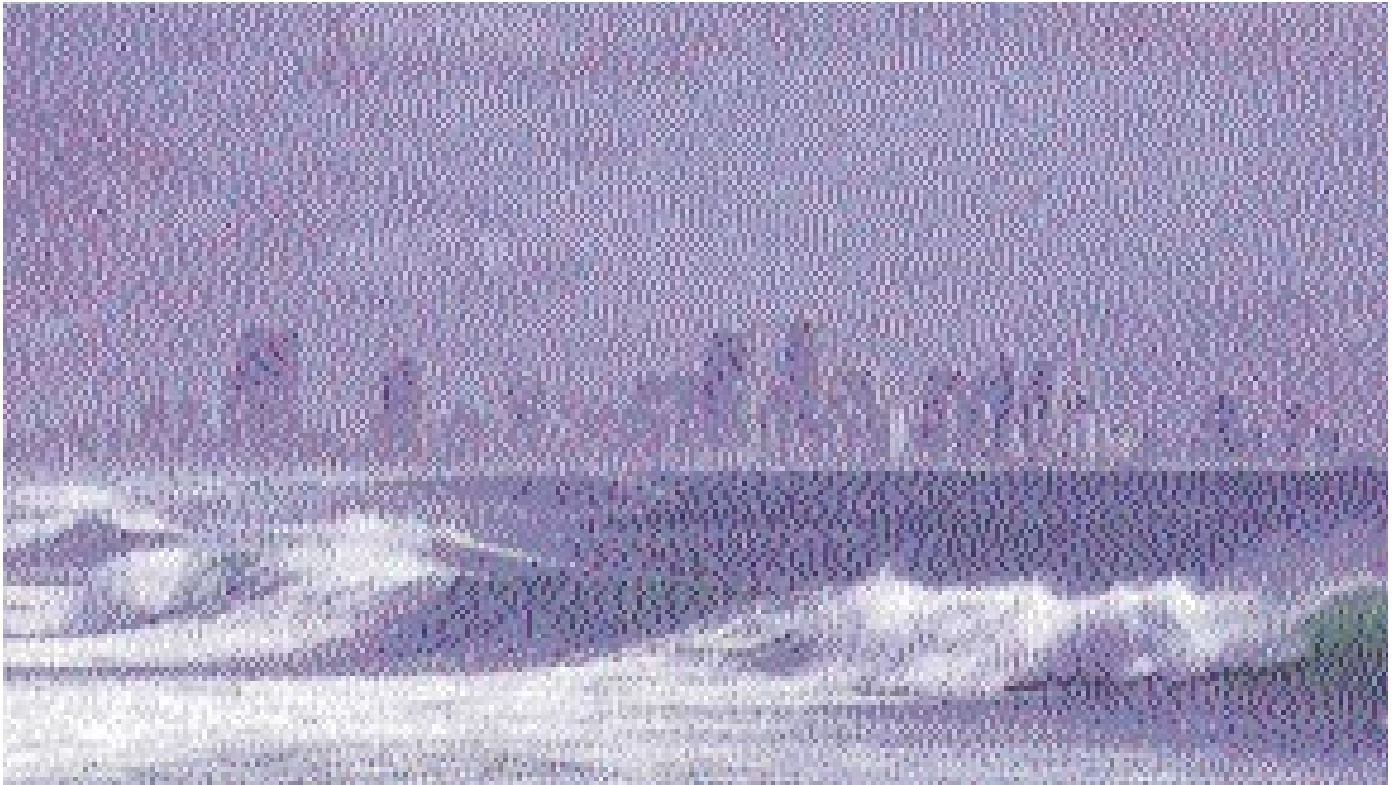# *Towards ecological sustainability*

Prepared by

The State of the Environment Advisory Council

Overall Message

- This is the first ever independent and comprehensive State of the Environment Report for Australia. It links land, water, air, plants and animals, human settlements and how we value them.

- An independent advisory council and seven expert groups prepared the report. It draws on the knowledge and skills of more than 200 eminent scientists and other experts.

- The report shows that Australia has a beautiful, diverse and often unique environment which is a priceless heritage and should be a source of pride to all Australians.

- Some aspects of the Australian environment are in relatively good condition by international standards. In some areas our approach to environmental management has won international recognition.

- In many other areas it is not possible to decide whether our environmental management is adequate. We urgently need better information and understanding, which will require data collection and research.

- The report also shows that Australia has some very serious environmental problems. If we are to achieve our goal of ecological sustainability, these problems need to be dealt with immediately. This will be no small task.

- The problems are the cumulative consequences of population growth and distribution, lifestyles, technologies and demands on natural resources over the last 200 years and more.

- No single government or sector is to blame for these problems. We are all responsible. Changes are needed in government policies and programs, corporate practices and personal behaviour.

- Australians are among the most environmentally aware people in the world. All sections of the community now recognise the need to do more to tackle environmental issues.

- Most of the problems identified in the report do have solutions. The report details many positive and successful initiatives.

- Our actions have been most effective where they have taken a comprehensive and systematic approach, integrating different aspects of the overall problem. By contrast, failures tend to be piecemeal efforts that treat symptoms rather than underlying causes.

- Australia has an international responsibility to protect its rich biological diversity and its unique environmental features such as the Great Barrier Reef and other World Heritage Areas. We also have a national responsibility towards future generations of Australians.

- Australia has a better opportunity than perhaps any other nation to protect its environment and use its natural and heritage resources sustainably. We need to do much more if we are not to lose this opportunity.

- Progress towards ecological sustainability requires recognition that human society is part of the ecological system and integration of ecological thinking into all social and economic planning.

Contents

Introduction

In this chapter the Advisory Council makes its assessment of the findings of the State of the Environment report and of our progress towards ecological sustainability. It has identified the key issues as: the need for an overall systems approach, biodiversity, water issues, land degradation, global climate change, coastal and urban environmental issues and finally social and cultural issues such as the well-being of indigenous Australians and protecting Australia's heritage.

The Council concludes that, despite positive achievements to date, some serious adverse trends need urgent attention.

Principles of ecological sustainability

Our traditional pattern of economic development has been at question since the publication of the reports of the Club of Rome, the Blueprint for Survival and the World Conservation Strategy, which coined the term 'sustainable development'.

Australian governments adopted the principle of Ecologically Sustainable Development, or ESD, as a major national strategy in 1992, following a national consultative process. This defined ESD as a pattern of development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (see the box below).

The National Strategy for Ecologically Sustainable Development

Core objectives

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations

- to provide for equity within and between generations

- to protect biological diversity and maintain essential ecological processes and life-support systems

Guiding principles

- decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations

- where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation

- the global dimensions of environmental impacts of actions and policies should be recognised and considered

- the need to develop a strong, growing and diversified economy, which can enhance the capacity for environmental protection should be recognised

- the need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised

- cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms

- decisions and actions should provide for broad community involvement on issues that affect them.

Source: Council of Australian Governments, 1992.

While all the objectives of the National Strategy are relevant, the key one for this report is the third: to protect biodiversity and maintain essential ecological processes and life-support systems. Of the guiding principles in the National Strategy, the first two are central to this report, which has the function of analysing progress toward the goal of ecological sustainability.

While this is a national state of the environment report, it is also set in a context of our global obligations, recognising the third guiding principle.

What do we need to sustain?

Ecological sustainability requires the sustenance of a healthy and diverse ecosystem on behalf of existing and future generations of humans and other species. To achieve this, we need to sustain biodiversity, ecological integrity, 'natural capital' and social integrity.

Biodiversity

Biodiversity, as introduced in Chapter 4, is the variety of species, populations, habitats and ecosystems. There are sound practical and moral reasons for seeking to maintain biodiversity by measures such as the reservation of representative ecosystems and habitats, the protection of endangered species and populations, and maintaining biodiversity in areas where many human activities take place. Conserving biodiversity allows for further studies to improve understanding of ecosystems and their dynamics. Such protection provides a stockpile of genetic diversity for potential use in agriculture and medicine. This is of economic importance because many of the industries using genetic resources produce high-value commodities. In the USA some 25 per cent of prescriptions are filled with medicines whose active ingredients are extracted or derived from plants. In Europe, Japan, Australia, Canada and the USA, the market value for both prescriptions and over-the-counter medicines based on plants was estimated to be nearly $60 billion in 1995 (ANZECC Task Force on Biological Diversity, 1994). The stockpile of genetic diversity can be a crucial defence against predators or disease. When phylloxera threatened to wipe out the European and Australian wine industries in the nineteenth century, the grapes were restored using phylloxera-resistant root stock from California.

Conserving biodiversity maintains ecosystem productivity and function. It increases the chance of ecosystem stability in the face of climate change and assists the absorption of waste products. Equally importantly, it provides places for rest, recreation and (where appropriate) tourism; we should not underestimate the psychological value to humans of areas which are not exploited for economic gain.

By protecting biodiversity we recognise that we share this planet with countless millions of other species. Many people believe that other life-forms have intrinsic value, whether or not they are perceived to be useful to humans. Even if an

endangered species had no economic value to us, there would still be a feeling in the community that it should be protected. There was, for example, a vigorous debate in the scientific community when it was proposed that the last remaining cultures of the smallpox virus should be destroyed.

The final argument for conserving biodiversity concerns the question of our state of knowledge. Do we have enough information to evaluate which natural resources need to be preserved for the future? In the absence of detailed information on which to base such decisions, it is prudent to err on the side of caution and attempt to retain our existing biodiversity.

Ecological integrity

Ecological integrity refers to the general health and resilience of natural life-support systems and encompasses their ability to assimilate wastes, such as pollution of air, water or soil, through basic natural cycles, such as the water, carbon and nitrogen cycles. It also includes the ability of ecosystems to withstand stresses, such as climate change or depletion of the stratospheric ozone layer. The effects of a growing human population, increasing resource use and consequent waste production have combined to impair the ability of natural ecosystems to provide these free services. The most dramatic examples in Australia in recent times have been large-scale nutrient overloads in waterways, culminating in an outbreak of blue-green algae that extended for 1000 kilometres in the Darling River — the longest outbreak ever, anywhere in the world. The underlying causes of these events are not yet fully understood, but they constitute a clear warning signal.

Maintaining the integrity of ecosystems requires a concerted local, national and international effort to increase energy and resource efficiency, encourage clean technologies and to implement appropriate pollution standards. It also requires, as discussed below, further research to obtain a better understanding of the impacts of human activities on natural systems.

Natural capital

A third consideration for sustainable development is the need to maintain our 'natural capital': the stock of productive soils, fresh water, the marine environment, forests, sub-soil assets and other resources needed for our survival and prosperity. In particular, we need to maintain our renewable resources. They are important indicators of the well-being of a community. They are part of our natural heritage and underpin much of our economic requirements and our cultural heritage. In simple terms, it could be argued that a society should live on the 'ecological interest' provided by the natural capital stock. By this standard, renewable resources would only be harvested at a rate no greater than the rate of natural replenishment.

Given our imperfect understanding of ecosystems, we are obliged to err on the side of caution. This

National environmental accounting

The Australian Bureau of Statistics is preparing a set of 'satellite accounts', which document changes in a range of natural assets such as land, water, forests and fish, as well as accounts associated with wastes and emissions. The satellite accounts, based on guidelines recently developed by the United Nations and other international organisations, will mesh with the conventional national income and production accounts. The complete system of accounts will provide a useful tool for assessing policy options for achieving ecologically sustainable development.

Environmental accounts can link economic information about various sectors and industries to environmental indicators, enabling us to assess the impacts of different patterns of economic growth and technological change on the nation's stock of environmental resources. Some economists believe that environmental accounts can be used to estimate 'green GDP'. The Gross Domestic Product, or GDP, is the sum of the total economic value of all transactions. 'Green GDP' adjusts the sum by including changes in natural resource stocks (depletion) and changes in services provided by the environment. These are dependent on environmental quality (degradation) as well as expenditures on environmental protection programs and projects. We clearly need better ecological, social and economic information if we are to manage our resources and environment in an integrated fashion.

means using renewable resources at a rate no greater than that needed to replenish stocks and using non-renewable resources with great care. It is possible to compensate future generations for losses, by producing other kinds of capital such as 'human capital' and physical capital (buildings, machinery, infrastructure). Such forms of capital are usually reproducible but may not be acceptable as substitutes for natural capital. In many cases, the destruction or degradation of natural capital is irreversible; it may not be possible to restore the environment, however much people are prepared to pay. A cautious approach is also necessary with 'cultural capital', which can be similarly destroyed or irreversibly degraded.

To be confident that our natural capital is wisely managed, we need a system of national accounts that informs us of changes in stocks of natural capital, as well as the flows of goods and services it provides (see the box above).

Social integrity

Sustainability refers not only to the natural environment; it also encompasses the resilience of social and cultural systems. Social and environmental issues are often intertwined. As a result of history and economic pressures, low-income households are often situated in degraded environments, near industrial plants and other hazards. Wealthy families have the economic freedom to move to more desirable environments.

Australia is a unique multicultural society with a distinctive and multi-layered cultural heritage. Preserving that heritage is important, as it helps us understand how we have reached our present position and gives us clues about our future choices. We need to examine our distinctive social

structures to preserve important elements for sustainable development, such as our love of the bush and our traditions of participation and social justice. Where our social structures are inconsistent with ESD, we will need to consider changes.

The overall framework

To achieve ecological sustainability, we need to incorporate ecological principles into our decision-making processes. Some groups in society have benefited more than others from unsustainable practices. The transition to a sustainable society should be managed to redress the extreme imbalances in access to 'environmental goods' between different groups. The sustainable society must incorporate equity within this generation as well as equity between generations. This is an explicit provision of the National Strategy for Ecologically Sustainable Development.

Thus, any development strategy that aims to sustain biodiversity, ecological integrity and the stock of natural capital must recognise the primacy of ecological considerations.

Achieving environmental change

Alleviating the pressures on the environment will require a considered effort to modify human activities. Change in human behaviour can be achieved in a number of ways including: regulation or legal force, economic inducements, and changes in attitudes.

Legislation

All spheres of government have enacted various measures to protect the environment, ranging from planning restrictions at the local level to World Heritage legislation by the Commonwealth. Some aspects of environmental protection are so important that they need to have the force of law.

Economic incentives

Rewards to encourage certain behaviour or penalties to discourage it can induce change. Response measures to environmental concerns may include a lower level of taxation on unleaded petrol or significant fines for polluting waterways. Many people believe that economic incentives are the most efficient means of achieving desired outcomes.

Demonstration projects

Schemes that provide practical examples of cleaner production practices, are proving effective. These can illustrate the benefits to be gained from environmentally-sensitive cleaner production and from careful 'eco-design' of products.

Attitudinal change

Finally, change can occur as a result of alterations in social attitudes; for example, the increasing volume of material being offered for recycling by Australian householders, without any regulatory provisions or economic inducements. When community attitudes support change, strong legal measures are easier to enforce, and governments have more incentive to offer financial support. On the other hand, incentives or sanctions may be ineffective if there is community opposition to change.

Accurate information

Providing accurate information about the state of the environment to the community can alter attitudes, both by dispelling groundless fears and by alerting people to previously unsuspected problems. A central aim of this report is to provide the most accurate picture possible of the state of the environment in 1995 and to direct community attention toward the most serious problems affecting our natural and cultural environments.

Global environmental context

We now recognise that we are a part of a global ecosystem and an integrated global economy. This poses a new set of questions for the sustainability of development. Local environmental effects associated with productive activity do not necessarily stop at national boundaries. This became apparent with the issue of acid rain. Canadian emissions from the Sudbury smelter affected the north-eastern United States, while emissions from United States' mid-western cities drifted into Canada. The patchwork of small nations in western Europe has become criss-crossed by plumes of emissions, defying any possibility of national sovereignty over pollution. The depletion of the stratospheric ozone layer, changes to the atmosphere and depletion of the world's marine resources are now seen as problems of global scope, demanding the attention of all nations.

Reaction to the depletion of the ozone layer clearly demonstrates an international ability to take concerted action when the threat is proven. The science showing that release of chlorofluorocarbons (CFCs) could deplete the ozone layer was published in 1974. But political will to tackle the problem was blunted by the suggestion that the science was uncertain. Little then occurred until 1987, when the 'hole' in the ozone layer was definitively shown to have been caused by CFCs. After measurement of the dramatic drop in ozone levels near the South Pole, the response was rapid and we now have international agreement to phase out the release of CFCs and other chemicals that cause depletion of the ozone layer. Australia played a leading role in these negotiations.

Global climate change is a much more difficult problem. CFCs have substitutes, so there need not necessarily be a conflict between the goals of economic development and environmental protection. Global climate change is predominantly caused by the use of fossil hydrocarbon fuels. No cheap substitutes exist for oil, gas and coal, so maintaining the quality of the global environment seems likely to be at some short-term economic cost.

It is certain that a natural greenhouse effect keeps Earth warmer than it would otherwise be. It is also certain that human activities are increasing the amounts of greenhouse gases in the atmosphere. The Inter-governmental Panel on Climate Change (IPCC) has now concluded that these increases are enhancing the greenhouse effect, resulting in an additional warming of Earth's surface.

It is calculated with confidence that carbon dioxide emissions are responsible for about 60 per cent of the enhanced greenhouse effect, and that overall emissions would need to be reduced below the current level to stabilise the composition of the global atmosphere. The IPCC believes that stabilisation, even at double the present level of carbon dioxide, will be very difficult to achieve, as it will require an overall reduction in the emissions resulting from human activity. The IPCC has reached similar conclusions about other key greenhouse gases, methane and nitrous oxide — in each case, stabilisation of the atmospheric concentration at today's levels would require reductions in emissions from human activity. The trends are not hopeful at this time, with global emissions still increasing.

This raises the issue of the standard of proof required before taking action. Traditionally, environmental damage has been expected to meet the criterion used in criminal law of 'guilty beyond all reasonable doubt' before action is taken. In the case of depletion of atmospheric ozone, for example, concerted international action only began when the ozone 'hole' was detected. Many people are now arguing that we should apply the principle used in civil law of the 'balance of probabilities'. This would justify taking action much sooner. The United Nations Framework Convention on Climate Change and the National Greenhouse Response Strategy are based on the 'precautionary principle': the idea that lack of full scientific certainty should not delay our response if the consequences of delay might be serious or irreversible.

Various other signs indicate global environmental stress. The Worldwatch Institute argues that the health of bird species is an indicator of the state of the global atmosphere, in the same way that canaries once indicated unsatisfactory air quality in mines. Of the world's estimated 9600 bird species, only 3000 are stable or increasing in population; the other 6600 are in decline, vulnerable or threatened with extinction. One obvious cause is the loss of habitat such as wetlands. In the United States, for example, the area of wetlands has halved in recent years, leading to inevitable decline of species which rely on those areas. Frog populations appear to be declining in all parts of the world, though nobody can say why with any certainty (Tyler, 1994). Coral reefs appear to be in trouble around the world, threatened by run-off from urban areas as well as other pressures.

Serious concerns also exist at the global level about biodiversity. Estimates suggest that humans use, directly or indirectly, 35–40 per cent of terrestrial

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The health of bird species and the state of coral reefs can provide an indication of the state of the global environment.

production of biomass (Vitousek *et al.*, 1986). The new estimate of the sustainability of fisheries argues that the current fish catch accounts for 24–35 per cent of the aquatic production in fresh water, upwelling and shelf systems (Pauly and Christensen, 1995). Thus, on land and on sea, we consume a large part of the total available photosynthetic product.

Key indicators of food production per head are falling at the global level (Worldwatch Institute, 1994 and 1995), leading to obvious concerns about the sustainability of the current level of population growth. Production of beef and mutton per head peaked in 1972 and has declined 13 per cent since, grain per head peaked in 1984 and has fallen 12 per cent, while seafood per head reached a peak in 1988 and has dropped nine per cent since then. Each year the human population increases by about 90 million. At a global level, farming and fishing are losing the battle to expand food production at the same rate as the population.

The Brundtland Commission concluded that two principal pressures are being exerted on the natural environment: population growth and associated poverty in the Third World, and unsustainable patterns of consumption in the industrialised world. Continuation of current trends will lead to inevitable difficulties, if not absolute limits.

The global economy

The recent liberalisation of Australian investment regulations and lowering of international trade barriers have stimulated areas of productive activity in which Australia has a comparative advantage.

The United States economist Michael Porter has refined the traditional theory of comparative advantage by arguing that those countries, and those companies, that show leadership in the move toward sustainable development will reap economic benefits as well as having reduced environmental impacts (Porter and van der Linde, 1995). Using the principle of sustainable development to guide the future search for comparative advantage is thus likely to benefit individual companies, and the economy as well as the environment.

In 1994, when the Australian government canvassed the possibility of discouraging use of fossil fuels by a modest carbon levy, opponents feared that it would reduce economic competitiveness. Little serious attempt was made to canvass the possible economic benefits that could be gained by improving our competitiveness in other areas of growing importance such as improved efficiency and renewable energy technologies. Several countries have now introduced carbon taxes. One argument used to support them is that they will encourage the development of greenhouse gas abatement technology.

We need to develop a framework that responds to both global and local agendas on the environment and the economy.

Australian context: constraints and driving forces

Australia's natural environment is a product of its geological history and the manifold impacts of human activity. Most of its physical features reflect the geological past of Australia as a very old, heavily weathered and extensively eroded landscape. As discussed below, variations in climate, especially rainfall, are part of the natural environment.

The long period of physical isolation from other land masses has resulted in a unique set of biota, with a large proportion of Australian flora and fauna found nowhere else on the planet. This rich endowment carries with it a heavy responsibility to ensure that our biological heritage is conserved, not just for future generations of Australians but for all people. As discussed earlier in this chapter, that biological heritage is an important economic resource, as well as an important source of resilience in the face of change.

Human population

The Australian cultural landscape is an important part of our heritage. For at least 50 000 years, people have lived here and modified the land by their actions. Since 1788, the impact of the human population has increased dramatically, both because of the rapid growth in the size of the population and because of land use practices such as agriculture, mining and the establishment of urban areas. Australia is one of the most urbanised of all nations, with the vast majority of people living in a few cities. This concentration of population leads to heavy localised environmental pressures. As discussed in Chapter 3, however, population levels do not relate simply to environmental impact; some of the most serious environmental deterioration noted in this report is in lightly populated agricultural areas.

Australia has a relatively high rate of population growth by the standard of OECD countries, although it declined slightly from 1.2 per cent in 1991–92 to 1.1 per cent in 1993–94. This decline was due to a reduction in the level of immigration. The 'natural increase', the difference between births and deaths, has been consistent in recent years at 0.8 per cent per annum, while the net inward migration has declined from 0.5 per cent to 0.2 per cent per annum. Inward migration has had a significant effect on the population level because of the high level of intake maintained for almost 50 years. At the 1991 census, almost four million of the 17.3 million people in this country had been born overseas, mainly in Europe.

In 1995, the population passed 18 million, and demographic analysis by the Australian Bureau of Statistics revealed a rate of increase of about 200 000 per year. On that trend, Australia will have another million people by the year 2000. The growth is unevenly distributed, concentrating in Queensland, Western Australia and New South Wales. Although other States have lower rates of population increase, all are still growing. The ABS forecasts that the population will not stabilise before the year 2030, on current trends.

The cultural heritage of Australia is diverse and multi-layered, reflecting cumulative impacts over thousands of years, with increasing pressure on the natural world in recent times. The heritage of Aboriginal and Torres Strait Islander people is particularly distinctive and significant because of the close relationship between the people, their culture and the natural world. This relationship was severely disrupted by the arrival of European settlers, but there is now increasing recognition of its value and the respect it warrants. The Aboriginal and Torres Strait Islander people now own or control 15 per cent of the land mass of Australia. For this reason alone, it is crucially important that they are actively involved in land management decisions in Australia and in managing their heritage.

The 1994 Report of the House of Representatives Standing Committee for Long Term Strategies pointed to the need to evaluate the 'carrying capacity' of Australia for a range of assumptions about lifestyle.

Pattern of human activity
Human settlements

Two unusual features of Australia's population distribution affect its impact on the natural environment. The first is the concentration of

population in the coastal zone, especially along the south-eastern and eastern coast-lines. The second is the concentration of population in a small number of urban centres. At the time of the 1991 census, more than 85 per cent of the population was located in urban areas; indeed, more than 60 per cent of the entire population is contained in the five large cities of Sydney, Melbourne, Brisbane, Adelaide and Perth.

Many inland communities are declining in population as settlement drifts toward the coast. This pattern of changing population distribution is straining the natural and cultural environments of the coastal zone as well as the cultural environment of inland Australia.

The more recent settlements are described as having very high 'metabolic flows'. In other words, they use large quantities of resources and produce large amounts of waste compared with the natural world and other advanced industrial nations. These metabolic flows per person have been increasing in recent years, compounding the heavy burdens imposed already on local environments.

Australian urban areas provide a comfortable living environment by international standards, and measure up well on indicators of 'livability'. However, one negative aspect of our towns and cities is that significant environmental problems are arising from the burden of waste products on natural systems. Another is that the loss of heritage places is reducing the 'livability' of our urban settlements by eroding our sense of place.

Lifestyles

A second major pressure on natural systems is the changing lifestyle expectations of the community. In Australian cities of 40 years ago most workers commuted relatively short distances by public transport. Emissions of fuel combustion products are much greater in our cities now, with people commuting long distances by car. Compared with an era of more food self-sufficiency when many households grew their own vegetables, modern centralised food production requires more fuel energy for production, processing and transport of food.

Changing patterns of domestic life impose new pressures. The size of the average household has contracted dramatically in recent years, so that half of all households now consist of one or two people, and two-thirds consist of three or fewer. That means that more housing is needed per head of population. It also means that people are more likely to travel to visit relatives, rather than living with them under the same roof.

Technological change

The third factor affecting human impact on the natural world is technology. Transport is one example. The move from public transport to the private car has increased fuel emissions significantly, as the fuel efficiency of our car fleet is about half that of public transport.

The fuel efficiency of vehicles has changed over time. Between 1960 and 1975, the average fuel

Aboriginal and Torres Strait Islander people now own or control 15 per cent of the land mass of Australia. It is important that they are actively involved in land management decisions and in managing their heritage.

efficiency of cars fell by about 25 per cent as they steadily became larger, more powerful and more extensively equipped with such accessories as air conditioning, automatic transmission and power steering. Between 1975 and 1987, technological improvement recovered the ground lost in the previous 15 years, returning the average fuel efficiency of the car fleet to the 1960 level. Further improvement has continued to result from changing patterns of consumer demand, though there are no specific regulations to encourage this process.

The average fuel efficiency of the Australian car fleet is poor by international standards. A significant factor is the average age of Australian cars. The improvements of recent years mean that new cars are generally more efficient than similar models which are ten years old. Australia has, by international standards, a very old fleet of private cars.

Economic activities and land use

Economic activities and changes in our approach to economic management create another set of pressures. Australia has a resource-intensive economy, with a strong export emphasis on minerals and agricultural produce. Expanding primary production will impose additional pressures on natural systems unless current practices are changed. Using fewer resources per unit of economic output could help make the Australian economy more sustainable.

The shape of our economy is determined partly by natural factors which give Australia a comparative advantage in various activities, and partly by a series of policy decisions that encourage those activities. For example, mineral royalties that are low by international standards encourage extraction — until recently, gold mining was exempted from taxation to stimulate that activity. In the area of research support, the traditional emphasis on primary industries has been of great assistance to their continuing competitiveness. Other examples are the pricing of irrigation water below the real cost of supply — the community provides a subsidy to water use for agriculture; and the provision of incentives to farmers to clear land.

Human uses of forests affect the habitats and population sizes of some native species as well as increasing the risk of invasion by exotic species. A recent government report showed that more than 20 per cent of natural land cover in Australia has been cleared for agriculture and grazing in the period since European settlement, representing a significant loss of natural habitat (Graetz *et al.*, 1995). The clearing of land for agricultural purposes still continues in various parts of Australia, setting in train a complex set of changes to the land including erosion, loss of soil structure and alterations to soil chemistry. As discussed in Chapter 6, similar comments can be made about some cultivation practices.

Land clearance leads to loss of biodiversity and additional pressure on natural systems. It may alter the pattern of water flow by causing erosion, by raising the local water table or by increasing salinisation. Salinity problems can arise from other practices associated with agriculture, most obviously the diversion of the flow of natural watercourses, as discussed in Chapter 7.

Chapter 6 lists the factors currently affecting our land resources. Australia feeds the equivalent of about 50 million extra people through our cereal production, produces twice as much meat as we consume and our grazing lands yield a third of the entire world wool production. So the effective population pressure on our land resources is much greater than that associated with the number of inhabitants, which are relatively few by world standards.

The Australian landscape is itself an economic asset of great worth. The recent rapid growth of international tourism here is a direct reflection of the interest of other people in our natural and cultural heritage. The growth in tourist numbers puts considerable pressure on the natural environment. As the recent government report *Living on the Coast* put it, there is a real danger that this pressure will degrade the asset so that it will be less valuable, in economic as well as ecological terms. Tourism also has potential negative impacts on our cultural heritage, as discussed in Chapter 9.

The ecological impact of mining operations causes public concern. Modern mining practice is much improved, to the point where the Australian subsidiary of the Alcoa company was entered on the United Nations Environment Program's Global 500 Roll of Honour for its rehabilitation of land mined for bauxite. The most serious conflicts now occur where proposed mining ventures are located on sites of significant habitat, high biodiversity or special cultural significance.

Widespread agriculture and the nature of past practices have measurably changed the flow regimes of watercourses, while coastal development has altered estuaries and the marine environment. These examples show that analysis of variability and change must go beyond natural variations to include changes effected by human agents.

Many of these human activities lead to high average levels of consumption of fuel resources:

annual per head domestic use amounts to five tonnes of black coal, 2.5 tonnes of brown coal, 1000 litres of petrol and 600 litres of diesel fuel (ABS, 1995).

The nature of the changes to natural systems are in turn influenced by our social institutions. At the local level, the High Court of Australia in its 1992 'Mabo decision' rejected the doctrine of '*Terra Nullius*' (that Australia belonged to no one at the time of European settlement) and held that a form of native title rights and interests survived European settlement (but are subject to the sovereignity of the Crown). This is likely to alter the pattern of land holdings, and may in turn change land use and impact on the natural world. These changes may be beneficial, or may have mixed effects.

Thus, this report can analyse the impacts of current human activities, but those impacts will alter as the scale of population and the balance of activities change.

Problems of predicting environmental impacts

The Australian landscape is characterised by variation and change. The natural variability of the weather limits our capacity to predict the impacts of human actions. In South Australia in the late 19th century, for example, a run of unusually wet seasons led to the view that 'rain follows the plough'. We now know that is not true. Climate variability has been a constant problem for people in Australia, as it causes natural fluctuations in vegetation and fauna. Rural Australians recognise the poetic description of the country as one of 'droughts and flooding rains'.

It is not the poor soils of this continent or the variability of our climate that put pressure on our land resources, but human activities that fail to take sufficient account of those characteristics. Land use planning should recognise both the historic natural variability of rainfall and the anticipated effects of global climate change, which is likely to accentuate the variability of the climate. It must also take account of the possible reduction in biodiversity, as the loss of any species can affect natural cycles and so alter the pressure of existing activities on land resources.

Our understanding of the link between the El Niño Southern Oscillation and the Australian climate is improving. Detailed time-series data on grain production in Queensland, for example, show the influence of El Niño events on agricultural productivity. There is concern that the recent run of El Niño events may represent a trend rather than a random fluctuation in the climate pattern. Scientific knowledge does not yet allow us to say whether we are seeing a minor fluctuation or a significant change to the long-term trend.

Examples such as the decline in seagrass and the increase in algal blooms illustrate how difficult it is to assess human impact on the natural world. The time scale of responses to our actions is often

long, measured in decades or centuries rather than years. The complex process of changing natural systems often defies simple analysis by cause and effect. It is rarely possible to refine our knowledge by controlled experiments. Environmental impact statements have a very poor record of predicting in advance the effects of human activity (Buckley, 1989).

This report contains many examples of known changes to complex ecosystems which cannot be attributed to a particular cause. In other instances, we know the cause, but have difficulty reversing an observed trend. Removal of vegetation in the Mallee has led to rising groundwater, and irrigation in the Murray–Darling Basin has led to increasing soil salinity. In both cases, it will take decades, possibly centuries, to restore the natural systems.

For the first time in our existence as a species, the size of the human population and its level of resource use has become a significant force for environmental change. At a global level, the scale of release of the chlorofluorocarbons and other compounds has measurably depleted the ozone layer which protects the natural systems from the sun's ultra-violet light. The widespread use of carbon fuels (coal, oil and gas) has changed the composition of the atmosphere so much that atmospheric scientists are confident we face inevitable changes to the climate.

Societal responses

The community undoubtedly believes that more attention should be paid to environmental issues. A 1994 survey by the Australian Bureau of Statistics found that 18 per cent rank environmental protection above economic growth, while 71 per cent believe the two are equally important — little different to the 70 per cent recorded in 1992. The ABS also found that community concern for the environment has increased 22 per cent over the last eight years (see Fig. 10.1). The 1992 survey was conducted at the time of the Earth Summit in Rio, which heightened community environmental awareness.

In recent years, all levels of government have begun to promote integrated approaches to environmental problems: cleaner production practices, recycling schemes, up-graded sewerage systems and improvements to water quality. Responses to environmental problems are by no means restricted to government. Community groups, for example, are involved in repairing degraded areas. Of added significance is the recent evidence that some corporations and employer representative bodies are accepting their environmental responsibilities. The private sector employs the majority of Australian workers, as well as using most of the resources and raw materials that flow through the economy. We are beginning to see the use of environmental auditing, more sustainable production methods and business plans that recognise environmental constraints (see Figs 10.2 and 10.3). The private sector still needs to do a lot more before it is seen to have accepted its full responsibility in the move toward sustainable development.

Figure 10.1 Community attitude to the environment

Environmental concern (percent of population)
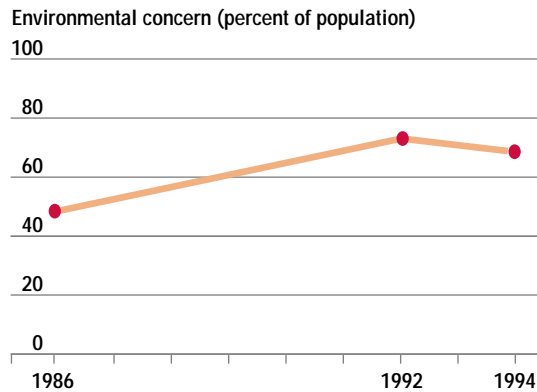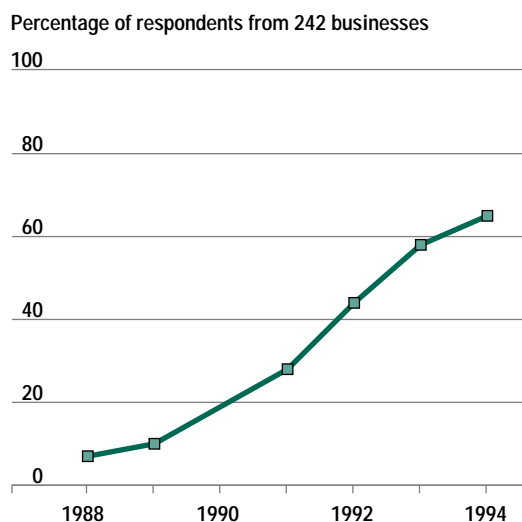
Source: ABS, 1986 and 1995.

Figure 10.2 Indications that environmental management is a key business issue

Percentage of respondents from 242 businesses
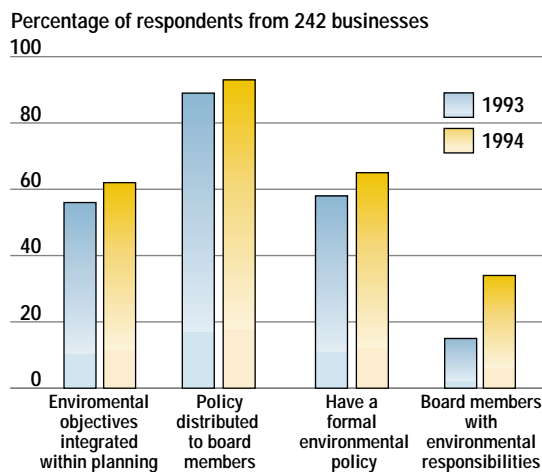
Source: Coopers and Lybrand Consultants, 1994.

Figure 10.3 Businesses with environmental policies

Percentage of respondents from 242 businesses

Source: Coopers and Lybrand Consultants, 1994.

Figure 10.4 Decision making framework for ecological sustainability
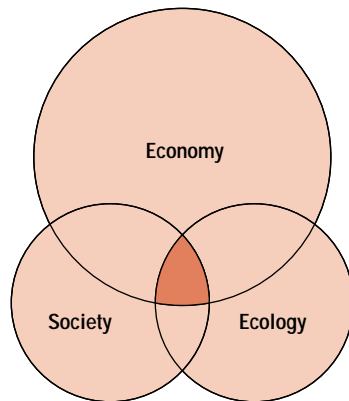
A. The predominant model of decision making in Australia until the 1980s. It gives primacy to economic decisions and assumes that environmental problems can always be solved if the economy is sound.
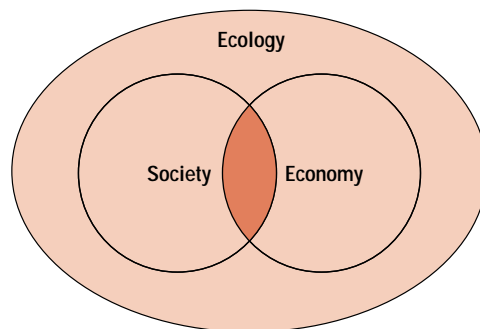
B. This model of decision making is a variant of the previous one. Use of this model began in the 1980s. It characterises the piecemeal approach towards ESD.
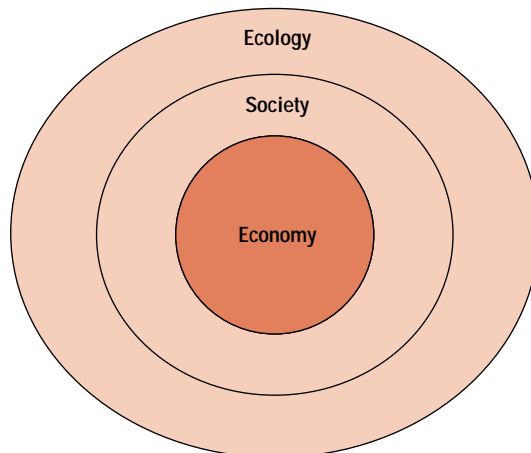
C. This is the decision making model needed for an ecologically sustainable future for Australia. It recognises that the economy is a sub-set of society, since many important aspects of society do not involve economic activity. Similarly, human society is totally constrained by the natural ecology of our planet. It requires integration of ecological thinking into all social and economic planning.

Source: Adapted from Lowe, 1994.

We base much of our decision making on the implicit premise that the prime consideration is economic and that environmental problems can always be solved if the economy is sound. Thus it is common to use a mental model like Fig. 10.4A, and the sort of model depicted by Fig. 10.4B is seen as a progressive variant. The only basis for sensible long-term decisions is the model shown in Fig. 10.4C. It recognises that the economy is a sub-set of society, since many important aspects of society do not involve economic activity. Similarly, the natural ecology of this planet totally encloses human society. Daly has made the same point, arguing that most poor planning arises from the palpably false premise that the ecology is part of the economy rather than vice versa (Daly, 1992).

Institutional arrangements

Historically, problems in our government systems, which have tended to use waterways as boundaries, have hindered rational management of catchments and marine ecosystems. This means that each complex ecosystem is managed as a series of isolated sectors, rather than as an integrated whole. A concern for integrated management of catchments has led to re-examination of the structural impediments to that approach. Some catchment management authorities have been formed, although so far without the power to prevent inappropriate patterns of development.

Concern is felt about the loss of biodiversity — caused mainly by the destruction of habitat — within our aquatic systems. The Murray–Darling Ministerial Council has just made a decision of great historic significance. It has agreed to place an upper limit on the extraction of water from our largest river system. This is a positive step in overcoming structural impediments to the management of complex ecological systems spanning jurisdictional boundaries.

Catchments are an extreme case of a general problem arising from the structure of government in Australia. As a federation of six States and two main Territories, Australia has so far shown little determination to take unified action on environmental issues. Many important decisions are the province of State governments, some of which have environmental protection low on their list of priorities. When one State takes a position of leadership on environmental issues, as South Australia has with container deposit legislation to reduce packaging waste, other States may see their own lower standards as offering a competitive advantage. Even common efficiency standards for electrical appliances have been delayed to allow for consensus between the Commonwealth and the States.

Impediments to concerted action also occur within each level of government. Resource development agencies and industry tend to press for economic development, leaving agencies charged with environmental protection to affect some compromise at the bureaucratic level. Thus the intentions of the National Strategy for Ecologically Sustainable Development are insufficiently translated into overall coordinated policies.

Key issues

The Advisory Council has identified the key issues arising from this report as: the need for an overall systems approach, biodiversity, land degradation, global climate change, water issues, coastal and urban environmental issues and finally social and cultural issues such as the well-being of indigenous Australians and protecting Australia's heritage.

Systems approach

The problems of catchment management provide a concrete example of the need for an integrated approach to management. Without that perspective, well-intentioned policies may inadvertently make the situation worse. Policy responses must consider the overall picture at the level of catchments and biophysical regions and have a cross-sectoral approach.

Similarly, agricultural advice needs to be based on a systems approach, rather than being directed to measures of short-term agricultural production. Some tillage practices have been associated with various forms of land degradation such as erosion, soil compaction and decline of soil structure. Growing awareness of these problems has led to improved management of agricultural land, but not universally. Integrated pest management appears to have better prospects of sustainable yields than a reliance on chemicals alone to defeat insect pests and weeds. In irrigated areas, unsustainable levels of water extraction threaten the health of riverine ecosystems, especially in seasons that are drier than average. A high priority for rational management is to improve understanding of both natural variability and the sustainability of different patterns of water allocation.

The problems of river systems literally flow on to estuaries and the ocean. If a river is heavily loaded with nutrients and sediments, it increases the burdens of sediments and nutrients in the sea. Estuaries tend to trap and accumulate pollutants. Thus the failure to address nutrient levels in run-off from agricultural areas or hydrocarbon waste in run-off from urban areas can reduce the capacity of an estuary to produce young fish and so reduce the productivity of a fishery.

These examples illustrate a general principle: the need for an approach that incorporates the complexity of natural systems as well as integrating natural and cultural environments. A coherent policy is unlikely to emerge from a compartmentalised approach where different government agencies and different levels of government all act separately.

Habitat loss and biodiversity

We have a rich and unique biota, with an unusually high proportion of local species found nowhere else on earth. Australia has accepted the responsibility of conserving its biological heritage for future generations. Through its ratification of the Convention on Biological Diversity and the development of the National Strategy for the Conservation of Australia's Biological Diversity, the

Australia has a rich and unique biota, with an unusually high proportion of local species found nowhere else on earth.

Australian government is commited to preserving our biodiversity through *in situ* conservation measures and the sustainable management of natural systems.

This report identifies four key issues affecting biodiversity: clearing of vegetation, especially sub-tropical woodland; loss of native forests; threats to individual species (especially from feral animals and other introduced species); and the absence from the reserve system of representative ecosystems. The biodiversity of marine ecosystems is also threatened by the degradation and destruction of coastal habitat. Underlying all these issues is our limited knowledge of the diverse biota of Australia.

Clearing of vegetation

The most serious pressure on biodiversity is loss of habitat. Clearing of vegetation removes trees and other plant species directly, but also disrupts the web of life. It removes the food of herbivores, which are in turn the prey of carnivores. It removes sites for nesting and breeding. By exposing the soil to sun, wind and rain, it sets in train erosion and loss of topsoil, as well as changing the local micro-climate and thus influencing its acceptability as a habitat. It can also change the pattern of run-off after rain and so affect the water table; in one example quoted in Chapter 4, clearing of vegetation has caused saline groundwater to rise by more than 20 metres.

Clearance of native vegetation is the single greatest threat to terrestrial biodiversity. Clearing began with the establishment of agricultural enterprises such as cropping and grazing. Further losses have resulted from over-grazing, salinisation or changes in the availability of water. Chapter 2 refers to the 'development ethos' which led to the clearing of considerable areas of land. To some extent, this ethos is still influential.

In Queensland and Western Australia, leases often specifically require that land be cleared. Clearing is still going on in Queensland at the rate of about half a million hectares per year. In 1994 alone,

permits were granted for the clearing of almost 1.1 million hectares, of which only about 0.4 million hectares was re-growth or woody weeds. These permits will remain valid for five years.

Experts advise that the scale of land clearing is causing serious loss of biodiversity as well as other effects such as increased emission of greenhouse gases. The issue is of such public concern that the Queensland government in 1995 announced its intention to introduce guidelines similar to those operating in South Australia, Western Australia, Victoria and New South Wales. Such guidelines effectively subject agriculture to the same sort of environmental restrictions as those routinely applied to other areas of economic activity.

Statistics from South Australia indicate that land clearing controls have protected significant areas of native vegetation that would otherwise have been lost.

Finally, bushland is being cleared on the fringe of major settlements as a result of urban spread. Clearing of sclerophyll forest in the south-east Queensland region is an inevitable consequence of a level of population growth greater than can be accommodated by the re-urbanisation discussed in Chapter 3. It represents the loss of the habitat of various plants and animals, including one which is almost a cultural icon in Australia: the koala.

The spread of suburbs, hobby farms and rural coastal development exerts related pressures on biodiversity. Scattered development into bushland clears habitat directly, but it also increases the problems of weeds and feral animals at the edges of the remaining uncleared bush. While there is a continuing debate about the degree of impact of feral cats on native animals, there is no dispute that cats are a significant problem. The pattern of development can also alter the fire regime, putting wildlife at greater risk (Flannery, 1995). The noise of human activity, especially the motor vehicles that make such scattered development possible, tends to drive away mammals.

Native forests

About 40 per cent of Australia's forests have been cleared in the 200 years since European settlers arrived, with another 35 per cent affected by logging. Political pressure is increasing to preserve as much as possible of the remaining 25 per cent of original forest as well as some areas affected by logging. Significant areas of forest are in reserves, national parks or World Heritage Areas, including a large fraction of our remaining tropical rainforest. However, even tropical rainforest is still being cleared for agriculture, tourism and housing.

The 1992 inquiry into the forest and timber industry by the Resource Assessment Commission (RAC) examined the options for 'old-growth' forests — forest that has never been logged. The RAC concluded that only about 14 per cent of all the unlogged forest is in conservation reserves, but this overall figure conceals a wide range of figures for different types of forests. Some 64 per cent of mangrove and swamp forests are in reserves, compared with only five per cent for south-eastern dry forests and woodland (RAC, 1992). These disparities strongly suggest that the reserve system is mainly protecting the resources that are not commercially significant. The Australian government recommended as a target in 1995 that the secure reserves should contain at least 15 per cent of the pre-European area of each forest type, with the aim of preserving the biodiversity in forest ecosystems.

The Regional Forest Agreement process initiated by the government in 1995 will assess the extent of old-growth forests and seek to place in a national reserve system at least 60 per cent of all existing old-growth area, including at least 90 per cent of rare types of old-growth forest. In December 1995 the Commonwealth established Deferred Forest Areas with the stated intention of protecting potentially important forests and reserves while comprehensive regional assessments are completed.

The RAC concluded that clearing of old-growth forests was potentially a violation of the precautionary principle in that an irreplaceable resource would be destroyed. The National Biodiversity Council and other authoritative bodies can see no justification for any further clearing of such forest remnants.

Proper management of old-growth forests is difficult to achieve. It takes many decades or centuries to recreate an old-growth stand. A policy of total preservation is not sufficient to maintain old-growth forests into the future. They are but one part of a cycle of renewal and ageing in native forests. Old-growth stands will inevitably be lost through wildfires and thus we need to ensure that there is a pool of maturing forests ready to replace them.

As the issue of logging in native forests arouses great passion, the Advisory Council had hoped to be able to use the State of the Forests Report to reach some conclusions on the sustainability of current operations, but that report has been delayed by difficulties in obtaining data from some States. This is an example of the problem discussed earlier — institutional arrangements constituting an obstacle to sustainable management of natural systems. Some States continue to subsidise logging operations that are not economically viable (see for example NSW Public Accounts Comittee, 1990) and have been reluctant to provide data that would allow outside scrutiny of their management of the forest resource.

Loss of species

As already mentioned, the most serious pressures on biodiversity arise from the large-scale modification of habitat, particularly the removal of vegetation for urban development, agriculture and forestry. The rate of loss arising from these pressures is dangerously high. Chapter 4 reveals that five per cent of higher plants, seven per cent of reptiles, nine per cent of birds, nine per cent of fresh-water fish, 16 per cent of amphibians and 23 per cent of mammals are extinct, endangered or vulnerable.

It is not only the group of species listed as endangered or vulnerable that are affected. This is the visible peak of the pyramid, but equally serious problems result at lower levels. For example, Table 4.11 shows that 0.5 per cent of fresh-water fish species are extinct, 4.1 per cent endangered and 3.7 per cent vulnerable, making a total of about nine per cent in these categories of very serious threat. However, a further nine per cent of species are poorly known and 17 per cent rare, making a total of one-third of all known species to be a cause for concern. This report contains a comprehensive list of species that are extinct or under varying degrees of threat (see Appendix 2).

The process is rarely a simple one, although examples occur where targeted human intervention has endangered or removed a particular species, as with the cutting of red cedar or the hunting of large whales. More often, a sequence of changes results from an action such as land clearing.

A lack of diversity in small populations can lead to increased susceptibility to disease or other threats. Removal of nutrients by activities such as timber harvesting may threaten the overall health of the ecosystem, although not enough data on re-growth forests are available to say whether current logging operations are having that effect. Clearing of trees and other vegetation leads to changes in rainfall interception and evapotranspiration, with subsequent impacts on the soil and the water table.

Introduced species have significantly disrupted local ecosystems. As discussed in Chapter 6, the introduction of exotic species continues, even though we understand the consequent problems better. Between 1947 and 1985, more than 450 exotic grasses and legumes were introduced into northern Australia; only four of these species turned out to be useful without also causing weed problems. Feral cats are a major problem right across the continent. At least 18 exotic mammals have established wild populations in Australia, including rabbits, foxes, dogs, pigs, water buffalo, donkeys, goats and horses. They exert a pressure on biodiversity by eating native fauna and flora, as well as competing with native species for habitat. European carp degrade inland aquatic environments and some introduced marine species are adversely affecting marine habitats. Foxes have been blamed for the decline, and possibly the extinction, of several native animals. The recent, unplanned release of rabbit calicivirus has exposed a range of issues demonstrating both the complexity of ecological systems and the difficulty of understanding the many consequences of changing the abundance or health of one species within a system.

There are inspiring examples of success in reversing the decline in biodiversity. The recovery of the Lord Howe Island woodhen was achieved by a management plan developed after detailed ecological study. On the other hand, the recovery plan for the Western swamp tortoise is a classic example of treating the symptoms of decline rather than the cause. However much effort is put into

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More than 20 per cent of Australia's natural land cover has been removed by clearing for agriculture since European settlement.

restoring the species, the plan is unlikely to succeed if the habitat continues to be depleted.

This example shows why protection of biodiversity must be part of the overall management of the ecological system. Chapter 4 discusses a variety of economic instruments that could be used to conserve biodiversity.

Lack of representative ecosystems in reserves

The reserve system has generally evolved through a series of ad hoc decisions to acquire parcels of land. Until recently there has been no strategic effort to ensure that all major biological communities are represented in protected areas. On the contrary, the tendency has been for land of marginal commercial value to be set aside as reserves. This issue was canvassed for the particular case of native forests on page 10-14.

Ecosystems most in danger of being displaced by crops or pastures often receive no protection; reserves occur where there are fewest competing claims on the land concerned rather than where the threats are greatest. Thus, they tend to be established on Crown land, which is often land that has not been released for other uses because it is too steep or too poorly drained.

The lack of a systematic approach means that the reserve system does not usually represent essential natural features, such as species or ecosystems. Inevitably some will be well represented and others overlooked. Priority in extending the reserve system should be the full representation of all major ecological communities.

We still have the opportunity to balance the conservation of biodiversity with social and economic objectives. The primary mechanism for ensuring that the loss of biodiversity is reduced and finally halted is the comprehensive implementation of the National Strategy for the Conservation of Australia's Biological Diversity and the National Strategy for the Conservation of Australian Species and Ecological Communities Threatened with Extinction.

Land degradation*

Land degradation is a complex issue and aspects of it are also discussed elsewhere in this report. Evaluation of the extent of degradation needs to take account of the intensity of land occupancy. The following criteria were used to assess land degradation:

• Roughly half the continental land cover retains essentially pre-European vegetation, but with numerous instances of genetic loss and physical erosion. These regions have been assessed relative to their pre-European ecological condition.

• Some 40 per cent of lands have been profoundly changed by complete clearing or thinning of native vegetation for agricultural and pastoral use. These lands have been evaluated relative to conditions required for optimal productivity under current systems of crop and livestock production.

• Five per cent of land is still forested, with multi-purpose values, including forest products, conservation and hydrology. This land was assessed against criteria framed to ensure retention and sustained future use.

Issue	Pressure	State	Response
Conservation of ecosystem integrity of desert, coastal, mountain reserves	Impact of numerous bore water points; invasions by vertebrate pests and weed; coastal development activities	30–40 per cent of floristic communities affected; 10 per cent severely (seagrass, woodlands, mangrove, rainforest, shrublands)	State legislation on clearing/pest control strategies; some increase in reserve size/number; very variable local government actions
Coastal and inland wetlands decreasing	Infrastructural impacts; off-site effects from rural–urban lands, drainage and water use schemes	Large reduction in area; increased exotic weeds and fish; increases in nutrient and heavy metal inflows	Increase in preservation orders — often ineffective, public concern (land care groups), more demand for recreational access
Increase in hobby farms with fragmented land management	Land-use intensified; land abandonment; inadequate local controls	All metropolitan regions affected; land and waterway pollution; reserve fragmentation	Varied —depending on local government control, planning and land values
Sustainability of rangelands	Overstocking by domestic animals in dry years; total grazing pressure greatly increased by vertebrate pests	Both positive and negative trends found in the 51 per cent of area surveyed; 2.3 per cent land irreversibly eroded; 15 per cent needs destocking to recover; weeds and small pest species increasing; large pests decreasing	Value of current pastoral systems being reassessed by governments and the private sector in light of pressures and developing alternative land uses (eg Aboriginal land uses and ecotourism); a National Strategy for Rangeland Management is being developed jointly by State, Territory and Commonwealth governments and non-government organisations, with extensive community consultation; it addresses the commercial viability of pastoralism, where appropriate; the draft strategy is expected to be released in mid 1996; new drought policies put onus on risk management
Sustainability of agricultural regions	Low profitability of 50 per cent of enterprises reduces resource care; major effects from loss of perennial vegetation, low use of lime and run-down in fertility; erosion from bare land and over-use of irrigation water	Secondary salinity increasing; saline ground-water rise increasing; soil acidification increasing; wind and water erosion stable; soil fertility declining in one third cropped land and increasing in 10 per cent; more lime and gypsum used	One-third of farmers in Landcare; catchment and regional plans for resource use in each State; changes to State resource legislation; controls on clearing; increases in water prices; controls on irrigation water use
Sustainability and multiple use of forest and woodland regions	Continued cutting and fragmentation of smaller remnants; altered fire regimes in large state-managed stands; low investment in plantation forestry	Historical overuse and genetic loss affect condition; smaller remnants are non-regenerative and still losing biodiversity; net area of clearing and mortality greater than area of tree-planting	Governments have agreed not to reduce forest estate further; poor reporting on biology acknowledged; comprehensive regional assessments initiated to manage forests; no tax concessions for plantations

*Synthesis by Ann Hamblin (CRC for Soil and Land Management, Adelaide), based on Chapters 4, 6 and 7.

Land degradation

Degradation of agricultural and pastoral land is a matter of considerable concern. The failure to take account of weather variability has led to overstocking of rangelands in dry years. Another serious pressure comes from introduced herbivores, such as rabbits and goats, and increases in populations of native herbivores such as kangaroo species. These factors have contributed to a situation in which more than two per cent of rangeland is irreversibly eroded and a further 15 per cent needs de-stocking to recover.

The condition of rangelands differs between regions. The Western Australia arid zone and particular areas of Queensland — Cape York and the Burdekin in the north and the Channel country and Maranoa/Warrego in the south-west of the State — are most severely affected. Local variability also occurs, with a tendency for most severe degradation to be along creek and river frontages. The problem may have a significant effect on the economic productivity of pastoral areas, on future alternatives for land use and on conservation values.

Much of Australia's agricultural land is also under pressure from erosion, loss of vegetation cover and overuse of irrigation water. Problems such as soil salinity, acidification and rising groundwater all appear to be increasing in severity. Soil fertility is declining in one-third of all cropped land, more than offsetting the improvement in the fertility of 10 per cent of land.

While remnants of native vegetation remain as narrow strips along road verges or isolated uncleared areas, the overall condition of land cover is a cause for concern. Some of this remnant vegetation appears to be in poor condition because seedling regeneration is limited by introduced herbivores or competition from introduced flora. In land not used for agriculture or grazing, invasion by weeds and vertebrate pests has had serious impacts.

Global climate change

Australia currently has the highest energy-related carbon dioxide emissions per unit of GDP of any OECD country. The various reasons for this include: our almost total reliance on the burning of fossil fuels as our primary energy source; the overall structure of the economy (taking advantage of our abundant natural resources) and subsidies to energy-intensive industries; land clearing for agriculture; the emphasis on the private car for personal transport and road transport for freight; and the 'tyranny of distance' between and within our cities.

The National Greenhouse Response Strategy provides a reasonable basis for addressing our obligations under the Framework Convention on Climate Change. However, there is little sign of a serious commitment to this Strategy. The most obvious problem is once again institutional. Energy and resource development agencies in some States, having charters that limit the possibility of considering broad issues such as global climate

Salt encrustation and soil erosion in the upper Kent River, south-west Western Australia.

change, are pressing ahead with plans to expand energy-intensive activities. At the recent Berlin conference of the parties to the Framework Convention it was clear that Australia and most other developed countries will fall short of returning their emissions to 1990 levels by the year 2000 as required under the Convention. International sympathy is unlikely for the view among Australian energy and resource development agencies that increasing our emissions is in the global interest.

Two recent initiatives are significant. The Commonwealth government released a package of response measures, *Greenhouse 21C,* and private sector peak bodies, in an endeavour to show that proposals such as a carbon levy will not be needed, began encouraging large companies to enter into cooperative agreements to limit carbon dioxide emissions. At the time of writing, it is too early to judge the effects of these initiatives.

Water issues: catchments and marine ecosystems

Chapters 6 to 8 of this Report detail the importance of managing Australia's natural assets on an integrated, large-scale basis. How we use land resources affects the state of inland waterways, which in turn affects the state of marine and estuarine environments. So, success will be more likely if future planning is based on biophysical regions, management of water systems on integrated catchments, and protection of the oceans on the basis of an integrated approach to the whole marine ecosystem. These conclusions are inescapable.

As Australia is the driest inhabited continent, it should not be surprising that a group of key issues relate to water and its management. The scarcity of water is an issue in many parts of the country, while water quality and nutrient loads are serious problems in many areas. Waste water disposal is a

particular problem in urban areas, while some parts of rural Australia are seriously affected by rising groundwater. Finally, pollution of coastal waters is both a problem in itself and a source of concern because of its impact on fish stocks.

Water quantity

Future planning must accept the high natural variability of rainfall and run-off in Australia. The level of stress affecting the Murray–Darling Basin is partly due to its lack of water which in turn is in part the result of past failure to recognise the variability of run-off. It is also partly a consequence of the allocation for irrigation of much of the natural flow of these rivers and their tributaries.

Seventy-five years ago, about 15 per cent of the average natural flow of the Murray–Darling Basin was diverted for human use, leaving 85 per cent to flow naturally through the river system to the sea. Today, about 80 per cent of the average natural annual flow is diverted, leaving only 20 per cent, which is not adequate to sustain the natural systems of the river basin. But the situation is even worse than suggested by this average figure; the considerable variability of rainfall and run-off mean that the volume diverted in dry periods may equal the total available water, leaving little or none to sustain the natural systems of the river basin.

Environmental consequences have followed inevitably. With rivers and wetlands starved of water, riverine environments have been disrupted and wetlands destroyed or seriously disturbed, putting great pressure on the species reliant on those habitats. Irrigation is also associated with waterlogging and salinisation of agricultural land: about one-third of the land area irrigated in Victoria now suffers salinity problems.

The figures suggest that the problem lies with a model of decision making, based on short-term economic objectives of individuals rather than long-term State or national interests. Thus irrigation and town water supplies have taken precedence over riverine ecosystems for the water in our inland rivers. Natural ecosystems must retain as much water as they need to remain healthy — one reason is to ensure the quality of drinking water. Only if spare capacity remains, should extractive uses such as irrigation be permitted.

Water availability is likely to be an increasingly serious problem in southern Australia. The Great Artesian Basin supports much of inland eastern Australia. It lies underneath about one-fifth of the continent, typically at depths of more than one kilometre. Uncontrolled extraction from bores has depleted the resource significantly. About 20 per cent of bores in south-west Queensland have ceased to flow because of declining water pressure in the Basin. Average flow rates have steadily declined from 600 million litres per day early this century to less than half that level today. A program of capping bores to conserve groundwater is underway, but it will take several decades to complete at the planned rate of implementation.

Thus, the viability of those agricultural activities that rely on bore water from the Great Artesian Basin is in doubt. They have relied on the harvesting of water, which has taken hundreds of thousands of years to percolate through rock strata to inland Australia. That practice clearly cannot be sustained at the historic scale.

Water quality and nutrient loads

Several of the impacts on inland waters are a direct consequence of land management practices. Many waterways are affected by sediment loads borne by run-off. The scale of these loads is a direct consequence of management practice. Nutrients, especially phosphorus and nitrogen, as well as pesticide residues, are washed into waterways.

Dryland agriculture is associated with increasing levels of salt in waterways, causing problems for aquatic biota. Many of these native species are in serious decline, partly as a result of the changes discussed above and partly because of the pressure of introduced species. Exotic fish, plants and mammals all pose threats to native species. Some significant fish species are trout and European carp, while considerable damage has also been done along waterways by introduced plant species such as *Mimosa pigra*. In the face of these problems, several States have adopted an integrated approach to the management of whole catchments. Significant initiatives have followed, ranging from catchment management authorities to major engineering works like the Dawesville Channel, intended to revitalise the Peel–Harvey estuary in Western Australia.

As Australian soils have low levels of naturally-occurring nutrients, our agriculture depends on chemical fertilisers for the phosphorus needed by crops and pastures, and the nitrogen needs of many crops. There is no doubt that some of the phosphorus in inland waterways is due to the application of fertilisers, while some is due to removal of the element by erosion on cleared land. The relative contributions of these two mechanisms is disputed, but there is no disagreement that the dominant source of the phosphorus burden in inland rivers is agricultural land.

Land use practices have changed local hydrology. Land clearing has raised water tables and caused salinisation. Storing water in dams is a rational response to variable rainfall from the viewpoint of the individual landholder, but the cumulative effect of diverting large volumes of water from natural watercourses is considerable change to the riverine environment. The inland rivers of New South Wales have been seriously affected by the level of withdrawal of water, mainly for agricultural purposes.

Groundwater disturbance

Groundwater is an integral part of the water cycle. People living in about 60 per cent of the land area of Australia are totally dependent on groundwater, while those in another 20 per cent use it for the majority of their needs. The time scale for change in groundwater systems is very long. While surface

water takes a few weeks to flow from the Great Dividing Range in Queensland to central Australia, water in the Great Artesian Basin takes millions of years to travel the same distance. Two serious problems are associated with groundwater: depletion of the resource in northern and central Australia and rising levels of groundwater in southern Australia.

Clearing has caused severe degradation of agricultural land. The replacement of deep-rooted vegetation, such as large trees, by shallow-rooted species such as crops, has caused groundwater levels to rise. Water-logging of the root zone can cause serious decline in economic yields in the short term. In some cases, the rising water levels are redistributing salt, leading to salinity problems. This can have devastating impacts on rural areas. The reclamation of agricultural lands affected by this condition may not be economically feasible, even over many decades. More than two million hectares of land in southern and western Australia are already affected. The levels of water tables are rising at rates as high as 50 centimetres per year. As the problem results from past indiscriminate clearing of land, the situation can be improved by planting salt-tolerant species of trees, but it requires an extensive and concerted approach.

Waste water disposal

A range of pollutants contaminate industrial and domestic waste streams and urban run-off. Few quantitative data are available, even at local levels, and there are no credible national figures for the resulting load on waterways and oceans. Chapter 8 quotes the impacts on Moreton Bay of suspended sediments, heavy metals, nutrients and pathogens in the run-off from the Brisbane River. A 1987 study estimated that 17 per cent of mangroves and 21 per cent of saltmarsh has been lost, with significant impacts also on seagrass meadows and algal communities. Despite growing concern about the state of Moreton Bay, crucial decisions remain fragmented among a host of different authorities.

Although the build-up of nutrients in waterways is a major problem, upgrading of waste water treatment is only proceeding slowly. Ocean outfalls continue to be the major form of disposal. In New South Wales, about 200 storm-water outlets discharge into the ocean adjacent to the Sydney metropolitan area.

Overall, it has been estimated that about 80 per cent of contaminants in the sea and estuaries have found their way into the water from the land. The main sources of contamination are storm-water systems, sewage effluent discharges and run-off from agricultural areas. In the absence of integrated systems of catchment management that include urban areas, there is little prospect of resolving this problem.

Coastal pollution and fish stocks

There are many adverse impacts on the coastal environment. An example is the increasing incidence and intensity of marine algal blooms, which have now been reported from most parts of

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Many areas of saltmarsh and mangroves have suffered from coastal development.

the coastline. Annual outbreaks in the Port River estuary, near Adelaide, have poisoned mussels and massive blooms of blue-green algae in the Peel–Harvey estuary in Western Australia are affecting fish catches and crab populations.

Shellfish beds in Tasmania and Victoria have been closed as a consequence of the less dramatic events now regularly occurring right around the coast-line. Evidence suggests that non-toxic algal blooms are associated with the die-back of seagrass. While it is suggested that the increased frequency and size of algal blooms in the waters off east Queensland may be caused by nutrient run-off from the land, the data are not conclusive.

Coral reefs appear to be in decline around the world. A definitive picture of the state of the Great Barrier Reef cannot be established at this time, as the current monitoring programs have not been conducted for long enough to give clear results. Photographic comparisons cited in Chapter 8 show reductions in the level of hard coral cover on some reef flats in the inter-tidal zone. Crown-of-thorns starfish have damaged nearly 20 per cent of reefs to a greater or lesser extent in the past 30 years, although there is still debate about whether or not these outbreaks are related to human activity.

Overexploitation has put several species of fish at risk, reducing the breeding stock to dangerously low levels. Examples include the southern blue-fin tuna and eastern gemfish. The orange roughy and coral trout catches per unit of effort are also declining, although there is no evidence that breeding stock has reached dangerous levels; continued monitoring of the situation is needed. While the numbers of other creatures such as sea snakes and turtles are more difficult to estimate, the overall population of loggerhead turtles is declining, to the point at which regional populations are now threatened.

On the other hand, the marine area can provide examples of successful management of resources through scientific assessment and subsequent intervention. Management of the tropical rock lobster fishery involves Commonwealth-State

cooperation as well as the involvement of another nation, Papua New Guinea. The goal of protecting the traditional way of life and livelihood of the Torres Strait Islander people has been achieved by restricting access by others. The fishery is still assessed as underexploited, or able to sustain higher rates of harvesting than the current activities.

Following assessments that the barramundi stocks of northern Australia were being seriously depleted, a management plan was introduced. While continuing to allow traditional fishing by local Aboriginal people, the plan reduced commercial exploitation to a level that appears to be sustainable. The development of such management plans for fisheries reflects increasing recognition of the need to exploit fish resources at rates below the maximum sustainable level.

The marine environment is also significantly affected by introduced species. Toxic marine algae threaten fisheries in Victoria and Tasmania, and concern is growing about the Northern Pacific Seastar, the spread of which is a hazard to scallop and abalone fisheries, aquaculture farms and marine life generally. Chapter 8 notes the invasion of saltmarshes by introduced species, capable of altering the natural ecology.

Coastal and urban environmental issues

Coastal settlement

Chapter 8 concludes that most estuaries well away from population centres experience little disturbance, but others are under heavy pressure. Regulations control emissions from point sources, such as major industrial operations, but significant problems arise from diffuse sources such as urban run-off from roofs, driveways and streets.

One factor likely to disturb the ecosystem of an estuary is land clearing. More than half the land area of the respective catchments have been cleared. Around 86 per cent of the estuaries in South Australia have more than 50 per cent of their land cleared, as do 60 per cent of those in Victoria and 37 per cent of those in New South Wales. Enclosed gulfs and bays near major cities, such as Port Phillip Bay in Victoria and Moreton Bay in Queensland, are particularly affected by run-off from urban areas.

These examples highlight a general problem: concentrated coastal settlement and its impacts on the coastal zone, especially in the east and south-east of the continent. Although Chapter 3 shows that environmental impacts per head are often higher in small settlements, urban environmental issues relate to the coastal zone and the major cities because these are the places where most people live. In recent decades the population of the non-metropolitan coastal zone has grown dramatically — it almost doubled in the 20-year period from 1971 to 1991. This urban growth involves clearing of land, damming of rivers for water supply or modification of flow regimes for flood control, as well as pollution of water from sewage and urban run-off. Other impacts include shore-line erosion associated with coastal engineering structures such

as breakwaters and sea walls. Above all else, the extensive development of the coastal zone is associated with the loss of bushland, degradation of coastal ecosystems, and impact on cultural heritage.

Developments ranging from dumping of rubbish to land 'reclamation' have damaged coastal saltmarshes in the inter-tidal zone. The loss of saltmarshes in the temperate zone of south-eastern Australia is linked to significant losses of endemic species. Extensive clearing of mangroves has occurred near urban areas, with further significant areas under threat from planned development.

A particularly serious problem appears to be the loss of seagrass beds, with more than 1600 square kilometres (about three per cent of the total known area of Australian seagrass) lost in recent decades around the coast. Much of this loss is attributed to floods and cyclones, with the remainder due to human changes such as elevated nutrient levels, run-off, dredging and reclamation.

Prospects for recovery are poor. There is no record of temperate seagrass recovering from damage or loss on reasonable time-scales, while the tropical and sub-tropical species take more than a decade to return under best conditions. Seagrass beds are critical habitats for turtles and dugong, as well as being important nursery areas for commercial and recreational fisheries. Their loss must cause concern, especially as the temperate seagrass areas may not respond successfully to changes in climate.

Thus a range of serious environmental problems affect our inland waters, estuaries and coastal regions. The biological and physical interactions mean that an integrated approach to these problems is needed, encompassing the chain of events from land management in catchments through to the coastal zone.

Towns and cities

Although the environmental problems of Australia's largest settlements are arguably less serious per head than those of many smaller settlements, urban problems in our cities are among the nation's most important environmental concerns. Four of these issues have been singled out for discussion in this chapter: the dispersed and low-density character of our settlements; waste minimisation and waste management; the retention of remnant vegetation and habitat; and changing patterns of population distribution.

The dispersed and low-density character of our settlements has created cities that depend heavily on motor vehicle transport. The rail networks in our cities, especially Sydney and Melbourne, are extensive but public transport patronage has declined significantly over the past 50 years. Research, funding and management for public transport have all been deficient. Commonwealth funding for transport has, until recently, concentrated on road building. Few attempts are made to integrate land use and transport planning across all possible modes, although it is rational to take a comprehensive approach to examining the best economic, environmental and social options

for transport provision along particular corridors or in particular areas. Severe environmental and social impacts are the result. Australian cities use high levels of transport energy, generate high levels of pollutant emissions and create unequal conditions for those with little or no access to a car.

The long-term trend toward smaller, more numerous households means that growth is compounded by a tendency to spread further from the urban cores, and use more transport fuel. As transport fuel use is a major source of urban air pollution, this problem is directly linked to population growth and distribution. A recent poll showed that Australians see urban air quality as one of the most important environmental problems. While most indicators of air quality are acceptable on most days, the trends are worrying. Precursor conditions for photochemical smog formation apply in some of our cities, and in all our major cities the emission levels of the gases which cause the problem are likely to rise given current trends in demography and motor vehicle use. A recent Perth study concluded that the city is on the verge of a significant air quality problem, mainly due to vehicle emissions of gases which lead to the formation of photochemical smog in hot weather (Weir and Muriale, 1994). The report noted that Melbourne and Sydney experience more photo-chemical smog events than Perth, which exceeds the World Health Organisation guideline for one-hour ozone levels on about ten days each summer.

Important changes have occurred recently. Comparative research on Australian and Canadian cities is showing that high levels of public transport patronage are closely related to the adequacy and frequency of services (Mees, 1994). This is confirmed by initiatives that provide a good public transport service. As Chapter 3 notes, the new Northern Suburbs railway in Perth has experienced dramatic growth in patronage because it provides a journey that is faster and more comfortable than driving a car. The Better Cities program is helping to improve public transport, through such schemes as the reconstruction of the Brisbane–Gold Coast railway and the development of the Ultimo–Pyrmont light-rail link in Sydney. The same program is encouraging integrated land use and transport planning, as well as supporting public transport. Bicycle networks are being built and used. At the same time, however, road building proceeds apace. As discussed in Chapter 3, large freeway programs are being undertaken in many of our major cities, although this is contrary to transport planning in most developed countries and contrary to the National Strategy for Ecologically Sustainable Development.

A different strand of responses relates to reducing vehicle emissions by improving engine efficiency, reducing the size of cars or changing the fuel used. Government policy has encouraged the use of unleaded fuel, but little impact has been made so far on vehicle size or efficiency. With petrol less expensive than almost any other liquid bought in bulk, change is unlikely to be achieved by the current approach.

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North coast, New South Wales; the population of the non-metropolitan coastal zone has grown dramatically over the past two decades.

A second urban environmental issue is waste minimisation and waste management. As cities grow, the larger population produces proportionally larger quantities of waste, putting greater pressure on natural and artificial waste management systems. Modern urban refuse systems are usually well engineered to minimise their impacts on natural systems, although some cases of groundwater contamination have occurred. More serious are the effects on the urban air-shed of combustion products and the impacts on waterways of run-off from residential, commercial and industrial premises. The oil industry has pointed out that more liquid hydrocarbons reach the ocean from urban run-off than from shipping accidents.

Urban areas also face problems of solid waste disposal. The average amount of domestic refuse is about one tonne per person per year, a major part of which is unnecessary packaging. Packaging makes up about one-third of the volume of domestic waste. Some cities have made significant steps toward kerbside recycling — a real success story in Australia. Although we have adopted a range of initiatives to achieve the national target of a 50 per cent reduction in waste going to landfill by the year 2000, we need to identify more materials for waste reduction, and place more emphasis on reducing the source, if we are to achieve this target. We also need better national information about the composition of the waste stream and waste generation rates, and effective waste minimisation methods. Once again, institutional arrangements inhibit a unified approach.

A third key issue is the retention of remnant vegetation and habitat. Some cities have retained their urban creeks and associated vegetation, providing corridors of wildlife habitat — Brisbane is a large-scale example, while Perth has a much higher proportion of remnant vegetation than many rural shires in the south-west of Western Australia. In Sydney and Melbourne, by contrast, many urban streams have been turned into concrete storm-water drains. The Better Cities program is demonstrating in a number of places

that water-sensitive urban planning can rehabilitate creeks and turn storm-water into a positive element of the urban landscape. While our urban areas have extensive areas of parkland, much of this is planted with imported rather than native species. Remnant bushland in urban areas is under heavy pressure from development for suburbs, hobby farms and coastal settlement.

A fourth issue relates to changing patterns of population distribution. Vigorous debate continues about the relative impact of people in different types of human settlements. It is clear that there are pressures on natural systems associated with the drift to the coastal zone, especially in Queensland and northern New South Wales, and to particular urban areas such as Brisbane, Perth and the western outskirts of Sydney. The movement of population also affects natural and cultural heritage. Growing social problems are arising from the decline of rural communities.

Social and cultural issues

These issues are particularly relevant to the first core objective and the first guiding principle of the National ESD strategy. Four key issues have been identified under this broad heading: various forms of social breakdown, the physical and cultural well-being of indigenous Australians, the need to maintain continuity under conditions of rapid change, and protecting our heritage.

Signs of social stress

Australians enjoy a high living standard, with a wealth per head which is higher than the OECD average. However, this living standard is not shared equally, with a growing gap between rich and poor households. In the 15-year period from 1976 to 1991, average household incomes in wealthy neighbourhoods (the top five per cent by income) increased by 23 per cent ($12 500) while the average incomes in the poorest neighbourhoods declined by the same percentage, or $7600. The difference in annual income between median households and those in the top percentile doubled in the same period, from $23 000 to $46 000. Australia remains a more equitable society than others such as the United States, because of the various provisions known as the 'social wage'.

However, there is a worrying trend toward a geographical concentration of disadvantage and the appearance of 'pockets of poverty' in our cities. A contributing cause is the changing pattern of paid employment, with a tendency for unemployment to be concentrated in areas of disadvantage, while two-income households are common in more affluent areas. The trend away from work in agriculture and manufacturing toward professional jobs in the service sector places a high premium on formal qualifications. The overall unemployment rate at this time is about eight per cent, but the rate among young people is more than three times this level. There is increasing concern that Australia is developing an under-class of young people who have no real prospect of paid work, as a result of

which they are isolated from the mainstream community. Aboriginal youth is particularly disadvantaged in the labour market.

On the whole, Australians enjoy good health. Average life expectancies are significantly better than in New Zealand, the United Kingdom or the United States, and similar to those in Sweden. There are, however, marked differences for some groups. Aboriginal health is a serious concern. There are also general problems of physical and mental health. Youth suicide rates are among the highest in the world. Where once the archetypal Australian was bronzed and fit, today only a small minority of adult Australians get enough exercise to maintain basic cardio-vascular fitness. While mortality related to heart disease has declined dramatically in the last 25 years, associated with improvements in diet, cardio-vascular diseases still account for almost half of all deaths. Injuries are a major health problem. Each year about 2700 Australians die as a result of work-related health problems, while more than half a million suffer work-related injuries or illness. Motor vehicle accidents are a major cause of deaths and injuries, especially in rural Australia, despite dramatic reductions since the introduction of compulsory seat belts and random breath testing. Recognising the health effects and costs of tobacco smoking, restrictions on smoking are being introduced in many enclosed public places and most advertising of tobacco products has been banned.

Well-being and culture of indigenous Australians

Many indigenous Australians suffer much poorer health than the rest of the community. While the average life span of the Australian community as a whole has increased by about 20 years this century, the average life expectancy of Aboriginal people has not and is 16 to 18 years less than the average for the whole population. Aboriginal babies are, on average, 200 grams lighter than the overall mean for the population, and infant mortality rates are four times that of the national average. Mortality of young and middle-aged adult males is particularly high; men aged between 35 and 44 die at more than six times the rate of the non-Aboriginal population (Aboriginal and Torres Strait Islander Commission, 1994). There are various contributing factors and no simple solution, but the issue deserves urgent, concerted attention. Environmental factors are directly involved in some health problems; for example, nearly 200 Aboriginal or Torres Strait Islander communities do not have adequate sewerage, contributing to high rates of preventable communicable disease.

Traditional social structures are under pressure from the encroachment of the values of the broader community, undermining the standing of elders. Cultural diversity and national heritage are being eroded through the disappearance of traditional Aboriginal languages, most of which have been lost. Of the estimated 250 languages in use 200 years ago, only 90 are still spoken today and only 34 have 200 or more speakers. Only about 20 are still being taught to children and used as the

primary means of communication. All of those are under threat, despite language maintenance programs, and could be lost within a generation. Like threatened species, they are unlikely to survive if the system which has supported them is under continuous attack.

Only about 800 places of significance to Aboriginal and Torres Strait Islander people are among the almost 11 000 places listed in the Register of the National Estate, although a much larger number of sites (some 85 000) are recognised under State or Territory lists or legislation. Existing listed conservation and heritage areas are skewed toward the south-east corner of the country, with relatively poor representation of the heritage of cultural groups living in the north and west, especially Aboriginal and Torres Strait Islander groups.

Cultural continuity in times of rapid change

Rapid technological change is causing associated social change. The cultural identity of the nation is being modified by a range of external influences, especially the mass media. At the same time, the changing balance of immigration to Australia is widening and enriching the cultural diversity of the country, leading to continuous re-evaluation of what it means to be an Australian. Australia is one of the most successful examples of multiculturalism anywhere in the world.

It is a challenge to maintain a resilient social structure and cultural identity. Since Australia itself can be seen as a social and cultural landscape, it can help people's sense of continuity in the face of change if they learn to acknowledge, value and protect their cultural heritage.

Protecting our heritage

Australia has a rich and complex heritage of places and objects and well-developed systems to identify, conserve and present that heritage on behalf of the public. Despite these advantages, much valued evidence of our cultural and natural history is being lost or mismanaged for two reasons. First, protective measures are incompletely and inconsistently applied across the country. Second, heritage administration is arbitrarily divided in several ways: between the natural and the cultural, between one type of place and another, between one type of object and another, or between places and objects with close associations.

The currently recognised set of heritage places is geographically unbalanced; it does not adequately reflect the heritage of the north and west of Australia. Chapter 9 lists several reasons for this imbalance. Often the heritage values are not recognised because of insufficient community involvement in the selection process. Sometimes there is inadequate recognition of social values in heritage studies. In other instances, there is insufficient assistance to the community to identify those aspects of heritage deserving protection.

The multicultural nature of Australian society and its values are inadequately reflected in heritage registers, museum collections and protective

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Results of vandalism on the Sun Theatre foyer, Yarraville, Vic. Cultural heritage needs to be acknowledged, valued and protected.

measures. This is despite recent efforts of heritage administrators. Minority groups have minimal access to heritage decision-making. In particular, the belief systems and relationships with place of indigenous communities, remain largely unrecognised.

More generally, the strong links between places, objects and the meanings they are given by Australians are rarely reflected in current policies and institutional approaches. No national heritage strategy exists to integrate natural and cultural values effectively. While our knowledge of Australia's heritage has improved significantly in the past decade, so that registers now list thousands of places of natural and cultural significance, there are still major thematic gaps.

Recent legislative measures have improved the protection of important heritage sites, but much remains to be done; places significant to indigenous peoples are still inadequately protected. Our collections of heritage objects have thematic gaps and some States have not yet enacted legislative protection for significant heritage objects.

Without a national overview of the physical condition of our known heritage places, or of the objects held in collections, we neither know what we are losing nor how fast it is going. No systematic processes are in place to monitor the loss of, or damage to, our national estate. Once again, an identifiable problem is the lack of coordination between the three levels of government. Heritage values need to be incorporated by all spheres of government into their policies and program development if they are to be maintained for future generations. It should not be overlooked that this approach includes integrating heritage values into the management of the natural environment.

In summary, it is probable that we will continue to lose significant aspects of our heritage. Losing our past makes it more difficult to evaluate our options for the future.

Information needs

It remains true, as reported by the Australian Science and Technology Council in 1990, that 'Australia lacks an integrated national system for measurement of environmental quality, a national database of sufficient calibre to assess and manage environmental quality, and appropriate national baseline data to evaluate the effectiveness of

Figure 10.5 Research effort by non-business sector organisations 1990–91
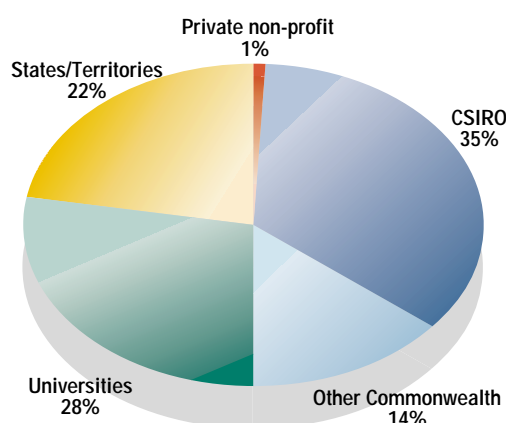
Source: Department of Industry, Technology and Commerce, 1994.

Table 10.1 Non-business sector spending on research and development, 1990–91

Research and development objective	$m	person years
Environmental research		
Natural ecosystems	76.1	1 181
Climate	19.5	213
Water resources	19.4	298
Impacts, protection	18.6	274
Oceans	12.4	130
Atmosphere	10.7	129
Land, land use	9.5	137
Other	9.3	133
Sub total	**175.7**	**2 495**
Research into environmental aspects of economic development		
Agriculture, forestry and fishing	87.5	1 231
Manufacturing	17.9	256
Mineral development	10.8	125
Energy	5.8	71
Construction	5.6	76
Commercial services	1.4	20
Transport	0.7	11
Other	8.2	105
Sub total	**137.9**	**1 895**
Environmental health		
	7.1	90
Total	**320.7**	**4 480**

Source: Department of Industry, Technology and Commerce, 1994.

strategies'. Without these requirements, we are unable to say whether our pattern of development is genuinely sustainable. Achieving sustainable development requires suitable information on which to assess whether activities are sustainable. Given the stated intention of Australian governments to develop our natural and cultural resources in an ecologically sustainable manner, we need to invest in understanding those resources and the consequences of human activities, existing and planned.

State of the Environment reporting is an important step towards improving our knowledge base for future decisions. In many areas, the available data are inadequate to assess whether current activities are sustainable.

Scientific knowledge is most complete in describing the condition of the environment and the pressures on it. Evaluation of responses is much less clear and we need to refine the knowledge base for making future response decisions. Responses can be directed at the state of the environment, for example, cleaning up a polluted river. They can also be directed at the pressure(s) responsible; in this case, activities up-stream leading to the pollution. Responses to the pressures on the environment are generally more effective in the long run. Treating the state without taking account of the pressures is like treating a person's fever by applying cooling towels; it may reduce the observable symptoms, but does not address the underlying problem.

Considerable effort already goes into research and the collection of data relevant to environmental issues. For the latest year for which data are available, the non-business sector spent about 4500 person-years of effort and more than $320 million on environmental research and development. The distribution of the effort is analysed in Fig. 10.5 and Table 10.1. On top of this is the considerable research spending of the private sector and the prodigious efforts of voluntary groups.

Considerable research effort is being expended in two areas: natural ecosystems, mainly in the universities, and the environmental aspects of primary industry, mainly conducted by State governments and CSIRO. Some impressive achievements appear, such as the deserved reputation of world leadership in ecosystem monitoring by satellite imaging. Key indicators of environmental condition such as the rate of land clearing, siltation of rivers and the health of coral reefs are being monitored through this new technology.

However, some aspects of the distribution of research funds are difficult to reconcile with the goal of Ecologically Sustainable Development; for example, the relatively small effort on the environmental aspects of transport. Although it is an area with a major impact on urban air quality, it apparently attracts only about 10 per cent of the spending on environmental aspects of mineral development and about one per cent of the funds

for study of agriculture's environmental impacts. The Australian government supports a transport research organisation, the Australian Road Research Board, which works mainly to improve road transport, but there is no body to fund parallel studies on public transport or related environmental issues such as air quality.

Despite the efforts of these thousands of full-time researchers and community volunteers, there are still large gaps of knowledge where we do not have enough information to judge whether the current pattern of development is sustainable. The earlier chapters of this report have detailed some priority areas for future effort in research and data collection. Four examples of information deficiencies illustrate this point.

Biodiversity

As Chapter 4 of this report shows, our current understanding of the biodiversity of Australia is limited. While we believe we have identified and described more than 90 per cent of vertebrate species and vascular plants, we have probably only identified about 50 per cent of the invertebrates and simpler plant species. Our knowledge of the fungi and bacteria is even more limited. With such a poor understanding of the existing biodiversity, it is not possible to say how much of it is threatened, nor what effects human activity may be having on the emergence of new species or natural selection between existing species.

The task of mapping the genetic diversity of Australia is a large one. Priority is being given to the species that are in decline or in danger of becoming extinct, but we do not have sufficient resources to preserve the current diversity. We also face the problem of inadequate knowledge about the nature of particular ecological systems to confidently establish operable recovery plans.

Air quality

Chapter 5 of this report concludes that it is impossible to assess whether all Australians are equally protected from air pollution. Data are not being collected for many important population centres, including Hobart and Darwin. As recent work on the Sydney air-shed has shown that transport of pollutants may occur between the city and the major industrial areas centred on Newcastle to the north and on Wollongong to the south, more extensive monitoring is clearly needed. Research on the formation of photochemical smog in the urban areas has also shown the need to collect different data, and Chapter 5 shows the need to monitor air toxics. As this report was being completed, the Environmental Protection Authority of Western Australia released the preliminary results of the Perth Photochemical Smog Study. The findings reveal that more extensive monitoring will be needed to identify long-term trends.

Much of the data that do exist are scattered around various industry bodies and government agencies, without an overall inventory of data holdings.

Community monitoring

In addition to formal research and data gathering networks, a huge volunteer sector exists. The Royal Australasian Ornithological Union coordinates a nation-wide network of amateur bird-watchers who provide constant streams of expert observations. About 6000 Bureau of Meteorology volunteers supplement the professional data-gathering capacity of the Bureau, 2000 of them collecting data daily. Through the Saltwatch program in the three eastern mainland States and the Ribbons of Blue program in Western Australia, adults and school-children test salt levels in local water supplies.

The Commonwealth government's Waterwatch scheme is providing nearly $3 million over three years to enable community groups to monitor physical, chemical and biological parameters of creeks and rivers. Some 3000 volunteers in south-east Queensland have collected data on local flora and fauna as part of a scheme organised by the State Department of Environment and Heritage. The Landcare program has funded hundreds of groups for monitoring activities.

Hopeful signs of change include such recent initiatives as the National Pollutant Inventory and the national approach to data collection and handling called for under the Intergovernmental Agreement on the Environment. A comprehensive national database on air quality indicators is an urgent priority.

Water quality

Chapter 7 shows that monitoring of water systems has been a low priority for most agencies, so that few long-term and nationally comparable water data are available and even basic water data do not exist in many areas. This is a cause for considerable concern, for it is impossible to say whether the water systems are being managed sustainably. Further data are needed to resolve questions about the relative contributions of various sources of nutrients affecting inland waterways.

Heritage

Chapter 9 identifies a lack of information about heritage objects and lack of monitoring of the condition of both heritage places and objects. No national monitoring scheme for either exists at present, nor for the state of traditional indigenous languages. Though the various heritage registers now list literally thousands of places of cultural importance, the picture has major geographic and subject gaps. More importantly, Chapter 9 concludes that heritage issues should figure more prominently in decision-making. There is little recognition of the need for information to allow heritage issues to be part of the political mainstream.

In conclusion, these information deficiencies together constitute a powerful case for an enhanced effort in monitoring, data collection and environmental research so that decision-makers can base their judgements on solid, credible information about the state of the environment.

Chapter 3 shows that it is not only the lack of information that matters. Information needs to be

collected in particular ways to be effective. It is argued that the most appropriate way to assess the environmental performance of cities and other settlements is the metabolism model which measures the amounts of inputs (energy, water, food and other commodities) and outputs (wastes and emissions). If this approach is to be used in future, the information needs to be assembled in a suitable form.

For future decision-making, we need credible indicators of the state of the environment. An initial set of environmental indicators was developed during the preparation of this report. These will continue to be refined and further developed to provide a set of indicators that identify trends in environmental quality.

Summary

Current state of the environment

This overall summary assesses both what we are doing well and the problem areas. This report has identified positive trends and examples of good practice to be publicised and reinforced. Important questions which cannot be answered by the information now available suggest priorities for research and data collection. The Advisory Council has singled out for attention in this final summary the most important trends deserving urgent action. In particular, several aspects of current environmental management are not adequate to achieve the goal of ecological sustainability.

Most serious problems identified here seem to be due to mismanagement, usually through ignorance. We are beginning to develop the more sophisticated understanding needed to plan for a sustainable pattern of development. Integrated management is a crucial step toward that goal, recognising the need for environmental issues to be considered with economic planning and for all elements of the environment to be considered together.

Positive trends

This report identifies areas of the natural environment that are not a cause for major concern and, in some cases, are grounds for cheer.

Unlike most industrial nations, we have no widespread problem with air-borne sulfur dioxide or its serious consequence, acid rain. Our urban water quality is generally very good, as is the standard of our food, with low levels of chemical residues and metals. Away from major urban areas, our oceans and estuaries are in relatively good shape. There are some success stories of fisheries' management reducing the fishing pressure, either to restore overexploited stocks or to reduce the risk of overexploitation. Our urban housing is generally of good quality, and we have a relatively high level of social cohesion. While there are emerging problems of air quality in some cities, this report concludes that guidelines are probably satisfied most of the time. A system for protecting significant indigenous and historic places is now well established.

Adverse trends

A variety of problem areas are revealed in this report. One of the most serious is the loss of biodiversity as a result of the loss of habitat. This theme recurred through several chapters. In each of the main biological systems of land resources, inland waters, estuaries and the sea, the same problem is evident. The same pattern recurs in wetlands and saltmarshes, mangroves and bushland, inland creeks and estuaries. Our record of biodiversity loss is very poor by international standards. This is probably the most urgent issue in the whole field of environmental management. In many cases, the loss of habitat is continuing at an alarming rate, with associated inevitable loss of biodiversity.

Land degradation has emerged as an area of grave concern. In our rangelands, 2.3 per cent is irreversibly eroded and another 15 per cent needs destocking to recover. Much of our agricultural land is suffering from groundwater rise, salinity, acidification and declining fertility. Rates of soil erosion from agricultural land leave no grounds for complacency. Marginal cropping areas are characterised by shallow soils and variable climate; there is evidence of some degradation of these areas. The data show grounds for concern about the continuing productivity of much marginal agricultural land. These issues will have future economic as well as environmental impacts.

A series of problems relate to our urban areas. Overall planning is essential for the transition to sustainable development of our cities. Priorities include transport planning, urban waste management and curbing the impact of settlements on water systems. The waste products of urban areas and the spread of settlement along the coast threaten coastal systems. Cultural heritage is inevitably lost in this process. The issue of the impact of human activity on the coastal zone deserves urgent attention.

Our inland water systems are in poor shape, due to poor management in the past. Apart from recent initiatives in the Murray–Darling Basin, jurisdictional boundaries have precluded overall catchment management, while water use has not taken sufficient account of rainfall variability and the long-term needs of riverine systems. Levels of nutrients and sediment are a cause for concern, as are salt loads. The public is understandably anxious about algal blooms.

Despite strong global measures to phase out chlorofluorocarbons (CFCs), the stratospheric ozone 'hole' over the southern polar region has been at its largest and deepest during the past three or four years, thereby subjecting more Australian people and other species to increased ultra-violet light. In addition, the Intergovernmental Panel on Climate Change (IPCC) concluded in 1995 that the balance of evidence suggests a discernible human influence on climate change through an increase in anthropogenic greenhouse gas emissions (for example, carbon dioxide and methane) in

combination with on-going impacts of sulfate aerosols from atmospheric pollution.

The report highlights the issue of health in Aboriginal communities. While in the population as a whole, such indicators as infant mortality and overall life expectancy reflect a high quality of life, they show that indigenous communities have not shared in the health benefits. This is a stark example of the pressures on our diverse cultural groups, needing urgent attention.

Where the judgement is complicated

Various problem areas are flagged by this report for investigation, as existing knowledge does not permit a clear assessment of the current situation. Others are shown as areas of concern rather than alarm. There is concern about the decline of some marine species, such as mammals, reptiles and certain types of fish. We cannot say whether some types of forest are adequately protected to ensure their survival.

Our reserve system is patchy, with a tendency to include areas of little economic potential while ecosystems on more productive land are rarely reserved. For a variety of situations discussed on pages 10-24 and 10-25, the available data do not permit a clear statement of the national picture; this applies to aspects of urban air quality, the natural and cultural heritage and many aspects of water systems. Better data and more credible models are needed for considered decisions to be made about complex environmental problems.

Responses and the path to sustainability

This report identifies areas in which our responses appear to be adequate, others in which they are questionable, and a third group in which they are either inadequate or counterproductive. It is important to consider this assessment as a whole.

There are many areas in which Australia is doing well. The listing of natural areas under the World Heritage Convention and their subsequent protection is a real success story, as is the increasing provision for other forms of reserve status. Some innovative structural solutions to complex management problems, such as the Great Barrier Reef Marine Park Authority and the Murray–Darling Basin Commission, are now internationally recognised as responses to these issues. In particular, the Great Barrier Reef Marine Park Authority is a good example of a multiple-use bioregion scale management regime, with a strong legislative base and tested inter-governmental arrangements. Prompt and purposeful action has been taken to phase out ozone-depleting substances, such as CFCs, earlier than required under the Montreal Protocol, and the Commonwealth government has instituted financial inducements to accelerate the transition to unleaded petrol. There have been successful initiatives to place management of significant elements of natural and cultural heritage — such as Uluṟu-Kata Tjuṯa, Kakadu and Jervis Bay — in the hands of the traditional owners.

The Landcare program involves people from both rural and urban communities.

The Landcare program is in many ways a commendable initiative, achieving desirable gains in the agricultural sector. However, the program strongly emphasises economic productivity, leading to concern about its ability to address wider issues such as water quality and loss of biodiversity. This is not a criticism of Landcare participants, but another example of the need for a systems approach to complex environmental issues.

While water extraction rates remain in many cases higher than can be sustained year-in, year-out without damage to natural systems, the emergence of catchment management bodies is a positive move forward, and the decision by the Murray–Darling Basin Ministerial Council in June 1995 to set a limit on extraction is a landmark for the sustainable management of waterways.

As part of a scheme to encourage a more responsible pattern of energy use, the Queensland government has introduced subsidies for solar hot water systems and compact fluorescent light bulbs, while the government of South Australia is publicly committed to an ambitious target of obtaining 25 per cent of its non-transport energy from renewable forms within ten years. The Rouse Hill development, on the western outskirts of Sydney, is being built around a dual reticulation system allowing 'grey water' from showers and sinks to be used for watering gardens and flushing toilets, in order to minimise impacts on the Hawkesbury River. Recent data show that more than $5 billion, or about 1.3 per cent of GDP, is now spent on environmental protection each year in Australia.

Kerb-side recycling schemes in urban areas have dramatically reduced the volume of waste and eased environmental problems associated with disposal of garbage. Better Cities demonstration programs, water efficiency appliance schemes, the National Pollutant Inventory and moves toward cleaner production are all positive initiatives that are reflected in improved environmental standards.

A second group of responses are questionable. Reform of the electricity industry is directed at

achieving greater efficiency and industry competitiveness, more efficient use of resources and lower electricity prices. The reforms may lead to increased electricity use and associated pollution.

The move toward regulation of aircraft noise by taxation and legislation is positive, but it comes at a time of widespread concern about the noise impact of the new runway at Sydney airport.

Third, there are areas in which our responses seem either inadequate or counter-productive. Despite occasional successes such as the Murray–Darling Basin Commission, the national ability to manage the environment well is continually hamstrung by structural problems between different areas of government. Environmental standards vary from one State to another. State and Commonwealth governments frequently battle over these issues. The National Environment Protection Council was established in 1995 with the aim of developing national environmental protection measures.

Measures to combat the continuing depletion of biodiversity are inadequate. There are still some concerns about whether the fisheries management measures introduced are sufficient to reverse the decline in some stocks.

Where environmental protection appears to be in conflict with potential economic development, some government agencies still promote economic development with little regard for the environmental costs. While land clearing is restricted in some States, in others it is still tolerated or even encouraged. Old growth forests continue to be logged.

Urban planning in general and transport planning in particular remain problem areas, with few effective attempts to contain the outward urban sprawl or improve public transport. As this report was being finalised, three State governments were proposing massive new urban arterial roads, encouraging more cars to drive longer distances. There is little sign of any concerted attempt to redirect the pattern of consumption into a sustainable direction.

Although the need to moderate emissions of greenhouse gases such as carbon dioxide is now internationally recognised, our response at all levels of government remains half-hearted. The European Union is committed to increasing the contribution of renewable energy sources from the current five per cent to 15 per cent within ten years. Funding of a new Cooperative Research Centre for Renewable Energy Technologies has just been announced, but we need to move beyond research to implementing programs that will curb growth in emissions.

As a general point developed in two earlier chapters, we do not yet have an integrated ecosystem-based approach to the management of our resources. Until we develop that approach, environmental management will be characterised by ad hoc responses to urgent problems without a strategic vision to achieve the ultimate goal of ESD. Despite the adoption in 1992 of the

National Strategy for Ecologically Sustainable Development and the emergence of the National Strategy for the Conservation of Australia's Biological Diversity, there is little evidence that these strategies affect decision-making in any but the most perfunctory way. Similarly, cultural heritage considerations are not systematically integrated into the management of natural resources.

Finally, there is little sign that economic planning takes serious account of the ecological impact of the options available at any time; it is assumed that the first priority is a healthy economy, with the doubtful corollary that other problems will be solved by sensible deployment of the wealth created. The economy is a subset of human society which is in turn part of the ecological system. Progress toward sustainability requires recognition of that fundamental truth and a willingness to build ecological thinking into all social and economic planning.

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