application of the EcoTender program, with both permanent carbon sequestration and biodiversity gains as targets of management plans.

LB9.7 The Victorian Government should allocate funding for continued research into technologies for reducing greenhouse gas emissions from agriculture, and should support commercialisation of effective technologies to facilitate rapid adoption by farmers.

LB9.8 The Victorian Government should adopt the precautionary principle in relation to climate change impacts on land and biodiversity and allocate adequate funding to address the critical risks.

LB9.9 The Victorian Government should incorporate climate change risk assessments into all government decisions surrounding land and biodiversity.

LB9.10 The Victorian Government should incorporate climate change adaptation responses into the upcoming Climate Change White Paper and climate legislation to ensure that risks are adequately addressed and managed.

Part 4.3 Inland waters

IWO Introduction

Key findings

- Direct pressures to inland waters include the construction of dams, flow regulation and water harvesting; draining of wetlands; desnagging; channelisation and the construction of levees.
- Clearing of almost half of Victoria's native vegetation and associated land use changes have had negative impacts on inland waters including loss of riparian vegetation, altered hydrology, erosion, and increased loads of sediments and contaminants such as salt, nitrogen and phosphorus.
- The 2004 Index of Stream Condition assessment reported that only 21% of major rivers and tributaries in Victoria were in good or excellent condition. Almost half the basins in Victoria have less than 10% of major rivers and tributaries in good or excellent condition.
- The extent of degradation indicated by the 2004 Index of Stream Condition assessment was present before the drought, but low streamflows combined with current levels of extraction have compounded pressures on inland waters since this assessment.
- The Sustainable Rivers Audit reported that 9 out of 10 Victorians basins in the Murray Darling Basin were in very poor ecological health, and one basin was in poor ecological health.
- In over half the river basins in Victoria, less than 20% of major rivers and tributaries have flow regimes in good condition. Changes to low flow events were most widespread, causing numerous pressures ranging from changed breeding conditions to poor water quality. Lack of flooding threatens the existence of tens of thousands of hectares of River Red Gum Forests.
- In 2004, just 6% of major rivers and tributaries had in-stream habitat in good condition based on the presence of large woody habitat, bank stability and barriers to fish passage.
- In 2004, 14% of major rivers and tributaries had riparian vegetation in good condition. Uncontrolled stock access to riparian zones continues to be the major pressure on riparian vegetation statewide.
- By 1994, 37% of naturally occurring wetland area had been lost, mainly due to drainage. A more recent statewide assessment has not been conducted.
- In 2005, water quality objectives for salinity were met at 68% of sites across Victoria, and objectives for total nitrogen, total phosphorus, and turbidity were met at less than half the sites monitored.
- Many species dependent on inland waters are now considered threatened, including 21 freshwater and estuarine fish species, 11 frog species and 29 species of waterbirds.
- In 2004, macro-invertebrate communities were in good condition across almost half of the major rivers and tributaries assessed.
- The total index of abundance for waterbirds in eastern Australia has shown a declining trend over past decades, with 2007 having the second-lowest abundance on record.
- Commitments to provide environmental water were qualified in 40 locations across Victoria in 2006-07, as part of drought contingency measures.
- Under climate change, streamflow is projected to decrease by up to 50% across much of Victoria by 2070. The present degraded state of many inland waters increases the challenge of mitigating the environmental impacts associated with climate change.
- Victoria's inland waters have inherent value, and contribute greatly to the broader environment, community and individual human health. Inland waters provide valuable ecosystem services such as drinking water, cycling of nutrients and maintenance of biodiversity, as well as recreational and cultural opportunities. Many markets fail to protect and may even encourage the degradation of these services, even though they support healthy economies and communities.
- Incremental degradation due to cumulative catchment and instream impacts remains an ongoing challenge. The expense and difficulty of rehabilitation highlights the importance of protecting high value areas.
- Over the past two decades, and particularly in the last decade, there has been increasing knowledge; investment; integration of management; on ground capacity and awareness to drive improvements in the condition of inland waters. In the context of ongoing drought and likely climate change the future health of many inland waters is uncertain and further action is necessary.

Recommendations

IWO.1 Implement consistent statewide reporting and data management of works implementation and condition assessment for rivers, wetlands and groundwater, aggregated at the basin or CMA level, to show the impact of management responses on environmental condition.

IWO.2 The Victorian and Commonwealth Governments should strengthen and improve management regimes of Ramsar wetlands, to ensure the obligations of the Convention are met.

IWO.3 The Victorian Government should reinforce its commitment to significantly improving the health of Victoria's rivers, floodplains and estuaries by 2010 as set out in *Our Water Our Future*, and other inter-jurisdictional river health initiatives.

IWO.4 Ecosystem services should be recognised as a component of the value of land, so that landholders can treat ecosystem services as an alternative source of income. Knowledge of the interaction between ecosystems and the services they provide to human settlements should be improved.

IWO.5 Institutional arrangements of catchment management authorities and water corporations should be reviewed with the goal of integrating water management to enable better delivery of water for the environment, and adaptation to climate change.

IWO.6 The Victorian Government should review reporting cycles of Index of Stream, Wetland and Groundwater condition indexes, and the State Wetland Inventory, to facilitate better integration with Victorian Catchment Management Council and State of Environment reporting.

IWO.7 Implement the Indexes of Wetland Condition and Groundwater Condition on a statewide basis as soon as possible, to enable more accurate reporting to inform decision making.

IW1 Flow regimes

Key findings

- A flow regime is a specific combination of the timing, size and duration of flow events. It is a key driver of river and floodplain wetland ecosystems.
- The main pressures on flow regimes are the presence of dams and other barriers; regulation of flow; extraction of water for consumption; channel modification; and changes in land use. Drought has compounded these pressures over the past 11 years; and they are likely to be compounded by climate change in future.
- In the past four years, over 75% of the total flow was harvested for consumptive use from a quarter of Victoria's river basins. During times of low streamflow, the water allocation system reduces environmental flows more than it reduces water for consumptive uses.
- Serious rainfall deficiencies over the past 11 years have reduced inflows to storages 30–60% below long-term averages. Water scarcity has been statewide in extent, and has deepened over time, with inflows to the Murray and Melbourne storages reaching record lows in 2006.
- In over half the river basins in Victoria, less than 20% of rivers have flow regimes in good condition. Changes to low flow events are most widespread, resulting in a number of pressures from changed breeding and spawning conditions to poor water quality.
- Due to river regulation and over-extraction compounded by drought, many tens of thousands of hectares of River Red Gum forests and wetlands in northern Victoria are highly stressed. Without adequate flooding in the near future they may be lost, requiring centuries to recover.
- Water availability will be cumulatively reduced by climate change and catchment processes such as forests regenerating after bushfires; the legacy of historic groundwater extraction; small unlicensed domestic and stock farm dams; and plantation forestry.
- In many rivers and aquifers the current environmental water reserve (EWR) is inadequate and vulnerable, placing environmental values at risk. Commitments to provide environmental water were qualified in 40 locations across Victoria in 2006-07, as part of drought contingency measures.

- Significant improvements in the way water is managed for the environment have occurred in the past decade, including the recognition of the environment's right to water in the allocation framework, commitments to improve flow regimes; better water accounting and scientific understanding.

Recommendations

IW1.1 Address the disproportionate reduction in water remaining in basins during times of low streamflow, which results from the current system of bulk entitlements defined as a volumetric share of the resource.

IW1.2 Provide environmental water requirements for groundwater-dependent ecosystems once the delivery methodology has been finalised.

IW1.3 Review allocations between all sectors within the current 15-year period, taking into account real and projected water availability.

IW1.4 Conduct the cyclical review of water allocations on an ongoing basis over a shorter period than 15 years, and make public the findings.

IW1.5 Disclose the reasons for, and likely environmental, social and economic impacts of the qualification of environmental flows, as decisions are made.

IW1.6 Act with urgency to increase environmental water reserves where they are currently insufficient to keep rivers in a sustainable condition, including buying back water. In particular, minor and moderate flooding events should be restored to floodplain ecosystems.

IW1.7 Review water trading rules to remove impediments to buying water to add to the environmental water reserve.

IW1.8 Adopt a new term for environmental flows that does not have connotations of being 'just for the environment', and expresses the importance of maintaining water quality and river health. For example, "essential baseflow" could be used to describe minimum flows required during low-flow periods to maintain water quality and river health.

IW1.9 Improve the awareness and understanding within the community of the importance of environmental flows for inland waters, and provide regular, consolidated reports on progress against the actions and outcomes within *Our Water Our Future* and the regional sustainable water strategies.

IW2 In-stream & wetland habitat

Key findings

- River channels and instream habitat, including wetlands, were historically modified without an understanding of the consequences. Many large-scale changes such as erosion and draining of wetlands are irreversible, and the historic legacy of channel modification still places pressure on in-stream habitat.
- In 2004, just 6% of the major rivers and tributaries assessed by the Index of Stream Condition had in-stream habitat in good condition, based on the presence of large woody habitat, bank stability and barriers to fish passage
- By 1994, 37% of naturally occurring wetland area had been lost, mainly due to drainage. An inventory showing the extent of wetlands has not been updated since then.
- The statewide condition of remnant naturally occurring wetlands are not available in detail. An Index of Wetland Condition assessment technique has been developed and is currently being finalised.
- River channels and wetland habitats are now managed with much greater sensitivity to, and understanding of, the ecological significance of their various components and processes. Remnant naturally occurring wetlands, particularly those on private land, remain vulnerable to incremental loss and degradation in quality.
- In many cases, restoration works involve putting back what was taken away many years ago. The ongoing investment and effort required show the benefits of avoiding damage in the first place.

Recommendations

IW2.1 Improve protection for wetlands on private land.

IW2.2 Increase protection of floodplain habitat, including wetlands, wood on the floodplain and in floodplain channels.

IW2.3 Remove all redundant in-stream barriers or provide fish passage at all artificial barriers.

IW2.4 More ambitious targets for the rehabilitation of in-stream habitat beyond 2011 should be included in the Victorian River Health Program, given the low proportion of reaches in good condition.

IW2.5 Include the reporting of wetland vegetation as part of the ongoing development of accounting processes for native vegetation (Net Gain reporting).

IW3 Riparian vegetation

Key findings

- Riparian vegetation in good condition supports the resilience of both aquatic and terrestrial ecosystems, allows recovery from disturbance and maintains biodiversity.
- Riparian land is valued for many human uses such as agriculture and recreation, but as a result riparian vegetation has been degraded.
- Uncontrolled stock access to riparian zones continues to be the major pressure on riparian vegetation statewide.
- In 2004, 14% of reach length assessed across Victoria was found to have riparian vegetation in good condition. Nearly half the reaches assessed had poor connectivity of vegetation. Groundcover weeds were widespread in riparian zones, but while shrub and tree weeds were less common, their impact on ecology was greater.
- About 30,000 km of Crown water frontages along rivers in Victoria, and a sizeable proportion are licensed to abutting owners, mainly for grazing. To date, the conservation intent of policy for these frontages has not translated to on-ground conservation outcomes.
- Protection and restoration of riparian vegetation has been promoted through a number of means; including large scale weed-control programs, riparian management agreements, and financial incentive programs.

Recommendations

IW3.1 The Victorian Government should consider more ambitious targets for the rehabilitation of riparian vegetation for the Victorian River Health Program beyond 2011.

IW3.2 The Victorian Government should consider progressively extending VEAC recommendations on phasing out uncontrolled grazing of domestic stock on Crown land water frontages to the rest of Victoria, beginning with the 2009 licence renewal process

IW3.3 The Victorian Government should update and streamline governance arrangements to facilitate protection and restoration of Crown Land water frontages.

IW3.4 The Victorian Government and catchment management authorities should consider regional-scale connectivity of riparian vegetation in the prioritisation of rehabilitation projects, as part of forming an integrated habitat network across the State.

IW4 Water quality

Key findings

- Land clearing for agriculture and urbanisation and contemporary land use changes have led to major catchment-wide changes, including erosion and salinity, which have significantly affected water quality in inland waters.
- In 2005, water quality objectives for salinity were met at 68% of sites across Victoria, and objectives for total nitrogen, total phosphorus, and turbidity were met at less than half the sites monitored.
- Concentrations of total nitrogen and total phosphorus posed a risk to ecosystem health at about 80% of lowland sites in 2005.
- Increasing trends in total nitrogen were detected at over half the sites across Victoria.
- River regulation, along with increased nutrient inputs and low streamflow, are now recognised as a major cause of cyanobacterial blooms in rivers.
- The degradation of important receiving waters such as Port Phillip Bay, Western Port, Gippsland Lakes and the Murray River is a major driver of water quality improvement programs. Management responses target a range of spatial scales, from regional to the individual.

Recommendations

IW4.1 The Victorian Government and catchment management authorities should continue to promote and encourage the uptake of current best practice land use management to minimise diffuse water quality pollution throughout Victoria.

IW4.2 State Environment Protection Policy (Waters of Victoria) should be reviewed to ensure consistency with best scientific practice in the context of a changing climate.

IW4.3 Further degradation of urban waterways should be reduced by applying similar integrated water management provisions to non-residential urban subdivisions as currently apply to residential subdivisions under Clause 56 of the Victoria Planning Provisions with continuation and expansion of capacity building programs for council and development industry practitioners.

IW4.4 The review of water quality management objectives based on reductions in contaminant export compared to a base case (e.g. stormwater management objectives for residential development) should factor in continued intensification of urban and rural land uses. Continued research and innovation to improve and develop management practices should be encouraged.

IW5 Aquatic fauna

Key findings

- Extraction of water, regulation of flow regimes and alteration of habitat are major pressures on aquatic fauna and a primary cause of decreasing native fish populations. Declining water availability over the past 11 years is also affecting the fauna of inland waters.
- Many species are now considered threatened, including 21 freshwater and estuarine fish species, 11 frog species and 29 species of waterbirds.
- Macro-invertebrate communities were found to be in good condition across almost half of the reach length assessed as part of the 2004 Index of Stream Condition.
- The total index of abundance for waterbirds in eastern Australia has shown a declining trend over past decades, with 2007 having the second-lowest abundance on record.
- Implications of the decline in the native aquatic fauna of inland waters include the reduced survival and diversity of species, and reduced ecosystem function and ecosystem services.
- Providing environmental flows, and maintaining and improving the quality and connectivity of in-stream habitat and riparian vegetation that supports aquatic fauna through their life history is essential to maintaining the conservation status of threatened species.

Recommendations

IW5.1 The Victorian Government should undertake regular, long-term, native fish population surveys across Victoria.

IW5.2 The Victorian Government, in conjunction with other State and Commonwealth Governments, improve knowledge and information regarding resilience and thresholds for species, communities and ecosystems in respect of water quality, reduced flow and invasive species.

IW5.3 The Victorian Government should develop a State action plan for exotic aquatic species.

IW5.4 The Victorian Government should incorporate all native fish stocking into population rehabilitation plans.

IW5.5 Recovery plans for threatened species should be implemented systematically, for the long-term benefit of the species.

IW6 Impacts of climate change on inland waters

Key findings

- By 2030, streamflow may vary from no change or slight increases in East Gippsland to 25-40% decreases in river systems in western and north-western Victoria. By 2070, streamflow may decrease by up to 50% across much of the State.
- A rise in temperature of 1°C in the Murray-Darling Basin reduces the annual climatological inflow by 15%, even if rainfall does not change.
- By 2020, a 10-40% reduction in snow cover is likely with potentially significant consequences for alpine and downstream inland waters in Victoria. Under a medium climate change scenario, frequency of significant floods in the Barmah forest will be once in 17 years. River red gums require significant flooding every five to 10 years, which means that without intervention, these trees are unlikely to survive.
- Forest regrowth following more frequent bushfires will be associated with heavy uptake of water by the young trees at the same time as predicted reductions in rainfall. This will have a significant impact on streamflow.
- The current degraded state of many inland waters increases the challenge of mitigating the environmental impacts of climate change.
- In the northern region, most of the water allocated to the environment is in the components of flow that will be most impacted by climate change; and thus potentially no longer able to meet the intended environmental objectives.

Recommendations

IW6.1 The Victorian Government should consider listing climate change as a threatening process under the *Flora and Fauna Guarantee Act 1988*.

IW6.2 Identify drought refugia and ensure adequate protection and improvement of sites during drought.

IW6.3 Provision of adequate EWRs for all rivers should receive priority over the provision of drought refugia.

IW6.4 Identify areas most at risk of in-stream habitat loss or degradation due to climate change impacts and incorporate these into regional river health strategies.

IW6.5 Increase the knowledge and understanding of the impacts of climate change on the environmental values of inland waters; including risks posed by acidification.

Part 4.4 Coasts, estuaries and the sea

CES0 Introduction

Key findings

- The Victorian coast is an environment with naturally high diversity that is also subject to intensive human use. It features landscapes, plants and animals that are highly valued by Victorians, and as a result it is subject to significant human-induced pressures.
- The coast is highly modified. This is characterised by removal of vegetation and a decline in estuarine condition, especially in closed embayments and close to large settlements. However, in many cases the current rate and extent of modification is not well monitored.
- The coast continues to be a popular place to live and to visit, with a coastal population growth rate of almost 1.4% - faster than the State average. This has resulted in the urbanisation of 16.5% of Victoria's total coastline by 2004.
- What we do on land affects the sea: Water quality is inversely related to land use intensity in the adjacent catchment. As a result, water quality in Port Phillip Bay, Western Port and the Gippsland Lakes is likely to be poorer than in the open ocean, which is characterised by high levels of mixing and flushing, and is further removed from high intensity land use.
- Reduced water quality has a negative impact on both human use of the marine environment, and marine biodiversity. However, in many cases (e.g. extent of seagrass), inadequate baseline data makes it very difficult to determine the scale and significance of the effects.
- Human use of marine species can change marine ecology. Certain species of fin fish have been historically over-harvested, and this has had repercussions on the structure of marine ecosystems. An example of this is the removal of top predators, leading to the formation of *urchin barrens*, a degraded form of marine habitat.

- Prevention is better than cure: introduced species are a constant threat to Victorian marine systems. There are now 161 introduced species in Port Phillip Bay, considered to be one of the most invaded marine ecosystems in the southern hemisphere, and these are changing its ecosystems. In the vast majority of cases, preventing the incursion of marine pests is cheaper than attempting to remove them once established.
- The establishment of marine parks and reserves that cover more than 11.7% of Victorian waters is a progressive step in the protection of Victoria's marine biodiversity. However, because of the interactions between coasts and the oceans, our marine biodiversity continues to be subject to exogenous pressures.
- As part of an interconnected global system, climate change applies ongoing pressure to Victoria's coastal and marine environments. For example, the projected increase in ocean acidity will have fundamental consequences for marine ecosystems and the industries that rely on them.
- Coastal settlements will be increasingly vulnerable to damaging weather due to climate change. Modelling shows that storm surges of up to 2.3 metres above sea level could be expected by 2070. Victoria must be prepared for these.
- Victoria's marine and coastal biodiversity, already threatened by a range of development and industry pressures, faces significant challenges as a result of climate change. Effects have already been observed and include alteration of breeding patterns and reduced distribution, including commercially important species.
- For several coastal and marine issues, data collection programs and levels of scientific understanding are inadequate for comprehensive environmental assessments. This is particularly the case for coastal vegetation and marine biodiversity.

Recommendations

CES0.1 Ensure that non-climate related stressors are minimised in regions identified as particularly vulnerable to compounding pressures associated with climate change.

CES0.2 Coordination of the monitoring and management of Victoria's coastal and marine environment should be improved. Review the governance

arrangements and strategic planning processes established under the *Coastal Management Act 1995*. A major focus should be on the capacity of coastal management bodies to successfully fulfil their legislative responsibilities and examine opportunities for improving coordination. State Government should provide appropriate funding to expedite the implementation of the review's recommendations into planning law.

CES0.3 As the key strategic plan for Victoria's coastal and marine environment, ensure that the actions outlined in the Victoria Coastal Strategy are implemented. The Department of Sustainability and Environment establishes and leads an interagency committee to coordinate and progress actions outlined in the Victorian Coastal Strategy.

CES0.4 Develop a set of indicators to provide coastal managers with a measure for successful coastal management.

CES1 Coastal modification

Key findings

- The population of coastal Victoria is growing faster than the State average, particularly in areas close to Melbourne.
- While generally the planning processes to accommodate growth and development pressures in coastal towns is improving, the amount of subdivision and rate of urbanisation along the coast continues to increase.
- The number of tourists visiting the Victorian coast is decreasing, largely due to a significant decrease in day-trippers.
- Extensive modification of vegetation and estuaries has occurred, with land within or in closest proximity to large coastal settlements most affected.
- The condition of most estuaries has been degraded, particularly those around the more populated and developed coastal centres, to the extent that only a few, mainly in the far east of the State, remain in near-pristine condition.
- While the coast has undergone significant modification from the natural state, it remains difficult to determine the status and trends of the natural coastal environment due to a lack of consistent, reliable data.

- Victoria has at least 55,000 ha of potential coastal acid sulfate soils, disturbance of which can cause the generation of sulfuric acid that can pollute, soil water, waterways, wetlands and estuaries.

Recommendations

CES1.1 The Victorian Government should allocate funds for and undertake five-yearly estimates of coastal native vegetation cover in Victoria, based on high quality aerial photography or satellite imagery (See also recommendation LB 1.7).

CES1.2 Develop strong and consistent indicators of coastal urbanisation to measure the impact of coastal development pressures on the coastal and marine environment.

CES1.3 Strengthen strategic and statutory tools for managing urban growth on the coast.

CES1.4 The State Government should better value and support the Committees of Management responsible for managing coastal Crown land. Review arrangements and level of support for Committees of Management to manage coastal Crown land under the *Crown Land (Reserves) Act 1978*. At the conclusion of the review, State Government should fund and resource any critical recommendations.

CES1.5 Develop indicators to monitor the impacts of urbanisation on the coastal and marine environment. Develop a program for ongoing monitoring of key coastal processes, ensuring that knowledge is utilised to inform coastal management decisions.

CES1.6 Identify a central agency to provide support and to coordinate coastal and marine education programs. Use this central agency to identify critical knowledge gaps and develop initiatives to improve connections between policy-makers, coastal managers and researchers.

CES1.7 The Victorian Government should continue the current CASS survey, along with development and implementation of the Coastal Acid Sulfate Soil strategy, which identifies risk areas.

CES2 Water quality

Key findings

- Activities on land affect water quality. Semi-enclosed embayments, especially adjacent to urbanised areas such as Port Phillip Bay, Western Port and Gippsland Lakes can be impacted by point and non-point sources of pollution that can reduce water quality.
- Locations within Victoria's estuarine environments that are directly impacted by inputs such as increased nutrient and suspended solid loadings have historically displayed the poorest water quality. Such sites include Long Reef and Hobson's Bay in Port Phillip Bay, and Corinella in Western Port.
- Due to the anticipated increasing pressures of climate change, dredging and inflow of nutrients, and the interactions between these pressures, there is an increased risk that bays and estuaries, particularly those close to human settlements, will experience reduced water quality in the future.
- While maritime activity is increasing and is projected to further increase, the number of reported marine pollution events in Victoria is declining.
- Most of the dredging in Port Phillip Bay and other Victorian ports over the last six years has been undertaken for maintenance purposes. In 2008 a significant dredging program was commenced that increased the amount of dredged material removed to more than 150 times the average annual dredge. This program is likely to have implications for water quality and water quality monitoring in Port Phillip Bay.

Recommendations

- **CES2.1** SEPP standards should be reviewed and strengthened as understanding of water quality under natural conditions increases and as existing targets are met.
- **CES2.2** Continue to monitor the efficiency of denitrification in Port Phillip Bay, with more frequent monitoring under conditions of likely denitrification stress, such as after significant storm events and during dredging.
- **CES2.3** Reduce nutrient loads to meet ecological objectives. Set stretch standards for eliminating nutrient flows for the Western Treatment Plant and Boags Rocks (Gunnammata) outfalls.
- **CES2.4** Establish a regular program of testing for toxicants in sediments and in key indicator species as well as in the water column.
- **CES2.5** Enhance catchment and stormwater education programs that highlight the risks of poor urban waste management to flora, fauna and human beneficial use of the marine environment.
- **CES2.6** Increase incentives for municipalities, communities and businesses to retro-fit water sensitive urban design into existing infrastructure.
- **CES2.7** Undertake strategic environmental assessment (SEA) in Victoria, ensuring that the long-term and flow-on effects of a project are considered to assess high-order concepts, prior to the site-specific assessment via existing EIA and EES.
- **CES2.8** Investigate opportunities for better observation and reporting of marine pollution events, specifically the numerous small events currently classified as unknown or not set.
- **CES2.9** Water quality programs must be methodologically sound, continuous and should provide an indication of water quality in all Victorian marine and estuarine waters. There is a case for regular, low frequency monitoring outside of the major embayments that should be investigated.
- **CES2.10** Review the Best Practice Environmental Guidelines for Dredging to ensure the dredging approval process remains current and consistent with the current knowledge and dredging management practices.
- **CES2.11** Support the development of a 'tool box' for State Government agencies to assist in the decision-making process for proposed dredging works.

CES3 Marine biodiversity

Key findings

- Macroalgal assemblages on shallow subtidal reef habitats appear to be in relatively good condition along Victoria's open coast.
- The area of seagrass habitat in bays and inlets has fluctuated over the last 50 years. Current coverage of seagrass at most locations appears to be within the range of historical (since 1960s) fluctuations.
- Ecological communities on soft sediments in Port Phillip Bay are degraded. The relative condition of open coastal soft-sediment assemblages is unknown.
- Some marine species have been overfished in Victorian waters.
- Introduced species have had a large impact on the ecology of Port Phillip Bay and other sheltered bays and inlets.
- Victoria's bays and inlets are under substantial environmental pressure and so are vulnerable to environmental changes.
- Limited data and understanding, and large natural variability, preclude comprehensive assessment of the condition of marine biodiversity against quantitative indicators. In lieu of adequate data, threat-based management using existing information should be used.
- Port Phillip Bay is considered to be one of the most invaded marine ecosystems in the Southern Hemisphere, with 161 introduced species representing up to 13% of all benthic sediment and encrusting species recorded in the bay.

Recommendations

- **CES3.1** Establish a long-term monitoring program to routinely monitor key subtidal reef communities along the Victorian coast to determine whether reef communities are changing in response to changing environmental conditions.
- **CES3.2** Provide ongoing support and adequate funding to continue marine habitat mapping of Victoria's deep water communities at appropriate spatial scales to provide a better understanding of habitat extent and condition. Information obtained should be used to inform the management of both Commonwealth and Victorian fisheries.

CES3.3 Ensure Fisheries Victoria is provided with sufficient resources and financial support to properly research and monitor fisheries stocks. Where fisheries are depleted, ensure that Fisheries Management Plans allow for the recovery of populations such that their resilience to known environmental pressures, such as the effects of climate change, as well as to unknown pressures, is rebuilt.

CES3.4 Update and finalise the Interim Victorian Protocol for Managing Exotic Marine Organism Incursions for marine pest management in Victorian waters, with greater emphasis on identification, prevention and rapid response to incursions.

CES3.5 Establish monitoring program for marine pest distribution and routinely monitor for new marine pest incursions in Victorian marine waters, particularly focusing on marine pest distribution in Port Phillip Bay.

CES3.6 Examine opportunities for applying an asset-based approach to managing the marine environment.

CES3.7 Continue to support and implement state, national and international ballast water programs to minimise the risk of marine pest incursions in Victorian waters.

CES3.8 Continue awareness campaigns on the risk of spreading marine pests by recreational boaters.

CES3.9 Determine gaps in current capacity to ensure effective compliance of Marine National Parks and Sanctuaries. At the conclusion of the review, State Government should fund and resource any critical recommendations.

CES3.10 Continue marine habitat mapping program and use information to determine adequacy of Victoria's protected marine areas and examine opportunities to expand marine areas under protection.

CES4 Impacts of climate change on coasts, estuaries & the sea

- The climate change factors of altered ocean currents and increasing sea surface temperature will affect coastal and marine systems via increased storminess and rising sea levels respectively.
- Increasing oceanic acidification, resulting directly from increased atmospheric carbon dioxide, and oceanic stratification will both impact marine biodiversity and, in turn, the industries and communities that depend upon it.
- The effects of increasing atmospheric CO₂ concentrations on the carbonate system in seawater are not reversible in human time scales.
- Coastal settlements and biodiversity are already affected and will continue to be affected by storm surges, which will intensify with rising sea level and localised land subsidence. Models show that storm surges of up to 2.3 metres above sea level could be expected by 2070.
- Coastal settlements are likely to be subject to flooding and inundation, which could damage infrastructure and put residents' health and safety at risk.
- Biodiversity in coastal environments is already under threat from a number of environmental pressures. The effects of climate change represent an additional pressure under which certain coastal ecosystems are unlikely to persist.
- In regard to existing marine systems, there are likely to be numerous, interdependent climate change-related factors causing pressure on populations and altering breeding patterns and distribution.

Recommendations

CES4.1 Ensure that all Victorian coastal and marine climate change policy is continually updated using the best and most recent climate change data, including sea level prediction data and that it accounts for uncertainty.

CES4.2 Ensure that all new and upgraded coastal infrastructure is resilient to a modelled 2070 1-in-100-year (or similar appropriate engineering standard) storm event, using the most recent sea level and storm surge projections.

CES4.3 Ensure that coastal land use and community planning is performed with consideration to the long term impacts of climate change and in consultation with all relevant service providers, including local councils and emergency services.

CES4.4 Government should provide guidelines and regional projections using the most recent sea level and storm surge projections, with due consideration for the precautionary principle, and incorporate these into the Victorian Planning Provisions, to assist local governments to make more informed planning decisions on coastal land subject to the impacts of climate change, and to provide the community with greater certainty in regard to these matters.

CES4.5 That government continue to fund research on the likely implications of climate change for coastal and estuarine biodiversity, and that coastal policy decisions take into account the expected impacts and their relative regions of influence.

CES4.6 That government continue to fund research on the likely implications of climate change for marine biodiversity, assess adaptation capacity and make marine policy decisions that take into account the expected impacts.

CES4.7 Ensure that the Victorian Coastal Strategy provides clear policy to address the coastal impacts of climate change.

CES4.8 Continue the implementation of the Future Coasts project with appropriate resource and funding support to ensure adaptation measures can be implemented along the Victorian coast. Update the Victorian Coastal Strategy as outcomes of the Future Coasts project become known.

CES4.9 Ensure mechanisms are established to provide information to local governments to assist in planning decisions that may be impacted by climate change on the coast.

PART 5 Living well within our Environment

Key findings

- The wellbeing of Victorians is ultimately dependent upon the health of the natural environment. The ecosystem services upon which we depend have been, and under business-as-usual scenarios will continue to be, compromised.
- Social and economic systems are vulnerable; as a result, so is human wellbeing. Urgent and fundamental changes are needed and government must provide transparent, exemplary leadership.
- Vulnerabilities are partly the inadvertent by-product of increasing efficiency, reducing the capacity of Victoria to adapt to looming sustainability challenges. Current vulnerabilities include the dependence on brown coal and petroleum and, globally, the ability to supply food under conditions of expected climate change and global population growth.
- A vision of Victoria where wellbeing is decoupled from increasing environmental pressure must be articulated and realised. Several methods for measuring and tracking progress towards sustainability have been proposed. For these to have influence, they require refinement and ownership at the highest levels of government.
- Victorians have proven talented and innovative, and, with government support, they are well equipped to deal with the challenges of moving into a post-carbon economy. Victorian industries want strong leadership and certainty from government as they adapt to this future.
- While it is essential to ensure that *future* development is within sustainable limits, Victorian society is unsustainable now. Refocusing on current patterns is necessary and possible through use of the term *ecologically sustainable use* (ESU). ESU is applied in this discussion to make the point that present uses affect the state of the environment as much as do growth and change.
- ESU becomes a reality when decoupling (a separation between an indicator of wellbeing and an indicator of environmental pressure) is demonstrated. Relative decoupling has commenced in many sectors, but ESU will only be realised when *absolute decoupling* is achieved.

- *Resilience* is so fundamental to sustainability as to be almost invisible. Essential ecosystem services and liveability, valued by all Victorians, can only be maintained when resilience – the ability to adapt to system shocks – is re-established within ecological systems and in society.
- In the context of the scale of the challenge, environmental governance is disparate and inconsistent. The current nature of environmental challenges means that governance must become strategic and future-focused. The technique of *strategic environmental assessment* should be used to address the long-term and wider implications of planning and policy.
- Market based instruments – a way of rationally pricing the environmental impact of goods and services – are being used increasingly in Victoria. Provided that ecosystem services are adequately valued and are supported by legislation, MBIs are a valid way of internalising environmental pressures within the economic framework.
- MBIs can only come into effect through regulatory action, while many activities and requirements will still need command and control approaches: carbon trading will only begin when government sets a cap and timetable. Appliance, liquid wastes and building construction standards depend on deliberate decisions being taken by government. The role of government continues to be critical.
- Technology has a significant role to play in reducing environmental pressures. However, due to associated inherent risks such as the *rebound effect* and the *paradox of efficiency*, technology alone must not be seen as a ‘silver bullet’. The environment doesn’t care how efficient our technologies are if overall pressures continue to increase.
- Victorians recognise their ability to influence the environment through their actions as consumers. They will be further empowered to reduce their personal impact through government’s fostering of ethical and informed decision-making, and establishment of frameworks that provide certainty, such as standardised eco-labels.

- On a global scale, Victoria’s level of responsibility for environmental problems is small in absolute terms. However, as a first world state with one of the highest levels of environmental intensity per capita, Victoria has an obligation to develop its role as an international environmental leader while also taking advantage of the huge business opportunities presented.

Recommendations

LW1 The Victorian Government develop and use a single robust and clearly defined vision of an environmentally sustainable Victoria, incorporating environmentally sustainable use of natural resources, and use this to develop an update to Growing Victoria Together.

LW2 The Victorian Government should ensure that the value of ecosystem services is factored into economic decision-making, as water and climate are starting to become. Agencies should become as adept at valuing and accounting for ecosystem services as they are economic and social services.

LW3 The Victorian Government develops Growing Victoria Together to monitor and report on holistic wellbeing using consistent, valid and statistically verified sustainability indicators that, as a set, comprehensively cover each of the environmental, social and economic values of importance to Victorians.

LW4 The Victorian Government develops an index of holistic sustainability (such as the GPI) for Victoria and report annually on progress towards sustainability.

LW5 When considering ecologically sustainable development, the Victorian Government should take into account the present and short-term (as well as longer term) impacts of the development process and use all available development opportunities to achieve reductions in absolute environmental pressures.

LW6 That decoupling of wellbeing from environmental pressures should be a major policy objective of the Victorian Government. Targeted policy, as well as public education programs, should be introduced to reduce the dependence of economic wellbeing on high consumption and its attributed environmental pressures.

LW7 That the Victorian Government comprehensively integrates decoupling, its stages and importance, into all Victorian Government decision-making at the strategic level.

LW8 That the Victorian Government, generally, employs better data collection, monitoring and reporting regimes, with a stress on long-term, consistent data sets.

LW9 That the Victorian Government, wherever possible, prevent the perpetuation of shifting baselines, particularly in regard to natural systems for which the crossing of thresholds are known and would constitute ecosystem collapse.

LW10 That the Victorian Government factors in likely compounding pressures such as the expected effects of climate change when setting targets for ecological restoration.

LW11 The Victorian Government should develop indices of resilience within the natural systems of Victoria so that defensible management measures can be determined.

LW12 The Victorian Government should develop and monitor indices of social resilience, measuring all its elements (for example, innovation, diversity, distributed systems and the ability to embrace change).

LW13 The Victorian Government should investigate ways to build greater levels of resilience into the community by:

- providing social (financial) support for communities to adapt, rather than not to adapt
- encouraging diversity of employment patterns, lifestyles and cultures
- actively encouraging community-based social support networks
- promoting and support innovation at its most fundamental level
- building awareness of the limitations of increasing efficiency.

LW14 Commonwealth, State, and local governments and their departments and agencies involved in overlapping and competing funding and policy areas (particularly transport – road and public, and metropolitan planning, and primary industry and biodiversity planning) must demonstrate greater coordination to avoid perverse and conflicting policy outcomes. The creation of strategic statutory bodies that are capable of holistic and long-term sustainability decision-making should be thoroughly explored (cf. the new Department of Transport).

LW15 An examination of current policy should be made by the Victorian Government to identify and reconcile subsidies, grants and programs that are perverse to agreed environmental objectives.

LW16 The Victorian Government should institute as soon as possible a statutory-based assessment of the full natural resource impacts of all policies, programs and strategies brought before Cabinet. The essential elements of broader environmental assessment as used overseas (such as Strategic Environmental Assessment (SEA)) should be used to support its existing ESF integration policy commitment. All pre-Cabinet processes will need to certify that a proper environmental assessment of all policies, strategies and programs has been conducted.

LW17 Victoria's proposed Climate Change legislation should incorporate the elements of Recommendations A1.4, A1.5, A1.6, A1.7 and A1.8 and A1.10 as detailed in Part 4.1: Atmosphere, Climate Change section of this Report.

LW18 The Victorian Government continues and expands at the highest level its role of public leadership for sustainability by visibly and transparently demonstrating commitment to environmental sustainability (in each of the areas of energy, water and materials) in all government operations – purchasing, decision-making, accounting, facilities and fleet management.

LW19 Ambitious stretch targets (including zero emissions) should be set and regularly reported against at a whole of government level in State budget papers. Detailed, entity-by-entity listing of performance should also be publicly provided.

LW20 As part of this process, an examination of all policy should be conducted by the Victorian Government to identify and reconcile subsidies, grants and programs that are perverse to agreed environmental objectives.

LW21 That the Victorian Government continues to investigate and implement market-based instruments to achieve positive environmental outcomes using prices set to account for the full value of ecosystem services. Any interventions should be by way of budget allocation and not through the creation of market distortions.

LW22 That the Victorian Government continues to support development and implementation of the Carbon Pollution Reduction Scheme, in a form that does not contain major interventions, by no later than 2010.

LW23 That monitoring of the on-ground outcomes of market-based instruments is conducted by the Victorian Government to enable a review of their effectiveness in terms of both monetary cost and environmental outcome.

LW24 That recognition should be accorded for the continued need for strong environmental regulation by the Victorian Government where a market-based approach demonstrably fails to achieve required outcomes.

LW25 When investing in research and development for innovative technologies and approaches to production, the Victorian Government should ensure that the productivity gains and the contribution to the economy do not come at the cost of absolute increases in environmental pressures.

LW26 The Victorian Government should accelerate the provision of programs (such as eco-labelling and public education campaigns) that raise awareness of the environmental impacts of all consumable services, particularly essential services.

LW27 The Victorian Government should continue to promote and fund a variety of community programs directed at resource conservation and environmental sustainability. There should be a thorough analysis of past and existing programs and the most effective approaches should be adopted in new programs as they develop. Continued Government investment from income streams charged or levied against environmentally costly or harmful activities would constitute a suitable source of funds.

LW28 The Victorian Government should finalise its Learning to Live Sustainably education strategy and review this within five-yearly cycles.

LW29 The Victorian Government should include the teaching of ethics and environmental science as integrated curriculum in primary and secondary schools.

LW30 The Victorian Government should give due consideration to, and raise the profile of, community and social programs' potential for reducing environmental pressures, particularly in funding schedules.