Environmental Issues and their Impact on Metropolitan Strategy

Technical Report 1

PLANNING MELBOURNE FOR THE 21ST CENTURY

Department of Infrastructure

Victoria
The Place To Be

Message from the Ministers

By world standards Melbourne is a great city. The Bracks Government is committed to maintaining Melbourne's reputation as a highly liveable city and an attractive investment destination. The Government has embarked on the preparation of a Metropolitan Strategy to set a clear vision for Melbourne's future liveability, prosperity and, importantly, its long-term sustainability.

The preparation of the Metropolitan Strategy is drawing on inputs from a wide range of sources. It is vital that the strategy has a sound research and information basis. It is also especially vital that community aspirations for the city's future be well understood. The key inputs to the strategy therefore include both a wide ranging public consultation program as well as a series of research or technical papers on issues that may have an impact on Melbourne's future.

The Bracks Government has given an undertaking to make as much of this background information as possible widely available to stimulate discussion about the future of Melbourne.

This report is one of the technical reports commissioned by the Department of Infrastructure, which we hope will stimulate feedback. At this stage content and recommendations are only the views of its authors and not necessarily the views of the Government. The Strategy is still in its early stages of development and we remain open to hearing what the broader community would like it to encompass.

We encourage you to read this and other technical reports and, should you wish, to make your views known about the future of Melbourne by contacting us on:

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Environmental Issues and their Impact on Metropolitan Strategy

This paper has been produced as a background discussion document for the Melbourne Metropolitan Strategy Project. The contents of this paper do not necessarily represent the position of the Department of Infrastructure or its employees or of the State of Victoria.

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EXECUTIVE SUMMARY

SCOPE OF ENVIRONMENTAL STUDY

This study is an examination of environmental issues and the way they should be considered in a metropolitan strategy.

The issues examined are: urban air quality; greenhouse gas emissions and energy efficiency; noise; water quality and catchment management; land development and the loss of habitat and biodiversity; industrial and household wastes.

HISTORY OF VICTORIAN STRATEGIC ENVIRONMENTAL PLANNING

Environmental factors traditionally have been considered during the development of strategic land use plans for Melbourne for over thirty years. Melbourne's original corridor-green wedge strategic plan was designed in part to protect resource and natural features. Structure planning for all Melbourne's growth corridors in the late 1980s assessed environmental features and designated strategic open space areas.

However environmental planning was limited in scope. It concentrated on natural resources and urban ecology - the protection of habitat, agriculture, resources, river catchments, landscapes and other natural values - and the purchase of strategic open space to form a metropolitan parks system. Planning generally did not analyse satisfactorily the impacts of alternative models of urban form, and the associated issues of energy use, and transportation models. Whole of government connections were rarely made between various sectoral planning elements, such as between urban expansion on the metropolitan fringe, air quality, public and private transport use, and various urban design models which might have led to alternatives to large scale car based retail/entertainment centres, and the proliferation of single use detached housing located away from public transport.

The 1987 Metropolitan Policy, for example virtually ignored transport, and the corridor planning process of the late 1980s paid no attention to urban form. Dual occupancy policy had little impact on density or population distribution and preempted more effective policy responses to population loss from the inner city areas. The few attempts at broader environmental planning, such as the District Centres Policy, were not implemented and usurped by political decision making which was responsive primarily to market pressures.

Urban consolidation policy in the 1990s similarly has been marked by contradictions. The coalition government in 1993 continued urban consolidation policy through *The Good Design Guide*. But at the same time it continued policies aimed at urban dispersal and sprawl, removed the minimum lot density requirement for corridor development, allowed massive expansions of car based regional activity centres and stand alone large retail stores outside traditional strip centres, and embarked on a major expansion of Melbourne's freeway system. Similarly, catchment management planning is not responding effectively to many important environmental problems and is not integrated with the land use planning process.

The current metropolitan strategy process offers a new opportunity to end fragmentation between agency decision making and to achieve whole of government responses to major issues. Melbourne has reached a critical phase in its history. The city continues to sprawl and is increasingly dependent on road based development. Demographic change and changing employment patterns have important implications for alternative patterns of urban form. Continued reliance on fragmented sectoral responses, such as continued freeway construction, without the full consideration of environmental and social factors, will lead ultimately to a crisis in the physical and social functioning of the city.

THE CONCEPT OF INTEGRATION

There are two major challenges associated with the Metropolitan Strategy process: addressing cross-sectoral issues, and ensuring that policy responses and institutional arrangements are integrated and implemented across government.

The concept of integration means that environmental, social and economic factors and their impacts on each other are considered.

First, the protection of environmental values must be regarded as fundamental.

Second, the scope of environmental planning must be broadened beyond issues related to urban ecology to a consideration of the impacts of different models of urban form on energy use, particularly transport energy use, and the impacts of different transport models on urban form.

Third, integration requires effective institutional arrangements including integration principles, the need for legislation and enforcement for policy implementation, and cross sectoral coordination

Fourth, integration requires the assessment of development proposals against a set of clearly stated criteria, including environmental criteria. The principles of ESD can serve as the basis for integrating the sectoral contributions to strategic planning decisions, and provide assessment tools to be applied to individual development proposals and decisions on urban systems through the assessment of such factors as life cycle greenhouse and energy impacts.

URBAN AIR QUALITY

BACKGROUND

On institutional arrangements, the National Environment Protection Council (NEPC) is the statutory body with law making powers and has Ministerial representation from each State, Territory and the Commonwealth. The State Environment Protection Policy (The Air Environment) 1981 was amended in 1999 to allow Victoria to formally adopt the 1998 National Environment Protection Measure for Ambient Air Quality (Air NEPM).

On standards, the Commonwealth Government is committed to the phased introduction of new emission standards for all vehicles based on the current United Nations Economic Commission for Europe Regulations (Euro) standards (DOTRS 1999). Significant emission reductions will be achieved for diesel vehicles. The EPA recently has released a preliminary draft State

Environment Protection Policy (Air Quality Management) (EPA June 2000), and has also released a draft Air Quality Improvement Plan for the Port Phillip Region.

The EPA also recently released the *Melbourne Mortality Study* (EPA 2000b), which details results of research into the health effects of air pollution in Melbourne. The pollutants identified as of most concern were ozone and nitrogen dioxide. The introduction of the new Euro standards for motor vehicles is likely to require more tightly specified fuel standards.

DATA AND TRENDS

The 1995/96 air emissions inventory shows:

- motor vehicles are a significant contributor to emissions of carbon monoxide,
- domestic wood combustion during the colder months is the most significant source of particles (PM 10 and PM 2.5)
- motor vehicles are the main source of the hazardous air pollutants
- emissions of the common air pollutants from motor vehicles decreased between 1990 and 1995/96 despite a 16% increase in vehicle kilometres travelled.

Motor vehicles and industry are the main sources of the precursors to ozone formation. The principal component of photochemical smog is ozone. Background levels during summer months are estimated to be as high as 0.04 ppm. There are three ambient air quality objectives for ozone, the most stringent being the eight-hour objective of 0.05 ppm. Melbourne has never achieved annual compliance with this objective since monitoring commenced in the airshed although there is downward trend.

Elevated particle levels occur mainly in autumn and winter. Particles less than 10 microns in diameter (PM10) are most widely associated with health impacts. In addition to the PM10 objective Victoria has a one hour air quality objective for visibility. The number of breaches in recent years is significantly lower (37 in 1998) but visibility is still a cause for concern.

The major source of nitrogen dioxide is the burning of fossil fuels with the motor vehicle being the predominant source. Peak levels of nitrogen dioxide are generally highest where traffic levels are greatest.

Motor vehicles emissions are also the predominant source of carbon monoxide. Melbourne's ambient levels of sulfur dioxide are low compared to other overseas cities. This is largely due to the low sulfur content of our fuel.

There has been a dramatic reduction in ambient lead levels since the introduction of unleaded fuel and levels have been well below the new ambient air quality objective for a number of years.

ISSUES

The Bureau of Transport and Communications Economics predicts that by 2015 car traffic is expected to grow by 20-40 per cent from 1995 levels in Australian's major capital cities and truck traffic by 60-80 per cent. In addition, inner city population, traffic densities, and therefore congestion, are expected to increase significantly particularly in the inner suburbs.

In Melbourne the average number of motor vehicle trips per capita has increased with a high proportion of relatively short trips (under 5 km) being made by car.

Industry is a major contributor to air pollution across the Port Phillip region and is often responsible for local air quality impacts. Projections for industry indicate that emissions will increase under the business as usual scenario.

The extent of motor vehicle usage is greatly influenced by a city's form. Integrated transport and land use planning are important long term strategies for reducing the level of motor vehicle dependence.

BEST PRACTICE

The control of our motor vehicle fleet is well behind world's best practice with more stringent emissions controls and fuel efficiency standards applying to most other developed countries.

The United Kingdom has introduced two new national planning policy guidance notes, PPG6 on town and retail development and PPG13 on transport. Their broad approach is to encourage urban containment especially for new housing, retailing, services and leisure and to underline the importance of retaining future transport choice by relating all major development to means of transport other than the car.

Poorly maintained cars can emit five to ten times the exhaust emissions of well maintained cars of the same age. It estimated that, on a fleet wide basis, exhaust emission improvements of 16% for VOCs, 25% for CO and 9% for NOx could be achieved through regular servicing.

An OECD report (1995a), summarising the available evidence, concluded that:

- building more roads has not noticeably reduced congestion - new road space is quickly filled
- where little or no attempt is made to increase road capacity in line with demand, cities do not grind to a halt. People and firms adapt and make other choices on mode or destination.

The OECD has also concluded that although congestion causes higher emissions, improving traffic flow eventually leads to more emissions overall as a result of the additional vehicle kilometres travelled generated.

Overseas a number of measures have been assessed or have been used or to influence motor vehicle use. Increases in charges for road use and parking were more effective than lowering public transport fares in reducing traffic growth. Improving public transport service has also been shown to be effective. Traffic calming aimed at reducing the attractiveness of private vehicle use can also be effective. A package of measures, including both incentives and disincentives, is required to reduce travel by motor vehicles.

LAND USE PLANNING

Urban form and air quality was assessed by one of the task groups as part of the Federal Government inquiry on urban air pollution. Modelling included a 'business as usual' scenario and 'compact', 'multi-node', 'corridor', 'ultra' and 'fringe' cities. From the available evidence, a preferred urban form from the point of view of air quality would most likely be a multi-nodal

metropolis with clearly defined activity centres centred on public transport, with many smaller 'urban village' type centres, along public transport routes. The aim would be to cluster destinations together at many mixed use centres – both larger and smaller ones

GREENHOUSE GAS EMISSIONS AND ENERGY EFFICIENCY

BACKGROUND

It will be important to ensure that future development assists, rather than hinders, reduction in greenhouse gas emissions, and that design and location of physical infrastructure takes account of the possible impacts of global warming,

Metropolitan development is a crucial climate change issue, as development influences the levels of greenhouse gas emissions associated with transport, buildings, infrastructure construction, biomass and industrial processes, as well as energy supply systems. If Victoria is to reduce its level of greenhouse gas emissions, urban systems must play a key role. Urban development strategies have potential to influence around 50% of Australia's energy use and greenhouse gas emissions.

One important issue is the extent to which the scope of a metropolitan strategy should be expanded to include elements that have traditionally been outside its scope, but which are potentially influenced by planning strategies. For example, urban planning decisions have important implications for energy use. Planning decisions lock-in travel patterns and land uses that have long-term effects. Urban areas also generate large quantities of organic wastes, and the ways they are managed and processed can have significant impacts on greenhouse gas emissions.

If we are to limit energy consumption and its economic, social and environmental costs, while continuing to develop our economy, it will be essential to decouple fossil fuel use from economic development. There is increasing evidence that this can be done at low cost, or even with economic benefits.

Institutional arrangements, policies and practices with regard to greenhouse gas emissions and energy are in a state of rapid transition. Restructuring of the electricity supply sector has contributed to an increase of 6 million tonnes of CO_2 per annum (almost 5%) above projected 'business as usual' nationally by 1998. The implementation of many elements of greenhouse strategies has also been slow and standards have been set at relatively low levels, as seen by very slow progress on improving new vehicle fuel efficiency. Other areas of activity that contribute to greenhouse gas emissions include organic wastes, industrial processes, agricultural practices, land use change and forestry practices. Stationary energy use is influenced by a range of policies and programs, including urban planning, building control, and appliance and equipment standards.

One important barrier to achieving greenhouse emission reduction objectives has been the failure to achieve 'whole of government' integrated responses. For example, to reduce transport energy and greenhouse gas emissions involves effective urban planning strategies on factors such as provision of public transport, road infrastructure, and parking. Each of these areas is controlled by a different institution and has a different culture.

DATA AND TRENDS

When the Kyoto Protocol is ratified, it will be necessary to clarify what constitutes a reasonable emissions target or reference level of emissions for Victoria, and for sectors within Victoria, so that government, business and the community can work within a more certain framework. It is likely that much larger emission reductions than now proposed will be required. If new urban infrastructure is not to become a barrier to further emission reductions, it must be designed to support and facilitate ongoing emission reductions in Australian greenhouse gas emissions.

Energy use is responsible for almost 80% of Victoria's greenhouse gas emissions. Almost all growth in emissions between 1990 and 1998 has resulted from energy growth. Of the end-use sectors, transport and manufacturing are the largest energy consumers, and both have experienced strong growth in recent years. Emissions are dominated by road transport, which uses over 85% of Victorian transport energy. Emissions from both transport energy and stationary energy have increased by around 20% over the period, with three-quarters of the growth in emissions from stationary energy coming from electricity generation and use. The overall increase in emissions has been just over 5 per cent. There has been significant growth in Victorian emissions since 1995, due largely to the increased utilisation of Victoria's older brown coal-fired power stations since privatisation.

Residential sector energy use is smaller than transport and manufacturing, but has grown strongly, with over 40% growth between 1981 and 1998, compared with 32% for transport and 24% for industry. Home heating and cooling, water heating, refrigeration and appliances are significant.

ABARE expects strong ongoing growth in transport and commercial sector energy use. On a statewide level, 81% of vehicle kilometres were travelled by passenger vehicles, 11.7% by light commercial vehicles (LCVs)), 6% by trucks and the remainder by motocycles and buses. Use of LCVs has been growing rapidly.

In 1999, the average passenger vehicle consumed 11.7 litres/100km. New car average fuel consumption for 1998 was estimated at 8.43 L/100 km, compared with a 1990 value of 8.9 L/100 km. Overall, Victorians pay over $4 billion each year for non-transport energy. It seems unlikely that prices will decline significantly.

A number of studies of the effects of different urban forms on transport energy use have confirmed that reducing the need to travel by locating people, employment and services closer together reduces transport energy consumption. Typically, households in inner suburbs own fewer cars per capita and are less likely to use cars to travel to work.

Both public transport vehicles and cars have potential to improve their energy-efficiency significantly, and could utilise a range of renewable transport fuels. Electrified public transport can, however, utilise low greenhouse intensity electricity without modifications. Provision of parking is becoming a major influence on urban planning.

Factors for commercial sector development that could be influenced during planning, design and construction include overall building energy efficiency or greenhouse gas emissions, energy efficiency of plant and fixed equipment, including lighting. Much of the energy used by industry is involved in processes that are not easily addressed by urban planning strategies, however, urban planning and development issues can affect energy use.

ISSUES

New institutional arrangements could include: relating the metropolitan strategy to a 'whole of government' greenhouse response strategy, developing partnerships with business and the community, clarification of the roles of market mechanisms, regulation, information and other policy options.

Other issues the metropolitan strategy could consider include: provision of access to natural gas and other low greenhouse impact energy sources in new (and existing) developments; energy-efficient building envelope design; installation of energy-efficient equipment; utilisation of renewable energy sources; management of organic wastes

OTHER POLICIES

For residential buildings, the existing insulation regulations provide only limited energy and greenhouse savings. A set of clear greenhouse criteria are needed, against which each dwelling can be evaluated.

The existence of provisions for building energy efficiency in the existing building regulations, and in the draft RESCODE sets a precedent for incorporation of building energy requirements in the metropolitan strategy. For non-residential buildings, a national building energy code is likely to have limited impact on greenhouse gas emissions.

Systems can be used to encourage or require developers, builders and market intermediaries (designers, consultants and contractors) to achieve high standards of performance. Energy performance provisions have been included in local planning requirements by several NSW councils.

New development projects should achieve much lower greenhouse gas emissions than existing urban stock. To achieve this, standard methodologies for evaluating the lifecycle energy/greenhouse impact of new developments are needed.

Increased utilisation of existing urban resources should be a key priority of the metropolitan strategy. Planning strategies can help to reduce transport energy use including facilitating easy and cheap access from homes to services and employment; promoting energy-efficient low greenhouse impact transport modes; discouraging inappropriate or inefficient use of road transport; developing practical strategies for management of car parking

NOISE

BACKGROUND

Preventing and resolving noise related problems requires effective land use planning, noise control from stationary sources, controls on traffic noise and considerate behaviour by all members of the community.

At a national level the National Road Transport Commission (NRTC) and the National Environment Protection Council (NEPC) have statutory roles related to the environmental performance of motor vehicles. The *Traffic Noise Reduction Policy* (1997) is administered by VicRoads. This policy, in the absence of any traffic noise standards being set by EPA, is an

internal policy containing objectives for major new roads. VicRoads endeavours to 'substantially comply' with the criteria using the most cost effective technology. VicRoads also operates a noise barrier retrofitting program whereby noise amelioration works are carried out on freeways built prior to 1979.

Local government has responsibility for local roads. The response by individual councils to traffic noise issues vary.

The *Environment Protection (Residential Noise) Regulations 1997* prescribes the types of noise emanating from residential premises. Concert noise from indoor and outdoor venues in Victoria is controlled by a combination of mechanisms established under the State's planning and environment legislation. One of the key mechanisms is the *State Environment Protection Policy (Control of Music Noise from Public Premises) No. N-2*. Noise limits of outdoor venues are 65dB(A) when measured outdoors and 55 dB(A) when measured indoors. The *State Environment Protection Policy (Control of noise from commerce, industry and trade) No. N-1* specifies maximum noise limits that may be emitted from commercial, industrial or trade premises.

DATA AND TRENDS

Over 9 per cent of the Australian population is exposed to excessively high levels and 39 percent to undesirable levels of noise. The noise with the greatest impact on residential communities originates from road traffic and barking dogs: 40 percent of Australians experience disturbance to listening activities or to sleep because of some form of noise pollution; 29 per cent of trucks generated noise in excess of Victorian requirements on a stationary noise test.

By 2015, car traffic is expected to grow by 20-40 per cent from 1995 levels in Australian's major capital cities and truck traffic by 60-80 per cent. This will lead to freeways operating to capacity, increases in traffic diverted to main arterial roads and increased stop-start traffic, all of which will result in elevated traffic noise levels.

ISSUES

Victoria's traffic noise policy, under VicRoads, aims to achieve levels that the OECD regards as inadequate, do not meet world's best practice, and are limited.

With the promotion and trend towards increased urban consolidation, adequate noise mitigation through good design and the use of materials with sound reducing properties will become increasingly important. Noise issues are currently not considered in the Residential 2000 Code and generally are not given adequate consideration in the development, design and building and approval stages.

The diversity of approaches to noise has led Austroads, the national association of state road authorities, to consider and possibly scope the formulation of a national noise policy. Expected date of completion of this process is the end of 2001. NSW has recently released a new traffic noise policy. It has the most stringent traffic noise criteria of any state in Australia and is considered world's best practice.

OTHER POLICIES

Noise impacts from roads and industry in residential and other noise-sensitive areas often stem from inappropriate land-use decisions that allow development close to these areas.

With increasing urban consolidation residential noise is likely to become a more important issue. Planning and building codes should be reviewed to ensure they include adequate measures to protect indoor amenity from noise. A traffic noise policy should be developed that meets world's best practice and covers all roads. Developing a whole of government approach to noise would maximise the impact of mitigation measures.

WATER QUALITY AND CATCHMENT MANAGEMENT

BACKGROUND

Melbourne Water Corporation is responsible for managing Melbourne's catchments, harvesting and storing water and supplying the water to the three retailers of water, City West Water, South East Water and Yarra Valley Water. For the City of Geelong, Barwon Water collects, stores and distributes water. Waterway management is undertaken by Melbourne Water. The West Gippsland Catchment Management Authority (CMA) is responsible for the Bass River Catchment and the Corangamite CMA for the catchments to Corio Bay. River Management is exercised by Melbourne Water and by the Corangamite and Wast Gippsland CMAs.

Allocation of water from streams and rivers to users is through two processes. For stretches of the river where storages regulate flows, bulk entitlements to water are negotiated after determining the flows that are needed to ensure the maintenance of stream ecosystems. Where river stretches are unregulated, Stream Flow Management Plans are prepared that identify the volumes of water that can be taken and still ensure adequate flows throughout the year.

Land use, land management and the activities that occur on rural and urban land are the determinants of water quality in our waterways and bays.

The Port Phillip Catchment and Land Protection (CALP) Board is one of ten organisations set up by the government under the *Catchment and Land Protection Act* 1994 to influence the way catchment land is managed throughout Victoria. The Port Phillip CALP Board and the Corangamite CMA have prepared Regional Catchment Strategies (RCSs).

The objectives for water quality of the rivers, streams and Bays are established through State Environment Protection Policies (SEPPs), prepared by the EPA.

DATA AND TRENDS

The water supplied to metropolitan Melbourne by Melbourne Water and its predecessor, the Metropolitan Board of Works, increased to the mid 1980s, growing on average by 2.9% each year. Waste water treatment plants operated by Melbourne Water collect over 300,000ML of water each year and potentially approximately this volume would be available for sale and reuse.

Waterways in parts of all sub-catchments are showing high levels of nutrients, high turbidity and suspended solids, unacceptable levels of E. coli and particularly in the middle and lower parts of catchments, stretches of waterways judged to be in poor condition. The Dandenong Creek catchment experiences particular problems with sedimentation arising from erosion at the top of the catchment and sediments from construction activity posing a serious problem. The urban area comprises only about 18% of the land area in the catchment yet contributes the greatest loads of nitrogen, phosphorus and suspended solids to Port Phillip Bay. Based on load per unit area, urban areas deliver twice the nitrogen, phosphorus and sediments compared with rural land uses.

Urban and agricultural activities are the main threats to the health of Western Port's environment. It is estimated that 70% by area and 85% by biomass has been lost with the reasons being unclear. Turbidity and desiccation may have exacerbated this loss. Nutrient levels appear to be low with the exception of nitrogen levels in the East Arm of the bay.

Port Phillip Bay was the subject of an extensive four year study by CSIRO commencing in 1991. The study found that nutrient loads in water flowing onto the Bay were central to maintaining a tenuous ecological stability. If nitrogen levels are not maintained below the critical level, CSIRO has predicted that far reaching changes to the Bay's ecological systems will occur. The CSIRO also emphasised the threat posed by the introduction of exotic species that can alter the way the entire Bay functions.

Subsequently, Regional Catchment Strategies and the SEPP for Port Phillip Bay stipulated the annual nitrogen load entering the Bay is to be reduced by 1000 tonnes by 2006 through a draft nutrient reduction plan and a reduction in the nitrogen load in water flowing out of the catchments.

Usage patterns seem not to have changed greatly, although internationally, Australia has one of the highest water consumption levels per capita. The combination of an increasing population, perhaps increased water use per household and more households, plus a higher degree of demand sensitivity to drought and continuing fringe development, strongly suggests that water consumption will continue to rise with periodic sharp increases due to seasonal conditions. The size of residential blocks is a major determinant of water consumption. Core and inner areas may consume two to three times less water per head than outer suburbs. Waste water collected by Melbourne Water may have fallen slightly over the past seven years.

Institutional frameworks generally have not been adequate to the task of protecting the water qualities and related ecological processes in both bays. There are no effective controls on runoff during road and building construction in Melbourne's growth corridors. Catchment management policies have been developed but will often be ineffective in controlling pollution of streams, and inadequately implemented. There are no satisfactory arrangements to relate catchment management policies to land use planning decisions. Excessive reliance continues to be placed on voluntary measures.

There can be little doubt that increasing the quality of water in urban waterways and the bays will require continuing and substantial investment in catchment programs tackling urban and rural issues. The waterways receiving greatest attention are those that fall within the jurisdiction of Melbourne Water. Investment in waterway restoration is minimal and little progress is being made on improving water quality and waterway health.

ISSUES

The quality of potable water supplied to urban areas from the forested and closed catchments has always been high. For urban areas, stream quality will generally be poor, influenced mainly by diffuse sources but also by some poorly managed point sources.

The sustainability response to the increasing consumption of a resource, in this case water, is to reduce demand and use the resource more effectively rather than seek to augment the stock of water to allow increased flows. There are various examples of housing projects where infrastructure is installed to allow reuse of waste water and capture of rain water.

A further approach to reducing water demand lies in stimulating the increasing demand for medium density housing in central Melbourne and the inner suburbs. This increases residential densities and reduces the use of water for lawns and gardens.

An important consequence of the lack of a Waterway Management Authority for much of the region is related to drainage and flood plain planning. This will be an increasingly urgent issue if outer urban development impinges on flood plains and catchment drainage patterns. A Metropolitan Strategy needs to address this issue.

OTHER POLICIES

A sustained, whole of government (including the retail water businesses) program is needed to reduce per capita consumption of water.

Other possible measures include the installation of water conservation systems (rain water capture, waste water reuse, storm water capture and use) by developers and builders; increased opportunities to reuse treated water; requiring on site containment of sediment during construction, and water reuse; ensuring that all planning schemes adequately reflect, through local policies, zones, overlays and schedules best practice management to improve catchment management and the health of waterways; strict controls over land uses and/or land management practices which lead to increased sedimentation; ensuring that proposals that could add to the existing nutrient loads in Port Phillip and Westernport Bays are subject to full examination so they are consistent with statutory requirements and the objectives of SEPPs.

Implementation arrangements would have to be put in place for these policies. These would have to be prepared by the EPA, other relevant government agencies, local government, community groups and the development industry and implemented through the planning and buildings approvals systems.

LAND DEVELOPMENT AND THE LOSS OF HABITAT AND BIODIVERSITY

BACKGROUND

Biological diversity (or biodiversity) includes the genetic diversity or variability which occurs within each species, the diversity of the Earth's species of animals, plants and other organisms, and the

diversity or range of different ecosystems these species form. Its conservation is necessary to retain the full evolutionary potential of our natural systems.

Australia has a rich and diverse range of native flora and fauna, comprising about 450,000 species or some 5% of the world's estimated species. In Victoria, 21 of 89 native mammal species have become regionally extinct and another 19 are considered endangered, rare or vulnerable. This is almost half the original total. Of a total of 3, 014 vascular plant species, 28 are extinct in the State another 815 are endangered, vulnerable or rare in Victoria, corresponding to 29% of all species.

The Department of Natural Resources and Environment (DNRE) has statewide responsibility for the protection, conservation and management of Victoria's natural environment. Parks Victoria, manages, on behalf of DNRE, Victoria's national, wilderness, state and regional parks, and Melbourne's metropolitan parks and open space network. It also has responsibilities for the recreational management of the Lower Yarra, Maribyrnong and Patterson Rivers and Port Phillip and Western Port Bays.

Australia ratified the international *Convention on Biological Diversity* in 1993 which places obligations on countries to protect biodiversity and their ecosystems, and establish equitable means for access to and utilisation of genetic resources. This is supported by a *National Strategy for the Conservation of Australia's Biological Diversity* (1993) which was approved by the Commonwealth and Victorian Governments.

The Victorian Biodiversity Strategy (1997) which complements the National Strategy and the *Flora and Fauna Guarantee Act 1988,* provides the overarching direction for biodiversity conservation and management in Victoria. It is coordinated with other natural resources management mechanisms such as Regional Catchment Strategies, Regional Forest Agreements, and National Parks and Reserve planning.

The Victoria Planning Provisions include a state policy reference, an overlay and a particular provision providing for vegetation retention.

DATA AND TRENDS

Most of the original native vegetation of the Melbourne metropolitan region has been cleared or substantially modified since European settlement: 98% of bushland has been lost to urban development with many of the remaining areas highly fragmented and under further development pressure. Urban and urban fringe areas often have small remnants of habitat, which are highly valued by the local community. Within greater Melbourne there is an important network of parks, trails, waterways and coasts. This network provides the foundation of significant remnant habitat for the protection of biodiversity.

Larger conservation reserves and a range of reservoir parks are supplemented by many rail and streamside reserves and smaller urban parks and reserves. In recent years there have been some significant additions to the conservation estate.

The major data sets available for analysis of the biodiversity in Melbourne comprise two forms: reports of flora and fauna surveys and assessments of habitat and sites of significance undertaken for various regions of metropolitan Melbourne and surrounds.

Sites of botanical, zoological and habitat significance from the national to local level have been identified in pockets across Melbourne. Of particular interest are the sites outside the parks and reserves network where important remnants and potential habitat linkages are to be found.

Strategic planning for Melbourne identifies urban growth corridors interspersed by 'green wedges'. The largest amounts of open land available for residential development are located to the west of Melbourne, in areas such as East Melton, Wyndham Vale and Point Cook, to the north around Whittlesea and South Morang and in the east along the Cranbourne – Pakenham corridor.

The on-going expansion of urban and rural housing development has important implications for biodiversity. This expansion will lead to large areas of land, previously under native vegetation or agricultural use, being subsumed by housing, road networks and associated infrastructure.

Over the past 150 years, most of Victoria's fertile lowlands have been cleared for grazing, cropping and residential occupation. The impacts have included loss of native plants and animals, slowly rising water-tables and salinisation of land and streams. Increased run-off from the cleared land has increased stream flows and led to significant erosion both of the land, streambanks and streambeds.

The size of the remnant area of native vegetation is a key determinant of its viability and value as habitat. Despite native vegetation retention controls, clearing of native vegetation continues across the Metropolitan region for agricultural land, for residential development, to assist in road works and to increase access for certain utilities.

Introduced species of plants and animals compete for food and space with native flora and fauna. Of the 4000 or so vascular plant species found in Victoria, approximately one quarter, are introduced.

Agricultural activity in the Metropolitan Melbourne region can lead to increased nutrient run-off and contamination of surface water run-off; degradation of riparian ecosystems; long term native vegetation and native bird habitat loss; chemical contamination and toxic impacts on the health of native fauna.

Development Trends in Outer Melbourne

The majority of original native vegetation in the Berwick – Pakenham corridor has been cleared or substantially lost, through agricultural and urban development.

Significant although highly fragmented areas of Plains Grassy Woodland are found in the Plenty Valley region. This vegetation type is now very rare, and considered depleted with less than seven percent of the remaining areas protected in conservation reserves statewide. There are a number of major conservation reserves in the area that are important reservoirs of biodiversity. The acquisition of the Craigieburn Grasslands has improved protection for a diversity of grassland communities and accompanying threatened flora and fauna.

Five sites of faunal and habitat significance representing significant stands of River Red Gum and associated native grasslands have been recommended for inclusion in the Plenty Growth

Corridor Red Gum protection zone. Urban expansion is likely to affect areas of remnant grassland and grassy woodland.

The City of Hume is projected to have the fifth largest net increase in population of all Melbourne Local Government Areas. All major waterways in this area, with the exception of Moonee Ponds Creek, are recognised as having highly significant environmental values. The natural vegetation remaining is small.

The City of Wyndham contains a number of publicly owned or reserved sites identified as having international conservation significance, including the Sewage Treatment Lagoons at Werribee and the Point Cook Coastal Park. New developments may affect the conservation significance of Point Cook and Skeleton Creek and the Werribee River.

Within the City of Brimbank, there are numerous sites of significance. Although the majority of the Derrimut Grassland is reserved, the integrity of the site is potentially threatened by nearby residential development. In particular, the changes to local drainage patterns likely to result from residential development could have implications for its long-term viability. The upper Werribee River is likely to be affected by urban development in Melton South.

The proposed extension of the Eastern Freeway may see the loss of substantial remnants of native vegetation which have persisted in the steep terrain of Mullum Mullum Creek. This will be dependent on the specific alignment and construction plans for the freeway.

The threats to biodiversity of major immediate concern in the Melbourne Metropolitan region are: the loss of remnant native vegetation, habitat and native species through urban land development and transport corridors through high conservation areas as well as continuing low-level clearing and the decline of isolated vegetation fragments; inadequate management of remnant vegetation; the impact of grazing on remnant grassland and wetland communities; predatory introduced species, particularly cats, dogs and foxes, on local wildlife; the pressures placed on the open space network by recreational users.

Effective conservation of biodiversity will require changes to current approaches to land use practices, pollution control, resource consumption, waste and recycling, valuation of natural resources and the role of the community and individuals in protecting the environment.

The Merri Creek Management Committee has achieved impressive results through its coordination of four local councils, Melbourne Water, local industry and residents. The on-going re-establishment of vegetation and wildlife corridors along the lower reaches of the Yarra River linking the disjunct sections of the Yarra Valley parklands provides an important case study in habitat restoration for migratory and threatened species as well as valuable recreational corridors.

OTHER POLICIES

A number of measures should be considered within the Melbourne Metropolitan Strategy. In particular there is a need to establish effective coordination in planning across state and local government to ensure implementation of the following policy measures: promote urban development in areas other than those identified as having significance for biodiversity; establish stronger controls to limit subdivisions where remnant vegetation or threatened species habitat is

located; prevent loss of habitat from future infrastructure installation; establish wildlife corridors; introduce stricter controls over the removal of remnant native vegetation and wetlands; prevent development in floodplains and agricultural or residential use of riparian zone land; restore vegetated streamside buffer zones and fence the riparian zone and stream banks from grazing; expand the strategic open space network; prevent road construction along native vegetation and waterway corridors; conserve roadside reserves.

INDUSTRIAL AND HOUSEHOLD WASTE

BACKGROUND

During recent years residential kerbside garbage and recycling collection have been consolidated and enhanced while an increased emphasis has been placed on voluntary industrial waste minimisation through eco-efficiency and cleaner production. In Victoria, currently over 90 per cent of homes have access to kerbside recycling.

In 1992, the Victorian State Government set a target to reduce waste deposited at landfills by 50% by the year 2000. According to the Victorian Auditor-General, the desired outcome has not been achieved, but as noted by the Environment Protection Authority, the target was set during a low point in economic activity in Victoria and no calculation has been made for population changes since 1992.

Location and management of landfill sites remain contentious issues and are highlighted by mistrust from the community, particularly in relation to prescribed waste facilities. A review of the management of industrial waste was completed in April 2000 in an attempt to address community concerns. Prescribed waste generated in Victoria increased by 54,294 tonnes from 597,706 tonnes in 1995 to 652,000 tonnes in 1998. Low-level contaminated soil accounted for approximately one third of this increase.

Environment Australia delivers national leadership on environmental issues through programs and policy. *The Environment Protection Authority* (EPA) utilises the Environment Protection Act 1970, State Environment Protection Policies, Industrial Waste Management Policies, and a range of tools including Best Practice Environmental Guidelines to help manage waste. The EPA offers a range of incentives such as loans and grants aimed at increasing the uptake of cleaner production by industry. *EcoRecycle* is Victoria's peak waste management organisation.

There are four Regional Waste Management Groups that represent the Melbourne Metropolitan region. These Groups have statutory responsibilities for waste management within their region, including the development of waste management plans. Waste Management Plans must be submitted to the EPA for approval.

Commonwealth and State governments are promoting improved management of industrial waste through policies, strategies, education (for example the Waste Wise Program), cleaner production and eco-efficiency. All States and Territories (other than NT), major business in the packaging chain, and some local government organisations have agreed to a voluntary National Packaging Covenant. A National Environment Protection Measure on Used Packaging Materials (NEPM) supports the Covenant. The Covenant places obligations on business and each state and territory to ensure implementation and ultimately a reduction in the use of raw materials, improved resource recovery and recycling.

In April 1998, the EPA released the new industrial waste strategy for Victoria*, Zeroing in on Waste.* In 1998 the EPA also released the draft SEPP for the Prevention and Management of Contaminated Land. In June 1999, the EPA released the draft Industrial Waste Management Policy (Prescribed Industrial Waste) for public consultation. Under the Victorian *Environment Protection Act 1970*, solid waste going to landfill in the metropolitan area, Mornington Peninsula, Geelong, Ballarat and Bendigo incurs a fee of $4 per tonne until 30 June 2002. In February 1999, the levy for hazardous waste going to landfill was increased to $10 per tonne to provide an incentive to reduce hazardous waste going to landfill.

DATA AND TRENDS

Significant improvements have been achieved in waste management at the municipal level but green, organic, commercial and industrial waste require attention in order to reduce the amount of waste being deposited at landfill. There has been a slight decrease in the amount of solid waste going to landfill from the Melbourne metropolitan area since 1992/93. The household garbage and recycling streams are increasing, however the overall diversion rate (amount of household waste diverted to recycling) is marginally decreasing.

Recycling levels have increased for ten categories. The most notable decreases are in food waste, aluminium, non-ferrous metals and plastic. An audit in 1999 indicated that approximately 184,000 tonnes of green organics were handled by local government. The most significant impediment to the reprocessing of organic waste is the availability of adequate and sustainable markets for the end product.

Prescribed waste includes solid and liquid wastes. Between 1995 and 1998 there was an increase of 54,294 tonnes of prescribed waste generated in Victoria. The increase in hazardous waste generation between 1995 and 1998 highlights the need for both eco-efficiency within industry and plans for future repositories, long term containment facilities or soil banks. The relatively low cost of disposing solid prescribed waste to landfill, (currently around $70 per tonne) is the single major impediment to innovation such as re-use, recycling or energy recovery. In 1998, almost 35 per cent of the hazardous waste sent to specially engineered landfills was contaminated soil.

Victoria currently has ample landfill and this keeps landfill charges low when compared to other parts of Australia and other developed countries. The availability of landfill minimises pressure on landfill operators to implement best practice. The Eastern Regional Waste Management Group appears to be the only metropolitan region that has insufficient suitable landfill space within its own region.

Transfer stations and Materials Recycling Facilities (MRF's) are being utilised and developed to address resource recovery needs of the regions. Over the past three years, EcoRecyle has provided over $10 million in funding to establish a network of best practice transfer stations and resource recovery facilities throughout Victoria. Therefore, with the exception of prescribed waste, transporting waste over excessively long distances is not considered to be a major concern in the foreseeable future.

During recent years there has been an increased recognition of the need to address industrial waste minimisation through eco-efficiency and cleaner production, though much more needs to

be done particularly on the performance of small to medium enterprises and through trade waste agreements. Residential kerbside garbage and recyclable collection are well established systems with high participation rates.

OTHER POLICIES

The Metropolitan Strategy should consider the need for land to be set aside for landfills, transfer stations, containment facilities and soil banks in strategic locations that minimise disturbances to residential areas and provide for transport routes that take into consideration economic, social and environmental impacts; industrial waste minimisation should be supported by substantial financial incentives, effective marketing and education, legislation and significantly increased disposal costs; an overarching strategic waste management plan could be considered to facilitate the integration of waste management for the whole of the Greater Melbourne Area.

URBAN DEVELOPMENT MODELS

The following models are generally accepted as the main alternative models of urban form:

- Compact city (conventional consolidation)
- Compact city, or multi-node city (traditional neighbourhood, or urban village, development)
- Dispersed city (business as usual, fringe or edge city)
- Corridor city
- Decentralisation and new towns (ultra city)

PREVAILING PATTERN OF DEVELOPMENT

Urban consolidation is typically defined as an increase in population and/or dwellings within an existing urban area, or the fullest use of an existing urban area. Intensification refers to both built form and activity.

In recent years, a reversal of the pattern of population loss from inner and middle ring municipalities has occurred. Urban consolidation has occurred through infill development and a pattern of incremental single lot redevelopment. Most of the medium density development which has occurred in the inner and middle ring suburbs has been built close to public transport. However, little mixed use development has occurred. Most has been car based, has not been linked to other measures designed to reduce car use, and has not been linked to public transport improvements. It is likely that increased medium density development in these areas has had little impact on public transport use.

The development model generally followed in Melbourne's urban growth corridors has been one of low density residential allotments and detached housing. No particular regard is usually given to public transport access, energy efficient design, water conservation and reuse, or integrated uses. Political and market forces have assisted the dispersal of key city elements such as housing, office, retail and service facilities. This dispersal is likely to be aided by urban freeways. This model of growth reinforces the use of motor vehicles.

URBAN FORM AND ENVIRONMENTAL BENEFITS

It is generally accepted that urban form affects the way cities function and can lead to social, economic or environmental benefits or problems. Manipulating land uses and forms, in particular the shape, size, density and uses in cities, is a way to promote environmental benefits. Conversely, the physical form of cities has led to serious environmental, social and economic problems.

Australia's high per capita energy consumption, low urban densities and high levels of road use make major contributions to very high per capita carbon dioxide emissions. Per capita motor vehicle travel is about 20 per cent higher than the OECD average. All transport accounted for 25 per cent of Australian sectoral CO_2 emissions from energy use in 1990-91, with road transport making by far the highest contribution at 76 per cent of the total transport emissions in CO_2 equivalent terms.

COMPACT CITY MODELS

A gradual consensus has emerged that compact cities emphasising the multi nodal city, with consolidation applied selectively around higher density mixed use activity centres linked to high quality (including high frequency) reliable public transport offer the best environmental, social and economic future. The benefits claimed include reduced car travel and emissions, lower infrastructure costs, more varied and intensified social activities particularly those associated with the public realm, protection of countryside, better access to services, and a range of claimed benefits relating to quality of life.

These changes to urban form need to be linked to other measures aimed at discouraging car travel, such as residential, commercial and retail car parking restrictions, pricing measures, traffic restrictions, and ultimately perhaps restrictions on car use. These other variables may be also important influences on the amount of vehicle use. There is evidence also that high quality public transport can reduce car use independently of urban form.

Other research points to complexities and the effect of variables other than urban form. There is still considerable debate over whether urban population and employment density independently affect travel demand and modal choice. There are also conflicting views about the impact of mixed uses on travel demand. Localization of employment and services, accessibility and high quality public transport are critical variables affecting results of studies.

It is sometimes argued that the conventional consolidation model may lead to increased vehicle use, congestion and emissions particularly in inner city areas. In particular, medium density single use housing dispersed anywhere in a city, not linked to policies discouraging vehicle ownership and use or the provision of alternatives to cars is said to encourage car use.

However, even the corridor city model performs better than the dispersed or fringe city on photochemical smog, particles, and emissions. Others have argued that the compact city was the most fuel efficient of all urban forms with 43 per cent less fuel consumption than business-as-usual, or laissez-faire, low density, dispersed development.

Transport infrastructure continues to affect land use.

Fuel pricing and demographic characteristics may also be important factors. Studies report that with increasing income, trip frequency increases, as do commuting distances and overall transport energy consumption. Typically households in inner suburbs of Melbourne and Sydney own fewer cars per capita than households in the outer suburbs and the Melbourne average, and are less likely to use them to travel to work.

AUSTRALIAN STUDIES INTO DENSITY, MIXED USE AND TRAVEL PATTERNS

A number of major Australian studies have provided empirical support for the benefits of the multi nodal compact city or urban village model and have examined the influence of urban form on travel patterns and energy use including studies by Kinhill, which found that greenfield residential densities of 15 lots per hectare and higher street connectivity led to a six per cent saving on infrastructure costs compared to a conventional "sprawl" scenario using 10 lots per hectare, and Maunsell and Glazebrook.

Loder and Bayly found that savings of up to 57 per cent of transport energy use could be achieved primarily by increasing the proportion of local employment, retail and related land uses which provided high levels of self containment for daily activities. Energy savings of up to 26 per cent over conventional detached housing could be made by designing houses to make the most of solar energy for heating and cooling, and using shared walls and floors like those in terrace or apartment housing.

POLICY IMPLICATIONS

Two forms of self contained neighbourhoods are being proposed in Australia and other countries. These are:

- revitalizing urban areas through infill and the development of mixed use areas around existing activity centres within 400 metres of a public transport stop
- designing new outer suburban "greenfields" sites using the same principles and a design model emphasising street connectivity, a range of lot sizes and an average density of 25 lots per hectare.

Some states have attempted to impose or encourage higher densities on the urban fringe, but not Victoria.

1. INTRODUCTION

1.1 SCOPE OF ENVIRONMENTAL STUDY

This study examines environmental issues and the way they should be considered in a metropolitan strategy. The study is one of a number associated with the development of a new metropolitan strategy for Melbourne and has been prepared for the Victorian Department of Infrastructure.

Study aims are to:

- gather data on environmental issues and to analyse this data
- provide advice on how these issues might affect metropolitan development
- indicate possible responses to data and issues identified in the development of a new metropolitan strategy

The issues chosen by the Department of Infrastructure for examination are:

- urban air quality
- greenhouse gas emissions and energy efficiency
- noise
- water quality and catchment management
- land development and the loss of habitat and biodiversity
- industrial and household wastes

1.2 STRUCTURE OF THE REPORT

Section 2 examines the history of attempts to consider environmental factors in strategic land use planning at the metropolitan level, and the concept of integration. A separate section is then allocated to the consideration of each issue. For each issue, the report is structured around a series of headings: background; data and trends; issue identification including legislative, policy and institutional frameworks; scenarios; best practice; and policy options. Section 9 introduces a number of urban development models and reviews the international research literature for the implications of these models for environmental performance. This section develops conclusions about which model of urban development includes the best environmental outcomes. Section 10 examines policy options and implementation arrangements.

2. BACKGROUND

2.1 HISTORY OF VICTORIAN STRATEGIC ENVIRONMENTAL PLANNING

The consideration of environmental factors has been a feature of strategic land use decisions in Melbourne for over thirty years. The former Melbourne and Metropolitan Board of Works (MMBW) assessed environmental and resource features and attempted to protect them in developing the original development corridor-green wedge strategic plan for Melbourne. The 1987 metropolitan strategy *Shaping Melbourne's Future* continued this approach by maintaining the corridor-wedge plan and the exclusion of further urban growth from important areas around the urban fringe.

Structure planning for all Melbourne's growth corridors in the late 1980s included detailed assessments of environmental features and the inclusion of strategic open space areas. Structure plans attempted to protect key environmental assets such as important red gums in the Plenty Valley, and native grasslands in the Werribee corridor. Strategic planning in the south east attempted to minimise impacts of urban growth on Western Port bay.

However this strategic planning was severely compromised by the South Eastern corridor structure plan extending urban development over a large part of the green wedge in the Cranbourne-Pakenham areas. During the 1990s, further incremental loss of the green wedge has occurred along with extensive development in other important environmental areas such as in the Upper Yarra Valley and Dandenong Ranges.

Environmental planning in Melbourne was also limited in scope. It concentrated on the protection of habitat, agriculture, resources, river catchments, landscapes and other natural values, and the purchase of strategic open space to form a metropolitan parks system. This focus on elements of urban ecology did not extend into analysing alternative models of urban form to limit private vehicle, reduce household and vehicle energy use, and control air pollution. Policies aimed partially at integrated land use/transport planning, such as the District Centres Policy, were not implemented and often undermined by other government decisions such as approving car based regional retail shopping centres. Many other elements of strategic land use planning contradicted the objective of environmental protection. In particular, the MMBW adopted both the *Melbourne Transportation Study* which produced a series of environmental problems and promoted increased car use through a massive system of freeway construction, and the corridor-wedge plan which proposed environmental benefits. The 1987 Metropolitan Policy virtually ignored transport.

Governments were slow to adopt housing policies which varied the traditional concentration of outward growth of single use detached housing far from public transport. Development of dual occupancy policy was slow and both ineffective and counterproductive as a means of promoting urban consolidation. The corridor planning process of the late 1980s paid no attention to urban form and led largely to the continuation of conventional detached housing on a range of relatively large lot sizes. This was a lost opportunity to reduce enforced dependency on the car through an intensification of housing and mixed uses close to public transport, and to vary the conventional street design. Nevertheless, by the early 1990s, the state government had moved towards the adoption of stronger urban consolidation policies through initiating VicCode 2, requiring a minimum density of 15 lots per hectare on the urban fringe, and through strategic planning statements such as the 1992 *Urban Development Options* and *A Place to Live.*

Urban consolidation policy in the 1990s similarly has been marked by contradictions. The coalition government in 1993 continued urban consolidation policy through *The Good Design Guide*. But at the same time it adopted policies aimed at urban dispersal and sprawl, removed the minimum lot density requirement for corridor development, allowed massive expansions of car based regional activity centres and stand alone large retail stores outside traditional strip centres, and embarked on a major expansion of Melbourne's freeway system. Consolidation policy attempted to promote mixed use higher density development around public transport through a design code which allowed single use medium density development anywhere in the metropolitan area. Much medium density development has been built close to public transport, but there is no evidence that this has led to changes in road use, or an increase in public transport use. This development may be close to public transport but does not seem to be transit oriented.

Similarly, the former coalition government's planning policy *Living Suburbs,* and its transport policy *Transporting Melbourne,* proposed the concept of integrated land use/transport planning, and mixed use centres, but promoted large scale freeway construction aimed partially at attracting road based development along freeway routes and interchanges and so influencing land use.

In summary, Melbourne's strategic environmental planning has been marked by limitations and contradictions. The attempt to protect key environmental features through the corridor-wedge plan has been compromised by large extensions of urban growth into green wedges, and by the loss of key habitat inside corridors. Environmental planning has concentrated on habitat and resource protection but generally has not adopted and implemented consistent policies aimed at influencing energy use, particularly transport energy use, and varying conventional approaches to urban form.

2.2 THE CONCEPT OF INTEGRATION

Earlier strategic planning gained environmental data, and attempted to protect land and water systems, values and resources, through zoning and other land use planning techniques. This attempt has been only partially successful and limited the scope of environmental factors to be protected.

There are two major challenges associated with the Metropolitan Strategy process: addressing cross-sectoral issues, and ensuring that policy responses and institutional arrangements are integrated and implemented across government. Programs such as the Victorian Urban Villages project have not been implemented by government or integrated with other change and urban development processes.

The concept of integration means that environmental, social and economic factors and their impacts on each other are considered. It means that the environment should not be regarded as a "limited independent sector" but that consideration of environmental values and the environmental impacts of proposals are built into decision making processes. The integration of environmental factors into decision making requires a series of institutional and decision making processes which have never been fully followed in Victoria.

First, the protection of environmental values must be regarded as fundamental, not incidental to the planning process. In the past, even the narrowly defined environmental values have often been traded off or otherwise lost in the process of development planning.

Second, the scope of environmental planning must be broadened beyond its historic scope in Victoria. The issues related to urban ecology are necessary but not sufficient components of a metropolitan strategy. Other factors such as industry, household and transport energy use are also essential elements. The previous government spoke of integrated land use and transport planning in its transport and metropolitan land use policies. But the issues of air and water quality, greenhouse emissions, energy use, waste and noise have never been systematically considered in the framing of strategic land use and transport planning proposals. The impact of outward urban growth, and freeway development on vehicle use and air quality, for example, has never been satisfactorily considered in metropolitan planning.

A full consideration of environmental issues requires a consideration of the impacts of different models of urban form on energy use, particularly transport energy use, and the impacts of different transport models on urban form.

The Environment Protection Authority (EPA) and other agencies such as various energy and conservation agencies have been responsible for policies and measures on environmental issues. The EPA's concerns with industry emissions, and prevention and control of waste and pollution from point or diffuse sources have not exerted a major impact on decisions on land use, transport and habitat protection. There has never been a thorough institutional linking between urban form, transport and environmental factors in a strategic or programmatic sense. Too often the environment has been regarded as a "limited independent sector" in the words of the 1980 *World Conservation Strategy*, and as a result marginalised.

The scope of the metropolitan strategy encompasses an integration between infrastructure, land use, transport planning, and environmental, economic and social factors and provides the opportunity to consider all these factors and their impacts on each other.

Third, integration requires effective institutional arrangements. The *World Conservation Strategy* (IUCN, 1980) proposes four integration principles:

- the adoption of clear government wide and agency conservation mandates
- legislation and enforcement for policy implementation
- cross sectoral coordination to avoid the fragmentation of resource management, and to avoid the same agency exploiting and protecting resources
- the use of anticipatory measures such as environmental impact statements, economic instruments, natural resource accounting, environmental planning including ecosystem evaluation, and including full life cycle costs into prices

One effective institutional model involves establishing a matrix management implementation process. This would require a central policy group to manage implementation, with implementation tasks clearly allocated to relevant public, private and community sector agencies and groups, along with an agreed timetable. The central policy group would be clearly separated from a resource or development responsibility and have a cross government role to coordinate, monitor and evaluate progress and report on progress to both cabinet and parliament.

The proposed Commissioner for Ecologically Sustainable Development (ESD) could contribute to achieving integration on this model. The responsibilities of this office may include an environmental reporting role including the preparation of State of the Environment Reports, monitoring the government's and government agencies' achievement of environmental objectives and implementation of environmental programs, and the impacts of other government and agency actions on the environment. The role of the Commissioner's office could be expanded to include the responsibility for environmental policy, the that role could be given to another agency.

Environmental reporting is another task linked to policy development and implementation. The government has stated a policy on the establishment of environmental reporting. This reporting should be linked to the performance of government agencies in implementing policy. The environmental performance of the metropolitan strategy would be monitored under this arrangement by an independent agency and the results made public.

Fourth, integration requires the assessment of development proposals against a set of clearly stated criteria, including environmental criteria. The concept of integrated assessment criteria has sometimes been used as a model for achieving integration.

This approach has been raised by a number of Australian governments. The Keating Commonwealth Government's *Greenhouse 21C Policy* required Transport Impact Statements for infrastructure projects requiring Commonwealth funding so that transport and land use planning were integrated into relevant projects. The policy also made funding for urban infrastructure dependent on the preparation of a strategic area plan demonstrating greenhouse gas reductions. The Goss Queensland government took a similar approach basing funding contributions to major infrastructure projects on benchmarks for greenhouse gas emissions, energy consumption and other factors, and made the commitment to "ensure a transit first approach is taken when considering urban transport infrastructure".

The Kennett government proposed in its transport policy an integrated transport investment appraisal process to require the consideration of economic, financial, social and environmental implications of projects before proceeding and a comparison of alternative solutions. This was indended to include the consideration of a wide range of options including the "no build" option to road developments, although this approach was not applied fully. The Australian *Urban and Regional Development Review* recommended a range of similar measures including proposals to make road funding contingent on integrated transport and land use planning and to allow national highway funds to be available for other urban transport improvements which might reduce the need for urban national highways. The Australian Transport Ministers in 1994 made a commitment to develop a more integrated approach to transport infrastructure in response to the report of the National Transport Planning Taskforce.

The Victorian government has proposed the principle of ESD as a guiding principle for metropolitan and freeway planning. ESD can serve as the basis for integrating the sectoral contributions to strategic planning decisions. In addition ESD can provide assessment tools to be applied to individual development proposals and decisions on urban systems through the assessment of such factors as life cycle greenhouse and energy impacts. For example, in assessing new retail centre proposals on sites away from existing centres and public transport, factors such as congestion costs, energy use, and emissions could be considered. This kind of assessment can be used to set targets, such as greenhouse targets, which all new development proposals are required to meet. These targets may need to be aggressive and achieve environmental performance levels which greatly exceed current levels in order to meet post

Kyoto downward revisions of international greenhouse emission levels. The longer this kind of analysis does not inform decisions, the more severe might be the environmental criteria eventually applied.

This kind of process can be used to inform policy development, for example, in the cases discussed above, of the type adopted in the U.K. Planning Policy Guidance Notes to control retail and freeway development. Ultimately, values and judgement also will be major factors in deciding the emphasis to be placed on environmental factors as components of decisions.

3. URBAN AIR QUALITY

3.1 BACKGROUND

Air pollution consistently ranks as one of the main environmental issues of concern to the general community. The quality of the air we breathe affects our health, our enjoyment of our surroundings and the health of our ecosystems. It is also an important indicator of how liveable a city is.

Melbourne's air quality compares well to other cities of comparable size. It has improved significantly over the last 20 years.

This improvement is due mainly to the phasing in of cleaner motor vehicles, controls on industrial emissions, the banning of backyard burning in most of the region and the increasing adoption of cleaner production and technology by industry. Measures such as the planned adoption of European based controls on motor vehicle emissions is expected to lead to further improvements.

3.1.1 INSTITUTIONAL ARRANGEMENTS - NATIONAL LEGISLATION

The National Environment Protection Council (NEPC) is a statutory body with law making powers and has Ministerial representation from each State, Territory and the Commonwealth. It aims to work cooperatively at a national level to ensure that all Australians enjoy the benefits of equivalent protection from air, water, soil and noise pollution and that business decisions are not distorted nor markets fragmented by variations in major environment protection measures between member Governments. NEPC has responsibility for making National Environment Protection Measures. The National Environment Protection Measure for Ambient Air Quality (Air NEPM) was made in 1998. Victoria took the lead role in its formulation. The Air NEPM sets goals for ambient air quality and has a monitoring and reporting protocol but it does not provide the management framework through which the goals are to be achieved.

The National Road Transport Commission (NRTC) and the National Environment Protection Council (NEPC) have statutory roles related to the environmental performance of motor vehicles under the National Road Transport Commission Act and the National Environment Protection Act. NRTC and NEPC have established the national Motor Vehicle Environment Council (MVEC) to coordinate the joint NRTC and NEPC work program on vehicle related environmental issues including the establishment of new vehicle emission and noise standards (Australian Design Rules, ADRs). ADRs are made under the *Motor Vehicle Standards Act 1989.*

3.1.2 INSTITUTIONAL ARRANGEMENTS - STATE LEGISLATION

State environment protection policies (SEPPs) are made under the Environment Protection Act 1970. They have the status of law in Victoria.

The State Environment Protection Policy (The Air Environment) 1981 was amended in 1999 to allow Victoria to formally adopt the 1998 National Environment Protection Measure for Ambient

Air Quality (Air NEPM). The inclusion of the Air NEPM in State policy was facilitated by the splitting of the 1981 Air State Environmental Protection Policy (SEPP) into two separate policies:

- The State Environment Protection Policy (Ambient Air Quality) 1999. This SEPP incorporates the air quality objectives of the Air NEPM for the common pollutants (nitrogen dioxide (NO_2), photochemical oxidants as ozone (O_3), carbon monoxide (CO), lead (Pb), sulfur dioxide (SO_2) and particles (as PM10) and the Air NEPM monitoring and reporting protocol. It also has a visibility objective and an additional ozone objective.
- The State Environment Protection Policy (Air Quality Management) 1999 which currently includes all the elements of the 1981 SEPP not included in the SEPP (Ambient Air Quality) such as design ground level concentrations for a large number of hazardous air pollutants (class 2 and 3 indicators). Some of the design ground level concentrations have been set to minimise the impact of odour while others are known carcinogens.

Other relevant State legislation includes regulations relating to motor vehicle emission standards and enforcement and fees under the Environment Protection Act 1970.

3.1.3 NEW INITIATIVES - NATIONAL

The Commonwealth Government is committed to the phased introduction of new emission standards for all vehicles based on the current United Nations Economic Commission for Europe Regulations (Euro) standards (DOTRS 1999). The new regulations are expected to be called Trans Tasman Vehicle Standards (TTVS) (which replaces the term Australian Design Rules). The timetable for their introduction is as follows:

Diesel vehicles

- Euro 2 – all new vehicles - 2002/2003
- Euro 3 – all medium and heavy vehicles - 2002/2003
- Euro 4 – all new diesel – 2006/2007

Petrol vehicles

- Euro 2 – all new vehicles – 2003/2004
- Euro 3 – all new vehicles –2005/2006

Table 1 provides a comparison of ADR 37/01 and Euro 2, 3 and 4 emission limits for petrol passenger cars.

Regulation	CO Exhaust g/km	NOx Exhaust g/km	VOC exhaust g/km	VOCs Evaporative g/test
ADR 37/01	2.1	0.63	0.26	2
Euro 2	2.2	(Combined VOCs and NOx) 0.5		2
Euro 3	2.3	0.15	0.2	2
Euro 4	1.0	0.08	0.15	2

TABLE 1. COMPARISON OF PASSENGER CAR (PETROL) EMISSION STANDARDS. *Source: MVEC 1998*

Significant emission reductions will be achieved for diesel vehicles with the introduction of Euro standards for diesel vehicles. For example oxides of nitrogen emissions for Euro 4 are less than half the emission limit of oxides of nitrogen emission limits for the current standard (ADR 70/00) and PM 10 levels[4] are more than one tenth the current limit.

3.1.4 NEW INITIATIVES – STATE

The EPA recently has released a preliminary draft State Environment Protection Policy (Air Quality Management) (EPA June 2000). This preliminary draft, which has been released for consultation, provides an indication of the direction that the SEPP (Air Quality Management) will take and the policy context in which the draft Air Quality Improvement Plan will operate. The preliminary draft SEPP features new provisions and approaches to air quality management including a new tool for assessing local air quality (intervention levels), which will be used to trigger action. This new tool aims to improve air quality in local hotspots and will lead to improve to improved regional air quality more generally.

The EPA has also recently released (June 2000a) a draft Air Quality Improvement Plan for the Port Phillip Region, which covers Melbourne, Geelong and the Mornington Peninsula. The Air Quality Improvement Plan aims to guide the decision making and activity of government, industry and the community to ensure continual improvement of Port Phillip Region's air quality. It proposes action on integrated transport planning, better public transport, controls on emissions from industry, vehicle improvements and community input.

3.1.5 OTHER RELEVANT STUDIES

EMISSIONS INVENTORIES

A number of air emissions inventories have been undertaken for the Port Phillip Region (Form and Substance Inc 1982; EPA 1991, EPA 1998). The most recent inventory (EPA, 1998) is an inventory for 1995/96, covers 33 air pollutants and provides data for inclusion in the National Pollutant Inventory. The 1995/96 inventory shows that:

- motor vehicles are a significant contributor to emissions of carbon monoxide, the precursors of photochemical smog (oxides of nitrogen and volatile organic compounds), lead and particles (particularly PM2.5 during summer)[5]
- domestic wood combustion during the colder months is the most significant source of particles (PM 10 and PM 2.5)
- motor vehicles are the main source of the hazardous air pollutants (HAPs) - benzene, 1,3 butadiene, formaldehyde, toluene and xylene. Most of the other HAPs included in the inventory are predominantly emitted by industry.

While direct comparisons cannot be made between the 1995/6 inventory and previous inventories for the Port Phillip Region because of differences in the methodology used, the following trends are apparent:

[4] PM10 are particles less than 10 microns in diameter.
[5] PM2.5 are particles less than 2.5 microns in diameter.

- emissions of the common air pollutants from motor vehicles decreased between 1990 and 1995/96 despite a 16% increase in vehicle kilometres travelled
- the decrease in lead emissions from motor vehicles between 1990 and 1995/96 was more than 60%

Some of the results of the 1995/96 are shown in Figures 1 - 18.

MELBOURNE MORTALITY STUDY

The EPA recently released the *Melbourne Mortality Study* (EPA 2000b), which details results of research into the health effects of air pollution in Melbourne. The pollutants considered were fine particles, ozone, nitrogen dioxide and carbon monoxide. Sulfur dioxide was not included as the levels in Melbourne are very low. The mortality data used for the study, which was obtained from the Australian Bureau of Statistics, was for the period 1 January 1991 to 1 December 1996. The air pollution data used for the study was EPA's air monitoring data.

The study concluded that "there is a close association between some air pollutants and increases in daily mortality in susceptible groups, particularly the elderly and people with existing respiratory disease" and these associations were stronger during the warm season.

"The pollutants identified as of most concern were ozone and nitrogen dioxide" (EPA 2000c). Associations were also observed for fine particles and carbon monoxide.

FUEL QUALITY STANDARDS FOR AUSTRALIAN ROAD TRANSPORT

The introduction of the new Euro standards for motor vehicles is likely to require more tightly specified fuel standards. For example the introduction of Euro 2 is likely to require 95 RON[6] unleaded petrol which is more expensive than the currently commonly available 91 RON unleaded petrol. The level of sulfur in diesel is also likely change (500ppm in 2002 and 50ppm in 2006) in line with the new vehicle emission standards.

Environment Australia commissioned a review of fuel quality requirements for Australian Transport (Environment Australia 2000). This review, for which consultation concludes at the end of June 2000, focused on six scenarios for new fuel specifications from the business as usual scenario to standards that are more strict than those required for Euro 4. The impacts on air pollutants (NOx, CO, PM 10 VOCs, SO_2, Pb and a number of hazardous air pollutants), greenhouse emissions and associated costs of altered fuel specifications were modelled. The review found that:

- fuel composition has little impact on greenhouse gas emissions,
- emissions of lead and sulfur vary in direct proportion with the fuel content of the pollutant,
- reductions up to 25 % could be anticipated for particles (PM10) between 2000 and 2010,
- significant reductions in benzene emissions (26% between 2000 and 2010 for the base case and up to 60% for the more stringent scenarios).

[6] RON = Research Octane Number

3.2 DATA AND TRENDS

The main forms of air pollution affecting the Port Phillip region are photochemical smog (O_3) during the summer months and particles during the cooler months.

Figures 1 – 18 provide an overview of air pollution levels for Melbourne over time as compared with the State Environment protection policy (AAQ). They also include comparisons with air quality in other cities for each pollutant and provide a summary of inventory data for each pollutant. All data was sourced from EPA.

OZONE

Figure 1 – 4 show ozone trends for the Port Phillip region, international comparisons and an emissions inventory of ozone precursors.

The principal component of photochemical smog is ozone. Ozone is a secondary pollutant which is formed by complex chemical reactions (VOC) involving oxides of nitrogen and photochemically reactive volatile organic compounds in the presence of sunlight. Peak levels of ambient ozone are generally recorded in the afternoon coinciding with its formation from the primary pollutants released during the morning peak hour. Background levels of ozone during summer months are estimated to be as high as 0.04 ppm.

Figure 1 shows maximum one hour ozone levels for the Port Phillip region against the new 1999 one hour ozone objective. There are three additional ambient air quality objectives for ozone, the most stringent being the eight-hour objective of 0.05 ppm. Melbourne has never achieved annual compliance with this objective since monitoring commenced in the airshed although there is downward trend. The principal health effect of exposure to ozone is impaired lung function but it can also cause eye and throat irritation and nasal congestion.

Motor vehicles and industry are the main sources of the precursors to ozone formation (see figures 3 and 4).

PARTICLES

Figures 5 – 7 show particle (PM10) trends for the Port Phillip region, international comparisons and emissions inventory.

Particles are a complex mixture of organic and inorganic substances. Particles less than 10 microns in diameter (PM10) are the particles most widely associated with health impacts as they can be inhaled deeply into the lungs. Health impacts included increased mortality, aggravation of existing respiratory and cardiovascular diseases and other respiratory symptoms. Elevated particle levels occur mainly in autumn and winter periods during calm stable weather conditions. They can accumulate under temperature inversions, which can last for several days before they are dispersed by wind or rain. During these periods domestic wood heaters are the main contributor. The maximum 24-hour particle levels shown in Figure 5 were recorded at a roadside site where the dominant source is motor vehicles.

In addition to the PM10 objective Victoria has a one hour air quality objective for visibility. In the early 1980s this objective was breached up to 167 times per year. The number of breaches in recent years is significantly lower (37 in 1998) but visibility is still a cause for concern. The measurement of visibility correlates reasonably well with particles less than 2.5 microns for which there is currently limited direct data and for which there is likely to be a national standard set in the next couple of years.

NITROGEN DIOXIDE

Figures 8 – 10 show trends for nitrogen dioxide for Port Phillip region, international comparisons and emissions inventory.

Nitrogen dioxide exposure is associated with decreased lung function and increased respiratory illness particularly in children, the elderly and people with existing respiratory and cardiovascular diseases. On the basis of recent health studies the nitrogen dioxide one hour objective was lowered in 1999 from 0.15 ppm to 0.12 ppm and an annual mean objective of 0.03 ppm was introduced. The major source of nitrogen dioxide is the burning of fossil fuels with the motor vehicle being the predominant source. Peak levels of nitrogen dioxide are generally highest where traffic levels are greatest.

Nitrogen dioxide is also precursor to photochemical smog (ozone).

CARBON MONOXIDE

Figures 11 – 13 show trends for carbon monoxide for the Port Phillip region, international comparisons and emissions inventory.

Carbon monoxide exposure is associated with a wide range of health affects including impaired learning ability and impaired performance at complex tasks plus a range of heart diseases (through to heart attacks). Motor vehicles emissions are the predominant source of carbon monoxide and peak carbon monoxide exposure occurs at roadside. The air quality objective for carbon monoxide was lowered to 9 ppm in 1999.

SULFUR DIOXIDE

Figures 14 – 16 show trends for sulphur dioxide for the Port Phillip region, international comparisons and emissions inventory.

In the Port Phillip region industry is the major source of ambient sulfur dioxide. The roasting of mineral ores containing sulfur and the refining of oils account for the higher levels of ambient sulfur dioxide in the Geelong region.

Exposure to sulfur dioxide can cause increased incidence of respiratory diseases and the aggravation of asthma. As of 1999 there are three air quality objectives for sulfur dioxide; a one hour objective, a one day objective and an annual objective. Comparisons are shown for the one hour and the one day objectives in Figure 14. Melbourne's ambient levels of sulfur dioxide are low compared to other overseas cities. This is largely due to the low sulfur content of our fuel.

LEAD

Figures 17 – 18 show trends for lead for the Port Phillip region and emissions inventory. There has been a dramatic reduction in ambient lead levels since the introduction of unleaded fuel and levels have been well below the new ambient air quality objective for a number of years. Levels are expected to continue to decrease particularly when lead in fuel is phased out in 2002.

Overall the key pollutants of concern in the Port Phillip airshed are ozone (and its precursors, nitrogen dioxide and volatile organic compounds) and particles.

There has been limited monitoring of hazardous air pollutants (class 2 and 3 indicators) in the Port Phillip airshed.

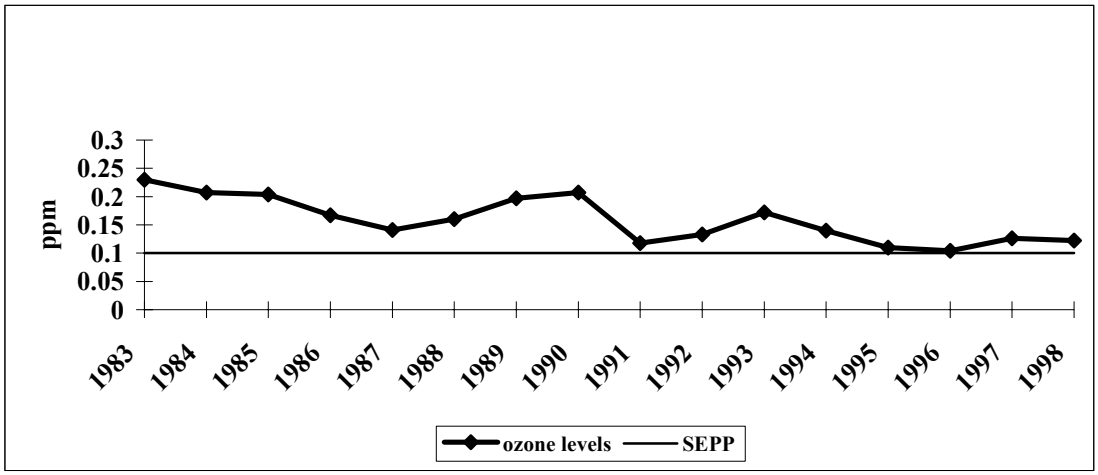

FIGURE 1. MAXIMUM 1-HOUR OZONE CONCENTRATIONS, PORT PHILLIP REGION

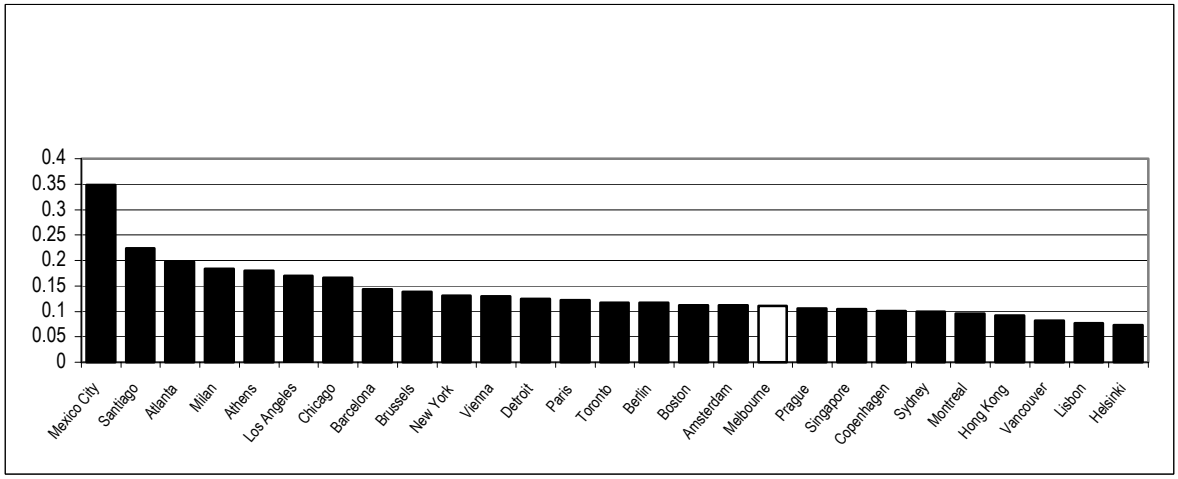

FIGURE 2. INTERNATIONAL COMPARISON - MAXIMUM 1-HOUR OZONE CONCENTRATION (PPM), 1995

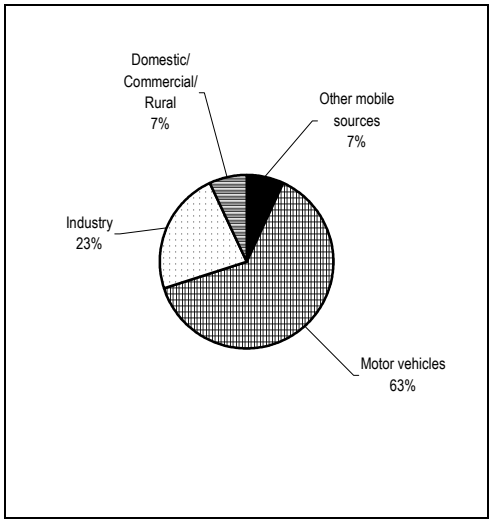

FIGURE 3. INVENTORY OF OXIDES OF NITROGEN – PORT PHILLIP REGION

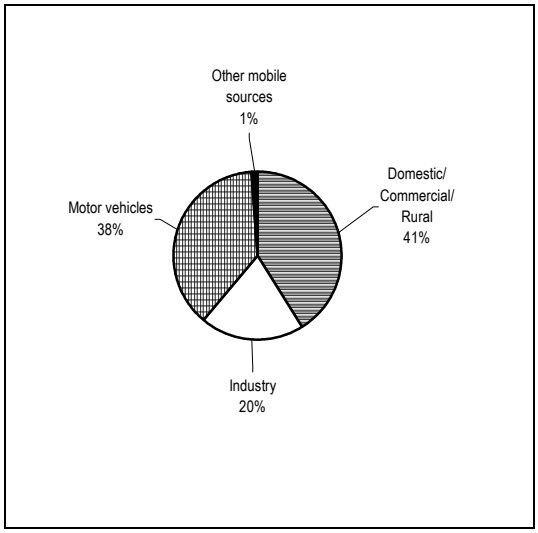

FIGURE 4. INVENTORY OF VOLATILE ORGANIC COMPOUNDS - PORT PHILLIP REGION

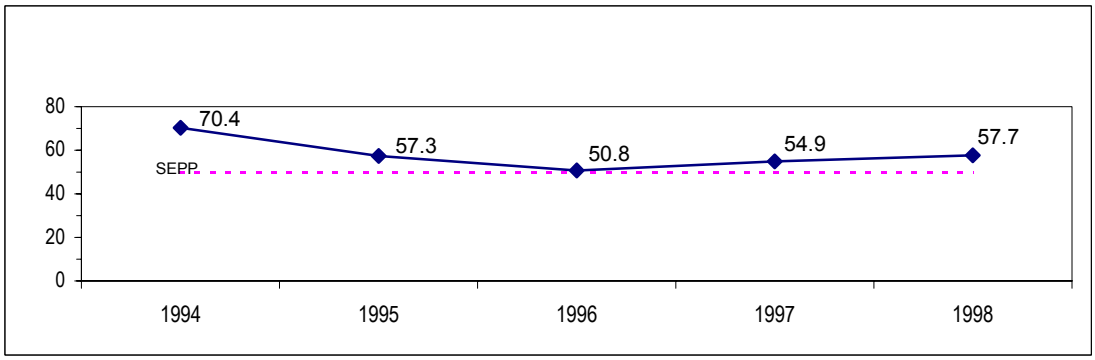

FIGURE 5. PARTICLES - MAXIMUM 24-HOUR PM_{10} (ug/m^3), MELBOURNE REGION

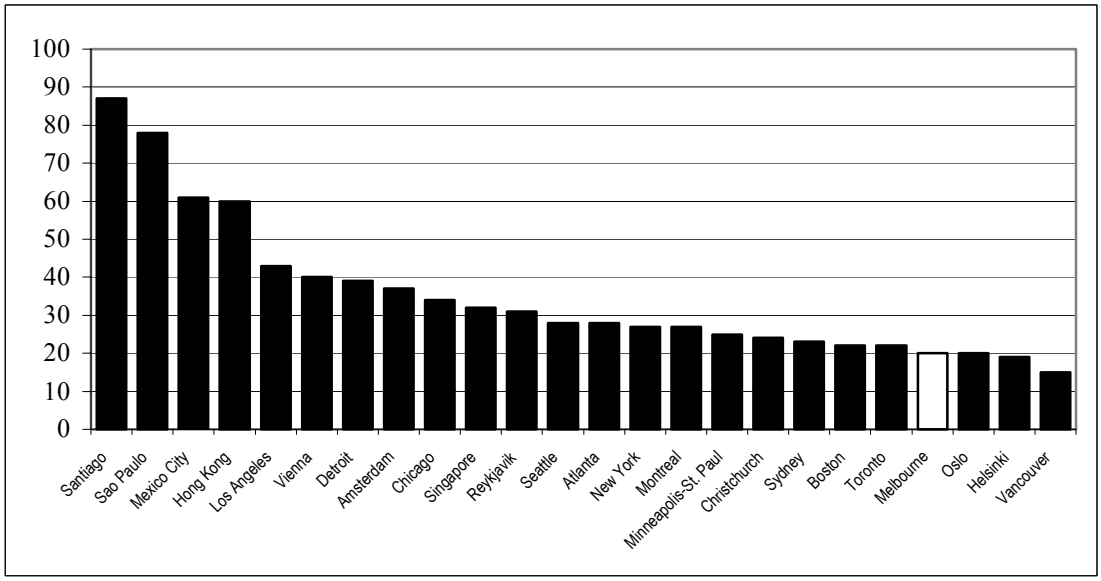

FIGURE 6. INTERNATIONAL COMPARISON - ANNUAL AVERAGE PARTICLES - PM_{10} (ug/m^3), 1995

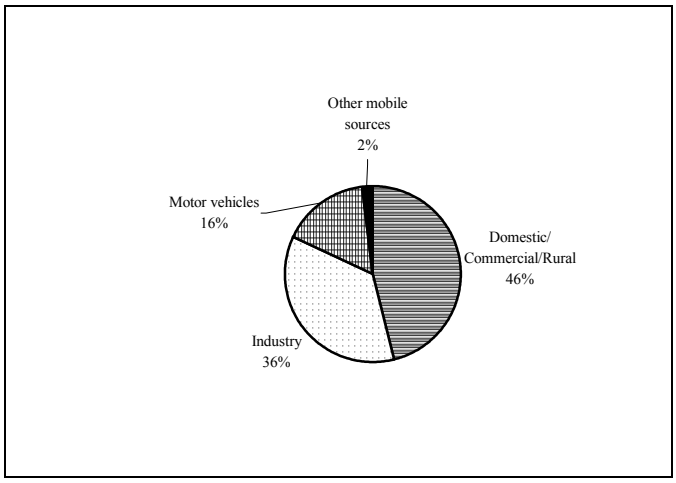

FIGURE 7. INVENTORY OF PARTICLES (PM_{10}) SOURCES - PORT PHILLIP REGION

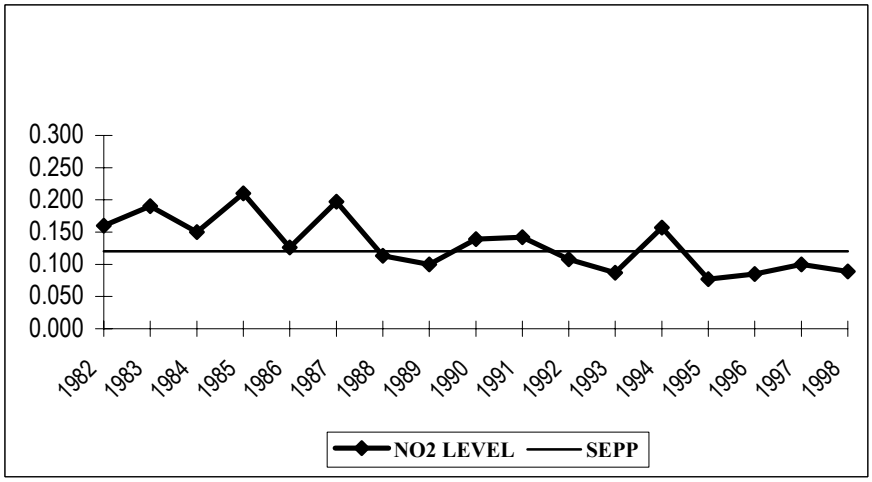

FIGURE 8. PEAK 1-HOUR NITROGEN DIOXIDE LEVELS (PPM), MELBOURNE REGION

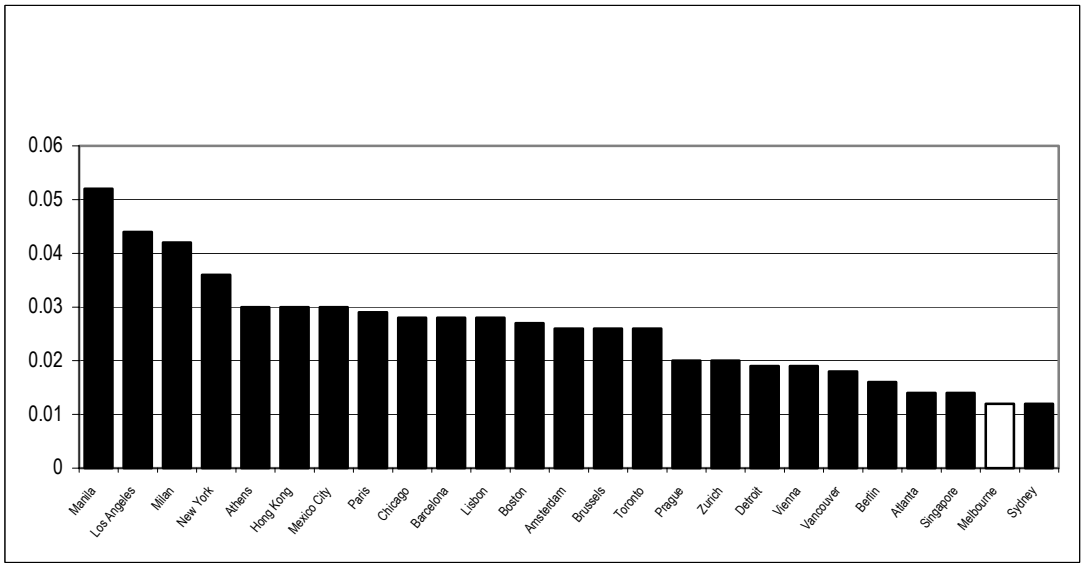

FIGURE 9. INTERNATIONAL COMPARISON - ANNUAL MEAN NITROGEN DIOXIDE (PPM), 1995

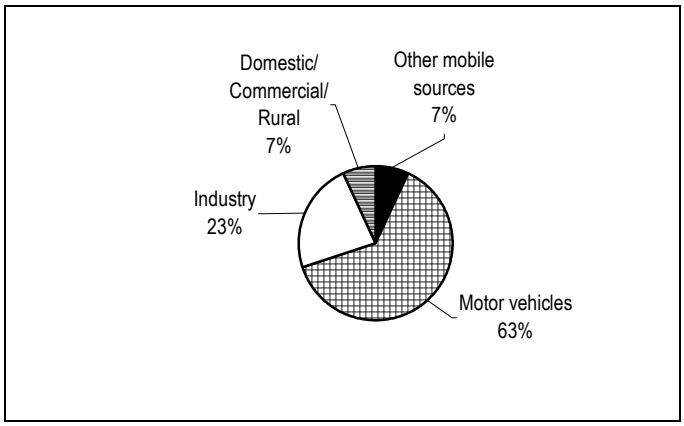

FIGURE 10. INVENTORY OF OXIDES OF NITROGEN SOURCES - PORT PHILLIP REGION

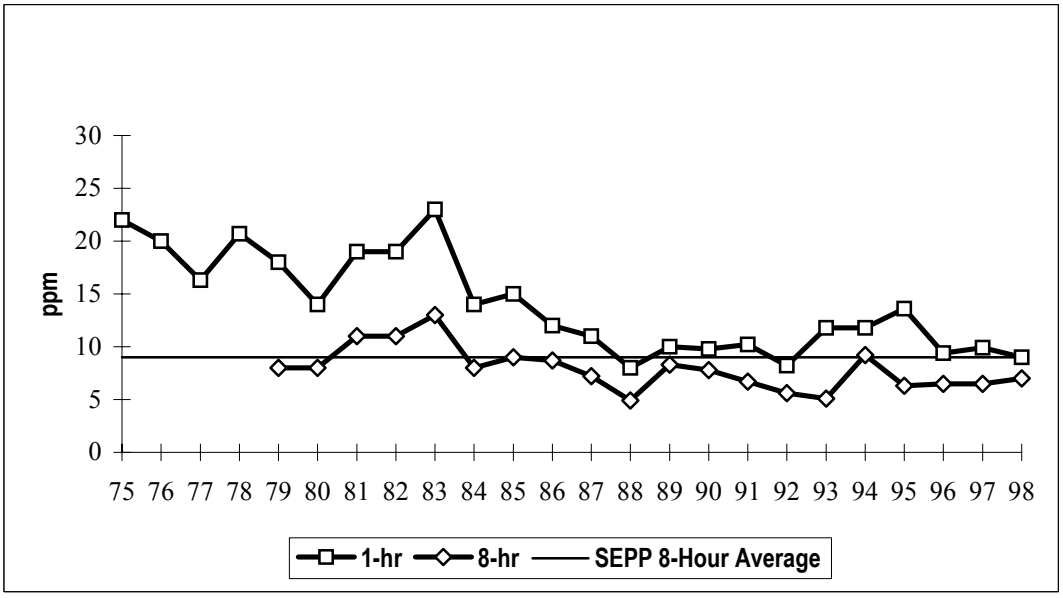

FIGURE 11. PEAK CARBON MONOXIDE (PPM) TRENDS, MELBOURNE

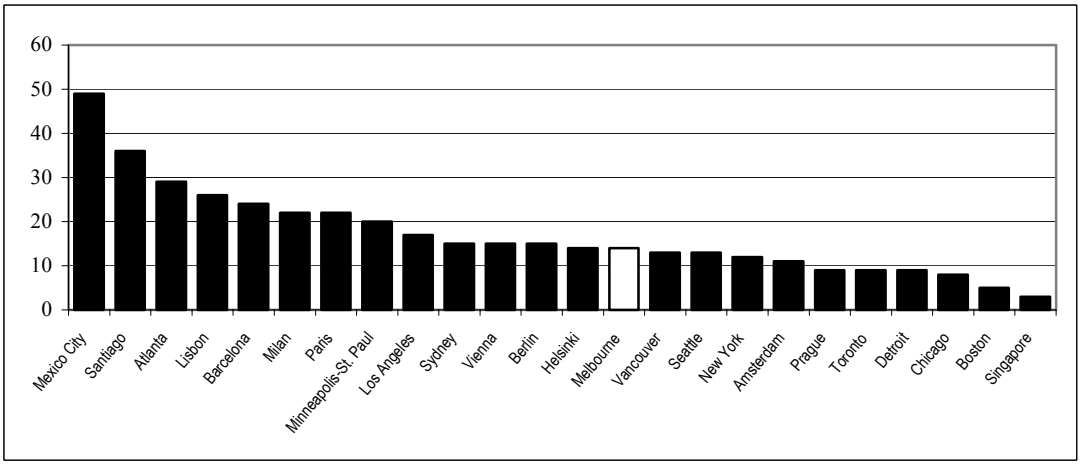

FIGURE 12. INTERNATIONAL COMPARISON - MAXIMUM 1-HOUR CARBON MONOXIDE (PPM), 1995

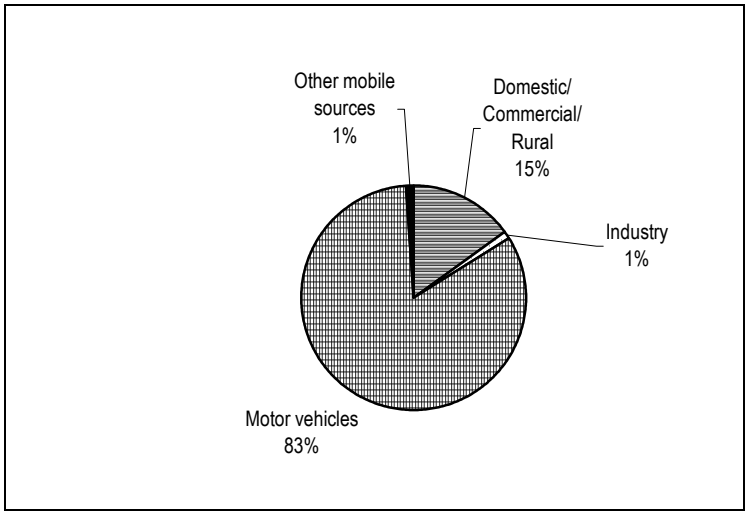

FIGURE 13. INVENTORY OF CARBON MONOXIDE SOURCES - PORT PHILLIP REGION

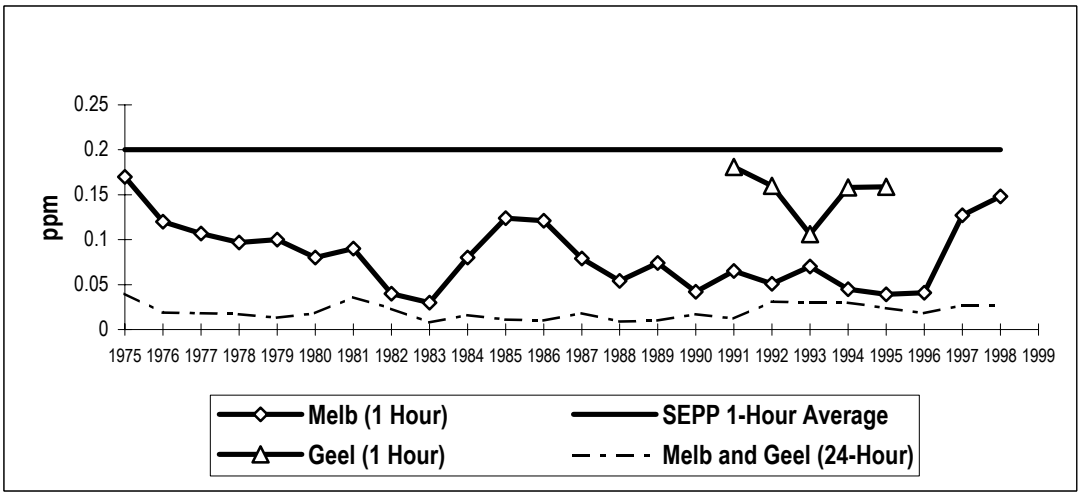

FIGURE 14. PEAK SULFUR DIOXIDE (PPM), MELBOURNE AND GEELONG

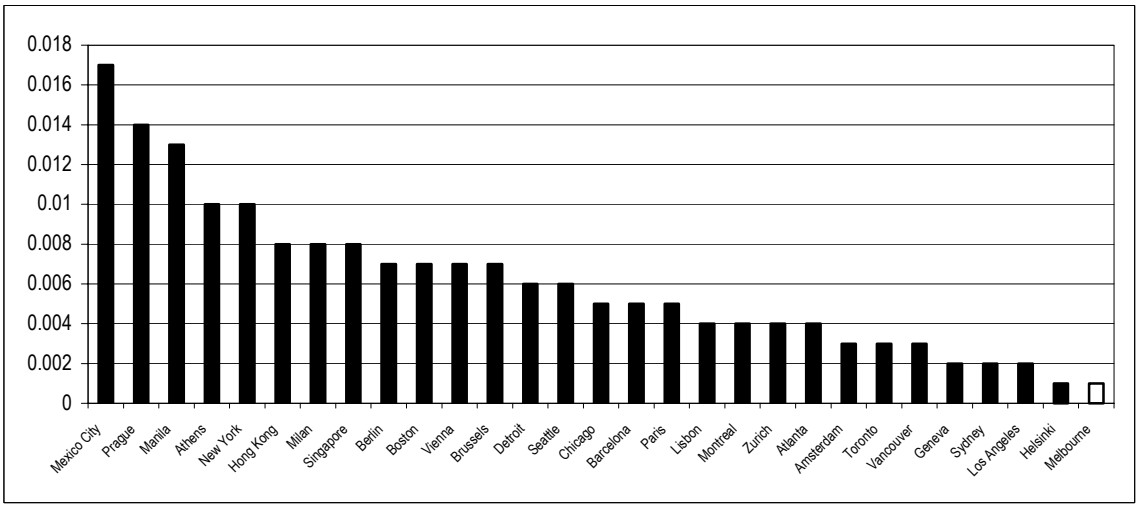

FIGURE 15. INTERNATIONAL COMPARISON - ANNUAL MEAN SULFUR DIOXIDE (PPM), 1995

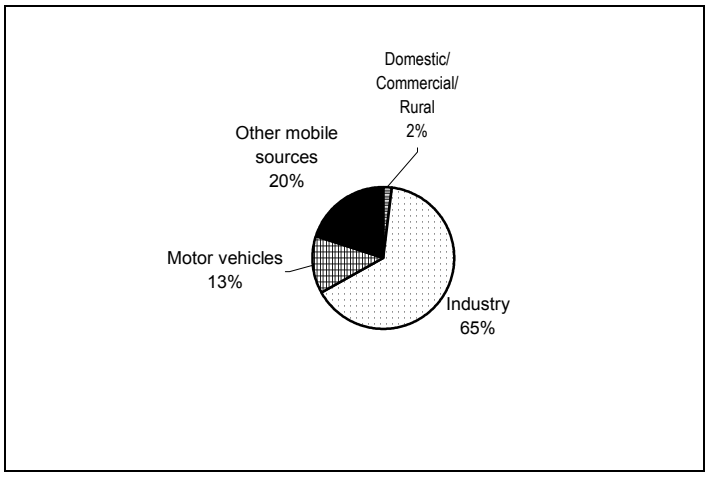

FIGURE 16. INVENTORY OF SULFUR DIOXIDE SOURCES – PORT PHILLIP REGION

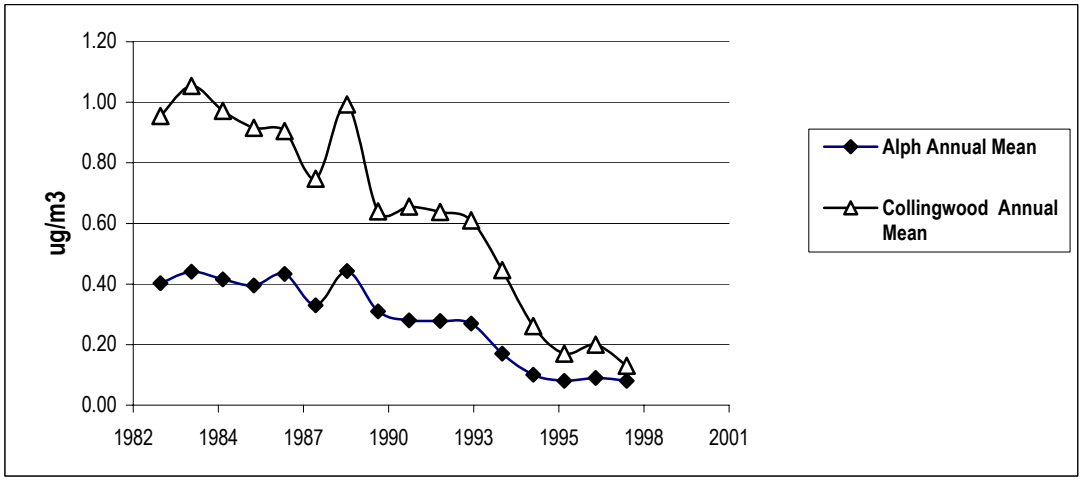

FIGURE 17. ANNUAL AVERAGE LEAD CONCENTRATIONS - MELBOURNE

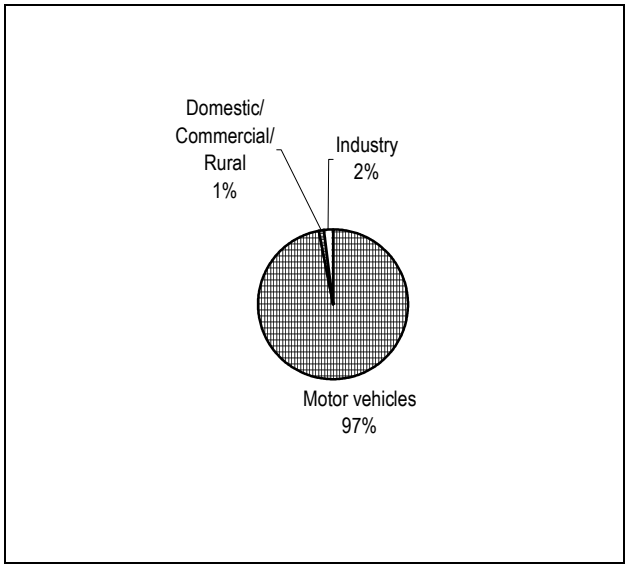

FIGURE 18. INVENTORY OF SOURCES OF LEAD AND COMPOUNDS – PORT PHILLIP REGION

3.2.1 IDENTIFICATION OF TRENDS

With the phased introduction of the Euro standards for motor vehicles, total emissions of the common pollutants are predicted to fall significantly (EPA 2000). The reduction is most marked for CO, NOx and PM10. The overall impact of Euro controls is least for VOCs with emissions expected to drop in the short term but increase to close to 1996 levels by 2021. Modelling of future levels of ozone is currently being undertaken by EPA.

With the exception of domestic wood heating, emissions of all pollutants from industry and other sources are projected to increase.

Therefore under the 'business as usual' scenario the general level of air quality is predicted to improve however air quality modelling is required to determine the extent of the improvement particularly for ozone and particles due to the influence of secondary processes (see figures below).

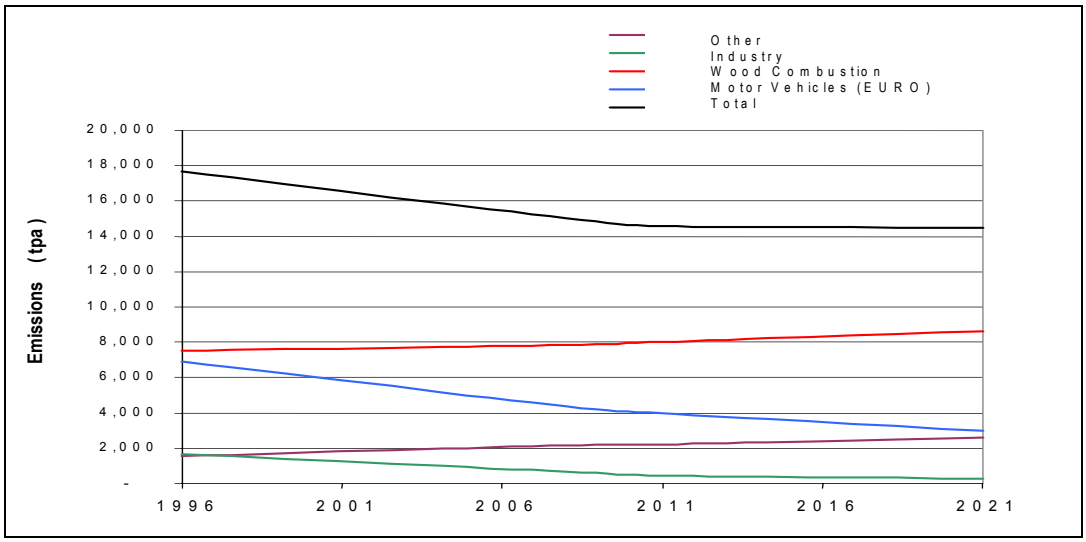

FIGURE 19. ANNUAL EMISSIONS OF PARTICLES (PM_{10}) FOR PORT PHILLIP REGION - WITH EURO CONTROLS

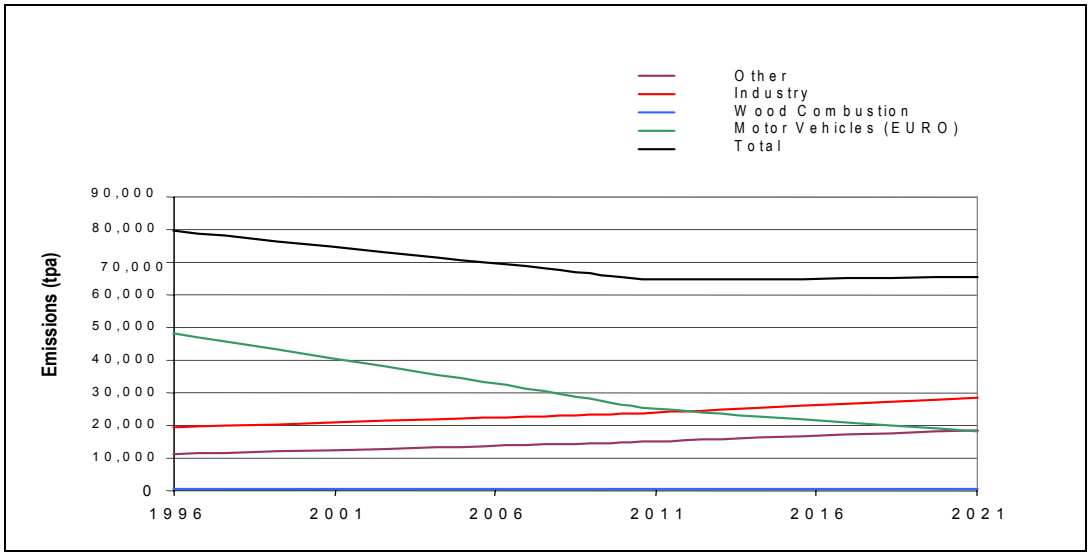

FIGURE 20. ANNUAL EMISSIONS OF NITROGEN DIOXIDE - PORT PHILLIP REGION - WITH EURO CONTROLS

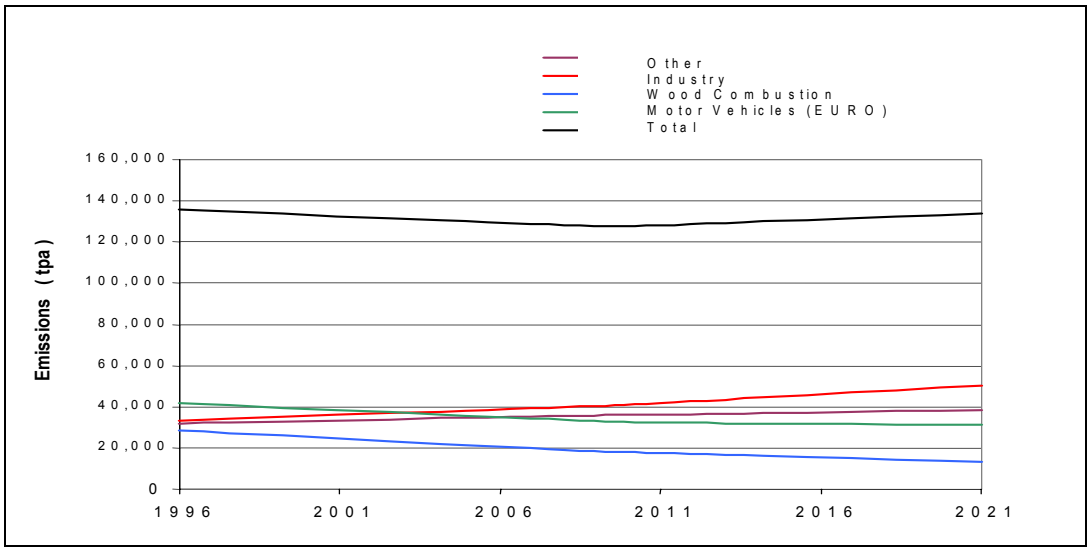

FIGURE 21. ANNUAL EMISSIONS OF VOLATILE ORGANIC COMPOUNDS FOR PORT PHILLIP REGION - WITH EURO CONTROLS

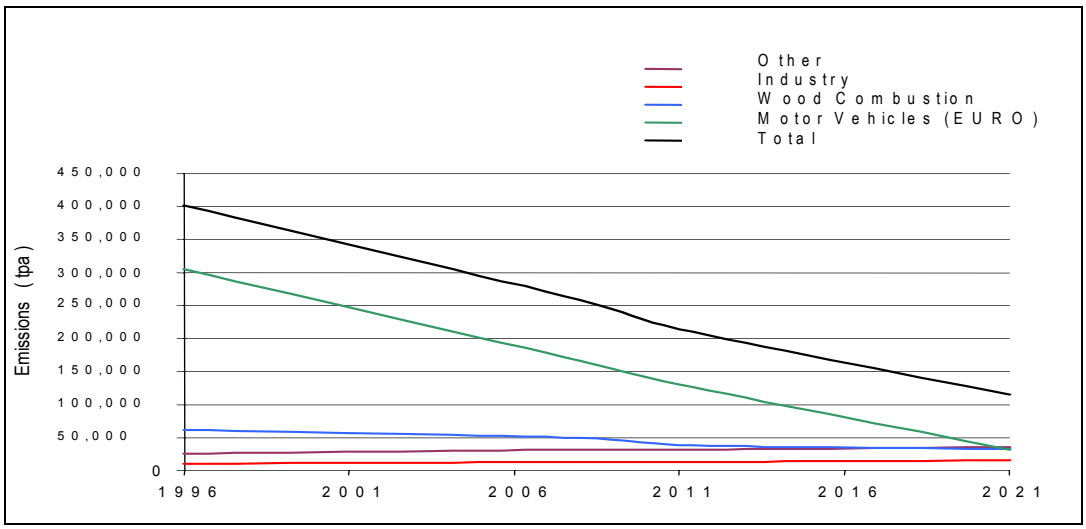

FIGURE 22. ANNUAL EMISSIONS OF CARBON MONOXIDE - PORT PHILLIP REGION - WITH EURO CONTROLS

3.3 ISSUE IDENTIFICATION

3.3.1 MOTOR VEHICLES

As indicated motor vehicle emissions are the key source of ambient lead, carbon monoxide and the precursors of ozone.

The Bureau of Transport and Communications Economics predicts that by 2015 car traffic is expected to grow by 20-40 per cent from 1995 levels in Australian's major capital cities and truck traffic by 60-80 per cent. In addition, inner city population, traffic densities, and therefore congestion, are expected to increase significantly particularly in the inner suburbs (EPA 2000a).

This increase arises from a range of social and economic factors including:

- increased vehicle ownership and greater reliance on motor vehicles for travel
- decreasing household size
- the dispersal of activities and population leading to longer car trips
- declining rates of walking and cycling
- declining vehicle occupancy.
- changing employment patterns such as longer working hours
- high growth in freight and light commercial traffic
- industry's shift to the outer suburbs to take advantage of cheaper land and transport costs and warehousing in line with a just in time philosophy

This increasing travel by motor vehicles is set against:

- a public transport use decline of a half since 1961 (in absolute terms) (Newman and Kenworthy 1993)
- a 50% increase in public transport fares in Melbourne compared with a 30% decrease in petrol since 1980 (Austroads 1997)

In Melbourne the average number of motor vehicle trips per capita has increased with a high proportion of relatively short trips (under 5 km) being made by car (ABS 1995). Cold starts will become increasingly more important as the proportion of catalyst vehicles increase in the fleet. Cold starts by non catalyst cars (ie pre 1886 cars) contribute about 25 % of VOCs and CO while catalyst vehicles (cars manufactured from 1986 onwards) produce about 60% of these pollutants from cold starts (Transportation Research Board 1995, in Boyle et. al. 2000).

The significance of cold starts means that short trips can contribute nearly as much as longer trips.

In addition, by standards in developed countries, Australia's motor vehicle fleet is old due to slow turn over of the fleet, our emission control technology lags behind many countries and Victoria's enforcement of vehicles with faulty emissions, while better than most other Australian states, is ad hoc.

3.3.2 INDUSTRY

Industry is a major contributor to air pollution across the Port Phillip region and is often responsible for local air quality impacts including, for certain industries such as broiler farms on the Mornington Peninsula, odour. Projections for industry indicate that emissions will increase under the business as usual scenario. A number of companies have reduced emissions through eco-efficiency measures. Industry can also reduce its through the development and implementation of best practice environmental guidelines (as has already occurred in some industries) and through the use of best available control technology.

Eco-efficiency is proposed by EPA (EPA 2000a), as a way to reduce industry emissions. Land use planning measures such as ensuring adequate buffers between certain industries and sensitive areas such as residential areas, schools and hospitals can help ensure industry does

not cause detrimental impacts on the health and amenity of communities. EPA is currently reviewing the management and control of odours including the role of buffer distances. The introduction of new buffer distance guidelines and other control measures which will require implementation by government and industry, will assist in lessening local odour and other emission impacts.

3.3.3 URBAN FORM

The extent of motor vehicle usage is greatly influenced by a city's form. Integrated transport and land use planning are important long term strategies for reducing the level of motor vehicle dependence. However the trend to greater urban consolidation of domestic and commercial activities could, without adequate planning, lead to negative air quality impacts emissions becoming more spatially concentrated exposing a larger portion of the population to primary pollutants.

One area of uncertainty about the affect of urban consolidation is on motor vehicle ownership and use. In Melbourne 87.3% of households own a car, however ownership is highest in the outer suburbs (92.2%) compared with ownership in inner Melbourne where it is 70% (Austroads, 1997). A similar phenomenon is apparent in Sydney here car ownership in lower in the rich inner suburb of Mosman compared to ownership in Sydney's poorer areas. There is however a strong trend to increasing car ownership in the Melbourne's inner suburbs. Changes in car parking policies in the inner areas may assist in halting this trend.

3.4 BEST PRACTICE

Air pollution levels in a city are influenced by a range of factors such as the city's topography, its climate and its meteorology. Other factors such as the level of industrialisation, a city's urban form, the quality of fuels, culture and the economy all influence a city's air quality. Combining all these factors result in air quality problems that have a level of uniqueness. It is therefore difficult to identify any particular country or city that has implemented actions on which to model strategies that could be implemented in Melbourne. Instead the following gives an overview of research and various actions being undertaken elsewhere can provide useful directions for improving in Melbourne's air quality.

3.4.1 MOTOR VEHICLES

The control of our motor vehicle fleet is well behind world' best practice.

In regard to emission controls:

- Euro 2 standards were introduced into Britain in 1992.
- The USA (USA EPA) has required onboard diagnostics, which detects malfunctioning emission controls, in all new cars manufactured since 1994, it phased out leaded fuel in 1996, introduced new tight emission standards in 1990 (Euro 2 or better) emission standards of standards and it requires that 30% of new cars purchased in 1998 to meet standards that are significantly tighter than Euro 4 with further controls planned for introduction in 2004.

- Reformulated fuel to reduce emissions from cars was introduced in the USA in 1995 and tighter fuel requirements for diesel were introduced in 1995/6.

For in-service vehicles:

- Many states in the USA and elsewhere have had annual vehicle inspection and maintenance programs for many years. NSW are currently trialing an inspection and maintenance program.
- USA has a 5 second smoke rule.

These controls compare to our largely ad hoc and limited control of emissions for in-service vehicles. For example, the main mechanism for detecting poor performing vehicles in Victoria is roadworthy testing when a vehicle changes ownership and the ten second smoke rule. EPA officer, police and the community have to observe a vehicle visibly emitting smoke for 10 seconds before any enforcement action is taken: 12,320 vehicles were detected this way in Victoria in 1998/99. This compares with the Federal Office for Road Safety's estimate that 20% of vehicles were poorly tuned and had high emissions.

3.4.2 LAND USE PLANNING AND TRANSPORT

The United Kingdom has introduced two new national planning policy guidance notes, PPG6 on town and retail development and PPG13 on transport, in the early 1990s (Quinn, 1996). These policies have statutory force and are required to be incorporated by local authorities in their forward development plans.

PPG6 aims to shift the balance back to mixed development and take the development focus away from regional shopping centres which require car based travel to access.

In 1994 the UK Government recognised that future transport were difficult to reconcile with sustainable development. Prior to the introduction of PPG13 the Government had previously stated that its policy was 'not to build new trunk or local roads to facilitate commuting by car in congested areas' and that 'there is scope for further improvements to vehicle emissions but they in themselves will not be enough.' PPG13 aims to shape land use patterns so as to reduce growth in the length and number of car journeys, to encourage alternative means of travel which has less environmental impact, and to reduce reliance on the private car.

PPG 13 asks authorities to reduce their car parking requirements, manage traffic access to favour transport other than the car and provide priority routes for pedestrians, cyclists and public transport.

The broad approach through implementation of PPG6 and PPG13 is to encourage urban containment especially for new housing, retailing, services and leisure and to underline the importance of retaining future transport choice by relating all major development to means of transport other than the car.

In its white paper *A new deal for transport* (UK 1998) the UK government sets a agenda that gives priority to walking, cycling and public transport. It has recently passed a Transport Bill

(December 1999) which includes provisions for improving public transport services, work place parking levies, local transport plans and road user transport charges.

3.5 POLICY OPTIONS

3.5.1 MOTOR VEHICLES – REDUCING EMISSIONS AT SOURCE

In addition to reducing emissions from new cars other actions to reduce emissions from vehicles can increase the use of cleaner fuels, for example by promoting the use of alternate fuels such as LPG or CNG, or by improving the emissions performance of in-service vehicles. A study by the Federal Office of Roads Safety found that poorly maintained cars can emit five to ten times the exhaust emissions of well maintained cars of the same age. It estimated that, on a fleet wide basis, exhaust emission improvements of 16% for VOCs, 25% for CO and 9% for NOx could be achieved through regular servicing. EPA (EPA 2000a) has proposed that instead of requiring costly annual inspection and maintenance regimes, as are common in the USA, that either proof of servicing in the last 12 months be required at the time of re-registering or that a differential registration charge be applied to vehicles that have not been serviced in the last 12 months.

3.5.2 MOTOR VEHICLES - CHANGING TRAVEL DEMAND

Some strategic road network improvements may relieve bottlenecks and improve traffic flow, thus improving local air quality, however an OECD report (1995a), summarising the available evidence, concluded that:

- building more roads has not noticeably reduced congestion - new road space is quickly filled. Even cities with the best road networks have high congestion levels
- where little or no attempt is made to increase road capacity in line with demand, cities do not grind to a halt. People and firms adapt and make other choices on mode or destination.

The OECD (1995b) has also concluded that although congestion causes higher emissions, improving traffic flow eventually leads to more emissions overall as a result of the additional vehicle kilometres travelled generated.

A 1995 survey found that 81% of all motorists were concerned about the effects of motor vehicles on the environment. However another NSW survey found that only about one third of the respondents were sufficiently concerned to take individual action such as walk rather than drive for short trips or change their driving behaviour. Relatively few were prepared to use public transport or share rides, with the rest either prepared to pay something to improve air quality rather take individual action, or not act in any way.

Overseas a number of measures have been assessed or have been used or to influence motor vehicle use. These include:

- improving public transport
- fuel taxes
- annual registration and insurance charges

- taxes on new cars
- road or congestion pricing
- banning parking or changing parking charges
- closing streets or city centres to traffic
- traffic calming measures

A study of five UK cities (Dasgupta et al 1994), found that increases in charges for road use and parking were far more effective than lowering public transport fares in reducing traffic growth. Halving the number of parking places had the greatest effect, reducing CBD trips by 20%.

Improving public transport service has also been shown to be effective. During the period 1960 to 1980, Toronto increased its public transport use by 48%. This increase is attributed to excellent bus feeder services to train stations. In general, the management of public transport as an integrated system is seen as particularly important (Mees 1997).

In the US and Canada raising parking charges has been found to be one of the more effective means of limiting car use (Cervero 1997).

Traffic calming includes measures that reduce the attractiveness of private vehicle use such as decreasing traffic speed, blocking off through traffic, giving priority to bikes and pedestrians at intersections and introducing priority lanes. In Germany reducing the speed limit in built up areas was found to reduce idle time by 15%, gear changing by 12%, brake use by 14% and petrol use by 12%(Transportation Research Board 1995). It has been estimated (Gardner 1998) that for every 1% of car trips replaced by cycling or walking, emissions from cars drop by 2 - 4%.

This indicates that a package of measures, that includes both incentives and disincentives, is required to reduce travel by motor vehicles and this must include alternatives that can effectively compete in terms of speed and convenience.

3.5.3 LAND USE PLANNING

Urban form and air quality was assessed by one of the task groups as part of the Federal Government inquiry on urban air pollution (ATSE 1997). Land use/transport and airshed models were applied to the Melbourne region and predictions made up to 2011. Modelling included a 'business as usual' scenario and 'compact', 'multi-node', 'corridor', 'ultra' and 'fringe' cities where:

Business as usual:
Outward expansion at random infill and dominated by the CBD as the key centre.

Compact city:
Increased population and density of inner urban area.

Multi- node city:
Increased population housing densities and employment in selected nodes across the city; increased investment in orbital rail links or freeways linking the nodes.

Corridor city:
Growth along linear corridors emanating from the CBD and supported by upgraded public infrastructure

Fringe city:
Additional growth is accommodated predominantly on the fringe of the city.

Ultra city:
Additional growth is accommodated primarily in provincial cities within 100km of the capital city and linked by high speed rail.

The various scenarios incorporated differing assumptions about the location of additional population growth, road and public transport infrastructure, employment distribution, and job self-containment.

The results indicated that:

- there is a 55% reduction in population exposure to photochemical smog under a corridor scenario compared to a 71% deterioration under the business as usual scenario
- for particles during winter there was a 14% improvement for a corridor city, a 61% deterioration for the business as usual scenario and the compact city produced the highest personal exposure to particles (160% deterioration) due to the greater concentration of the population
- continuation of the business as usual scenario results in continued growth in emissions particularly for CO and CO_2

From the available evidence, a 'preferred' urban form from the point of view of air quality would most likely be a multi-nodal metropolis with clearly defined activity centres centred on public transport, with many smaller 'urban village' type centres, along public transport routes. The aim would be to cluster destinations together at many mixed use centres – both larger and smaller ones – based on accessibility criteria to maximise the opportunities for multi-purpose trips and use of local facilities. It would also provide opportunities for fast, efficient public transport to other employment centres and complemented with measures that discourage private car (Boyle et al, 2000). Planning at the sub regional and local levels would also be needed to ensure the population exposure to motor vehicle emissions in activities centres is minimised.

Brunton and Brindle (1999) indicate that having a high level of accessibility to activities provides a useful key to help guide planning policy. They also concluded that planning should strongly discourage motor vehicles within activity centres where people congregate for work, shopping and recreational activities, with the aim of encouraging the use of alternatives and also minimising local impacts of exposure to air pollution associated with motor vehicles.

A UK Royal Commission also made similar conclusions:

> "there is no single pattern of land uses that will reduce the need for travel and so reduce the effects of transport on the environment…….[We support] the promotion of development which does not rely on car access; the location of developments which generate high travel demand where they can be reached on foot, bicycle or public transport [and] the encouragement of housing development which enables people to

> live near their work…..Land use policies will not lead people to use cars less if there is no attractive alternative…..good public transport and town centres which are safe and attractive to cyclists, pedestrians and public transport users are essential if habits are to be changed' (pp. 151, 152, 157).

Considering air quality impacts, a multi-nodal city is more likely to be optimal (Boyle et al, 2000). Key features would include:

- a multi-nodal corridor structure based around a public transport network. Where these nodes should be concentrated from an air quality perspective will be become clearer once EPA has completed its ozone modelling.
- increased population densities mainly in and around activity centres and along transport corridors
- high quality public transport linking surrounding communities to activity centres and between centres
- high quality and safe pedestrian and bicycle facilities to and within these centres, coupled with strong disincentives to private car use into and within the centres
- urban planning and design to reduce exposure of populations to motor vehicle pollutants – particularly in areas of high traffic volumes and congestion.

4. GREENHOUSE GAS EMISSIONS AND ENERGY EFFICIENCY

4.1 BACKGROUND

A metropolitan strategy alone will not achieve urban energy efficiency and substantial greenhouse gas emission reductions because of the range of factors influencing energy supply and use and emissions. A metropolitan strategy is a necessary, but not sufficient, condition for achievement of those outcomes.

Global warming is a key consideration in development of the metropolitan strategy. Scientific opinion now strongly supports the view that global warming is occurring, and that human activity is a major contributor to it. In order to limit concentrations of greenhouse gases in the atmosphere to within two or three times those of pre-industrial times, large emission reductions of 60 to 80% or even greater are required over the coming decades. Even these dramatic reductions will not stop significant warming and its consequences, including climate change, higher sea levels, greater variability in climate and changes in rainfall patterns.

Within a metropolitan strategy it will be important to ensure that future development assists, rather than hinders, reduction in greenhouse gas emissions, and that design and location of physical infrastructure takes account of the possible impacts of global warming, such as more intense periods of rainfall and higher sea levels. Development should also aim to provide corridors for plants and animals to migrate as climate changes, otherwise, they may die out as climate change makes their existing locations unsuitable.

From the perspective of greenhouse gas emissions, metropolitan development is a critical issue, as it influences the levels of greenhouse gas emissions associated with transport, buildings, infrastructure construction, biomass and industrial processes, as well as energy supply systems. If Victoria is to reduce its level of greenhouse gas emissions, urban systems must play a key role.

How significant is urban development strategy with regard to energy use and global warming? Almost three-quarters of Victorians live within metropolitan Melbourne. All other things being equal, it would follow that around three-quarters of the energy and greenhouse gas emissions associated with the Victorian economy, daily activities, and provision of food, materials and services would be linked directly or indirectly to metropolitan Melbourne. However, a number of factors influence the level of energy and emissions attributable to urban systems:

- Australia is a major exporter of energy-intensive commodities, and it has been suggested that our imports are mainly low energy-intensity products. According to Department of Foreign Affairs and Trade (DFAT, 1997), exports represent about 20% of Australian GDP, so DFAT argues that at least 20% of Australian energy use and energy-related greenhouse gas emissions can be attributed to the net effect of exports/imports. However, a study of the energy embodied in Australia's imports (Lenzen 1998) found that the energy embodied in our imports almost equalled that in our exports – 1222 PJ embodied in imports compared with 1379 PJ embodied in exports, a different view from that of DFAT
- Over half of Australia's agricultural activity is export-oriented, so a significant proportion of non-energy agricultural greenhouse gas emissions could be attributed to exports. The situation is not so clear-cut with regard to land use change and forestry

- Much of the energy used for urban activities relates to activities such as operation of appliances and equipment and, as such, can be influenced by strategies traditionally consider to be outside the scope of the metropolitan strategy, such as appliance efficiency improvement.
- Large quantities of materials are used for urban infrastructure development, so the energy and greenhouse gas emissions embodied in them contribute to urban energy impacts, even though the impacts may occur elsewhere
- Much urban activity relies on electricity use. Each unit of electricity consumed requires the burning of three to four units of fossil fuel energy, so the primary energy (and greenhouse) implications of urban energy use are much greater than might be expected

Given these factors, it seems likely that urban development strategies have potential to influence around 50% of Australia's energy use and greenhouse gas emissions. Melbourne, as a major Capital city, has a key role to play in greenhouse response.

An issue that must be considered in development of a metropolitan strategy from energy and greenhouse perspectives is the extent to which its scope should be expanded to include elements that have traditionally been outside its scope, but which are potentially influenced by planning strategies. For example, in New South Wales, a number of local planning codes (for example, Botany and North Sydney Councils, and councils using the Sustainable Energy Development Authority's *Energy Smart Homes* policy) include controls or guidelines for specification of commercial building lighting, heating and cooling systems, domestic hot water services, clothes drying facilities, and so on.

A further issue is that the energy and greenhouse implications of metropolitan strategies may depend upon actions in other spheres. For example, the long-term viability (with regard to energy and greenhouse impacts) of a car-based, low density development strategy is dependent upon provision of very fuel-efficient vehicles and transport fuel from renewable energy sources. Is it reasonable to assume these will become reality? Should urban planners become actively involved in ensuring that they are delivered?

Finally, it must be recognised that a large proportion of the physical infrastructure of the future Melbourne is already in existence. This now uses large quantities of energy unsustainably and is a significant contributor to greenhouse gas emissions. But the materials, buildings, infrastructure and systems are also assets into which we have already sunk large quantities of energy, money and other resources. It will be important to utilise and enhance these assets in ways that support rather than block a transition towards an ecologically sustainable urban system.

These issues will be considered in more detail later in this chapter.

4.1.1 ENERGY AS A KEY ISSUE FOR METROPOLITAN MELBOURNE

As noted earlier, urban energy use is a major component of the total quantity of energy used. Use of energy within urban areas is a major contributor to urban pollution (see other chapters in this report). The provision of energy for Melbourne to function also involves extraction and processing of large quantities of fossil fuels in other parts of Victoria (such as the Latrobe Valley) or elsewhere. These activities have significant environmental and economic implications for

those regions. Even the renewable fuels we use, such as hydroelectricity and firewood, have significant environmental impacts on the regions where they are produced, including Victoria's forests and the Kiewa and Snowy Mountains regions. Delivery of energy to urban areas also involves environmental impacts, such as clearing of land for power lines and pipelines, potential for powerlines to start bushfires, and so on. Through its contribution to global warming, urban energy use also has global implications. So the overall impact of urban energy use extends far beyond the boundaries of the urban system, and this must be considered in development of urban strategies.

The economic implications of energy supply are also very significant. Large capital investments are involved, as shown by the sale of Victoria's electricity supply assets for over $23 billion during the 1990s. These large costs are reflected in our energy bills: an average Victorian household spends over $1200 each year for electricity and gas. Together, Victorian homes and business spend over $4 billion each year on energy bills, and a similar amount on fuel for cars and trucks.

The cost of equipment and infrastructure that consumes energy is also very high. Each household owns many thousands of dollars worth of heating, cooking, washing, drying and other appliances that consume energy. An average household has over ten thousand dollars of capital tied up in its cars. Airconditioning equipment comprises up to 20% of the cost of an office building. At a broader level, construction of each kilometre of freeway or public transport system can cost tens of millions of dollars.

4.1.2 ENERGY: AN INPUT TO SERVICES, NOT AN END IN ITSELF

Energy is an essential input for the functioning of an urban system. We use energy because it is an input to the delivery of services we value or need.

If we are to develop more sustainable energy solutions, it is important to separate out the significance of the services that energy helps to deliver from the amounts and types of energy that we use. For example lighting a living room to a specified standard with inefficient low voltage halogen lamps could consume three times as much energy as using energy-efficient fluorescent lamps. It is now possible to use a range of technologies and strategies to deliver the same or higher standard services while consuming less energy.

The efficiency with which we supply and use energy, and its sources have major impacts on the total cost of satisfying service requirements, and the amount of energy infrastructure needed to deliver those services reliably. They also influence our capacity to satisfy service requirements in an ecologically sustainable manner.

Traditionally, energy growth and growth in use of fossil fuels have been seen as necessary requirements for economic growth. However, this is no longer the case, and many countries (including both developed and developing countries) have begun to ‘decouple’ energy growth from economic growth (WRI, 1998). They are doing this in a number of ways, including:

- Utilising more energy efficient technologies and systems in both energy use and energy conversion

- Replacing physical activities with electronic alternatives
- Shifting from material to service based economies (for example, replacing paper-based commerce with electronic commerce, production and use of virgin metals with recycling)
- Re-using and recycling materials
- Utilising renewable energy resources and natural materials

If we are to limit energy consumption and its economic, social and environmental costs, while continuing to develop our economy, it will be essential to decouple fossil fuel use from economic development. There is increasing evidence that this can be done at low cost, or even with economic benefits (see, for example, Jacobs, 1991). To pursue this path first requires acceptance of a number of key factors which many economists and policy makers find difficult. They include:

- Existing levels of energy efficiency are very low (often between 1 and 30% of the feasible maximum)
- There is scope for large improvements in energy efficiency at negative or low cost
- The rate of efficiency improvement now being achieved falls far short of what is economically viable (and socially and environmentally desirable) because of many structural, institutional and other barriers that could be overcome with sufficient commitment
- Some industries that are economically important today may not be important in the future, while others that are minor today will become important (for example, the sustainable energy industry is growing rapidly at the expense of centralised power generation, companies providing recycled plastics at the expense of traditional chemical industries)

Until these circumstances are acknowledged and addressed in policy development and implementation, we will struggle to make headway towards a low energy society.

From an energy perspective, urban areas have greater potential for efficient energy use, and relatively less access to renewable energy sources than do rural areas. For example, in well-planned urban areas, public transport can play a major transport role while, in rural areas with very low population densities, this is less likely to be the case. On the other hand, large solar, wind and biomass resources are available in rural areas while they are limited in urban areas. Nevertheless, the renewable energy resources available within urban areas are significant, and have potential to provide most or all of the energy required to operate an efficient economy and society without heavy reliance on imported energy.

Urban planning decisions have substantial and long-lasting implications. This has important implications for energy use. First, planning decisions ‘lock-in’ travel patterns and land uses that have long-term effects. For example, a new regional shopping centre that leads to 50,000 customers per week driving an average of only 4 kilometres further than they otherwise would for shopping increases transport fuel consumption by around a million litres per year and greenhouse gas emissions by 2,500 tonnes per year, and 0.25 million tonnes of greenhouse gas over a 100 year period. Such a development also reinforces reliance on cars. Because urban development involves construction of infrastructure, large quantities of energy are embodied in the materials consumed. If the infrastructure is inappropriate for long-term sustainable use, it may not be possible to recover much of that embodied energy. The ongoing energy overheads of urban development can also be significant. One study (Loder & Bayly et al, 1993) has estimated

that the amount of streetlighting energy used in low density (10 dwellings/hectare) development is around half as much as the lighting energy used within the homes.

4.1.3 GLOBAL WARMING AS A KEY ISSUE FOR METROPOLITAN MELBOURNE

While energy is the major contributor to Victoria's greenhouse gas emissions, other significant areas of activity include organic wastes, industrial processes, agricultural practices, land use change and forestry practices (see Figure 23 and Table 2).

Urban areas generate large quantities of organic wastes, and the ways they are managed and processed can have significant impacts on greenhouse gas emissions. The materials used for urban infrastructure construction, particularly cement (which generates CO_2 during manufacture) and aluminium (which generates greenhouse-active perfluorocarbon gases during smelting), also generate significant process emissions. Land use conflicts due to urban development can influence both agricultural practices and landclearing. For example, expansion of urban areas may displace agricultural activity and/or involve clearing of land for urban development. Demand for forestry products for urban development and construction influences emissions from forestry activity. The net greenhouse impacts of changes may be positive or negative, depending on their nature and the mode of response, for example higher demand for forestry products could be satisfied by sustainably managed plantations or clear-felling of native forests, with very different implications for global warming and the environment.

4.1.4 INSTITUTIONAL ARRANGEMENTS, POLICIES AND PRACTICES

Institutional arrangements, policies and practices with regard to greenhouse gas emissions and energy are in a state of rapid transition.

Victoria and Australia have developed and implemented various greenhouse response strategies, in particular the National Greenhouse Response Strategy (NGRS, 1992) and the National Greenhouse Strategy (NGS, 1998), which have been adopted by Heads of Government. The NGRS was ineffective in limiting greenhouse gas emissions. In some cases, this was because other trends, policies and strategies have encouraged greater growth in emissions. Response strategies have, in some cases, had unexpected effects. For example, restructuring of the electricity supply sector was expected to lead to reduction in greenhouse gas emissions but, in practice, it had contributed to an increase of 6 million tonnes of CO_2 per annum (almost 5%) above projected 'business as usual' nationally by 1998 (Allen Consulting/MMA, 1999). The implementation of many elements of greenhouse strategies has also been slow and standards have been set at relatively low levels, as seen by very slow progress on improving new vehicle fuel efficiency (Lumb et al, 1996).

The outcomes of the 1998 NGS are not yet clear, as implementation has been relatively slow. One important barrier to achieving greenhouse emission reduction objectives has been the failure to achieve 'whole of government' integrated responses. This problem is beginning to be addressed as acceptance of the reality of global warming spreads, and consideration of global warming in the development of the metropolitan strategy reflects this trend.

The Victorian government is developing a Victorian Greenhouse Strategy, which will play a critically important role in management of global warming issues, and should provide a framework within which the metropolitan strategy can be placed.

As noted above, other areas of activity that contribute to greenhouse gas emissions include organic wastes, industrial processes, agricultural practices, land use change and forestry practices. Demand for products from a number of these areas (eg concrete and timber) can be influenced by urban development strategies and, hence, by the institutions that develop and implement relevant policies such as local government, road construction and authorities and housing agencies. Management of organic wastes involves both local government and state government, as well as the private sector (including collection and processing of wastes, as well as generation of wastes from industry and business). Urban development agencies can influence emissions from land use change by controlling the extent and direction of urban expansion, as well as how land within urban areas is managed.

In the stationary energy sector, a shift has occurred from strong government policy and publicly owned utilities, to a mostly privately owned market framework. Over the next few years, the markets will become increasingly national in their nature, as energy supply networks are interconnected and energy retailers take on national and even international roles (through foreign ownership, provision of consultancy services, etc). Under the previous government, the level of public policy involvement declined markedly. However, the present government has indicated a stronger policy role by foreshadowing stronger regulatory frameworks, expanding Energy Efficiency Victoria into the Sustainable Energy Authority of Victoria (SEAV), and announcing a range of new policies (ALP, 1999). Nevertheless, the private sector will deliver energy and manage relevant infrastructure, and government will regulate and influence the ways energy markets operate. State governments will have a declining capacity to directly influence the operation of energy markets, which will become increasingly national in their focus. State governments will continue to determine licence conditions for energy retailers and will regulate distribution networks. Various requirements and conditions can be placed on operators using these mechanisms. There is also scope for state governments to take a more pro-active role in driving demand-side action through government agencies (such as SEAV and business development agencies) and partnerships with business and community.

Stationary energy use is influenced by a range of policies and programs, including urban planning, building control, and appliance and equipment standards. Levels of energy use are heavily influenced by the operation of markets for housing and other buildings, appliances and equipment. User behaviour is also an important factor. While these markets are influenced to some extent by perceptions about the cost, convenience and environmental impacts of energy, they are dominated by other factors. Moves towards introduction of building energy rating schemes, energy performance standards and further development of appliance energy labelling reflect an increasing recognition within government that these markets are not very responsive to energy pricing or environmental issues. Victoria has had mandatory requirements for residential insulation since 1991. Planning codes have made some reference to energy efficiency, but have failed to include specific requirements. The recently released draft ResCode (2000) takes a significantly stronger position, with further requirements for energy rating of new dwellings, and some protection of solar access. However, it will be important to evaluate the possible impacts on transport energy and urban sprawl if the new code limits urban consolidation.

Transport energy supply policy is mainly managed at a national level. However, provision of transport infrastructure (for road, rail, air and sea) involves Commonwealth, State and local governments. Taxis and some buses have a long tradition of private ownership and operation. Sale of public transport services and construction of City Link by a private consortium have expanded private sector involvement. A stronger focus on outsourcing and sub-contracting by local and state government has also increased private sector involvement in transport infrastructure construction and maintenance.

This overview of institutional arrangements highlights the breadth of circumstances across which energy and greenhouse issues will need to be addressed if appropriate responses are to be made. In many cases, the action must be pursued by one organization, but the benefits may accrue elsewhere or at some time far into the future, so achieving change is difficult. For example, to reduce transport energy and greenhouse gas emissions involves effective urban planning strategies complemented by appropriate decisions regarding provision of public transport, road infrastructure, parking, etc. Each of these areas is controlled by a different institution and has a different culture.

So a combination of central coordination and policy development, combined with agency-specific energy/greenhouse teams and partnerships with business and the community seems likely to be needed if policies, strategies and programs are to adequately address these issues. Mechanisms that facilitate re-allocation of resources will also be needed. For example, instead of providing funding for roads separately from public transport and bicycle infrastructure, a common pool of funds that can be allocated according to broader priorities may be preferable.

4.2 DATA AND TRENDS

4.2.1 TRENDS IN GREENHOUSE GAS EMISSIONS

When the Kyoto Protocol is ratified, Australia will have an obligation to limit its average annual net greenhouse gas emissions (that is, emissions minus sinks and credits for approved overseas emission reduction activities) to 108% of 1990 emissions over the period of 2008 to 2012 and must demonstrate substantial progress towards this target by 2005. It is not yet clear what types of sinks, international projects (under the Clean Development Mechanism and Joint Implementation clauses) and forms of international emissions trading will be allowed. Scientific uncertainties regarding measurement of carbon flows into and out of the biosphere are also not fully resolved. For these reasons, Australia's actual task is still not well-defined. But it is clear that achievement of the target will be a substantial challenge.

It seems unlikely that specific emission targets will be set for individual states and territories, or for industry sectors, but there is a clear expectation that all jurisdictions and sectors will be expected to play their part. Recent studies of the emissions from residential and commercial buildings for the Australian Greenhouse Office (Harrington and Foster, 1999 and EMET/SOLARCH, 1999) both compared projections of building energy emissions against the Kyoto Target, so it seems that it is being used at least as a reference point, if not as a target for some sectoral studies.

It will be necessary to clarify what constitutes a reasonable emissions target or reference level of emissions for Victoria, and for sectors within Victoria, so that government, business and the

community can work within a more certain framework. In considering this issue, it should be noted that, on one hand, Victoria's population growth and rate of economic development are expected to be slightly slower than some other states, and a large number of resource development projects is proposed for Western Australia and Queensland. On the other hand, land clearing rates in some other states are very high, while Victoria has achieved low rates of land clearing, has less area for planting of new forests and plantations, and is reliant on brown coal for much of its electricity generation. In the context of urban planning, where much of the infrastructure of 2010 is already in place, achievement of reasonable progress on greenhouse response might be evaluated separately for new infrastructure and development (which should aim to achieve emissions per unit of area or service delivery well below the average for existing stock) and existing systems, which would need to be evaluated on different criteria. These might take into account capacity to increase utilisation, re-use or recycling of materials from demolition, potential for retrofitting to reduce emissions, etc.

It should also be recognised that, beyond the Kyoto timeframe, it is likely that much larger emission reductions than now proposed will be required. If new urban infrastructure is not to become barrier to further emission reductions, it must be designed to support and facilitate ongoing emission reductions, rather than just achieving levels consistent with compliance with the Kyoto Protocol. So buildings with very energy-efficient envelopes and potential to utilise renewable energy, new developments designed to encourage less travel and use of low environmental impact transport modes should be encouraged.

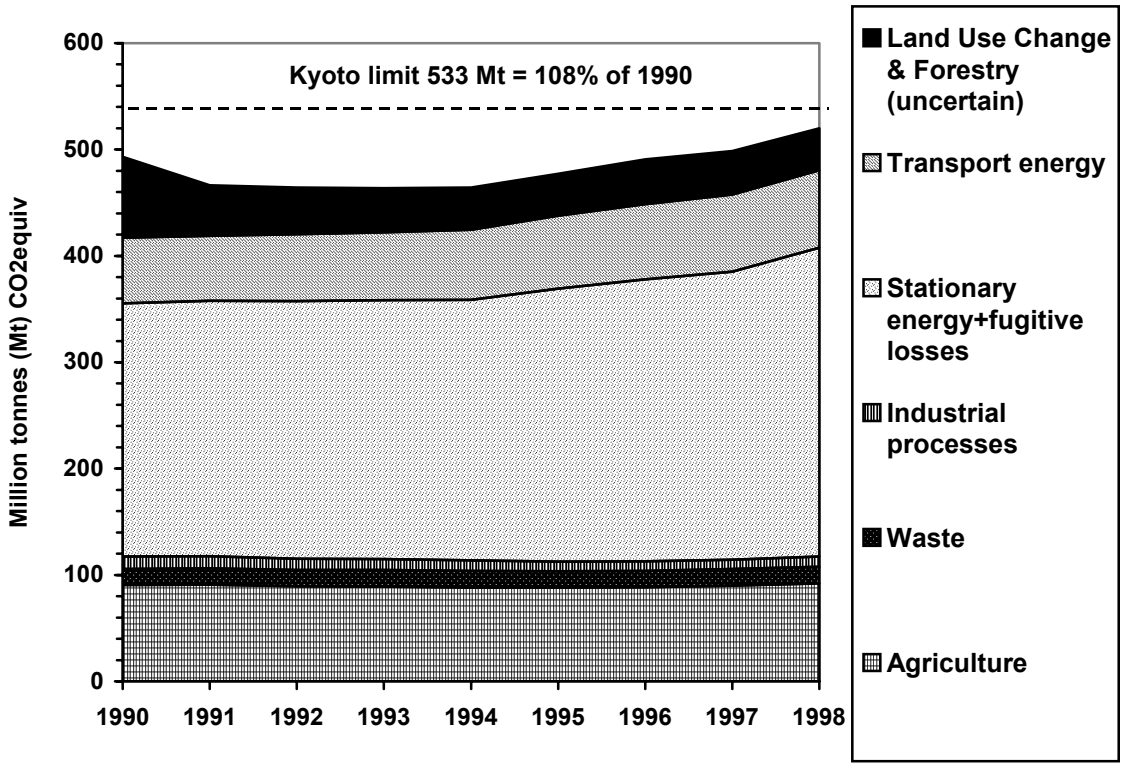

FIGURE 23. AUSTRALIA'S GREENHOUSE GAS EMISSIONS, 1990 TO 1998 (AGO, 2000)

Figure 23 shows recent trends in Australian greenhouse gas emissions, including the rather uncertain estimates for land use change and forestry (due mainly to uncertainties in estimates for land clearing). Almost all growth in emissions between 1990 and 1998 has resulted from energy growth. Emissions from both transport energy and stationary energy have increased by around 20% over the period, with three-quarters of the growth in emissions from stationary energy coming from electricity generation and use. A large reduction in net emissions from land use change and forestry and a small reduction in industry process emissions have offset this strong growth in energy-related emissions to a great extent, so that the overall increase in emissions has been just over 5%.

Data for Victorian emissions are not so well documented. Table 2 shows data published for 1990 and 1995. It is likely that there has been significant growth in emissions since 1995, due largely to the increased utilisation of Victoria's older brown coal-fired power stations since privatisation (see Figure 24a). Stationary and transport energy comprise a larger proportion of Victorian emissions (78%) than for Australia as a whole (70%), while land use & forestry and agriculture comprise smaller proportions for Victoria. On this basis, it is particularly important for Victoria to address energy-related greenhouse gas emissions.

SECTOR	**1990 (MILLION TONNES CO_2EQUIV)**	**1995 (MT)**
Stationary energy	63.6	66.5
Transport energy	15.7	16.4
Industrial processes	3.5	1.8
Agriculture	15.0	15.8
Wastes	3.9	4.2
Land Use Change & Forestry	2.1	1.8
TOTAL	103.8	106.5 (+2.6% from 1990)

TABLE 2. ESTIMATES OF VICTORIAN GREENHOUSE GAS EMISSIONS (NGGIC/AGO, 1998)

4.2.2 TRENDS IN ENERGY USE

Trends in final energy use (that is, energy as measured at the point of use, eg gas meter or petrol pump) by sector within Victoria are shown in Figure 24a. Electricity generation is the biggest single sector of energy use. However, the consumption shown is the large energy conversion losses in electricity generation – 70% or more of the energy in the coal consumed in Victoria's brown coal-fired power stations is lost as waste heat. It should be noted that electricity is merely an intermediate form of energy, so energy use by the electricity generation sector is a consequence of both the technologies used for generation and the quantity of electricity consumed by end use sectors such as industry, commerce and households.

Of the end-use sectors, transport and manufacturing are the largest energy consumers, and both have experienced strong growth in recent years. However, much of the growth in industrial energy use has been associated with expansion of aluminium smelting. For example, energy growth in Victorian manufacturing without the basic metals sector between 1981 and 1994 was less than 6% while, if basic metals are included, the sector's energy growth was 17.3%.

Residential sector energy use is smaller than transport and manufacturing, but has grown strongly, with over 40% growth between 1981 and 1998, compared with 32% for transport and 24% for industry. This reflects a number of factors including:

- increasing population
- declining household size, which means the number of households is increasing more rapidly than the population, leading to increased ownership of appliances and equipment per capita
- a strong trend towards central heating and, more recently, airconditioning
- increased ownership of appliances per household
- increasing house size

Improving appliance efficiency and building energy efficiency has damped some of the growth that would otherwise have happened (Harrington and Foster, 1999).

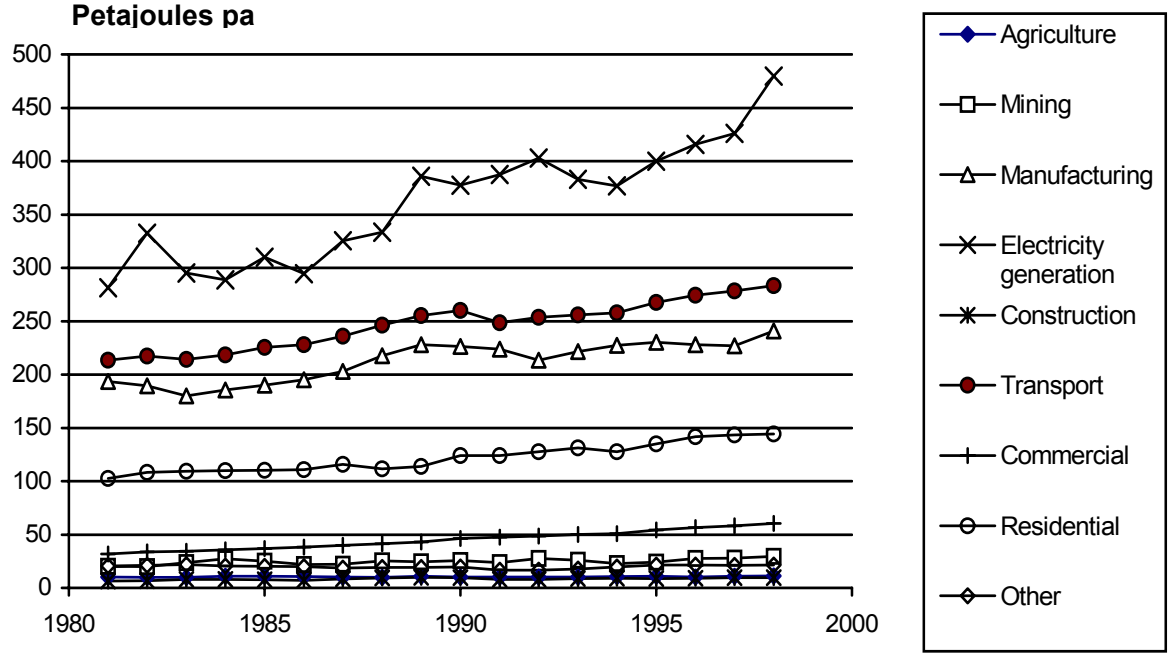

FIGURE 24A. TRENDS IN FINAL ENERGY USE BY SECTOR, VICTORIA (BUSH ET AL, 1999)
Note that energy use for electricity is conversion losses in power generation.

Projected trends in energy use by sector are shown in Figure 24b. ABARE (Bush et al, 1999) expects strong ongoing growth in transport and commercial sector energy use, while manufacturing is also expected to grow significantly. Electricity generation energy use is expected to stabilise, as more efficient plant replaces older equipment.

Since transport is a key issue for the metropolitan strategy, further discussion of energy use trends within the transport sector is warranted.

Electricity consumed by Victorian rail transport is growing slowly, and was around 1.1 PJ in 1997-98. This compares with fuel use for road transport of more than 220 PJ per annum, with

strong growth. Road transport is responsible for 85% of Victorian transport energy use, and is a clear priority area for action within the metropolitan strategy.

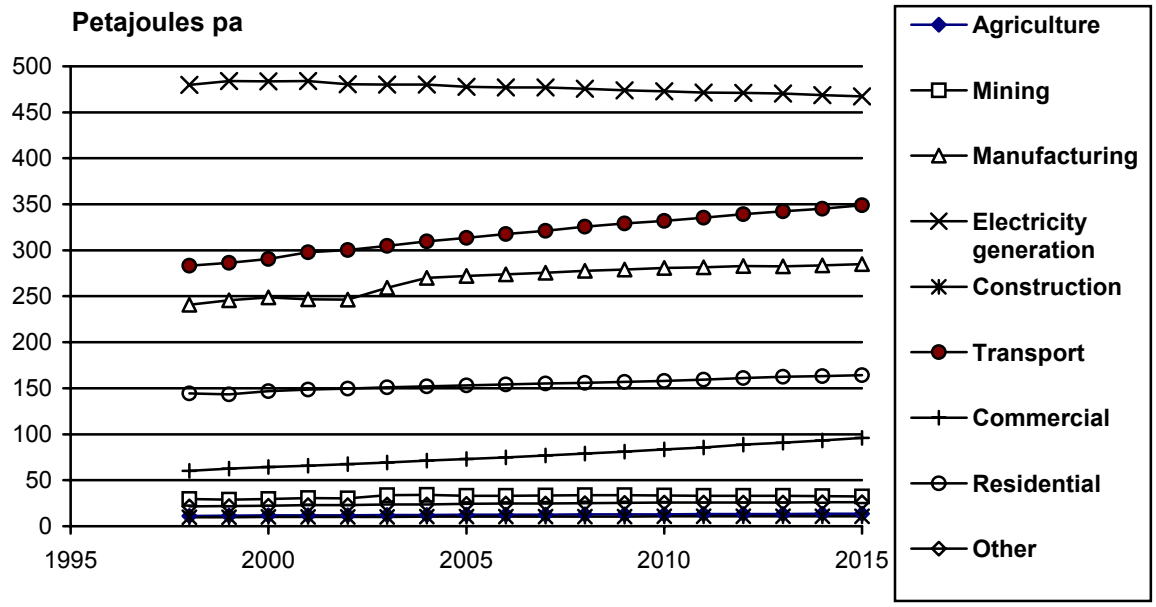

FIGURE 24B. PROJECTED TRENDS IN VICTORIAN ENERGY USE (BUSH ET AL, 1999)

The most recent ABS survey (ABS 2000c) indicates that total vehicle kilometres travelled within Melbourne in 1998-99 were 28.75 billion kilometres, 62% of total vehicle kilometres travelled in the State. But a significant proportion of the non-Melbourne travel would have been to or from Melbourne.

Data for urban travel in 1999 are not yet available but, on a statewide level, 81% of vehicle kilometres were travelled by passenger vehicles, 11.7% by light commercial vehicles (LCVs)), 6% by trucks and the remainder by motocycles and buses. Cars consumed 66% of transport fuel, while LCVs used 14% and trucks consumed 18% (ABS, 2000c).

Use of LCVs has been growing rapidly. However, they are by far the least fuel-efficient of freight vehicles. In 1995, LCVs in urban areas used 27.1 MJ/tonne-km, while rigid trucks used 3.1 MJ/tkm and articulated trucks 1.5 MJ/tkm (Apelbaum 1997). The growth in use of LCVs reflects a variety of changes, some of which are increasing energy use (such as courier services delivering small parcels) and some of which may be reducing it (such as mobile car repair vans and 'fast food' delivery). The average LCV in Victoria carries 484 kilograms of load, but almost half of the load carried is described as 'tools of trade'.

In 1999, the average passenger vehicle (including four wheel drives used for passenger purposes) consumed 11.7 litres/100km, while LCVs consumed 13.3 L/100 km, rigid trucks 28.0 and articulated trucks 51.5 L/100 km. Only 47% of kilometres travelled by LCVs were laden business travel, 22% were unladen business travel, 13% travel to or from work, and 19% for personal and other travel. 25% of car travel was for business, 24% to and from work, and 51% for personal and other use (ABS 2000c).

New car average fuel consumption for 1998 was estimated at 8.43 L/100 km, compared with a 1990 value of 8.9 L/100 km (Usher, 2000), a 5% improvement. It should be noted that this is based on testing to AS 2877, which is not directly comparable to on-road fuel consumption, as surveyed by ABS (above). This new vehicle value does not include fuel use by four wheel drives, which have increased their market share dramatically during the 1990s: according to RACV (2000), 1999 sales of 4WDs reached 104,000, 16% of passenger vehicle sales, compared with 8.6% of a smaller market in 1995. Since 4WDs typically use more fuel than conventional cars, overall new passenger vehicle fuel consumption has probably deteriorated over this decade when they are included. This is clearly inconsistent with a trend towards environmental sustainability.

Heavy (and increasing) dependence on cars and light vans leads to increasing fuel consumption, air pollution, traffic congestion and parking problems. If we are to reduce energy consumption and its associated economic, social and environmental costs, the metropolitan strategy must address the problems created by existing the level road transport use and likely short term increases, while facilitating a long term transition to a society less dependent on road transport.

4.2.3 ENERGY RELATED COSTS

While much has been claimed about the financial benefits of privatisation of Victoria's energy sector, Victorian residential sector electricity prices (General Domestic tariff) are the highest in Australia, except for Tasmanian consumers using less than 3,500 kWh per year (OTER, 1999). It is not clear what will happen to prices when households become contestable in 2001, but one promotional offer now available proposes maintaining existing prices with full CPI indexation in exchange for a refund of one month's electricity consumption each year (part of which the consumer can elect to donate to charity), with the actual month – presumably that in which the lowest consumption occurs - to be selected by the retailer (Australian Energy Services, 2000). This rebate is probably equivalent to around a 5% discount, but its value will be eaten up by inflation within two years or so. Other retailers are developing a range of promotional offers that suggest competition in the household electricity market will focus more on packaging of a range of services than on reducing electricity prices.

Victorian households pay low prices for natural gas, with an average cost per Gigajoule in 1996-97 of $9.34, compared with $11.16 in ACT, $13.31 in NSW and even higher prices in other states. These low prices reflect the economies resulting from the widespread usage of gas in Victoria, and the outcome of favourable contract prices negotiated by the Victorian Government in the 1960s and 1970s – these contracts will expire over the next few years.

Data on overall household energy costs are limited. Preliminary results from the 1999 Household Expenditure Survey survey indicate a weekly expenditure of $22.47 for an average Melbourne household for 1999 (ABS, 2000), the highest for any Australian capital city apart from Hobart, and significantly higher than the Australian Capital city average of $18.57, although costs for Canberra and Darwin were close to Melbourne.

Table 3 shows data from the 1993-94 Household Expenditure Survey for Melbourne households. The Table shows that, while the average Melbourne household spent only 2.8% of income on fuel and power, low income households (which were also smaller than average) spent up to

8.9% of income on energy bills. Low income households also spent more per person on energy bills. This is due to two factors. First, all households pay fixed charges ($2.50/week for electricity and $1.50 for gas if connected) as part of their energy bills, regardless of household size. Second, larger households share the use of major appliances such as refrigerator and home heating over a larger number of people, so energy consumption per person for these activities is lower than for small households.

Since July 2000, households have paid GST on energy bills, with overall increases of close to 10%. This has added over $100 to a typical household's annual energy bill.

	LOWEST 20%	SECOND QUINTILE	THIRD QUINTILE	FOURTH QUINTILE	HIGHEST 20%	AVERAGE ALL HOUSEHOLDS
Weekly expenditure on fuel and power	$15.31	19.49	22.03	23.90	27.96	21.74
% of income	8.9%	5.1	3.5	2.5	1.7	2.8
Ave household size (no of people)	1.50	2.43	2.87	3.04	3.15	2.6
Fuel & Power cost ($/capita)	10.17	8.01	7.68	7.88	8.88	8.36

TABLE 3. EXPENDITURE ON FUEL AND POWER BY MELBOURNE HOUSEHOLDS, 1993-94 (ABS 6533.0)

For small businesses (annual consumption 30,000 kWh), electricity prices in Victoria in 1998-99 were the highest in Australia, at 16.84 cents/kWh compared with 10.42 to 12.84 cents in NSW (OTER, 1999). Larger contestable customers, particularly very large consumers, have been able to negotiate relatively low electricity prices compared with states where competition has not yet been introduced. However, recent price trends have been upwards as the initial price war has run its course, and other states are introducing contestability, so it is unclear whether large Victorian consumers will continue to benefit from a price advantage.

In 1996-97, Victorian commercial sector gas consumers paid 20% less for gas than the Australian average of $8.05/GJ, while industrial customers paid $3.68/GJ, 16% less than the Australian average (AGA, 1998). These prices reflect the favourable supply contracts negotiated by the Victorian government some decades ago. Given these low prices relative to the rest of Australia, the introduction of a national gas market may well see Victorian gas prices increase. Indeed, a study by Dalzeill et al (1993) suggests that Melbourne natural gas prices would increase by up to $0.60/GJ and Sydney prices would decline by $3 or more per GJ if grids were interconnected. So Victorian business gas consumers should not expect reductions in gas prices in coming years.

Overall, Victorians pay over $4 billion each year for non-transport energy. It seems unlikely that prices will decline significantly. Indeed, given the discussion above, prices may well increase in some cases. Further, introduction of greenhouse gas emissions trading or carbon taxes will increase fossil fuel prices by at least 1 cent/kWh for electricity and $0.65/GJ for gas – and potentially by much more (see below).

This means Victorian households, business and government agencies should now be using a higher energy price as a basis for assessment of investments in energy efficiency. It is also time that they were educated to look at their total energy cost, rather than the price per unit of energy. Cutting energy use by 20% through energy efficiency improvement will deliver a sustained reduction in total energy costs – something that negotiating a low energy contract price cannot do. The metropolitan strategy should aim to assist households and business to position themselves to reduce energy consumption over time, and to switch to lower cost energy sources such as natural gas.

Transport costs for Melbourne households are shown in Table 4. This Table shows low income households spend a higher proportion of their income on transport. In this case, they spend less per capita than do wealthier households. However, this reflects the fact that much expenditure on transport is for elements other than fuel costs, such as vehicle ownership, as shown in Table 5. Since larger, wealthier households are likely to own newer cars and more of them, their non-fuel costs can be expected to be much higher. Table 5 shows a breakdown of transport-related costs for an average Australian household. It shows 1993-94 fuel costs were, on average, just over a quarter of transport costs. Public transport was a minor component of transport costs, comprising only 3% of transport expenditure.

These data suggest that there are significant equity issues to be considered with regard to transport. For low income households which are more likely to own older, cheaper cars, fuel costs are likely to be a higher proportion of total transport costs, so increases in fuel costs may have disproportionate financial impacts. Application of 'user pays' charges to road use may also have a disproportionate impact on low income households. For example, if a car user paid an average of 5 cents per kilometre for 20,000 kilometres of road use (the non-peak price for suburban arterial road proposed in BTCE (1996)), the annual cost would be $1,000 on top of existing vehicle operating costs - $19 per week, and a 52% increase on the lowest quintile's transport costs. The data also indicate that if a household can locate itself where it does not need to own a car, or it needs fewer cars, substantial financial benefits can be gained.

	LOWEST 20%	SECOND QUINTILE	THIRD QUINTILE	FOURTH QUINTILE	HIGHEST 20%	AVERAGE ALL HOUSEHOLDS
Weekly expenditure on Transport ($)	36.93	68.84	98.03	100.95	173.82	95.7
% of income	21.4	18.1	15.5	10.5	10.3	12.5
Transport cost ($/capita)	24.53	28.28	34.16	33.26	55.20	36.82

TABLE 4. EXPENDITURE ON TRANSPORT BY MELBOURNE HOUSEHOLDS, 1993-94 (ABS 6533.0)

AVERAGE TRANSPORT COSTS	WEEKLY ($)	% OF TOTAL
Purchase of vehicles	27.45	29
Fuel	25.57	27
Reg/ins	14.75	16
Other running costs	19.87	21
Public transport	2.79	3
Other fares/freight	3.15	3
TOTAL	**93.58**	**100**
ave/capita	35.58	

TABLE 5. HOUSEHOLD EXPENDITURE ON TRANSPORT BY ELEMENT, 1993-94 (ABS 6535.0)

The impact of the introduction of GST has been to slightly reduce purchase cost of cars, slightly increase the cost of public transport and reduce business fuel costs. The impact on private fuel costs has been an increase of up to 1.5 cents per litre, but this impact is expected to decline over time to less than 0.5 cents/litre. However, oil price rises over the past year have led to substantial transport fuel price increases. Higher fuel costs will tend to impact more on households that are more car-dependent, and on businesses with high levels of transport activity.

In the longer term, a number of factors will influence energy and transport costs:

- Transition to renewable energy sources could lead to price increases. For example, electricity prices may increase by 0 to 3 cents/kilowatt-hour for electricity, depending on the extent to which economies of scale and technology development reduce renewable energy costs. Renewable transport fuel could cost as much as $2.50 per litre if existing taxes and charges continue to apply and further reductions in production cost are not achieved (Foran and Mardon (1999) estimate production cost of methanol at around 90 cents/litre and ethanol from wood at $1.90/litre including an allowance of 20-30 cents for purchase of biomass input, compared with an import cost of around 35 cents/litre for petrol)
- Introduction of greenhouse gas emissions trading seems almost inevitable by the end of the decade. Fossil fuel consumers will have to purchase permits to emit greenhouse gases at a price determined by demand. Estimates of the likely price of permits vary widely, from around $7/tonne of CO_2 to more than $50. At $10/tonne of CO_2, the impact on electricity cost would be 1-1.4 cents/kWh, and on petrol, 2.5 cents/litre. However, taxes and profit margins may inflate these increases.
- Wider use of road user charges could increase peak hour travel costs by 7 to 57 cents/kilometre, and non-peak costs by 4 to 37 cents/km (BTCE, 1996)
- Ongoing restructuring of the energy sector may lead to price reductions – although there is uncertainty in this area.

The messages for urban planning strategies on the energy front seem to be:

- Investment decisions should be based on the assumption that energy prices will be significantly higher in the future than in the past
- There may be some constraints on oil supply, and reliability of electricity supply during periods of peak demand may be not be guaranteed
- To limit the total cost of both transport and non-transport energy for urban dwellers and businesses, it will be necessary to improve efficiency of energy use, so that the reduction in usage offsets the increases in prices per unit of energy
- There are already significant variations in energy costs across socio-economic groups and with location, and these gaps may well increase unless pro-active strategies are introduced. Planning that reduces dependence on energy will help to reduce this inequity.

4.2.4 OTHER ENERGY ISSUES

Within the urban context, ownership and use of cars varies with a number of factors including:

- wealth
- access to alternative transport modes and to services

- household size and age distributions

A limited analysis by the authors of data from *Melbourne In Fact* (DoI 1998) provided the data shown in Table 6. It can be seen that, typically, households in inner suburbs own fewer cars per capita and are less likely to use cars to travel to work. It would be desirable to do more detailed analysis, matching household demographic and economic criteria, to remove some of the underlying variables. For example, inner suburban households tend to be smaller, but have a higher proportion of people of driving age than households in outer areas.

AREA	CARS/HOUSEHOLD	CARS/CAPITA	USE OF CAR FOR TRAVEL TO WORK (DRIVER OR PASSENGER)
Metropolitan area	1.5	0.56	68.6%
Outer growth areas	1.66-1.78	0.5-0.6	70-76%
Inner suburbs	1.24	0.44-0.54	55-65%

TABLE 6. OWNERSHIP AND USE OF CARS (AUTHOR'S ANALYSIS OF DATA FROM DOI (1998)

Another equity issue associated with transport relates to the increasing dependence on cars for mobility. While it is widely recognised that a car-based system creates inequity for the young, old and poor, other groups are also disadvantaged. One study (Industry Commission, 1994) reports that for 23 percent of Melbourne car trips the driver was dropping off or accompanying someone – effectively acting as a chauffeur. The uncosted time involved in these trips is a significant impost on car drivers, and reflects the lack of acceptable alternatives available.

Some studies have addressed the costs of congestion. For example, a paper by Miles in VTES (1994) analyses the situation in Melbourne, using a VicRoads computer model. This estimated the present cost of congestion at around $2 billion per annum. It showed that, even with significant expansion of the road network, the annual cost of congestion could quadruple by 2011 if total annual vehicle kilometres increased at 2% per annum – roughly the historical trend. Congestion is high in the city area, but is expected to increase to serious levels in the Dandenong and Berwick areas to the south-east, and Sunshine and Werribee areas to the west. This study highlights one of the basic problems that faces a road transport-based strategy. It raises questions about the effectiveness of applying road user charges (without other complementary policies) to congested roads, as the future congestion may lie where there is little congestion now, so application of road user charges may increase future congestion problems by encouraging businesses and households to relocate away from today's congestion, adding to the problems elsewhere.

A number of studies of the effects of different urban forms on transport energy use have confirmed the obvious - that reducing the need to travel by locating people, employment and services closer together reduces transport energy consumption. Three examples of studies are:

- use of the Monash University LAND model by Young (1996) for the *Urban Villages* (project), which suggested that containment of development at a rate of 25% could limit transport energy growth to 23% by 2011 compared with 51% for 'Business as Usual'
- CSIRO modelling for an inquiry into urban air pollution (AATSE, 1997) which showed that more compact urban design could cut transport energy use by up to 40% compared with BAU by 2011

- modelling by Nairn et al for the Greenhouse Neighbourhood project (Loder & Bayly et al, 1993), which estimated that transit oriented development could reduce car transport greenhouse gas emissions by more than 55%

An important issue that influences perspectives on the potential to reduce transport energy use and greenhouse gas emissions is the estimated energy use by various modes of transport under a range of conditions. Some commentators point to data that shows average greenhouse gas emissions from electrified public transport are similar to those from car usage as evidence that mode switching will have little impact on transport greenhouse gas emissions. This interpretation is potentially misleading. VTES (1994) points out that the average emissions per passenger-kilometre from public transport vary widely over the day. During peak periods, when occupancies are high, emissions/passenger-km are from 23-57% of those from cars. Outside peak periods, when public transport is providing a socially important role and often has very low occupancy rates, emissions from public transport vary from 73 to 153% of emissions/passenger-km from cars. VTES points out that actions leading to increased utilisation of existing public transport services lead to travel at very low greenhouse impact (0.002-0.006 kg CO_2/pass-km compared with an average of 0.21 kg CO_2/pass-km for cars), and new services with reasonable levels of occupancy generate emissions as low as a sixth of those from cars. Both public transport vehicles and cars have potential to improve their energy-efficiency significantly, and could utilise a range of renewable transport fuels. However, in most cases this would require significant changes to vehicles and fuel distribution technologies. Electrified public transport can, however, utilise low greenhouse intensity electricity without modifications.

For business, fuel cost is a modest component of urban freight costs, which tend to be dominated by labour cost. So strategies that reduce travel time have significant benefits for business, even if there are some costs (such as use of toll roads). Computerised tools are becoming available to assist businesses to locate in optimum areas, select appropriate vehicles, organise optimum travel routes, and share vehicles.

There are increasing concerns that world oil production may peak over the next few years (see, for example, Flea, 1995). This may not only place pressure on fuel prices, but could constrain supply. While Australia exports around as much oil as it imports, feedstock for diesel fuel production is largely imported and, as such, is vulnerable to world events.

Provision of parking is becoming a major influence on urban planning. Congestion and interference with existing householders' use of street parking have emerged as common arguments against higher density development. At the same time, the high cost of provision of underground carparking (which facilitates street level housing, which is beneficial for safety and sense of community) means that either new development is constrained, or density is increased to spread the cost of the carpark over a larger number of dwellings. This is an example of the kind of problem that can create serious blocks to transition towards environmental sustainability. If urban consolidation strategies are successful, in the longer term the carparking problem should decline but, in the short term, it is a very visible area of conflict.

In the non-transport sector, there are indications that the present market frameworks may not yet be functioning smoothly with regard to reliably meeting peak electricity demand. This seems to be due to inadequate financial incentives for both investment in peak demand supply and

management. If this issue is not resolved, the resulting blackouts or brownouts may impact on use of large airconditioned buildings and cause disruptions to business activity.

4.2.5 ACTIVITIES AND ASSOCIATED GREENHOUSE GAS EMISSIONS

ENERGY-RELATED ACTIVITIES

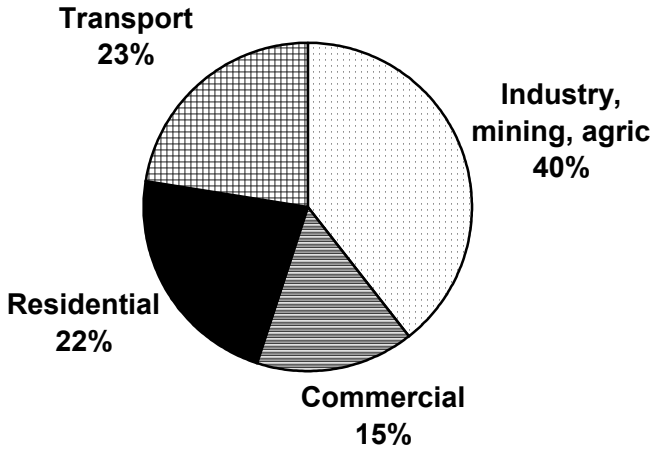

FIGURE 25. VICTORIAN ENERGY-RELATED GREENHOUSE GAS EMISSIONS, 1995 – TOTAL 79.3 MT (WILKENFELD, 1998). Note that approximately 17% of these emissions (43% of industrial emissions) result from the basic metals sector, mainly aluminium smelting.

Victoria's energy-related greenhouse gas emissions by end-use sector are shown in Figure 25. These should be considered in the context of the overall emission picture for Victoria presented earlier in Table 2. Emissions from electricity generation have been apportioned to the sectors where the electricity is consumed. In the commercial and residential sectors, a high proportion of energy used is in the form of electricity, which has a greenhouse intensity up to six times that of other fossil fuels. So these sectors show up as much more significant contributors to greenhouse gas emissions than would be expected from their significance if just end-use energy is considered, as in Figures 24a and 24b.

As for energy use, residential sector greenhouse gas emissions have grown rapidly over the past two decades, due to factors discussed previously. Over 80% of household energy-related greenhouse gas emissions result from use of electricity, despite the widespread use of natural gas. This reflects the much lower greenhouse intensity of natural gas relative to Victorian (and, indeed, Australian mainland) electricity.

Commercial sector energy use and greenhouse gas emissions have grown rapidly from a low base. This growth results largely from the sector's increasing share of economic activity, which reached 56% of Total Factor Income by 1998 (ABS, 2000) compared with 17% for manufacturing. Within the commercial sector, retail activity has become more energy intensive (due to more refrigeration and cooking equipment, higher lighting levels and more airconditioning) while offices have slightly improved their energy efficiency. Over 90% of greenhouse gas emissions from this sector result from electricity use.

Transport energy-related greenhouse gas emissions are both substantial and growing rapidly. Emissions are dominated by road transport, which uses over 85% of Victorian transport energy. Within the road transport sector, cars are the dominant energy users, with light commercial vehicles growing rapidly as discussed previously.

As discussed earlier, energy is not consumed for its own sake but is used to deliver services. So, to act to reduce greenhouse gas emissions, data on how energy is used within each sector are needed. Unfortunately, the data available are not based on detailed measurement, but rely mostly on expert judgements, so they should be considered indicative only. It should also be appreciated that there is wide variation in energy use and greenhouse gas emissions from household to household and business to business. For example, 5% of households use around 15% of household electricity (Pears, 1998).

Greenhouse gas emissions associated with typical residential sector energy use are shown in Figure 26. This shows the significance of home heating and cooling in the overall picture. But it also shows that other activities such as water heating, refrigeration and appliances are very significant. The breakdown does not indicate the significance of some energy-intensive activities that are carried out by limited numbers of households (such as swimming pool pump operation) or may become increasingly significant in future. The latter includes electric clothes drying, which may generate up to 2 tonnes of CO_2 per annum for a household that dries all its clothes this way, and trends towards higher lighting energy consumption as a result of increasing use of inefficient low voltage halogen lamps.

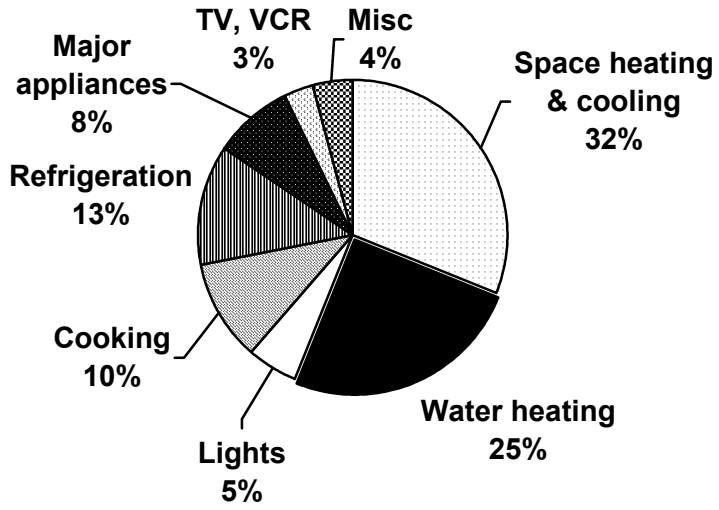

FIGURE 26. TYPICAL VICTORIAN HOUSEHOLD GREENHOUSE GAS EMISSIONS BY ACTIVITY (ENERGY EFFICIENCY VICTORIA (NOW SUSTAINABLE ENERGY AUTHORITY OF VICTORIA), 2000).

Not all household activities can be influenced during the planning, design and construction processes. However, a variety of possibilities exist. Some of these are listed in Table 7.

ACTIVITY	RANGE OF GHGS	OPTIONS FOR INFLUENCING THROUGH PLANNING, BUILDING CODES, ADVISORY PROGRAMS ETC
Space heating and cooling	0 to 20 tonnes	• Access to natural gas or other low greenhouse intensity energy sources • Solar access • Zoning of building, including cross-ventilation • Specify efficient and flexible heating/cooling system • Building envelope efficiency (eg 5 Star rating) • Specify light colours for building surfaces exposed to sun • Encourage appropriate vegetation
Water heating	0 to 6 tonnes	• Access to natural gas or other low greenhouse intensity energy sources • Provision for solar hot water (roof slope, solar access) • Lengths and sizes of water pipes (house layout) • Water-efficient taps and shower fittings
Lighting	0 to 4 tonnes	• Design for utilisation of daylight • Specify energy-efficient lighting standards • Limit outdoor lighting and use efficient solutions
Cooking	0 to 1.5 tonnes	• Access to natural gas or LPG as an alternative to electricity
Clothes drying	0 to 2 tonnes	• Protected outdoor drying area • Provision of indoor drying facilities (eg vented drying cupboard, built-in drying racks, skylight to laundry, etc)
Pool filter pumps	Up to 3 tonnes	• Limit hours of operation • Specify pipe sizes, motor efficiency, controls etc
Pool heating	0 to 15 tonnes	• Provision for solar heating • Protect from wind, provide access to sun
Transport	0 to 20 tonnes	• Selection of location • Provision of access to employment and services • Provision of alternative modes of transport, or infrastructure to support them

TABLE 7. OPTIONS FOR INFLUENCING GREENHOUSE GAS EMISSIONS AND ENERGY EFFICIENCY OF HOUSES DURING PLANNING, DESIGN AND CONSTRUCTION (BASED ON PEARS, 1997)

In the commercial sector, there is wide variation in energy use from sub-sector to subsector, and within them. All commercial buildings have a base energy requirement for maintenance of occupant comfort and lighting. Beyond that, energy use for services varies widely, from offices where some computers and office equipment are the only energy consumers, to shops where large refrigeration plant and cooking equipment can be the dominant loads, to hospitals where long operating hours, demand for hot water, laundries and specialist medical facilities can lead to high consumption.

The variability of energy use within each subsector is illustrated by Figure 27, which shows energy data for a sample of office buildings in Australasia. The BOMA target referred to on the graph is an industry benchmark which has proved to be quite difficult to achieve but is feasible with best practice. There are few data on the relationship of energy efficiency to building age, but

performance does seem to be linked to a range of factors including the standard of equipment installed, building envelope characteristics, quality of operational management and maintenance.

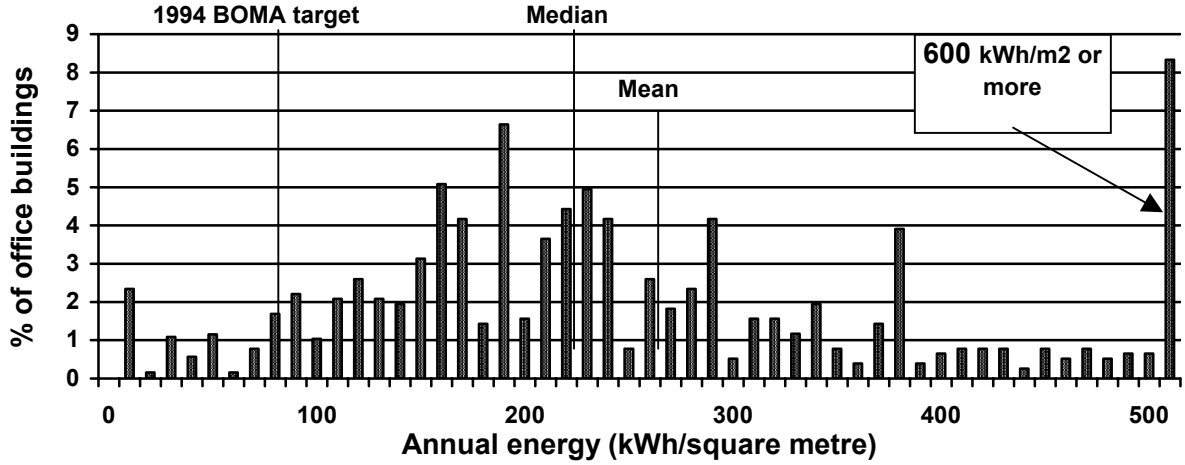

FIGURE 27. DISTRIBUTION OF ENERGY USE FOR A SAMPLE OF 270 AUSTRALIAN AND NEW ZEALAND OFFICE BUILDINGS (BANNISTER, 1999)

Figure 28 shows a breakdown of Victorian commercial sector greenhouse gas emissions by activity. This indicates that the bulk of the energy is used for space conditioning and lighting.

Factors for commercial sector development that could be influenced during planning, design and construction include:

- Overall building energy efficiency or greenhouse gas emissions (for example, the SEDA Commercial Building Greenhouse Rating Scheme)
- Energy efficiency of plant and fixed equipment, including lighting
- Building envelope characteristics
- Location relative to low energy transport infrastructure, customers, staff (and potential staff), and suppliers

Australian industrial greenhouse gas emissions are shown by sub-sector in Figure 29, and by activity in Figure 30. Victorian data are not available for this sector. From Figure 29 it can be seen that much of the energy used by industry is involved in processes that are not easily addressed by urban planning strategies. However, urban planning and development issues that may be relevant to industry include:

- location relative to staff, sources of inputs and customers
- access to low greenhouse impact energy sources - either by ensuring they are provided or limiting location to where they are available
- facilitation of low greenhouse impact energy sources, such as cogeneration and (with appropriate consideration of local air pollution issues), utilisation of landfill gas and biogas, etc

- facilitation of utilisation of wastes, recycling of materials by creating industrial parks, facilitating co-location of complementary industries, making recyclables collected locally available to local industry, etc
- encouraging low greenhouse intensity industries to locate through provision of support infrastructure and complementary industries/businesses, etc. The City of Yarra has been pursuing planning strategies along these lines (Terjung, 2000)

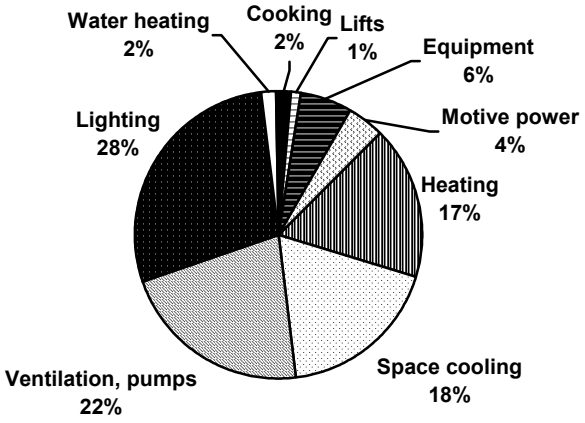

FIGURE 28. ENERGY-RELATED GREENHOUSE GAS EMISSIONS FROM THE VICTORIAN COMMERCIAL SECTOR, 1995 TOTAL EMISSIONS 12.3 MT (Wilkenfeld 1998).

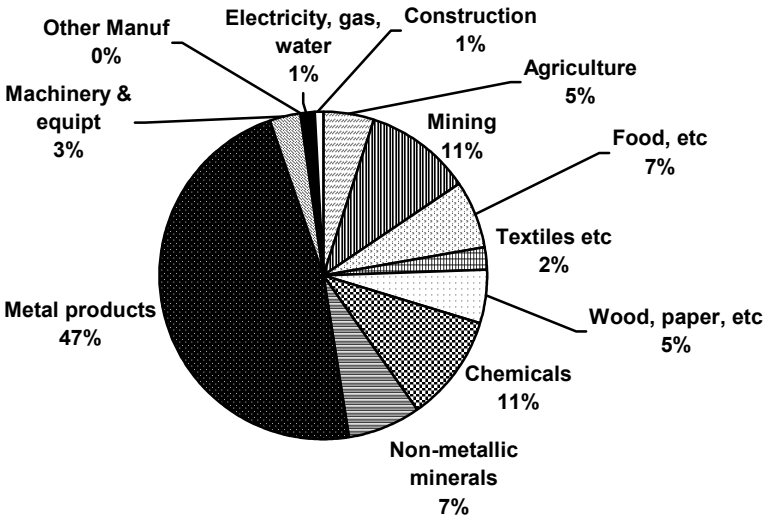

FIGURE 29. AUSTRALIAN INDUSTRIAL GREENHOUSE GAS EMISSIONS BY SUB-SECTOR, 1995. TOTAL 130 MT CO2E (Wilkenfeld, 1998)

Significant quantities of industrial energy are incorporated into the materials used to construct buildings and infrastructure. Concrete, bricks, glass, aluminium, steel and other common construction materials require large quantities of energy for their production. For example, the

materials in a typical office building may have required 10 to 20 Gigajoules per square metre for their manufacture, equivalent to 10 years or more of building operational energy use. Selection of low embodied energy materials, re-use and recycling can reduce the quantity of energy embodied in buildings and infrastructure.

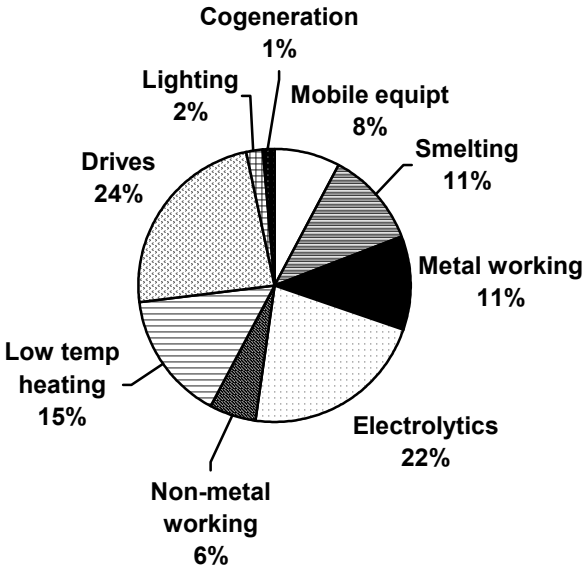

FIGURE 30. INDUSTRIAL GREENHOUSE GAS EMISSIONS BY ACTIVITY, 1995 (Wilkenfeld 1998)

OTHER ACTIVITIES THAT GENERATE GREENHOUSE GASES

While energy use is responsible for almost 80% of Victoria's greenhouse gas emissions (see Table 2), agriculture, industrial processes, wastes and landuse change & forestry contribute the remainder.

Urban development contributes to emissions from industrial processes mainly through its demand for cement, for use in concrete. These process emissions are equivalent to around 0.5 tonnes of CO_2 per tonne of cement, or 0.067 tonnes of CO_2 per tonne of concrete (Potter, 1992). Concrete is used extensively in construction of buildings and urban infrastructure. Use of cement extenders such as fly ash from power station wastes and blast furnace slag from steel production to dilute the cement content of concrete can reduce emissions per unit of concrete by 30 to 60%. Cement extenders have been used at lower concentrations by the cement industry for many years to enhance the properties of cement. A Port Melbourne plant already produces cement blended with up to 60% blast furnace slag.

Emissions from agricultural practices comprise the second largest component of Victoria's greenhouse gas emissions, at around 15%. Urban development influences agricultural emissions to the extent that the urban population creates demand for agricultural produce. Urban use of fertilisers is likely to be small relative to the total, but there is some anecdotal evidence of excessive use on some gardens: fertiliser is a significant source of the very active greenhouse

gas nitrous oxide, N_2O. Where urban development displaces agricultural activity onto less fertile land, it may encourage additional fertiliser use, with associated emissions.

Organic wastes generate around 4% of Victoria's greenhouse gas emissions, and have increased over the past decade. Emissions are dominated by landfills. The wastes include food wastes, green waste and wood & timber. Waste volumes have been growing, although an increasing proportion of green waste is being diverted to composting schemes. An increasing proportion of Melbourne's landfills are installing gas collection systems, and are either flaring the gas collected or using it to generate useful energy. Sewage treatment plants are also making greater efforts to capture and utilise methane (CH_4), or are avoiding the anaerobic conditions in which methane is produced.

Net emissions from land use change & forestry comprise less than 2% of Victoria's emissions. Urban development has mixed impacts on these emissions. Where land is cleared either for urban development, or indirectly as agricultural activity is forced into new areas, emissions may be increased. However, urban activities such as tree-planting and soil enhancement for gardens build up the carbon store, increasing sink capacity. Urban development creates demand for forestry products including timber products, firewood and paper products. Where land clearing is associated with such activity, emissions would be increased. On the other hand, expansion of plantation areas to supply forestry products is building up Victoria's carbon sinks.

4.3 SCENARIOS

The "business as usual" scenarios for energy use and greenhouse gas emissions are covered by the projections presented earlier in this document. They are all ecologically unsustainable.

There is technological potential to reduce fossil fuel use and reduce greenhouse gas emissions to levels within the capacity of natural systems. However, many barriers remain to be overcome. So the rate at which change occurs relative to the 'business as usual' scenarios shown in Figures 24a and 24b is very uncertain. The rate of change is also dependent on a number of separate factors, including how existing infrastructure is managed and developed, the performance of new infrastructure, and the performance of many factors traditionally external to urban planning strategies.

Given these circumstances, there is little point in presenting scenarios for alternative future development strategies at the moment, although such scenarios should be developed and used to explore the implications of alternative strategies.

4.4 ISSUE IDENTIFICATION

There is a need for clarification of the position to be taken within the metropolitan strategy on a number of parameters regarding energy use and greenhouse gas emissions. These include:

- 'business as usual' scenarios or trends in population, numbers of dwellings, employment, industry development policy, etc. For example, DoI (2000) suggest that Melbourne's population will grow by 16% and the number of households by almost 30% between 1996

and 2021, with much of this growth occurring in outer suburban areas. These trends create a context for the metropolitan strategy

- the range of energy and greenhouse-related activities considered to be appropriate aspects of the metropolitan strategy. As pointed out earlier, some planning codes now include requirements for appliance and equipment performance that have traditionally been seen as beyond the boundaries of planning, but some are now being incorporated into planning codes and guidelines
- the approach to external factors such as vehicle fuel efficiency, greenhouse intensity of electricity supply, forestry practices, etc. If the metropolitan strategy can rely on significant improvements in these areas, different strategies and priorities may be set. At the minimum, processes are required to identify appropriate default scenarios, and to inform those with primary responsibility for these factors of the assumptions being used for metropolitan planning purposes and their implications for planning strategies
- estimates of likely long-term energy prices for urban energy consumers. These values can then be utilised in cost-benefit studies and other economic analysis. If future prices are likely to be higher than today's, investment decisions made using today's energy prices will undervalue the benefits of higher energy efficiency and switching to low greenhouse impact energy sources
- clarification of what constitutes 'playing our part' on greenhouse gas emissions in the context of the metropolitan strategy, and direction on the extent to which consideration should be given to achieving much lower greenhouse gas emissions beyond the Kyoto timeframe. Given the long term impact of decisions regarding urban development, likely requirements for emissions in 2050 and beyond will be of significance in decisionmaking
- the criteria that might be used to assess impacts of strategies and individual developments on social equity

Further work is required to clarify the implications of global warming for adaptation within the urban region. There is significant uncertainty about the timing and extent of changes to rainfall patterns, sea level, vegetation, etc. Changes in sea level may influence the location of future urban development (for example, development in low-lying areas or those near creeks that could flood), infrastructure design (such as slopes of drainage systems, need for pumping stormwater and sewage, protection of coasts, etc). Changes in peak rainfall may necessitate incorporation of detention facilities, larger capacity systems, etc. Changes in average rainfall may focus greater attention on water conservation and re-use (which may involve a second water reticulation system in some areas), and review of vegetation practices.

Consideration needs to be given to the form of institutional arrangements at several levels. For example:

- Fitting the metropolitan strategy within a 'whole of government' greenhouse response strategy, taking into account the Victorian Greenhouse Strategy now being developed, industry development policies, social policies, etc
- Methods of encouraging capture of synergies through actions that offer multiple benefits across a number of traditionally separate areas
- Pooling money and other resources to improve effectiveness of resource utilisation
- Development of partnerships with business and the community to facilitate cultural change and greenhouse response actions

- Utilisation of market mechanisms – both existing and potential – to deliver appropriate signals to market participants
- Clarification of the roles of market mechanisms, regulation, information and other policy options in greenhouse response. For example, where long term impacts across a range of groups are involved, it is difficult to make market mechanisms such as pricing fully reflect the value of those impacts, because discounting of future costs and benefits reduces the weight placed on them.

The policy criteria appropriate for ongoing maintenance and development of existing urban infrastructure are quite different from those that should apply to new development. There is a case that new development should support lifestyles and business behaviour consistent with much reduced greenhouse gas emissions and energy use relative to the existing average, because new development will have long-lasting implications for emissions and energy use. For existing areas, more varied policy criteria may have to be applied, depending on the exact circumstances of location, potential to contribute to a low energy/greenhouse impact future, etc. There is a need to develop appropriate criteria, and to trial their application.

Work is needed to clarify the costs and benefits of a range of potential greenhouse response actions, and to monitor their costs on an ongoing basis, so that optimal decisions can be made. It is important to recognise that costs of environmentally-preferable products and systems are changing (mostly declining) rapidly, due to economies of scale, technological improvement and adoption by mainstream businesses. Failure to account for these changes means that potentially cost-effective actions may be rejected.

At a more concrete level, the kinds of issues that may be addressed by the metropolitan strategy if it is to reduce greenhouse gas emissions and promote improvement in energy efficiency include:

- provision of access to natural gas and other low greenhouse impact energy sources in new (and existing) developments
- access to cogeneration systems for efficient production of electricity and heat: this may require careful consideration of local air pollution requirements
- energy-efficient building envelope design
- installation of energy-efficient equipment
- utilisation of renewable energy sources
- encouragement of use of low embodied energy materials in construction of buildings and infrastructure
- replacement of refrigerants with low greenhouse impact alternatives - these may require different planning controls and guidelines
- management of organic wastes, preferably by waste minimisation or conversion to energy and avoidance of release of methane

If these issues are to be considered in urban development, there is a need for convenient analytical tools and clear guidelines, targets etc, so that individual project proposals can be evaluated against clear criteria. Guidelines and techniques are also needed so that long term costs and societal costs can be adequately incorporated into analysis of private projects. Where societal costs impact on a private action, mechanisms for financial adjustments may be required.

4.5 POLICY OPTIONS

The options discussed in this section provide a range of possibilities to incorporate effective reduction of greenhouse gas emissions and promotion of energy efficiency improvement into the metropolitan strategy. It is assumed that the metropolitan strategy will include a wider range of issues than has traditionally been the case, as these factors may be best addressed in this way.

4.5.1 BUILDINGS

It is clear that existing buildings and new buildings being constructed today fall far short of the standards of energy efficiency and greenhouse gas emissions that will be required to play an appropriate part in meeting greenhouse targets, limiting the cost of building operation, and achieving high standards of comfort and productivity.

There is a need for policies that achieve ongoing improvement in the performance of existing buildings and much higher standards of performance in new buildings. Transport issues relating to location of buildings are discussed later in this section.

In setting appropriate standards for performance, likely long-term energy prices and future costs for new technologies (taking into account potential economies of scale and ongoing refinement) should be used when estimating cost effectiveness. Also, low or zero discount rates should be used, to reflect the long-lasting impact of urban development decisions.

For residential buildings, the existing insulation regulations provide only limited energy and greenhouse savings. The draft RESCODE (2000) proposes that single dwellings should comply with either the existing insulation regulations, or achieve a 3.5 star rating using the House Energy Rating scheme (HERS). Developments with three or more dwellings would have to achieve a 4 star rating. HERS (especially the Victorian adaptation, *First Rate*) is a useful tool, but deals with only the building envelope, which is a subset of the issues that must be addressed. A set of clear greenhouse criteria is needed, against which each dwelling can be evaluated. One option could be a *Greenhouse Checklist* that allows each dwelling (both new and existing) to be rated on the greenhouse impact of its envelope (based on HERS) and the fixed equipment and facilities installed, including the features listed in Table 7. The scores in the checklist should take into account the number of people for which the dwelling is designed. They should also take into account any long-term commitment made to utilisation of renewable energy, either through direct investment in renewable energy systems or through long-term contracts to purchase renewable energy.

Once the checklist exists, it could be used in a variety of ways, such as:

- for new dwellings, builders could be encouraged or required to achieve specified levels of performance, required to disclose performance, or given financial incentives linked to performance. Such actions could be specified in planning codes
- for existing dwellings, householders could be encouraged to assess their home's performance, and incentive schemes could be offered to assist in improvement, sellers could be required to disclose performance at time of sale, etc

- for manufacturers, designers, installers and other market intermediaries, financial incentives and/or performance standards could be based on the performance of their products or their installations

An appropriate target for new dwellings of average size could be around 3 tonnes of CO_2 per annum, compared to an average for today's dwellings of 6-8 tonnes per annum for the specified activities.

The existence of provisions for building energy efficiency in the existing building regulations, and in draft RESCODE sets a precedent for incorporation of building energy requirements in the metropolitan strategy. The SEDA *Energy Smart Homes* policy in NSW includes a wider range of energy related requirements in planning controls, which sets a precedent for expansion beyond the limits now applied in Victoria.

For non-residential buildings, a national building energy code is under development, but is expected to take several years to introduce. Even when it is introduced, it is likely to have limited impact on greenhouse gas emissions, as it is intended to remove only the worst performing buildings from the market. Voluntary schemes such as SEDA's *Commercial Building Greenhouse Rating Scheme* and the Australian Building Energy Council's voluntary codes are emerging. The SEDA scheme is already operating in NSW, and is being extended to other states. ABEC's scheme is still under development. Both are designed for voluntary adoption, rather than as mechanisms for mandatory arrangements.

Arrangements for existing and new non-residential buildings would have to be different, as expectations of performance would differ, and there are many complications in this sector due to complex and varying arrangements between tenants and landlords.

For new non-residential buildings, as for residential buildings, the building envelope and installed equipment influence ongoing energy use, but a significant proportion of total energy use is determined by operational factors. To address issues relevant to design and construction a number of options exist, such as:

- as developed by SEDA, a 'commitment rating' system could be introduced, where a developer makes a commitment to achieve a specified level of performance, and legal agreements are used to ensure compliance. In SEDA's case, the incentive for the developer is the right to use the star rating negotiated in the agreement in its promotional strategy in which it aims to attract tenants. But such an approach could be used with other incentives or penalties
- an energy or greenhouse checklist or rating system (including performance assessment or simulation) related to the factors determined or influenced during design and construction, similar to that described for the housing sector, above

Systems such as these can be used to encourage or require developers, builders and market intermediaries (designers, consultants and contractors) to achieve high standards of performance. Energy performance provisions have been included in local planning requirements by several NSW councils, including North Sydney and Botany, so there seems to be no fundamental reason why they could not be included in Victorian codes.

For existing non-residential buildings, and for new ones when they are operating, total energy use and greenhouse gas emissions are sensitive to the kinds of activities pursued and the quality of management and maintenance. For these reasons, a variety of benchmarks will be needed, and performance needs to be evaluated on the basis of actual energy use data. SEDA's scheme, which is initially being used for office buildings, provides one voluntary model for such an approach. A more interventionist approach could be based on an annual building registration and reporting scheme, like car registration, with a requirement that annual energy and greenhouse data for each facility be reported to maintain registration – and access to specified privileges or to avoid penalties. Such schemes could be operated through councils or state government agencies.

It will be important that manufacturers, designers and installers of high performance materials and equipment have access to incentives to achieve high standards of performance.

4.5.2 NEW DEVELOPMENT

It is critical that new development projects achieve much lower greenhouse gas emissions than existing urban stock. To achieve this, standard methodologies for evaluating the lifecycle energy/greenhouse impact of new developments are needed. These should include materials, operational energy use and transport implications. Where targets are not met, proposals could be revised or contributions to offsetting emission reduction activities made.

For new housing developments, a *living cost analysis* should also be carried out. This could be based on estimates of transport costs (including long term fuel prices and vehicle ownership costs, road usage charges, and an hourly rate for time spent travelling). The estimate should be take into account the time and travel activity involved in gaining access to employment and services necessary to live a high quality lifestyle. Developers could reduce this estimated cost by providing local employment and services, public transport infrastructure, etc, or by contributing funds to their provision by the public sector.

Government could play a pro-active role identifying suitable development sites, consolidating sites, coordinating infrastructure development, etc.

New development should also take into account the adaptation requirements discussed later in this section.

To support flexibility, it would be important that a range of options for compliance with emissions targets or benchmarks be offered. For example, where a development increased transport emissions, the developer may offset these emissions by contributing to installation of renewable energy equipment, or renewable transport fuel production capacity.

4.5.3 DEVELOPMENT IN EXISTING AREAS

Increased utilisation of existing urban resources should be a key priority of the metropolitan strategy. A resource assessment process is needed to identify the locations of opportunities for

development activity that will assist in emission reduction. Government action may be necessary to consolidate sites, provide appropriate planning guidelines (for example, for mixed use areas).

Where a new development in an area of high potential to reduce greenhouse gas emissions does not fulfil that potential (or increases greenhouse gas emissions), there may be a case to provide disincentives (such as rates and charges based on the full potential utilisation of the site, rather than the actual utilisation). For example, construction of a large house on a site that is well-suited to medium density development in terms of access to public transport and access to infrastructure and services could be carefully reviewed. Development of a car-based shopping facility within an existing area would be assessed based on its impact on transport energy, cost and customer travel time, as well as its embodied and operational energy implications, in order to evaluate its impact on energy, emissions and equity.

Where more intensive development of an existing area can be shown to reduce lifecycle greenhouse gas emissions and achieve below average costs in a *living cost analysis* there may be a case for government to provide incentives for such development, or to facilitate it in other ways, as a reward for its contribution.

4.5.4 TRANSPORT

Planning strategies can help to reduce transport energy use by:

- facilitating easy and cheap access from homes to services and employment for people of all ages through effective land use policies
- minimising the distances over which goods must be transported by encouraging coordination of freight management
- promoting energy-efficient low greenhouse impact transport modes, and
- facilitating efficient and effective utilisation of transport infrastructure and vehicles
- discouraging inappropriate or inefficient use of road transport
- developing practical strategies for management of car parking as part of the transition towards a low greenhouse impact urban system

As discussed above, development of simple analytical tools for estimation of the energy and greenhouse impacts, financial implications and social aspects of the transport implications of development strategies, and of individual developments, is a key requirement. Once such tools are available, they can be used to set criteria for new developments. These could be supported by incentive schemes, information schemes and/or regulatory support.

The metropolitan strategy could also facilitate increased use of transport planning computer systems for freight, which would assist with appropriate location of warehouses and other facilities, as well as encouraging improved utilisation of freight vehicles.

A critical issue will be the reallocation of funding priorities towards low greenhouse impact transport options. This will require institutional restructuring and new approaches to funding allocation.

Over the coming years, it will be important to develop effective transition mechanisms so that individuals do not experience the shift to a low greenhouse impact transport system as a negative experience. This means positive alternatives and incentives must be emphasised, rather than financial penalties and prohibition.

4.5.5 INFRASTRUCTURE

Infrastructure should facilitate emission reduction and improvement in energy efficiency. It will also need to be flexible, to reflect uncertainties in future requirements and conditions.

Specifications for 'greenhouse friendly' infrastructure in new developments could be drawn up, including features such as:

- energy efficient streetlighting
- gas supply to all houses
- services run through a common duct that is easily accessible for installation of additional cables, pipes, etc
- allocation of space for recycling and waste management
- provision for compatible industries to trade wastes, resources and energy with each other
- provision of low greenhouse impact transport infrastructure such as low speed vehicle lanes and light rail, warehousing space for consolidation of freight to maximise vehicle utilisation

Developments that met these criteria could be supported via promotional schemes (such as a star rating), financial incentives, assistance in achieving compliance, or assistance with securing tenants or purchasers. Alternatively, requirements could be made mandatory.

4.5.6 ADAPTATION

Most adaptation issues relate to the design of urban infrastructure to cope with climate change, and provision of wildlife corridors. The timeframe over which global warming is expected to occur, as well as the scale of change, influence the degree of adaptation that should be incorporated into urban development strategies. These factors are still not well understood, although the quality of data is improving all the time. Issues relating to energy include:

- design of buildings to achieve comfort and energy efficiency in hotter weather and to take into account higher peak rainfall, storm events and variations in long-term rainfall patterns and quantities
- avoiding development in areas that may become vulnerable to flooding, sea level rise or storm damage
- location of power and communication lines underground or well clear of trees that could disrupt supply
- selection of vegetation to cope with predicted climatic conditions
- allocation of space for production of renewable materials and possibly food production

- provision of regulatory support and physical conditions to facilitate establishment of local energy storage and production capacity, including mechanisms for considering and managing local pollution from these activities
- provision of transport infrastructure that supports energy-efficient transport
- infrastructure support for strategies that reduce the need for travel

There is a need for further research into the potential implications of climate change over the next century, so that a clear framework can be established to guide adaptation strategies.

4.5.7 EMBODIED ENERGY AND INDUSTRIAL EMISSIONS

Policies can reduce greenhouse gas emissions associated with embodied energy (the energy used to process and manufacture materials or products) and non-energy industrial emissions (mainly produced as a result of chemical processes during cement manufacture and aluminium smelting) by encouraging or requiring utilisation of low embodied energy and low non-energy emission materials (including those with high recycled or renewable resource content), facilitating recovery, re-use and recycling of material.

It would be possible for state and local government to recommend or specify use of appropriate cement blends in infrastructure projects, and to use planning guidelines to promote their use in building projects. It should be noted that the amount of energy embodied in materials can vary significantly from one production plant to another, as well as from one material to another, so care will be needed in development of any guidelines or requirements.

4.5.8 OTHER GREENHOUSE GAS EMISSIONS

The Metropolitan Strategy has limited impact on agricultural emissions, which relate to animal management and farming practices. If organic wastes from urban areas could be processed to generate energy, the residues could replace artificial fertilisers, and emissions from this source could be reduced. This may require provision of appropriate space within urban areas for processing of these wastes.

Breakdown of organic and green wastes from urban areas in landfills and poorly managed compost bins are significant contributors to Victoria's greenhouse gas emissions (see Table 2). The best option here is to minimise the quantities of waste generated. However, once wastes exist, they can be converted into useful energy in biogas digesters, by pyrolysis or, under carefully managed conditions, by combustion. Provision would have to be made for these facilities in or near urban areas. A second-best solution is to avoid production of methane (a very active greenhouse gas) during breakdown by carefully-managed composting. This probably involves introduction of centralised composting systems or much more sophisticated home composting equipment as, at present, household composting is often poorly managed and generates significant quantities of the very greenhouse-active gas, methane (see Buxton et al, 2000).

Urban expansion may lead to direct land clearing or force agricultural activity onto new land. Demand for materials from forestry for construction of buildings, furniture and equipment, as well

as paper places pressure on forests. Containment of urban expansion, or direction onto unused land that has already been cleared can limit land-use change impacts. Revegetation of urban areas can build the carbon store within those areas, increasing sink capacity.

A range of strategies can be used to reduce pressure on forests for materials, including switching to plantation timber, re-use or recycling of timber, increased utilisation of timber (eg laminated beams, RadCon sawing, etc). Over 10% of urban waste is wood or timber (Buxton et al, 2000), so there is significant potential for its recovery for re-use, reprocessing or energy production.

5. NOISE

5.1 BACKGROUND

Noise is frequently overlooked as an environmental problem because:

- it does not cause major health problems
- most of the population accept a certain level of noise as a normal part of the environment in which they live, and
- the population is not uniformly exposed to its adverse effects

Noise however has demonstrated affects on sleep, stress levels, mental health and can disturb activities such as communication and learning.

Studies undertaken in OECD member countries (OECD 1991) indicate that adverse effects from external traffic noise on the indoor environment may be correlated with noise levels at the housefront as follows:

Below 55dB(A)	adverse effects are very slight.
Between 55dB(A) and 60 dB(A)[7]	noise impacts limited but more sensitive individuals may experience some disturbance
Between 60 dB(A) and 65 dB(A)	effects on sleep and the level of annoyance increase appreciably
Above 65dB(A)	constrained behaviour patterns arise which are symptomatic of serious adverse impacts caused by noise.

The OECD report concluded that " in order to keep the noise levels for comfort indoors (30-35 dBA L_{eq} at night and 40-45 dBA L_{eq} in the daytime) a maximum external level of 65 dBA would be necessary[1]. However, in so far as possible, and particularly for new residential areas, the outdoor limit should not be higher than 55dBA."[2]

The World Health Organisation also recommends that "a level of less than 35 dB(A)L_{eq} (indoors) is recommended to preserve restorative sleep."[3]

Excessive noise can result from a diverse range of activities including industrial, commercial and residential activities, entertainment events and traffic and other transport activities.

[1] Noise is measured in decibels (dB (A)) which is a logarithmic scale and closely approximates response of the human ear.
[2] Source: Lansdell and Cameron, 1998.
[3] Source: Scoresby Transport Corridor, Environmental Effects Statement, Supplement Volume 1, 1998

Preventing and resolving noise related problems requires effective land use planning, noise control from stationary sources, controls on traffic noise and considerate behaviour by all members of the community.

In Victoria, State government agencies, local government, police and transport agencies all have a role in ensuring noise is effectively controlled. There are also a number of federal government agencies and national bodies whose policies and regulations have a major impact on controlling noise.

Unlike many other environmental controls the legislation, regulations and other mechanisms used to control noise relate directly to the noise source. These are outlined below.

5.1.1 TRANSPORT AND TRAFFIC NOISE

NATIONAL LEGISLATION

At a national level the National Road Transport Commission (NRTC) and the National Environment Protection Council (NEPC) have statutory roles related to the environmental performance of motor vehicles under the National Road Transport Commission Act and the National Environment Protection Act. NRTC and NEPC have established the national Motor Vehicle Environment Council (MVEC) to coordinate the joint NRTC and NEPC work program on vehicle related environmental issues including the establishment of new vehicle emission and noise standards (Australian Design Rules, ADRs). ADRs are made under the *Motor Vehicle Standards Act 1989.*

ADR 28/01, which became a national standard in 1989, defines the limits on external noise limits generated by new motor vehicles (cars, trucks and buses). ADR 28/01 is based on 1984 European regulations. ADR 28/01 requires that noise made by vehicles be measured both for the vehicle in motion and for the vehicle when stationary. ADR 39, which was issued in 1986, specifies external noise requirements for new motorcycles and ADR 56/00 defines noise limits for new mopeds.

VICTORIAN POLICIES AND REGULATIONS

The *Traffic Noise Reduction Policy* (1997) is administered by VicRoads. This policy, in the absence of any traffic noise standards being set by EPA, is an internal policy containing objectives for major new roads. The policy applies “where arterial roads or freeways are built on new alignments, or where existing arterial roads or freeways are widened by two or more lanes and buildings previously protected from traffic noise are exposed by removal of buildings required by widening”.

The Policy details three noise level criteria as shown in Table 8. VicRoads policy is that these criteria are mandatory and will be complied with, however it should be noted that these limits are within the OECD ‘s undesirable range.

APPLICATION	CRITERIA
Category A – residential dwellings including homes, hospitals, aged persons homes, motels, caravan parks	63 dB(A) $L_{10\ (18\ hr)}$[4] or existing level, whichever is greater. *Averaged from 6am to midnight.*
Category B – Schools, kindergartens, libraries and other noise-sensitive community buildings	63 dB(A) $L_{10\ (12\ hr)}$ or existing level, whichever is greater. *Averaged from 6am to 6pm.*
Where the existing noise level adjacent to category A or B buildings was less than 50 dB(A) $L_{10\ (18\ hr)}$	Consideration will be given to limiting the noise increase to 12 dB(A).

TABLE 8. VICROADS ROAD TRAFFIC NOISE CRITERIA

VicRoads endeavours to 'substantially comply' with the criteria using the most cost effective technology. VicRoads limits noise amelioration works to road surfacing and the use of barriers on road reserves thereby excluding architectural treatments. VicRoads practice is to only provide amelioration work to the lowest habitable level of a building.

VicRoads also operates a noise barrier retrofitting program whereby noise amelioration works are carried out on freeways built prior to 1979. Work is carried out as funds permit to address those sites where the older freeway noise objective of 68 dB(A) $L_{10\ 18\ hour}$ is exceeded.

Environment Protection (Vehicle Emissions) Regulations, 1992, (incorporating amendments as at 20 April 1998) specify standards, test methods and penalties for motor vehicle air and noise emissions. These are emissions standards for in-service vehicles, are based on a stationary noise test and relate to vehicle year of manufacture. For example for passenger cars manufactured before 1 November 1983 the permissible level is 96 dB(A) and after this date, 90 dB(A).

Local government has responsibility for local roads. Individual council's response to traffic noise issues vary.

5.1.2 PASSENGER TRAINS AND TRAMS

With the exception of noise from shunting yards, which is covered by the State environment protection policy (control of noise from commerce industry and trade) No. N-1, there are no regulations or policies governing rail noise from trams or trains. Rail noise is deemed, by legislation, not to be a nuisance. Noise standards however are to be established for the proposed airport rail link.

[4] Non continuous noise is described in terms of the level exceeded for a percentage of time during the measurement period. For example $L_{10(18\ hr)}$ describes the level exceeded 10% of every one hour period during 18 hours. L_{eq} is a descriptor of the average noise level or the equivalent of the continuous noise level.

5.1.3 AIRCRAFT NOISE

Aircraft operating in Australia must meet noise standards imposed through the Commonwealth *Air Navigation (Aircraft Noise*) R*egulations*[5]. Approval for limited operations by aircraft not complying with those standards may be granted for activities such as displays of historical aircraft and other relevant public interest activities.

In addition Australian Noise Exposure Forecasts (ANEF) are used by land use planning authorities when they are considering which kind of developments should be allowed in areas around airports. ANEFs describe, by a contouring system, how much aircraft noise is received at locations around an airport. Australian Standard AS 2021-1994 outlines building site acceptability criteria for land use planning based on the ANEF system and takes into account individual aircraft noise, frequency and time of day[6].

5.1.4 ENTERTAINMENT NOISE

Concert noise from indoor and outdoor venues in Victoria is controlled by a combination of mechanisms established under the State's planning and environment legislation. One of the key mechanisms is the *State Environment Protection Policy (Control of Music Noise from Public Premises) No. N-2*. The State Environment Protection Policy (Control of Music Noise from Public Places) No N-2 (SEPP N-2) establishes standards and controls over music originating from indoor and outdoor venues. Indoor venues include hotels and discos and public halls that hold occasional functions where loud music may be played. Outdoor venues include sports and other outdoor arenas used for open air concerts. The Policy aims to protect the beneficial use, sleep at night time, and at other times, normal domestic and recreational activities such as reading, watching television and listening to the radio from noise from indoor venues. The beneficial use - normal conversation, is protected from noise from outdoor concerts.

Noise limits of outdoor venues are 65dB(A) when measured outdoors and 55 dB(A) when measured indoors.

SEPP N-2 has recently been varied. This variation takes into account the new planning regime for Docklands and the adjacent noise attenuation area. The amendment removes outdoor venue music noise limits within a Scheduled area, referred to as the noise attenuation area in Amendment L262 (Part 4 of the City of Melbourne Planning Scheme, approved August 1997). The scheduled area includes the Dockland area itself plus a small area at the western end of the Central Business District.

The variation also requires that all new and refurbished development to be purpose built to protect residents from concert noise through building design and the use of noise attenuating building materials to provide acceptable maximum noise levels in habitable rooms when concerts are in progress at the Stadium. The operators of the Stadium will be required to prepare an EPA approved noise and operational plan which outlines the measures that will be taken to minimise noise.

[5] Source www.dot.gov.au/airports division - Aviation Environment - Aircraft Noise Regulations
[6] Source www.dot.gov.au

Outside this area the normal provisions of SEPP N-2 will apply and adequately protect residents from music noise.

5.1.5 COMMERCIAL, INDUSTRIAL AND TRADE NOISE

The *State Environment Protection Policy (Control of noise from commerce, industry and trade) No. N-1* aims to protect people from the effects of noise in noise sensitive areas such as where people sleep or carry out other normal domestic activities (eg residential buildings, hospital wards, hotels and motels). The SEPP specifies maximum noise limits that may be emitted from commercial, industrial or trade premises.

The SEPP is also a planning tool, and new and proposed industries are required to be designed so that noise limits are not exceeded.

The SEPP applies to the Melbourne metropolitan area only.

5.1.6 RESIDENTIAL NOISE

The *Environment Protection (Residential Noise) Regulations 1997* prescribes the types of noise emanating from residential premises during which time excessive noise resulting from their use is deemed to be unreasonable. These include music noise and noise from motor vehicles, lawn mowers, power tools and other electrical equipment.

5.1.7 OTHER NOISE GENERATING ACTIVITIES

EPA has guidelines (EPA, 1992) that are primarily intended for use by municipal officers to avert a possible noise nuisance or to assist in resolving a noise complaint. The guidelines can also provide a basis for local laws, for example the City of Greater Dandenong has local laws covering noise generally and for noise from building works (City of Greater Dandenong), or they can be incorporated into the conditions of a development. These guidelines consider hours of operation and other operational issues and cover the following:

- aircraft and helicopters
- industrial and domestic waste collection
- deliveries, truck mounted refrigerator units and noise from shops
- road repair and track maintenance
- dog kennels and scareguns
- fixed domestic plant such as air conditioners
- construction and demolition site noise and gardening on non-residential property
- public address systems
- mini-motor cycle circuits

The Domestic (Feral and Nuisance) Animal Regulations 1996 includes provisions for controlling, through local laws, noise from animals and birds, including barking dogs.

5.2 DATA AND TRENDS

Several Australian Studies have highlighted the significance of noise problems.

In 1989-90 an Australian Environment Council (now ANZECC) study of the exposure of the Australian population to road traffic noise indicated that, on the basis of OECD criteria over 9 per cent of the Australian population is exposed to excessively high levels, of 68 dB(A) $L_{eq\ 24hr}$ or above and 39 percent to undesirable levels of noise of 58 dB(A) $L_{eq\ 24hr}$ or above[7].

A social survey to assess the extent of community noise disturbance undertaken by the Australian Environment Council in 1986 (AEC 1988) concluded that the noise that had the greatest impact on residential communities originated from road traffic and barking dogs. The survey found that overall 40 percent of Australians experience disturbance to listening activities or to sleep because of some form of noise pollution. Listening to television, radio or music was most likely to be disturbed by traffic noise (13 percent) and barking dogs (8 percent). Of respondents living on main roads 25 percent named traffic noise as the noise that disturbs listening compared to 10 percent not living on main roads. Similarly 24 percent living on main roads named traffic noise as a noise that disturbs sleep compared with 9 percent not living on main roads.

In their report for the EES for the Scoresby Transport Corridor Carr Marshall Day say that "people are probably least tolerant of noise when it affects sleep. Sleep deprivation can cause irritability, reduce work performance and make people withdrawn and uncommunicative." [8]

A study in Denmark showed that the population exposed to daytime traffic noise of levels greater than 70 dB(A) L_{eq} had consulted psychiatrists or psychologists more frequently than the population not exposed to these noise levels and that the exposed population consumed more tranquillisers (AEC 1985). Studies in Sweden in the 1950's also demonstrated a clear connection between traffic noise and neurological and cardiovascular anomalies (Nelson & Wolsko 1973).

5.2.1 TRAFFIC NOISE

As traffic noise is the most widespread source of noise, with most other forms being localised and less frequent occurrences, most of the available noise data relates to traffic noise. Even so local data on traffic noise has generally been collected on an ad hoc basis, targeting noise hotspots or the data available from campaign road-side enforcement programs, rather than a systematic and strategic approach aimed at determining long term traffic noise trends.

Table 9 shows the results of truck noise tests taken in 1991 at various locations in Victoria against the Victorian truck noise requirements.

[7] Source: Lansdell. H, Cameron C, 1998

[8] Source: Scoresby Transport Corridor, Environmental Effects Statement, Supplement, Volume 1, 1998

RELATIVITY	LOCATION				
	PAKENHAM	KALKALO	LARA	PORT MELB	FOOTSCRAY
	Non Urban	Non Urban	Non Urban	Capital City	Urban
3 dB or more below	44%	62%	54%	43%	38%
2 dB below	25%	22%	7%	27%	24%
1 to 3 dB above	11%	10%	20%	14%	16%
4 to 6 dB above	10%	5%	15%	10%	13%
7 dB or more above	10%	1%	5%	6%	10%
Sample Size (vehicles)	63	73	41	79	63

TABLE 9. NOISE MEASUREMENTS AT VARIOUS LOCATIONS IN VICTORIA – PROPORTION WITHIN ADR LIMITS
Note 1: In service requirements, exhaust level at 1500 mm or more measured at 1 metre.
Note 2: Point of reference is 99 dB for vehicles manufactured after 1 July 1983 as per EPA (Vic) regulation.
Source: VicRoads pers. comm[9]*.*

Table 9 indicates that overall 29 per cent of trucks generated noise in excess of Victorian requirements on a stationary noise test. This therefore does not take into account other truck related noise such as noise generated by moving trucks which is the most common form of community complaint (Appelbaum Consulting Group 1999). At low traffic speeds the majority of traffic noise is caused by vehicle engines, transmissions, exhaust and brakes. As speed rises the noise from the interaction of tyres and the road increase and at speeds of over approximately 70 kph this becomes the dominant factor with the magnitude of this noise being determined by both the road surface texture and tyre patterns. As speed increases air disturbance by moving vehicles also becomes an important factor. Road texture can influence the overall noise level by 9 to 14 dB(A), tyre type can influence noise levels by up to 5dB(A) for cars and up to 10 dB(A) for trucks (Apelbaum Consulting, 1999).

Table 10 indicates the number of vehicles (trucks and cars) that were issued with noise notices for excessive vehicle noise as tested by a stationary noise test. Yearly variations in the number of noise notices issued, in part, reflects the number of roadside activities undertaken during a year; for example, there were 169 roadside enforcement activities in 1998/99 compared to 57 in 1996/7 (EPA 1999). The level also indicates that if, as indicated above, 29 per cent of trucks generate excessive noise on a stationary noise test enforcement activities are only netting a small proportion of noisy trucks and other vehicles on Victorian roads.

1998/99	1997/98	1996/97	1995/96
4,049	4,659	2,790	3,013

TABLE 10. MOTOR VEHICLE ENFORCEMENT - NOISE NOTICES ISSUED BY EPA OR THE VICTORIAN POLICE

[9] Source Apelbaum, 1999

Source: EPA (1999)

Figure 31 provides an estimate of the number of dwellings exposed to different levels of noise on a state by state basis. It indicates that more Melbournians are exposed to highly excessive traffic noise levels (ie above 70 dB(A)) than that experienced by Australians living in other capital cities.

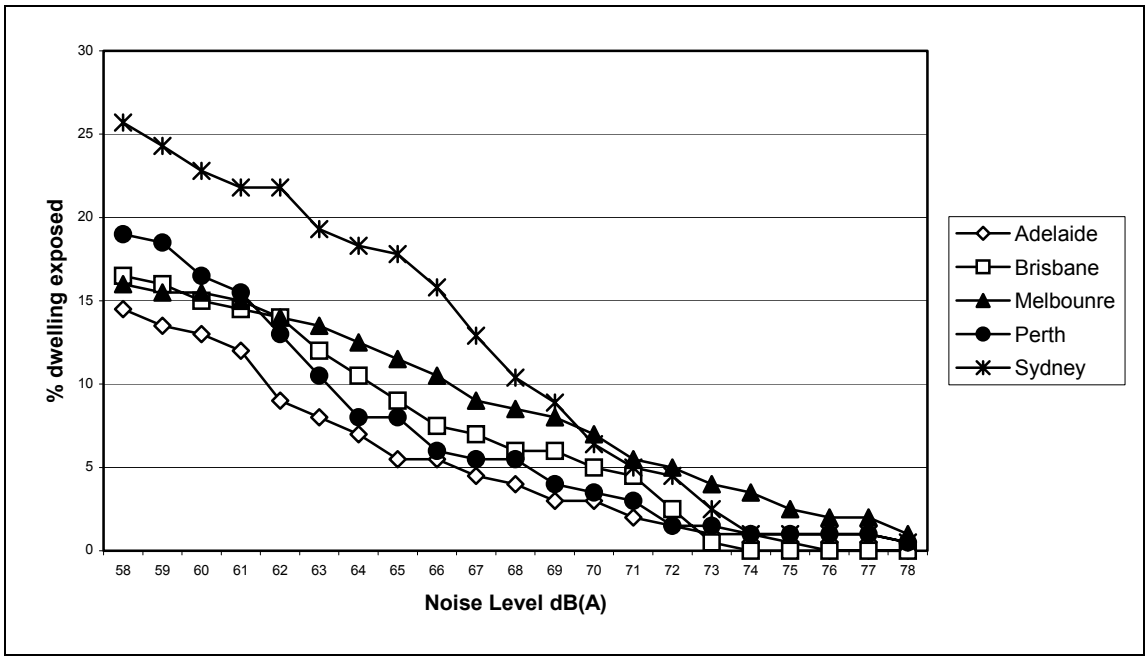

FIGURE 31. TRAFFIC NOISE EXPOSURE (LEQ-24 HOUR) - ALL ROADS (Austroads, 1999)

5.2.2 OTHER TYPES OF NOISE

Noise issues are a major concern in the community. This is highlighted by the number of complaints received by EPA, police and local councils about local noise issues: of the 5,371 community complaints received by EPA in 1998/99 local noise complaints are the second biggest source of complaint (EPA, 1999 and EPA pers.comm.); and the City of Greater Dandenong received 363 complaints from residents about noisy animals (mainly barking dogs) in 1999/2000 (City of Greater Dandenong, pers. comm.).

5.2.3 IDENTIFICATION OF TRENDS

TRAFFIC NOISE

The Bureau of Transport Economics projects that, by 2015, car traffic is expected to grow by 20-40 per cent from 1995 levels in Australian's major capital cities and truck traffic by 60-80 per cent. In addition, based on population projections, traffic densities, and therefore congestion, are expected to increase significantly particularly in the inner suburbs (EPA 2000). This will lead to freeways operating to capacity, increases in traffic diverted to main arterial roads and increased stop-start traffic, all of which will result in elevated traffic noise levels.

This trend is confirmed by Apelbaum (1999) who predicts that ambient noise levels and subsequent public discomfort from commercial vehicles may worsen due to the:

- expected growth in road freight traffic. Given the flexibility of road freight in the provision of door-to-door transport services, the preference for smaller inventories and continued real reductions in unit freight rates, the road freight task (measured in tonne-kilometres) may more than double by 2014/15 (ACG, 1997)
- increased economic life of road freight vehicles

There is national recognition that traffic noise is of concern however noise issues have generally been given, at the national level, a medium priority rating, behind air quality improvement initiatives.

A two part project has recently been initiated by the Motor Vehicle Environment Committee to NRTC and NEPC. The first part is to identify a test to evaluate the noise emitted by engine brakes by in-service vehicles. The second part is to determine the need to review of ADR 28/01, ADR 39/00 and ADR 56/00 in light of the changes to the European UN ECE regulations. These projects are due for completion by the end of 2000 (MVEC , 1998).

If the outcome of the MVEC review results in more stringent noise standards for new vehicles this is unlikely to have a significant impact on traffic noise in the short to medium term. This is due to the lead time generally required for implementation by vehicle manufacturers and also, most importantly, the comparative low turnover of the truck fleet and the age profile of the Australian transport fleet (notwithstanding the fact that newer vehicles have higher activity levels than existing vehicles).

The development and implementation of a standardised engine brake test has the potential for more immediate gains in reducing traffic noise. However the success in reducing the affects of engine brake noise will rely on implementation by the states.

RESIDENTIAL NOISE

With increased urban consolidation, in the inner suburbs in particular, residential noise is likely to become a more prominent issue.

5.3 ISSUE IDENTIFICATION

5.3.1 TRAFFIC NOISE

Traffic noise is the issue of key importance as:

- it is the noise issue that most concerns the community
- it is indicated that a very sizable proportion of trucks on Victorian roads do not meet current noise limits

- a greater proportion of the Melbourne population are subjected to high traffic noise levels (above 70 dB(A)) than in other Australian capital cities
- traffic noise levels are predicted to rise in the future
- the introduction of new ADRs, which only apply to new vehicles, take a long time to have any significant affect

As indicated above, Victoria has a number of traffic noise legislative mechanisms however they are either limited in scope, are not enforced to a level that ensures the problem is contained and, or, the penalties are not set at a level that act as an adequate deterrent.

For example, Victoria's traffic noise policy, under VicRoads, aims to achieve levels that the OECD regards as inadequate, do not meet best practice, and are limited because:

- it only covers freeways and arterial roads;
- it does not have a night time objective;
- the objective only applies to the noise measurement at the lowest habitable floor of a building; and
- amelioration work is limited to noise attenuation measures such as noise barriers and mounds on road reserves. This has limited scope for noise attenuation on arterial roads as there is usually a requirement for both vehicle (from side streets and driveways) and pedestrian access.

5.3.2 RESIDENTIAL NOISE

With the promotion and trend towards increased urban consolidation, adequate noise mitigation through good design and the use of materials with sound reducing properties will become increasingly important. Noise issues are currently not considered in the Residential 2000 Code and generally are not given adequate consideration in the development, design and building and approval stages.

5.4 BEST PRACTICE

NSW has recently been actively addressing noise problems through the release of a range of new policies that reflect best practice. The new policies are highlighted below.

5.4.1 TRANSPORT AND TRAFFIC NOISE

Outside Victoria, traffic noise policies have either recently been revised or are currently under review in those Australia states with large urban populations, including NSW, Queensland, South Australia and Western Australia (review currently underway).

The diversity of approaches to noise has led Austroads, the national association of state road authorities, to undertake consideration and possibly scope the formulation of a national noise policy. Expected date of completion of this process is the end of 2001.

NSW has recently released a new traffic noise policy (NSW EPA, 1999). It has the most stringent traffic noise criteria of any state in Australia and is considered best practice. Some key features of this policy include:

- administration by NSW EPA and implemented by NSW RTA which will allow for the policy to cover all roads
- the policy is focused on mitigating noise during the early stages of any road development process. This is in recognition of the high cost of engineered noise solutions compared with the more cost effective approach of avoiding population noise exposure through good land use planning and traffic management.
- the criteria are non-mandatory targets in recognition that solutions may be difficult to achieve in certain circumstances
- the noise criteria are expressed in dB(A) L_{eq} which better targets noise that has the potential to disturb sleep (compared with dB(A) L_{10} as per the VicRoads Policy)
- has day and night time traffic noise criteria. For example the daytime criteria for new freeways is 55 dB(A) $L_{Aeq(15hr)}$ and the night time criteria is 50 dB(A) $L_{Aeq(9hr)}$ (55 dB(A) $L_{Aeq(15hr)}$ is approximately equivalent to 58 dB(A) L_{10} (15 hr)).
- the criteria covers multi-storey dwellings
- the criteria is to apply to traffic volumes projected for 10 years' time.
- noise mitigation measures are performance based which allow for the full range of noise attenuation measures to be considered both within and outside the road reserve. The NSW government will acquire property or compensate property owners in lieu of noise mitigation.

NSW has also recently released a draft Protection of the Environment Operations (Noise Control) Regulation 2000 (NSW EPA 2000). This policy has similar in-service vehicle emission noise limits to those provided in the Victorian Environment Protection (Vehicle Emission) Regulations 1992 however the penalties (up to $5,500 for an individual or up to $11,000 for a corporation) are significantly higher than those in the Victorian regulations.

5.4.2 INDUSTRIAL NOISE

NSW has also recently revised its industrial noise policy (NSW EPA January 2000). The determination of noise in a complex environment needs to account for a range of factors to determine noise levels. These factors include topography, meteorology, tonal adjustments, intermittency, reflection and zoning. The Victorian Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) appears to afford at least similar protection to that provided in the revised NSW policy.

5.4.3 RESIDENTIAL NOISE AND OTHER ACTIVITIES

NSW's draft Protection of the Environment Operations (Noise Control) Regulation 2000 (NSW EPA 2000) prohibits the time of use of a range of items, sets noise limits and penalties. Many of these are similar to items prescribed in the Victorian Environment Protection (Residential Noise) Regulations 1997, however, it also covers a number of items not explicitly covered in the Victorian regulations. These include motor vehicle refrigeration units, marine vessel sirens,

engines and sound systems, motor vehicle sound systems, horns and intruder alarms, and building intruder alarms. The regulations also require noise labelling on many of these items. A full risk assessment has been undertaken on the application of the NSW regulations and is open for public comment until 3 July 2000.

5.4.4 RAIL NOISE

Both Queensland and NSW have standards related to rail noise. Queensland is currently actively installing noise barriers beside railway lines to reduce rail noise impacts.

5.5 POLICY OPTIONS

5.5.1 WHOLE OF GOVERNMENT APPROACH

Noise comes from a range of sources including road, rail, industry, commerce and other activities. Its combined effect can be more disruptive than noise from individual sources. Developing a whole of government approach to noise would maximise the impact of mitigation measures.

5.5.2 LAND-USE AND TRANSPORT PLANNING

Noise impacts from roads and industry in residential and other noise-sensitive areas often stem from inappropriate land-use decisions that allow development close to these areas. Once land is developed in this way, the range of available noise-control measures is restricted to better management and engineering solutions. These conflicts could be avoided if appropriate land-use decisions are made at the initial stage of land-use planning.

Appropriate land use initiatives that reduce noise impacts include restricting the location of major heavy vehicle trip generators and associated traffic routes, using road side barriers, increasing the separation distance between roads and noise-sensitive and land-use activities and the locating of major freight distribution centres in fringe areas.

To complement land use planning initiatives, building construction requirements for dwellings should be reviewed to ensure that where planning is not ideal, measures are taken to protect indoor amenity.

There is also a range of transport planning measures that should be considered to mitigate existing noise problems. These include:

- reducing speed limits on high speed roads adjacent to noise sensitive facilities, and
- removing vehicle humps and associated speed reduction measures adjacent to noise sensitive areas

5.5.3 RESIDENTIAL NOISE

With increasing urban consolidation residential noise is likely to become a more important issue. Consideration should be given to:

- reviewing planning and building codes to ensure they include adequate measures to protect indoor amenity from noise.
- reviewing the Environment Protection (Residential Noise) Regulations 1997 and EPA's Noise Control Guidelines with a view to covering additional noise generating activities and equipment.
- reviewing local laws to ensure they adequately address the various forms of nuisance noise and they are effectively enforced.

5.5.4 TRAFFIC NOISE POLICY

Traffic noise is the most widespread form of excessive noise within the community with the truck fleet being the predominant source. Serious consideration therefore should be given to

- developing a traffic noise policy should be developed that meets best practice and covers all roads;
- Supporting, at the national level, long term measures to reduce traffic noise levels eg changes in ADRs;
- increasing motor vehicle noise enforcement activities to reduce the number of vehicles breaching the traffic noise regulations and increasing associated penalties; and,
- introducing a systematic noise measurement program to determine long term traffic noise trends.

6. WATER QUALITY AND CATCHMENT MANAGEMENT

6.1 BACKGROUND

The supply of potable water to Melbourne and Geelong and the disposal of waste water requiring treatment is tightly regulated and controlled through a reticulated system.

The quality of water and flows through the catchments of Port Phillip and Westernport Bays via the waterways is less regulated and is influenced by private and public land use and a multiplicity of urban and rural activities.

6.1.1 INSTITUTIONAL ARRANGEMENTS

WATER SUPPLY AND WATERWAYS

Water flows to and through Melbourne via two systems. The first is the 'closed' system supplying drinking or potable water. Water is harvested from the closed catchments of the Yarra Ranges supplemented by water from the Thomson River catchment and the Yarra River downstream from Yarra Glen. Drouin and areas to its south are supplied from water collected from the Bunyip basin, the Mornington Peninsula is supplied from the Cardinia storage, while water for the City of Geelong is harvested from the Moorabool River catchment that is mostly private land.

Water is collected in many storages and is distributed through a reticulation system to the end users.

For metropolitan Melbourne, arrangements for the supply and distribution of water changed in 1995. Previously Melbourne Water harvested, stored and distributed water.

Melbourne Water is now responsible under the *Melbourne and Metropolitan Board of Works Act* 1958, *Melbourne Water Corporation Act* 1992 and the *State Owned Enterprises Act* 1992 for managing the catchments, harvesting and storing water and supplying the water to the three retailers of water, City West Water, South East Water and Yarra Valley Water. The retailers operate under three pieces of legislation: the *State Owned Enterprises Act* 1992 and the *Water Industry Act* 1994. A Heads of Agreement between Melbourne Water and the three retailers includes the arrangement for bulk water transfers while a memorandum of understanding and treatment plant discharge licences between Melbourne Water and the Environment Protection Authority (EPA) concerns the treatment of sewage.

For the City of Geelong, Barwon Water collects, stores and distributes water operating under the *Environment Protection Act* 1970, the *Water Act* 1989 and the *Health Act* 1958 (WSAA, 1999).

Water from the reticulated system is used in a variety of ways and for a multiplicity of purposes. Eventually however, it is discharged, after varying degrees of treatment, to the atmosphere (evaporation) or to the receiving waters of Port Phillip, Westernport Bays or Bass Strait either via the catchment waterways or as effluent after treatment. Industrial discharges to the sewerage

system are licensed under the *Environment Protection Act* 1970 and the Industrial Waste Management Policy (EPA, 2000, currently in draft).

The second or 'open' system of water flow into metropolitan Melbourne and Geelong is via rainfall onto the catchments and drainage into the waterways, streams and rivers. Waterway management is undertaken by Melbourne Water. The West Gippsland Catchment Management Authority (CMA) is responsible for the Bass River Catchment and the Corangamite CMA for the catchments to Corio Bay. Waterway Management is exercised under the *Melbourne and Metropolitan Board of Works Act* 1958 by Melbourne Water and the *Water Act* 1989 by the Corangamite and Wast Gippsland CMAs. Melbourne Water regulates diversions from the river systems within part of its area of jurisdiction (Yarra catchment and the lower Maribyrnong catchment and Kororoit Creek – see Figure 32), while in the remaining part of the region shown in Figure 32, Southern Rural Water regulates diversions from the streams and extraction of ground water for the entire region. There is no authority responsible for waterway management in the Little River and Werribee River catchments nor in upper sections of Kororoit Creek, the Maribyrnong River and Merri Creek catchments.

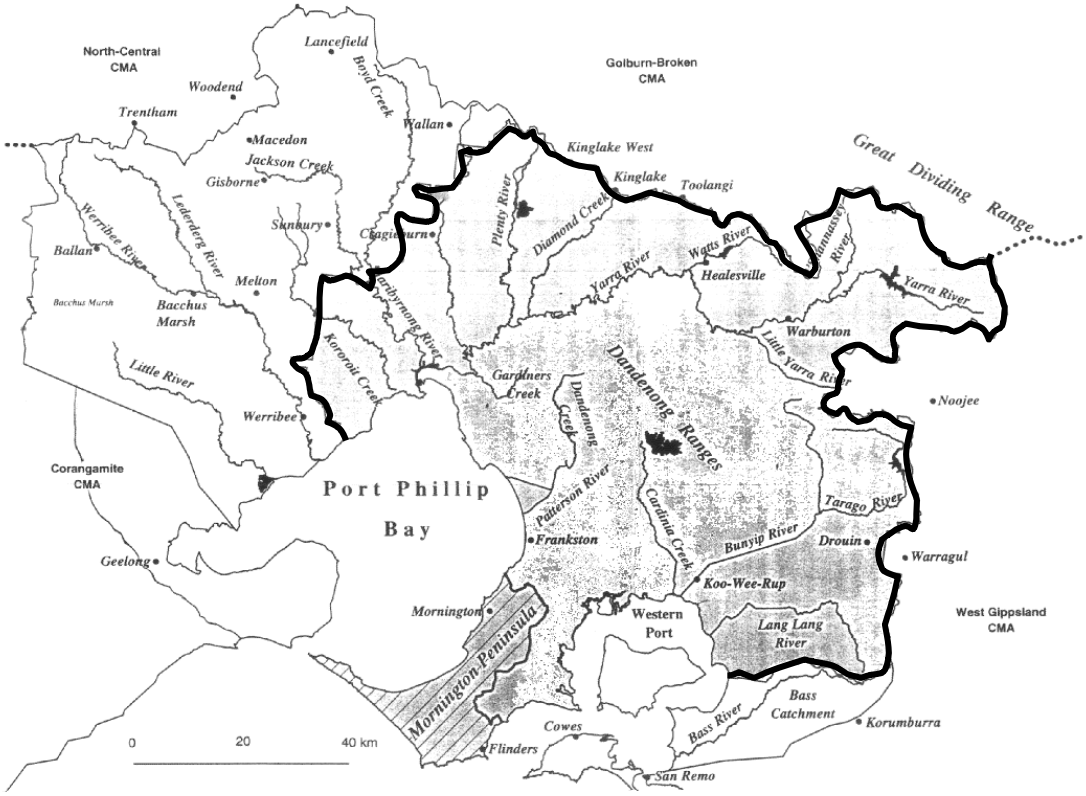

FIGURE 32. WATERWAYS MANAGED BY MELBOURNE WATER. (Black line delineates areas for which Melbourne Water is responsible for waterway management).

Allocation of water from streams and rivers to users is through two processes. For stretches of the river where storages regulate flows, bulk entitlements to water are negotiated after determining the flows that are needed to ensure the maintenance of stream ecosystems. Where river stretches are unregulated, Stream Flow Management Plans are prepared that identify the volumes of water that can be taken and still ensure adequate flows throughout the year.

Apart from harvesting water to supply the metropolis there is only one major industrial user of water, the AMCOR paper mill at Fairfield. Other users throughout the region abstract small quantities mainly for agricultural and horticultural uses. Increasingly, particularly in the Yarra Valley, large on-farm storages are being constructed.

CATCHMENTS AND WATER QUALITY

The quality of water entering the waterways and flowing into Westernport and Port Phillip Bays is a major environmental issue because of the economic and life style significance of these water bodies and because of the biodiversity implications of deteriorating water quality.

Land use, land management and the activities that occur on rural and urban land are the determinants of water quality in our waterways and bays.

The Port Phillip Catchment and Land Protection (CALP) Board is one of ten organisations set up by the government under the *Catchment and Land Protection Act* 1994 to influence the way catchment land is managed throughout Victoria. The Port Phillip CALP Board region covers the catchments of Port Phillip and Westernport Bays except for the small catchments of Hovell and Cowies Creeks running into Corio Bay. These lie in the Corangamite Catchment Management Authority (CMA) region.

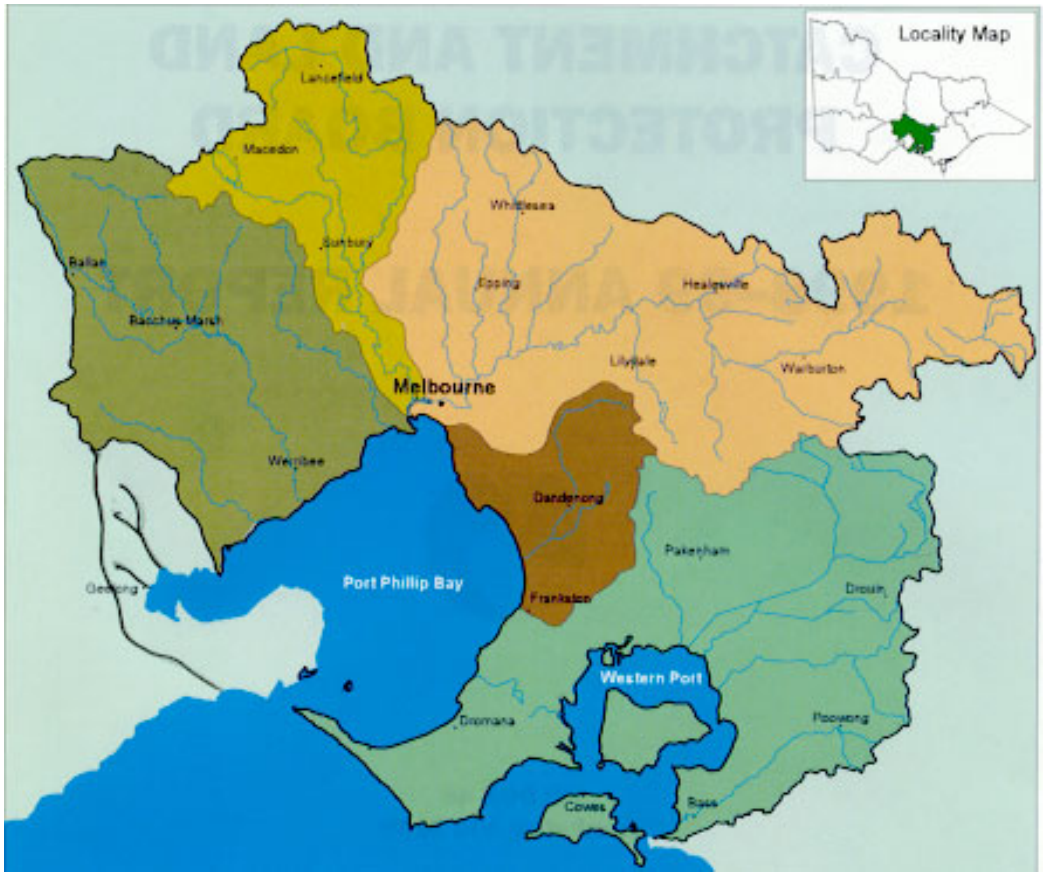

FIGURE 33. THE FIVE CATCHMENTS COMPRISING THE PORT PHILLIP CALP BOARD REGION.
(The small catchment in which Geelong is located lies within the Corangamite CMA region).

The Port Phillip CALP Board and the Corangamite CMA have prepared Regional Catchment Strategies (RCSs) endorsed by the government and referenced in the Victoria Planning Provisions. To implement the Port Phillip RCS the region is organised according to the five sub-catchments comprising the catchments of Westernport Bay, Dandenong Creek, and the Yarra, Maribyrnong and Werribee Rivers (see Figure 33).

All five sub-catchments contain parts of metropolitan Melbourne with the Dandenong sub-catchment being the most highly urbanised. Development mainly follows the perimeter of the Bays with growth corridors extending up into the catchments. For all five of the sub-catchments Action Programs have been prepared to implement the Regional Catchment Strategy.

The objectives for water quality of the rivers, streams and Bays are established through State Environment Protection Policies (SEPPs), prepared by the EPA as statutory instruments under the *Environment Protection Act* 1970. These set the physical, chemical and biological standards that must be regularly measured and reported against by the responsible agencies, although they do not necessarily set out stream flow objectives.

The SEPPs identify the beneficial uses of water and the key areas or activities that require action. The relevant policies are:

- SEPP Waters of Victoria, 1998 (currently under review)
- SEPP(Waters of Victoria) Schedule F6 Waters of Port Phillip Bay, 1997
- SEPP (Waters of Victoria) Schedule F7, Waters of the Yarra catchment, 1999
- SEPP (Western Port Bay and its Catchment), 1979; a draft SEPP (Waters of Victoria) Schedule F8, Waters of Westernport Bay has been released for public consultation.

The SEPP for the Yarra catchment is supported by the Yarra Action Program prepared by Port Phillip CALP Board and the Yarra Implementation Committee. This outlines the actions needed to achieve the objectives in the SEPP.

6.2 DATA AND TRENDS

6.2.1 WATER USE

The volume of water supplied to metropolitan Melbourne by Melbourne Water and its predecessor, the Metropolitan Board of Works, has increased since 1890 to the mid 1980s, growing on average by 2.9% each year (see Figure 34) with fluctuations during drought years when water restrictions were introduced. From 1985, a combination of water conservation programs, strongly promoted by Melbourne Water, and then pricing reforms appear to have slowed the rate of growth.

It is difficult to assess what changes, if any, have occurred on a per capita basis as the census boundaries do not correspond well with the boundaries of the water retailers. Their boundaries (see Figure 35) however, coincide reasonably well with the area to be included in the Metropolitan Strategy. Figure 35 does not however, include the City of Geelong.

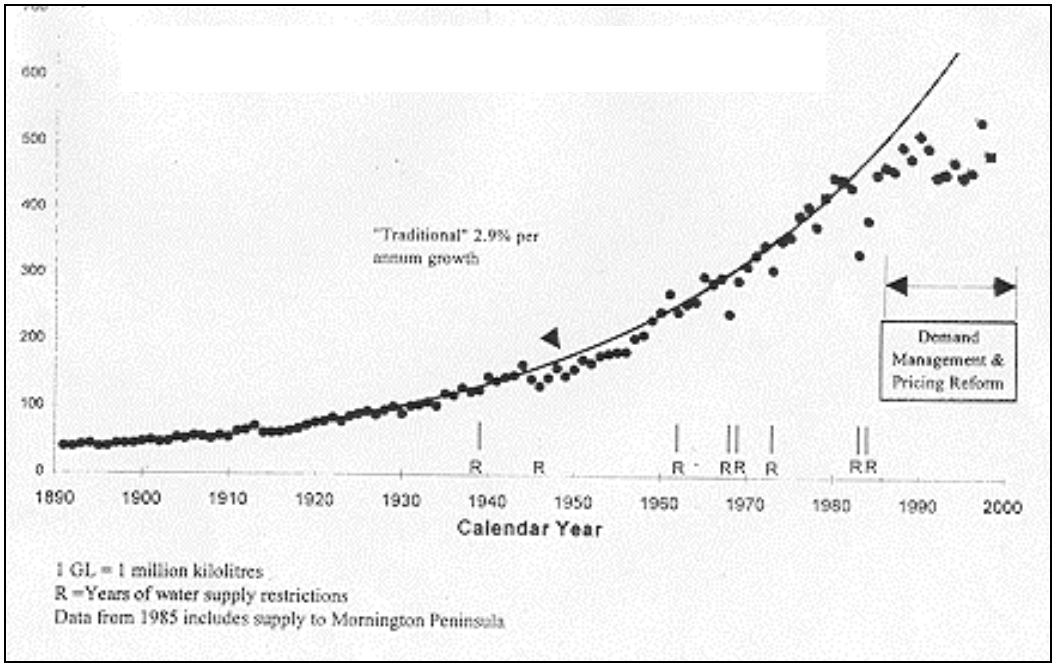

FIGURE 34. ANNUAL SUPPLY OF WATER
Source: Information to Department of Infrastructure supplied by Melbourne Water.

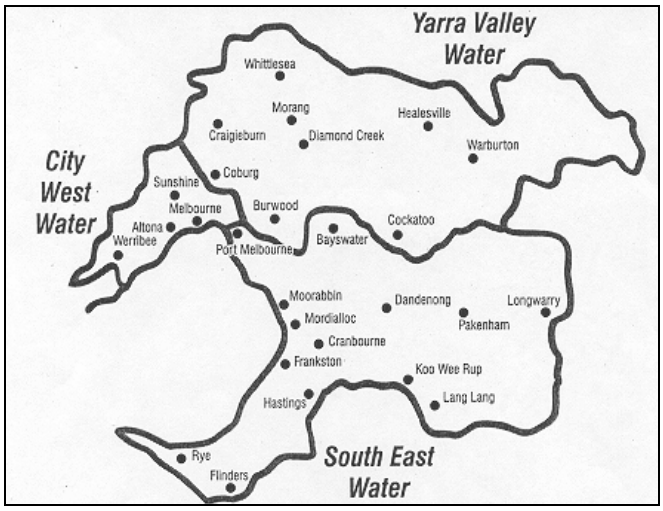

FIGURE 35. BOUNDARIES OF THE WATER RETAILERS

Consumption of water is highly dependent on rainfall and temperature. Figure 36 demonstrates the inverse relationship between water consumption (based on supply figures) and rainfall with consumption falling in wet years and rising in years of low rainfall.

Without correction for these effects, it is difficult to establish benchmarks for comparison on a per capita basis or even household basis.

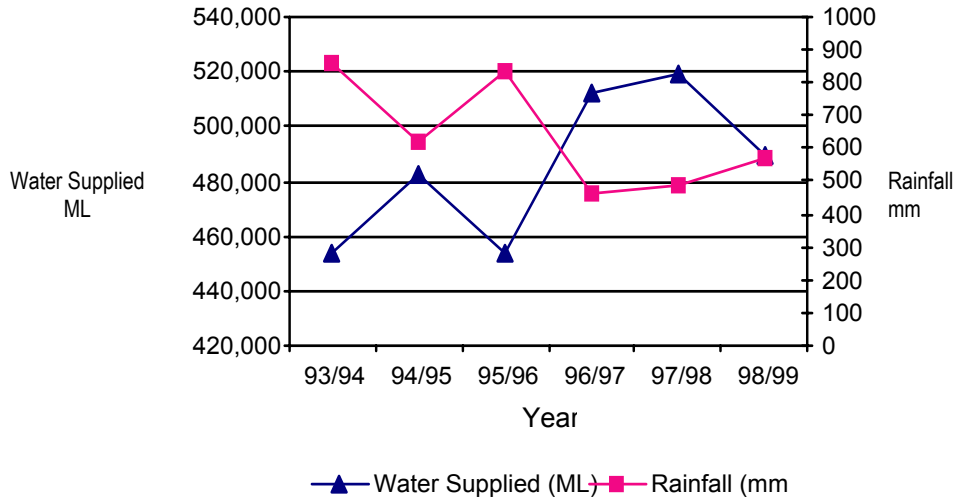

FIGURE 36. RAINFALL AND WATER CONSUMPTION. *Figures extracted from WSAA 1999.*

6.2.2 WASTE WATER

Also of interest is the ratio of water supplied to the quantity received at the sewage treatment plants. The figures in Table 11 are for the areas serviced by Melbourne (water distributed through the retailers after 1995). Again, it is difficult to assess whether the amount of waste water is being influenced by the behaviour of the users, that is, whether water use within households has changed so that Melburnians are less profligate in the way they use water.

Comparing years when the water supplied was about the same (93/94 and 95/96; 94/95 and 98/99; 96/97 and 97/98) tends to suggest that usage patterns seem not to have changed greatly. In wetter years waste collections may have been boosted by infiltration into the sewerage system (WSAA, 1999).

	93/94	94/95	95/96	96/97	97/98	98/99
Waste Collected	357,165	318,564	334,614	321,691	309,000	317,222
Water Supplied	453,300	428,050	453,615	512,269	519,604	489,780
Percentage	78.8%	66.1%	73.8%	62.8%	59.5%	64.8%

TABLE 11. WASTE WATER COMPARED WITH WATER SUPPLIED (ML) (MELBOURNE WATER CORPORATION)
Source: WSAA, 1999.

6.2.3 WATER REUSE

Table 12 indicates that waste water treatment plants operated by Melbourne Water collect over 300,000ML of water each year and potentially approximately this volume would be available for

sale and reuse (P. Scott pers. com.). The percentage of treated water reused has increased considerably over the years 1996/97 to 1998/99 (WSAA, 1999).

Although the water retailers also collect and treat waste water, the volumes are small compared to that treated by Melbourne Water.

YEAR	WASTE WATER COLLECTED (ML)	WASTE WATER REUSED (ML)	PERCENTAGE OF WASTE WATER COLLECTED
1996/97	321,691	28,300	8.8
1997/98	309,000	48,200	15.6
1998/99	317,222	59,300	18.7

TABLE 12. WASTE WATER TREATED AND REUSED

The use of treated or reclaimed water must follow EPA guidelines. These are currently in draft. The guidelines will complement the *Environment Protection Act* 1970, the *Livestock Disease Control Act*1994 and the *Health Act* 1958. EPA regulations specify the premises discharging waste that are subject to licensing and works approvals. Waste water meeting certain requirements can gain exemptions from works approved and licensing.

6.2.4 MONITORING AND WATER SUPPLY

MONITORING AND WATER QUALITY STATUS

The quality of water entering Westernport and Port Phillip Bays is monitored to varying degrees with most monitoring activity located in the catchment to Port Phillip Bay.

There are many organisations and community groups undertaking waterway monitoring. Monitoring varies across the region ranging from long term fixed sites to once-only sampling. Sampling is undertaken for a number of reasons including the need to establish compliance with EPA licensing conditions, the extent to which SEPP water quality objectives have been satisfied, research to assess the effectiveness of land management, and changes in river flows.

The monitoring network has recently been reviewed for the Port Phillip and Westernport region (AWT, 2000). The report indicates the complexity of the existing monitoring arrangements with seven different monitoring programs being undertaken together with other short term localised programs.

The most recent assessments of the condition of the waterways in four of the five sub-catchments have been compiled by EPA in implementing one of the actions in the Regional Catchment Strategy (EPA, 1999). These snapshot reports identify the pollution sources, map locations of the sources and prioritise areas for future action.

All of the reports indicate that waterways in parts of all sub-catchments are showing high levels of nutrients, high turbidity and suspended solids, unacceptable levels of E. coli, an indicator of faecal contamination and, particularly in the middle and lower parts of catchments, stretches of waterways judged to be in poor condition.

The water quality issues differ across the sub-catchments. Those issues considered of most significance have been identified from the literature and during a workshop associated with the preparation of the AWT report and are listed in Table 13 taken from the draft report.

ISSUE	CATCHMENT WITHIN PORT PHILLIP REGION				
	Westernport	Dandenong	Yarra	Maribyrnong	Werribee
Nutrients	High concentration	Elevated	Elevated	Elevated	Elevated
Toxicants			✔	✔	Kororoit Creek
Water Consumption	✔		Increasing	Increasing	Increasing
E.coli/Faecal Contamination	✔	✔		✔	
Bacterial Contamination		✔	✔		
Biocides Contamination	✔		Vineyards		
Heavy Metals		✔	Urban Areas	✔	✔
Suspended Solids in Water	✔		✔	✔	
Riparian Vegetation	✔		✔		✔
Salinity				✔	Little River
Seagrass	✔				
Algal Blooms	✔				
Drinking Water Quality	Phillip Island				
Sediment Deposition/Transport	✔	✔			
Lack of Habitat			✔		
Flooding				✔	
Pest Plants and Animal Infestation			✔	✔	
Litter		✔		✔	
RAMSAR Site Protection					Lake Boorie
Altered Flow Regimes	✔		✔		✔
Urban Development	✔		✔	✔	✔

TABLE 13. KEY WATER QUALITY ISSUES ON A CATCHMENT LEVEL IN PORT PHILLIP REGION IDENTIFIED DURING THE WORKSHOP AND FROM BACKGROUND INFORMATION

Note 1: ✔- identified as an issue.

Note 2: Issues in Corio Bay have been included in the Discussion of Werribee catchment.

Note 3: Text on each cell represents either the location of the issue in the catchment or the severity of the issue.

URBAN IMPACTS

The aspects of greatest interest in developing a metropolitan strategy relate to water quality issues that can be influenced by the strategy. Certainly, impacts on water quality that have their origins in urban development are of interest. The 'hot-spot' reports (EPA, 1999) identify generic water quality problems associated with urban areas and growth corridors (see Figure 37).

For urban areas, stream quality will generally be poor, influenced mainly by diffuse sources but also by some poorly managed point sources. Litter and diffuse pollutants from cars, roads, industrial estates and residential areas will be present in storm water. Domestic and industrial discharges to the sewerage system will periodically overflow to the storm water drainage system because of high rainfall events or illegal connections. Minor waterways will have been replaced by drains and major waterways modified to accommodate peak flows and flooding.

Modern drainage systems incorporating waterway protection measures, gross pollution traps. Wetlands and other features are implemented by Melbourne Water in new development corridors to mitigate development impacts. However, there is little opportunity to address problems in older areas at an acceptable cost. Development outside the area covered by Melbourne Water is not well planned or controlled from a storm water perspective.

The growth corridors will have these plus additional pressures associated with greater land clearance, road and building construction.

Significant information about the nutrient and sediment loads and their sources has been identified for all five sub-catchments and maps similar to those shown in Figure 37 for Maribyrnong and Dandenong have been produced. Other data has been developed for the Yarra sub-catchment (see Table 14). This clearly demonstrated the extent to which urban areas are contributing to the nutrient and sediment loads entering Port Phillip Bay.

	LOAD (TONNES/YEAR)		
	NITROGEN	PHOSPHORUS	SUSPENDED SOLIDS
Urban	480 (1660)	73 (262)	40,763 (117,195)
Forested	195 (890)	11 (53)	19,929 (39,358)
Rural (horticulture/agriculture)	32 (65)	5 (52)	2,151 (6,228)
Rural (pasture)	467 (708)	43 (99)	37,650 (108,986)

TABLE 14. ESTIMATED AVERAGE NUTRIENT LOADS AND SUSPENDED SOLIDS*
Note: Values quoted are based on typical (average) generation rates (kg/ha) with the upper end of the range in brackets.
Source: Centre for Environmental and Applied Hydrology 1998.

The urban area comprises only about 18% of the land area in the catchment yet contributes the greatest loads of nitrogen, phosphorus and suspended solids to Port Phillip Bay. Based on load per unit area, urban areas deliver twice the nitrogen, phosphorus and sediments compared with rural land uses.

CONDITION OF BAYS

Westernport Bay is a highly valued natural and commercial asset. It is a deep water port, supports commercial fishing and is an extensively used recreational asset. It is also nationally and internationally significant for the ecosystems it supports – mangroves, salt marsh, seagrass, reef and soft seabed communities.

Loss of seagrass was first reported in the 1970s. It is estimated that 70% by area and 85% by biomass has been lost with the reasons being unclear. Turbidity and desiccation may have exacerbated this loss (EPA, 1996) but there is still conjecture about the initial cause and the extent to which these causes are still exerting impacts. It is widely considered that these turbid waters are preventing the re-growth of seagrass and other marine vegetation communities.

Nutrient levels appear to be low with the exception of nitrogen levels in the East Arm of the bay. Monitoring indicates that high levels of sediments continue to discharge to the Bay and species

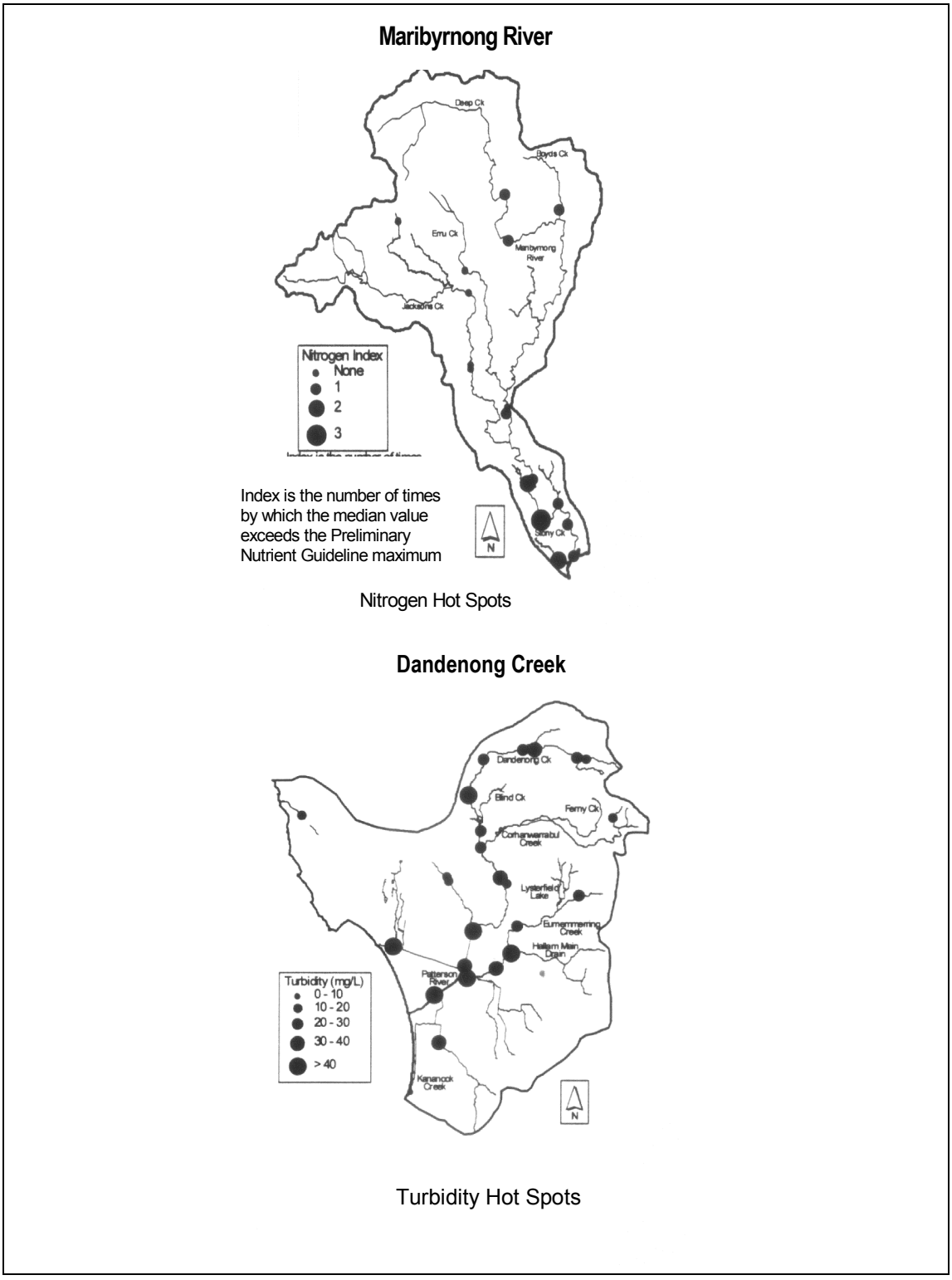

FIGURE 37. 'HOT SPOT' MAPS – MARIBYRNONG RIVER AND DANDENONG CREEK
Based on medians from EPA snap shots (spring and autumn 1996), MW Streamwatch sampling (annual medians, 1996/97) and Victorian Water Quality Monitoring Network medians (January 1990 to May 1997).

diversity at the biological monitoring sites of the waterways entering the Bay are low (EPA, 1996).

Urban and agricultural activities are thought to be the main threats to the health of Western Port's environment. Other activities such as road development and forestry also contribute to degradation of the environment. Inputs from the catchment have increased as swamps and wetlands have been drained, the forested areas of the lower catchment substantially cleared and a change from agricultural to urban land use has occurred. It is believed that the health of the Bay is dependent on improving management practices in urban and rural areas. A detailed discussion of threats to the bay is contained in the draft Policy Impact Assessment for the Draft Western Port SEPP.

Port Phillip Bay was the subject of an extensive four year study by CSIRO commencing in 1991. The importance of this study is related to the social and economic significance of the Bay to metropolitan Melbourne and Geelong. Previous studies have been central in capturing the interest of governments and the public and resulted in programs to reduce discharges from industry, extensions to the reticulated sewerage systems and discharging of effluent from the Eastern Treatment plant into Bass Strait rather than the Bay.

The study (CSIRO, 1996) found that controlling the nutrient loads in water flowing onto the Bay is central to maintaining a rather tenuous ecological stability. Nutrients must be kept below threshold levels with nitrogen being the most significant. If nitrogen levels are not maintained below the critical level, CSIRO have predicted that far reaching changes to the Bay's ecological systems could occur.

The CSIRO also emphasised the threat posed by the introduction of exotic species that can alter the way the entire Bay functions.

Subsequently, Regional Catchment Strategies and the SEPP for Port Phillip Bay (EPA, 1997) stipulated the annual nitrogen load entering the Bay is to be reduced by 1000 tonnes by 2006 through.

Nitrogen currently enters the Bay in the effluent from the Western Treatment plant (3,200 to 4,100 tonnes a year), waterways and drains (between 1,900 to 3,600 tonnes a year), deposition from the atmosphere mainly due to motor vehicles (about 1000 tonnes a year) and a small amount from ground water.

It is proposed to achieve a reduction in annual nitrogen loads in two ways. Firstly, a draft nutrient reduction plan being developed by the Department of Natural Resources and Environment and proposes a reduction in the nitrogen in effluent from the Western Treatment Plant of 500 tonnes Secondly, a reduction in the nitrogen load in water flowing out of the catchments by 500 tonnes is proposed. The Yarra drains more than half of the catchment to the Bay and will receive priority attention. The CSIRO report pointed out the significance of storm flows from the Yarra into the northern sections of the Bay and suggested that these events were more important than diminishing the base flow nitrogen load. It planned to achieve a reduction of 500 tonnes each year from the surface waters that eventually end up in the Bay with about 350 tonnes of the total coming from reductions in nitrogen from the Yarra and Maribyrnong catchments.

However, there are questions about the predictability of these reductions. In addition to emphasising the need to reduce nitrogen loads, CSIRO pointed out the importance of nitrogen cycling through the sediments, water column and biomass of the Bay. This cycling is critical to the eventual flux of nitrogen as gas to the atmosphere. It is in delicate balance that could be affected by introduced exotic organisms (NRE, pers. com.).

6.3 SCENARIOS

6.3.1 WATER CONSUMPTION

The trend to about 1985 for water consumption has been an annual growth of nearly 3%. Since that date the growth appears to have tapered somewhat but trends are not clear. Since 1993/94 fluctuations in water consumption appear to be very much influenced by rainfall and temperature (see Figure 36). Nevertheless, although the rate of population growth will fall, population will increase and the total demand for water will also increase.

This could be exacerbated by increasing affluence that often sees increasing per capita use of resources and output of waste unless behavioural changes occur (DOI, 2000). As indicated previously, a benchmark figure for per capita consumption of water is not easily able to be calculated. However, internationally, Australia has one of the highest water consumption levels per capita (OECD, 1995). Recent data on consumption per residential property is shown in Table 15. With an increasing rate of household formation and a decreasing number of people per household (DOI, 2000), a decreasing rate of water consumption per household might have been expected. The reverse may be occurring even though the effect of the drier El Niño years confounds the figures in Table 15.

RETAILER	1995/96	1996/97	1997/98	1998/99
City West Water	209	249	246	232
South East Water	195	232	233	218
Yarra Valley Water	231	244	255	240

TABLE 15. RESIDENTIAL WATER CONSUMPTION* (KL/PROPERTY)
Note: Figures rounded

The climate modelling scenarios are now consistently showing that El Niño events will probably increase in frequency and intensity, that is, more periods of drought and more severe droughts (Hennessy *et al*, 1998).

A further factor influences water consumption.

The intensity of housing in outer urban developments is lower than that occurring with medium density development. Although the inner city and suburbs will experience growth, the urban fringe will also grow strongly albeit at a lower rate than in the past. There may also be a shift to more up-market development catering for higher income second and third home buyers (DOI, 2000). The implications for water consumption lie in data suggesting that size of residential

blocks is the major determinant of water consumption. Core and inner areas may consume two to three times less water per head than outer suburbs (SOAC, 1996).

The combination of an increasing population, perhaps increased water use per household and more households, plus a higher degree of demand sensitivity to droughty weather and continuing fringe development, strongly suggests that water consumption will continue to rise with periodic sharp increases due to seasonal conditions.

6.3.2 WATER REUSE

While national figures for waste water collected have increased (total volume and volume per property) by 7.8% and 5.7% respectively in 1998/99 compared with 1997/98, waste water collected by Melbourne Water may have fallen slightly over the past seven years (WSAA, 1999).

It is not known whether this trend will continue but it is clear that a resource in excess if 300,000 ML a year of treated water (secondary level of treatment) will continue to be available. The use of this resource is clearly increasing and is being strongly promoted by Melbourne Water.

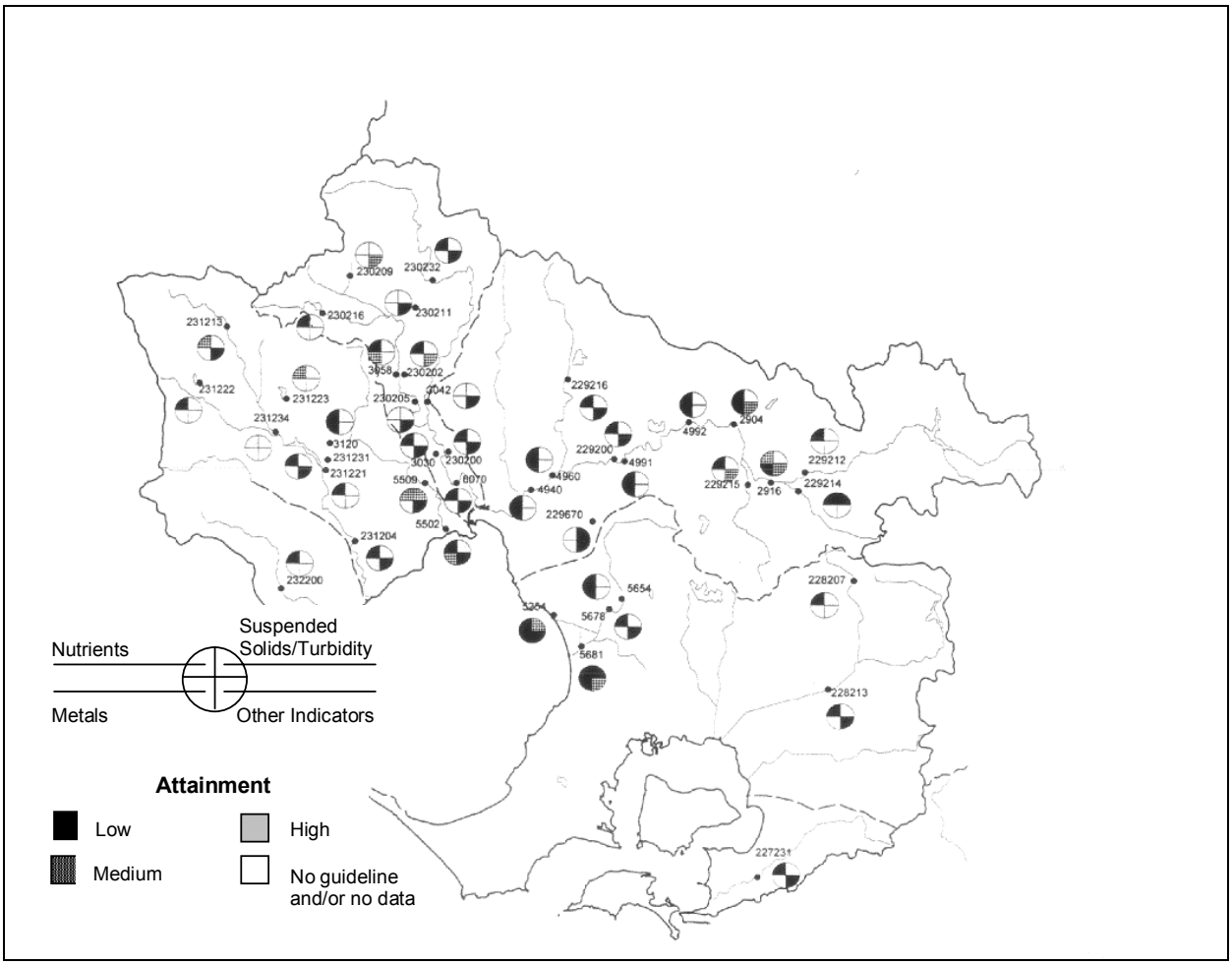

FIGURE 38. LOCATION OF SITES AND ATTAINMENT OF WATER QUALITY OBJECTIVES
Taken from Victoria Water Quality Monitoring Report, 1998.

6.3.3 WATER QUALITY

Monitoring of water quality is generally presented in one of three ways – reporting on the extent to which objectives in SEPPs have been achieved, reporting on the ecological health of the waterways often against an index made up of in-stream and riparian components and reporting of trends identified through analysis of results obtained from long term monitoring sites. Despite the extent of these sites and the length of time over which measurements have been taken, there are considerable uncertainties about the extent and direction of change in the parameters that describe water quality.

The recently completed annual report on Victorian water quality monitoring (NRE, 1998) includes sites in the Victorian Water Quality Monitoring Network and EPA sites but not those maintained and operated by Melbourne Water. The report lists the extent that recorded levels of nutrients, sediments, turbidity, heavy metals, electrical conductivity and pH meet either ANZECC or SEPP objectives (see Figure 38), and for sites where longer term data are available, statistical trends were identified.

6.3.4 THE BAYS

Water quality of waterways within the Port Phillip and Westernport CALP Board region is generally poor with respect to the attainment of water quality objectives for nutrients, with the Bass and Bunyip Rivers and Dandenong and Mordialloc Creeks performing poorly, particularly for nitrogen. Indeed, the total Maribyrnong system showed high nitrogen concentrations. Attainment for phosphorus was variable across the region.

Generally, suspended solids meet water quality objectives. Exceptions included sites in the Dandenong Creek catchment, a tributary to the Yarra at Warburton, and Kororoit Creek. For other parameters, pH, dissolved oxygen and conductivity, performance was variable with sites in most river and creek catchments failing to meet attainment objectives.

Performance against water quality objectives in any one year provides no indication of change. Trend analyses for the region shows a region-wide increase in waterway acidity with the magnitude of the increase being quite marked, mainly in the Westernport catchment. The number of sampling stations is quite limited, for example, there is only one site in the Dandenong sub-catchment but this site showed a downward trend in pH, electrical conductivity, total nitrogen and total phosphorus but an improvement in turbidity. The interpretation of such data must be made with caution as the Dandenong Creek catchment experiences particular problems with sedimentation arising from erosion at the top of the catchment and sediments from construction activity posing a serious problem. This issue has been recognised for some years now and the trend may be reflecting the level of activity to restore the badly degraded Dandenong Creek and local government programs to check sediments from building sites and other sources.

The health of streams in the Westernport catchment showed a transition, as would be expected, from the top of the catchment to the lower reaches with the more pollution sensitive macro-invertebrate communities found in the forested areas. As water quality deteriorates, so diversity declines and in the lower reaches the macro-invertebrate communities comprise a few pollution

tolerant families (EPA, 1998). A similar situation was found in the Yarra River catchment (Metzeling, 1994).

The waterways receiving greatest attention are those that fall within the jurisdiction of Melbourne Water (see Figure 32). For this part of the region Melbourne Water is the Waterway Management Authority. Except for the Bass River catchment, where the West Gippsland CMA is the Waterway Management Authority, waterways in the remainder of the region are without a Waterway Management Authority.

A recent government stormwater management initiative provides a funding base for tackling the major urban water quality issue, litter and chemical pollution. The urban drainage system, designed to avoid flooding, has been overtaken by increasing urbanisation leading to a substantial increase in impervious surfaces. This increases the volume and velocity of storm water flows and the pollutant loads carried to the waterways.

Guidelines for urban stormwater management have recently been prepared and published (Storm Water Committee, 1999). The guidelines provide a detailed approach to all aspects of stormwater management covering the preparation of plans, the use of the planning system to put the guidelines into practice, and design techniques for implementing the guidelines.

6.3.5 FUTURE WATER QUALITY

There can be little doubt that improving the quality of water in urban waterways and the bays will require continuing and substantial investment in catchment programs tackling urban and rural issues.

The data recorded from monitoring sites indicates that there is an overall failure to attain water quality objectives but the trends, based on only a small number of the total sites monitored, other than for pH, are not clear. That is, based on these sites there has been no measurable change in nutrients or turbidity over the past ten years. It is also difficult to assess whether the ecological health of the waterways is getting better or worse. Certainly it is poor overall at the moment but there are reasons to believe that improvements to the riparian environment will be beneficial for the in-stream biota.

The catchment programs facilitated by the Port Phillip CALLP Board and the Corangamite CMA for the Corio Bay catchment, continue to be supported by government (Commonwealth, State and local) funding and active on-ground programs undertaken by Melbourne Water. However, the lack of a Waterway Management Authority for a substantial part of the region (about half if public land is excluded) will continue to hamper waterway improvement in the Werribee and Maribyrnong River catchments and the top of the Merri Creek catchment.

Expanding urban areas in the catchments to Port Phillip and Westernport Bays will increase the sediments and nutrient loads in both. This is a major threat that will only be diminished by effectively confronting the urban stormwater issues and nitrogen sources. The Stormwater Guidelines, supported by State government funding of $22.5m, provide the opportunity to do this.

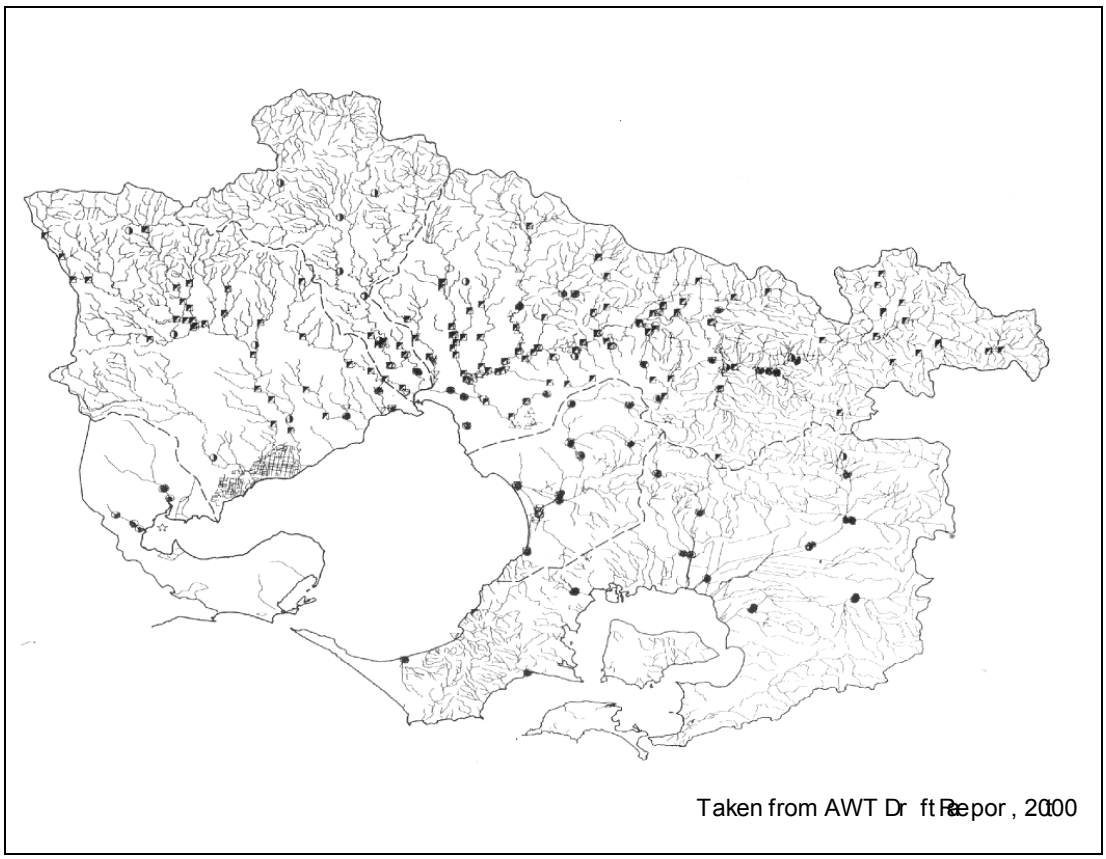

FIGURE 39. CURRENT MONITORING SITES IN THE PORT PHILLIP AND WESTERNPORT CATCHMENTS

There are a number of deficiencies with water quality monitoring in the region. A report prepared for the Port Phillip CALP Board outlines these (AWM, 2000). It suggests:

- there is an incomplete monitoring network within the catchments to Port Phillip and Westernport Bays (see Figure 39) with a preponderance of sites in the Yarra River catchment
- it is difficult to link existing catchment programs with changes in water quality
- existing monitoring is not responsive to emerging issues
- few monitoring programs can report on nutrient and salt loads
- trends in waterway health are not yet able to be determined due to infrequent monitoring or short duration of the program

Developing scenarios about future water quality are hampered by the lack of trend data and uncertainties about the success of current rural and urban programs.

6.4 ISSUE IDENTIFICATION

6.4.1 REUSE OF WATER

Of all the natural resources, the use of water is emerging as one of the most critical issues facing Melbournians in the medium term. The metropolitan strategy will be a major determinant in the

nature and location of development and will require decisions to be made about future infrastructure and services. These decisions will determine the economics, practicality and effectiveness of endeavours to reduce the per capita consumption of water and optimise opportunities for water reuse.

Currently waste water is treated at the bottom of the sewerage system. This has direct implications for the potential to reuse treated water associated the costs of its transfer and imposes restrictions on how treated water can be used. The development of 'local' treatment plants should be considered in framing the strategy.

6.4.2 HEALTH OF THE WATERWAYS AND BAYS

The quality of potable water supplied to urban areas from the forested and closed catchments has always been high. The 10% of water supplied from outside the closed catchments of the Yarra ranges is fully treated and meets Australian and World Health Organisation guidelines (Melbourne Water, 1999).

The quality of water draining from the catchments to the waterways and flowing to the Bays, together with discharges from the storm water collection system, continues to be an issue.
The quality of water in waterways and streams is important for a number of reasons:

- the aquatic environments of metropolitan Melbourne and Geelong – the waterways and bays – are highly significant elements of urban biodiversity. The waterways and bays provide perhaps, the greatest opportunities to enhance biodiversity capacity in urban areas. Threats to aquatic biodiversity stem mainly from sediments and the adsorbed pollutants – nutrients, heavy metals and organic compounds – and threaten the ecological health of the waterways and Bays.
- the waterways and Bays are used for a diverse range of water-based recreational pursuits. They provide the leisure environments and promenades for walking and bicycling and the landscape settings that frame city and urban development. High water quality is necessary for many of these activities with litter being a highly significant visual pollutant.
- the quality of water flowing to Port Phillip and Westernport Bays will determine their ecological and economic futures. For Westernport, the continuing re-establishment of the sea grass is the key with the level of sedimentation thought to be the critical factor (Lowe, 1999) although it is possible that the ecology of Westernport Bay has fundamentally and irreversibly changed. In Port Phillip Bay nutrient cycling, mainly nitrogen, has been identified as the major factor in maintaining the health of the Bay (CSIRO, 1996).

6.4.3 INSTITUTIONAL RESPONSES

Institutional frameworks generally have not been adequate to the task of protecting the water qualities and related ecological processes in both bays. Natural processes in Port Phillip Bay have continued to function despite a continuation of discharges to the Bay, and the failure to control the impacts of dredging because of reliance on a voluntary protocol. However in Westernport, the impacts have been more severe with sea grass communities, for example, overwhelmed.

The failure of institutional arrangements has continued into recent times. Extensive sedimentation occurred during the recent construction of most of Melbourne's freeways until belatedly controlled by the EPA. There are no effective controls on runoff during road and building construction in Melbourne's growth corridors and in the Metropolitan area, or site containment programs. Catchment management policies have been developed but will often be ineffective in controlling pollution of streams, and inadequately implemented. There are no satisfactory arrangements to relate catchment management policies to land use planning decisions. Key provisions in the new format planning schemes, such as controls on clearing native vegetation and over coastal subdivision and development, construction of farms dams and the ability to control agricultural activities continue to be inadequate. There are no planning protective mechanisms for other vital elements of a healthy catchment, such as over draining and development of wetlands. A healthy riparian zone is particularly beneficial to aquatic macro-invertebrate communities and the riparian zones of waterways in parts of the region are the focus of many programs funded by the State and Commonwealth governments, local government and Melbourne Water. However excessive reliance continues to be placed on voluntary measures.

6.5 BEST PRACTICE

The sustainability response to the increasing consumption of a resource, in this case water, is to reduce demand and use the resource more effectively rather than seek to augment the stock of water to allow increased flows. This makes economic sense and has been recognised by Melbourne Water who have mounted strong demand management programs in the past.

These programs need to be sustained and supported by the water retailing companies. This raises the issue of conflicting objectives as the revenue streams of the retail businesses are linked to consumption.

A second aspect of water conservation concerns the way homes and non-residential buildings are designed and constructed. There are various examples of housing projects where infrastructure is installed to allow reuse of waste water and capture of rain water. Mobbs (1998) provides detailed discussion about the design of residential water collecting and water reuse systems including other case studies in Australia and elsewhere as do the comprehensive guidelines for urban stormwater (Storm Water Committee, 1999).

There are a number of best practice examples where developers in Sydney and Melbourne have installed infrastructure that integrates water supply, waste water and drainage. These dual systems allow treated and disinfected water to be used for toilet flushing and the garden with potable water able to be used for drinking and washing. The co-location of industries able to use treated water would further reduce the use of high quality water (AURDR, 1995).

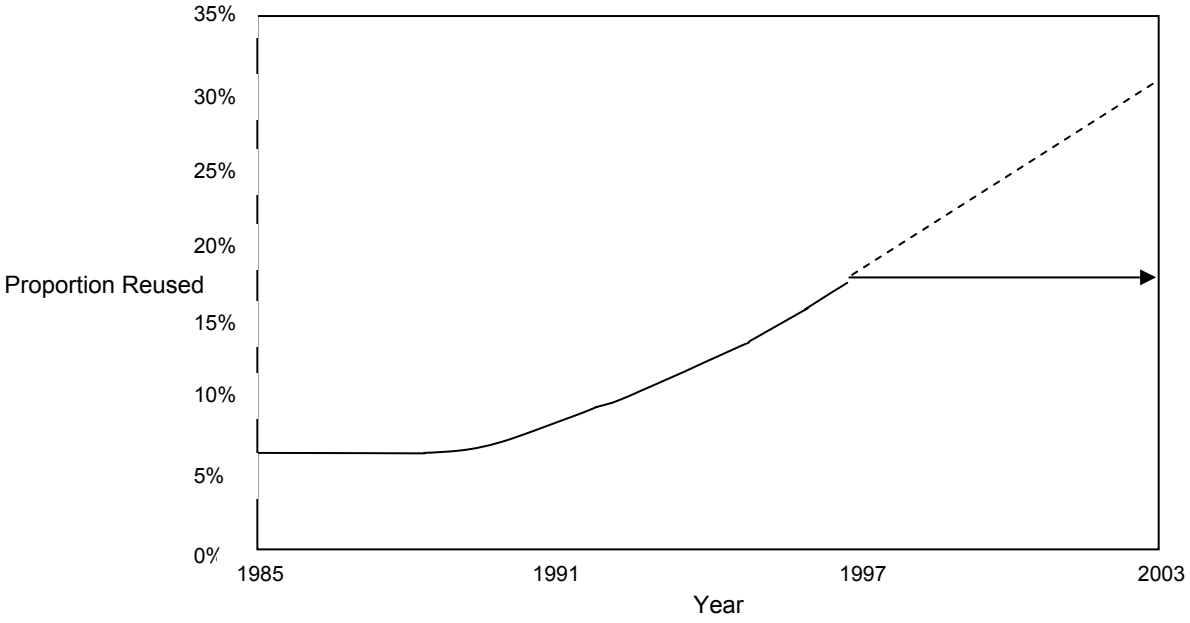

FIGURE 40. ESTIMATED TRENDS IN OVERALL PROPORTION OF WATER REUSE IN SOUTH AUSTRALIA
Taken from Yencken & Wilkinson, 2000. Source: Leahy et al, 1998.

A further approach to reducing water demand lies in stimulating the increasing demand for medium density housing in central Melbourne and the inner suburbs. This increases residential densities and reduces the use of water for lawns and gardens.

The continued reuse of treated water places a value on this substantial resource and prices as high as $1,000/ML have been quoted (NRE, 2000) for access to water for irrigating high value horticultural crops.

In South Australia, the reuse of urban storm water and treated effluent is a major government program that is projected to achieve 30% by 2003 (see Figure 40) and provides a benchmark for other States.

An important consequence of the lack of a Waterway Management Authority outside Melbourne Water's part of the region is related to drainage and flood plain planning. Waterway Management Authorities are referral authorities for sub-divisions and other development proposals on flood plains. In the absence of a Waterway Management Authority this role is undertaken by local government with support from DNRE. This will be an increasingly urgent issue if outer urban development impinges on flood plains and catchment drainage patterns. A Metropolitan Strategy needs to address this issue.

Two pieces of work provide excellent examples of how land use planning and catchment management priorities can be assisted by decision support systems linking water quality data with land requiring priority management. The "Filter" model developed by the Centre for Environmental Applied Hydrology and Melbourne Water (CEAH, 1999) provides the means for targeting key sub-catchments and predicting the outcome of management actions. This provides

a mechanism for identifying the water quality issues already associated with land and allows an evaluation of what would be needed if this land were developed. It also proposes remedial action for existing urban areas.

A further example of work that also aids land use planning and targeted catchment management is the series of reports prepared by the EPA for the Maribyrnong and Werribee River catchments, the catchment to Dandenong Creek and the catchment to Westernport Bay (EPA, 1999). These reports map the areas and land uses within these catchments that are believed to be major contributors to poor water quality. These hot spot maps offer valuable guidance when assessing where and under what conditions new development should occur (see Figure 37).

The Stormwater Guidelines are a further example of best practice. These are linked to the Victoria Planning Provisions through a number of broader provisions and receive further statutory support through the *Catchment and Land Protection Act* 1994. The adoption of the guidelines by all Councils would be a major step in tackling urban pollution and contamination of waterways. The significance of urban areas as a source of nutrients and sediments is well demonstrated in the CEAH report referred to earlier (CEAH, 1998).

6.6 POLICY OPTIONS

6.6.1 WATER USE

The Metropolitan Strategy would be an appropriate mechanism to address the question of reducing the intensity of water use and increasing the use of treated water.

The following policies should be considered:

- defer the need to augment Melbourne's water supply, by introducing a sustained, whole of government (including the retail water businesses) program to reduce per capita consumption of water
- promote/require the installation of water conservation systems (rain water capture, waste water reuse, storm water capture and use) by developers and builders. Installation of dual system infrastructure could be required when large greenfield sites are developed
- reduce water consumption through increased residential densities (smaller block sizes)
- increase opportunities to reuse treated water through co-location of industries needing water with those treating water to required EPA standards prior to discharging
- create opportunities to reuse treated waste water through appropriate land use, location of industries and other development that makes the best use of existing infrastructure and adds value to the resource
- examine the location of treatment works at the bottom of the 'system' to determine the economic implication and reuse potential of installing local waste water treatment plants.

The Minister for Environment and Conservation has announced that Melbourne Water will prepare a water resources strategy for Melbourne which will address many of these issues. The Metropolitan Strategy will need to interface with that strategy.

6.6.2 WATER QUALITY

The government has made a number of commitments relevant to metropolitan policy development on water quality and catchment management. *Labor. New Solutions, A Better Environment* states that a Labor government would implement a river and catchment restoration program, address the causes of river and land degradation and ensure the implementation of integrated whole of catchment management; protect remnant vegetation along stream sides and on private land through a range of measures including an improved system of native vegetation retention controls; implement storm water management programs.

These are strong policies. In addition, a number of policies which are relevant to the Metropolitan Strategy are proposed below. These policies relate to decisions about the location of development, how development might be undertaken and institutional arrangements necessary for making better planning decisions in parts of the region where there is no Waterway Management Authority.

These policies could:

- require that all developments and infrastructure are planned, designed and constructed in accordance with the Urban Stormwater Best Practice Environmental Management Guidelines, and other tools such as the SEPPs and EPA guidelines, works approvals and licences, that on site containment of sediment occurs during construction, and that water reuse is promoted
- ensure that the location and nature of future development and infrastructure takes full account of known sources of nutrient and sediment loads
- provide support (education and training) to ensure that all planning schemes adequately reflect, through local policies, zones, overlays and schedules best practice management to improve catchment management and the health of waterways
- support the need to develop an integrated, effective and efficient region-wide water quality monitoring network that allows the identification of trends and the impacts of investment decisions and management practices
- recognise the importance of high quality waterway management and identify the need for effective waterway management arrangements to be established for the entire catchments to Port Phillip and Westernport Bays
- ensure that flood plain and drainage plans are prepared for the entire Port Phillip and Westernport region to guide future development
- ensure that proposals that could add to the existing nutrient loads in Port Phillip and Westernport Bays are subject to full examination to ensure they are consistent with statutory requirements and the objectives of SEPPs
- ensure that proposed developments and infrastructure do not destroy existing natural wetlands and swamps or cause their condition to deteriorate
- assess the impact of unsewered developments on water quality.

Implementation arrangements will have to be put in place for these policies. For example there are no statutory provisions requiring on site containment of sediment during construction. These would have to be prepared by the EPA, other relevant government agencies, local government, community groups- and the development industry and implemented through the planning and

buildings approvals systems. Similarly, storm water management plans prepared at the council level could be the mechanism for determining that future development takes account of sources of nutrient and sediment. Close collaboration could occur on this point also between water authorities (for example over trade waste) and Melbourne Water, local government the EPA and the developers. Local government could make greater use of land capability assessments to guide decisions on appropriate land use and development decisions. It may be necessary to be more discriminatory about the sediments targeted for better management as there is a distinct possibility that "fresh, clean sediments from greenfield construction sites" have a dilution effect on the polluted dusts and grits from urban areas – and may be contributory to the maintenance of ecological system in waterways and the bays. Sediments of greatest concern are those carrying pollutants such as heavy metals.

7. LAND DEVELOPMENT AND THE LOSS OF HABITAT AND BIODIVERSITY

7.1 BACKGROUND

Biological diversity (or biodiversity) includes the genetic diversity or variability which occurs within each species; the diversity of the Earth's species of animals, plants and other organisms; and the diversity or range of different ecosystems these species form. Its conservation is necessary to retain the full evolutionary potential of our natural systems.

Australia has a rich and diverse range of native flora and fauna, comprising about 450,000 species or some 5%of the world's estimated species. Because of our evolutionary isolation from the rest of the world, some 80 percent of these species are endemic or unique to this continent. The impact of European settlement on Australian ecosystems over the past 200 years has been significant. In Victoria, 21 of 89 native mammal species have become regionally extinct and another 19 are considered endangered, rare or vulnerable. This is almost half the original total (OCE 1992). Of a total of 3, 014 vascular plant species, 28 are extinct in the State (four of which are Nationally extinct), another 815 are endangered, vulnerable or rare in Victoria, corresponding to 29% of all species (OCE 1992, DCNR 1994).

The loss of biodiversity weakens the resilience of natural ecosystems, leaving them less able to deal with subsequent stresses. It often lowers their basic productivity, also affecting their present and potential future economic value.

7.1.1 INSTITUTIONAL ARRANGEMENTS

The Department of Natural Resources and Environment (DNRE) has statewide responsibility for the protection, conservation and management of Victoria's natural environment. The Parks, Flora and Fauna Division oversees the implementation of the *Flora and Fauna Guarantee Act* and the *Wildlife Act* which covers all land and water resources of the State across all land tenures and management regimes. Based on a Management Services Specification, Parks Victoria, established under the *Parks Victoria Act*, manages, on behalf of DNRE, Victoria's national, wilderness, state and regional parks, and Melbourne's metropolitan parks and open space network. It also has responsibilities for the recreational management of the Lower Yarra, Maribyrnong and Patterson Rivers and Port Phillip and Western Port Bays. DNRE also works with other land authorities such as Melbourne Water and local government municipalities and supports conservation measures on private land through programs such as Land for Wildlife.

There are a number of other important legislative and policy arrangements that relate to the protection of biodiversity at the national and local level.

Australia ratified the international *Convention on Biological Diversity* in 1993 which places obligations on countries to protect biodiversity and their ecosystems, and establish equitable means for access to and utilisation of genetic resources. This is supported by a *National Strategy for the Conservation of Australia's Biological Diversity* (1993) which was approved by the Commonwealth and Victorian Governments. Victoria is also signatory to other national agreements and strategies including the *Intergovernmental Agreement on the Environment*

(IGAE); *National Strategy for Ecologically Sustainable Development;* and the *National Strategy for the Conservation of Threatened Species* and *Communities in Danger of Extinction*.

The Victorian Biodiversity Strategy (1997) which complements the National Strategy and the *Flora and Fauna Guarantee Act 1988,* provides the overarching direction for biodiversity conservation and management in Victoria. It is coordinated with other natural resources management mechanisms such as Regional Catchment Strategies, Regional Forest Agreements, and National Parks and Reserve planning.

Victoria, through the Department of Natural Resources and Environment, works co-operatively with the Commonwealth Government and other State and Territory governments to implement the Ramsar Convention in Victoria, guided by the statement of wetlands policy in The Flora and Fauna Guarantee Strategy: *Victoria's Biodiversity - Directions in Management* (Part II, Wetlands).

Victoria has ten listed wetlands of international importance or Ramsar wetlands. These include the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar and Western Port Ramsar sites. The primary obligation is to maintain the ecological character of these areas.

Ramsar wetlands are matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act* . The Act provides that actions which are likely to have a significant impact on the ecological character of a Ramsar wetland are subject to a rigorous assessment and approval process. Such actions may take place outside the boundaries of a Ramsar wetland.

At the 1996 Ramsar conference of contracting parties, a program to establish a Shorebird Site Network (SSN) along the East Asian-Australasian Flyway was launched to highlight the importance of wetland areas for migratory shorebirds and promote conservation activities. To date, the SSN includes 19 sites in eight countries. Victoria has nominated Corner Inlet to the Network and is preparing nominations for the Western Port and Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar sites.

Species listed on JAMBA and CAMBA bilateral agreements with the governments of Japan and China are mainly migratory shorebirds and seabirds, but also include swallow and wagtail species. There are about 80 species listed in both agreements, 59 of which are common to both. JAMBA and CAMBA also include additional annexes that list birds in danger of extinction in Australia and Japan.

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range. It is one of a small number of intergovernmental treaties concerned with the conservation of wildlife and wildlife habitats on a global scale. Since the Convention's entry into force on 1 November 1983, its membership has grown steadily to include 66 Parties from Africa, Central and South America, Asia, Europe and Oceania.

Parties to CMS work together to conserve migratory species and their habitats by providing strict protection for the endangered migratory species listed in Appendix I of the Convention; by

concluding multilateral Agreements for the conservation and management of migratory species listed in Appendix II; and by undertaking co-operative research activities.

There are three wetland areas in the metropolitan region recognised in 'A National Plan for Shorebird Conservation in Australia' as of international and national significance for migratory shorebirds:

- Western Port Bay
- Werribee-Avalon
- Altona

Migratory species listed under JAMBA, CAMBA and the CMS are also matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act.*

Wetlands listed in the Directory of Important Wetlands in Australia are recognised as significant in the national context. The following wetlands in the metropolitan area are listed in the Directory:

- Edithvale-Seaford Wetlands
- Western Port

The Victoria Planning Provisions include a state policy reference, an overlay and a particular provision providing for vegetation retention.

Other documents which may affect planning and management in the region are catchment and land protection plans, shire planning schemes, fire prevention plans, land slip risk assessments, forestry management plans and park/reserve management plans.

7.2 DATA AND TRENDS

DECLINE IN BIODIVERSITY

Most of the original native vegetation of the Melbourne metropolitan region has been cleared or substantially modified since European settlement: 98% of bushland has been lost to urban development with many of the remaining areas highly fragmented and under further development pressure (Beardsall, 1997).

The Victorian Biodiversity Strategy (1997) notes that urban and urban fringe areas often have small remnants of habitat, which are highly valued by the local community. The biodiversity values remaining in these areas can be particularly important for providing unique examples of pre-existing flora and fauna, for protecting sites of biological significance and as seed sources for revegetation with indigenous species. Importantly, those areas provide local and other urban dwellers with a direct link to the natural heritage of a locale, contributing to a sense of place in urban environments.

Within greater Melbourne there is an important network of parks, trails, waterways and coasts. This network provides the foundation of significant remnant habitat for the protection of

biodiversity, as well as providing highly valued recreational cultural and economic benefits essential to creating a healthy, functioning and livable city (Parks Victoria, 1998).

Larger conservation reserves such as Mornington Peninsula, Dandenong Ranges and Kinglake National Parks, Dandenong and Yarra Valley Parklands, Plenty Gorge Park and Point Cook Coastal Park, and a range of reservoir parks are supplemented by many rail and streamside reserves and smaller urban parks and reserves. There are however many important areas of biodiversity which are not managed for conservation.

In recent years there have been some significant additions to the conservation estate. The transfer of sites of national significance such as Plenty-Janefield, Morang Wetlands and Laverton Saltworks to public land has greatly increased the reservation of highly depleted grassland and wetland communities, and increased important areas for migratory birds. On the other hand, the three most intact volcanic plains grassland sites remaining in greater Melbourne in 1986 were Craigieburn Grasslands, Derrimut Grasslands and Taylors Lakes-Sydenham Grasslands (Beardsall 1997). Of these sites, only Craigieburn has been adequately secured as public land for conservation. Derrimut Grasslands was fragmented by industrial development and the Western Ring Road before being reserved, while Taylors Lakes-Sydenham Grasslands have been lost to housing.

DOCUMENTATION OF INDICATORS OF BIODIVERSITY

The major data sets available for analysis of the biodiversity in Melbourne comprise two forms: reports of flora and fauna surveys and assessments of habitat and sites of significance undertaken for various regions of metropolitan Melbourne and surrounds; and geospatial data sets such as the Flora Information System and Victorian Wildlife Atlas maintained by DNRE. Much data in written reports has been digitised and there is some level of overlap. Nonetheless both forms of data provide at best a patchy and incomplete picture of the distribution and abundance of species and habitats.

For the purposes of this study, the geospatial data set for broad vegetation types (BVTs), the consolidated vegetation layer developed for the Port Phillip CALP Board Regional Vegetation Study and various studies of sites of significance are used to identify key strategic issues pertaining to the protection of biodiversity in the region.

A more thorough analysis should be undertaken using consolidated regional vegetation data, a completed bio-sites layer, specific threatened flora and fauna layers overlaid with updated urban land release and freeway corridor data, when available. Between 2000-2003, the Flora and Fauna Branch of DNRE will be completing an analysis of Ecological Vegetation Classes (EVCs) for Port Phillip, including an evaluation of site of significance. This information should greatly assist a more comprehensive assessment of biodiversity indicators within the Melbourne Metropolitan region.

Significant remnants of two depleted BVTs are found in the Melbourne Metropolitan region: Plains Grassy Woodland, and Grassland (PP CALP, 2000). A depleted BVT is one that has been largely destroyed since European settlement. Plains Grassy Woodland has approximately 4%, and Grassland has approximately 0.4% of their pre-settlement areas remaining anywhere in the

state. Many of the remnant areas within the region are on private land and have been the focus of efforts to develop conservation reserves over the past few years.

Significant areas of Plains Grassy Woodland remnants fall in the valleys of Plenty River and Merri Creek, predominantly in the local government area of Whittlesea. Most of the Grassland BVT falls to the West of Melbourne in the municipalities of Hume, Brimbank, Melton, and Wyndham.

Sites of botanical, zoological and habitat significance from the national to local level have been identified in pockets across Melbourne. Of particular interest to this report are the sites outside the parks and reserves network where important remnants and potential habitat linkages are to be found.

DEVELOPMENT TRENDS FOR METROPOLITAN MELBOURNE: IMPLICATIONS FOR BIODIVERSITY

Population projections for Metropolitan Melbourne indicate continued growth over the next 20 years at an annual average rate of 0.7 percent (DoI, 2000a). This growth is projected to occur across all local government areas except the Yarra Ranges. Coupled with a projected decrease in household size, the annual growth in household numbers is likely to rise 1.1 percent (DoI, 2000a). The urban fringe is projected to see the highest rates of growth, particularly in the local government areas of Casey, Melton, Wyndham, Whittlesea and Hume. Housing development in these areas is largely separate single dwelling housing (Hughes, 1997). The rate of growth in these areas is expected to be slower than in the past, in part due to redevelopment opportunities in inner and suburban Melbourne where there is a greater level of medium density housing being developed.

Strategic planning for Melbourne identifies urban growth corridors interspersed by 'green wedges'. The largest amounts of open land available for residential development are located to the west of Melbourne, in areas such as East Melton, Wyndham Vale and Point Cook, to the north around Whittlesea and South Morang and in the east along the Cranbourne – Pakenham corridor (DoI, 2000b).

There are a number of major freeway developments currently under consideration by VicRoads that form part of Melbourne's Strategic Road Network. These include the Eastern Freeway extension from Springvale Rd to Ringwood; Scoresby Freeway between Ringwood and Frankston, the Hume Freeway from north of Craigieburn to the Metropolitan Ring Road; and the Western Freeway from Rockbank to the Western Ring Road (VicRoads 1998).

Recreational use of urban parks and waterways has been steadily increasing for many years, as a result of increased population levels and increasing opportunities for outdoor leisure activities. Metropolitan Parks managed by Parks Victoria received over 11.8 million visitor days in 1997-98. The extended areas of open space across Melbourne, particularly along creek lines are also subject to significant visitation by local residents.

There is a range of threats to biodiversity resulting from human activities. These include loss of habitat; fragmentation of habitat; over-exploitation of species and ecosystems; spread of exotic species and diseases; air, soil and water pollution; and human-induced climate change. Most

areas of Australia, including the remaining remnants of ecosystems in Metropolitan Melbourne are afflicted by each of these threats to a greater or lesser degree.

URBAN EXPANSION AND RURAL RESIDENTIAL DEVELOPMENT

The on-going expansion of urban and rural housing development has important implications for biodiversity. This expansion will lead to large areas of land, previously under native vegetation or agricultural use, subsumed by housing, road networks and associated infrastructure.

Ecological impacts associated with urban expansion and rural residential development include:

- clearing of remnant native vegetation and native animal habitat for residential development and for new fire breaks
- increased predation by domestic cats and dogs on native fauna, and resultant loss of animal species
- further introduction of environmental weeds and other 'garden escapees' into native vegetation
- problems associated with disposal of putrescible and non-degradable waste;
- sewerage treatment and disposal problems affecting streams and land;
- increased road traffic, road construction and pressure for road improvements;
- increased recreational use of environment and associated disruption of flora and fauna
- altered drainage and increased stormwater;
- segmentation of streams between retarding basins, and
- impact on estuaries
- salinisation arising from excessive clearance of recharge areas, such as Mernda corridor

CLEARING NATIVE VEGETATION

Over the past 150 years, most of Victoria's fertile lowlands have been cleared for grazing, cropping and residential occupation. The impacts have included loss of native plants and animals, slowly rising water-tables and salinisation of land and streams. Increased run-off from the cleared land has increased stream flows and led to significant erosion both of the land, streambanks and streambeds.

The size of the remnant area of native vegetation is a key determinant of its viability and value as habitat. Its size influences the botanical complexity of the fragment and the diversity of native animal and bird species that can survive in it over time. The smaller the fragment, the fewer species that can depend upon it for survival (Bennett 1997).

In addition, studies of islands of native vegetation indicate that if the remnant is small, slow deterioration occurs over time with the incursion of weeds (edge effects) or the loss of influences necessary for natural plant reproduction, such as fires - or protection from frequent burning. If the fragment is small and isolated, or has been significantly modified (for example, through the clearing of understorey species), its faunal species are less likely to be able to maintain sufficient genetic diversity or find sufficient food and habitat to reproduce and survive (Bennett 1997).

Despite native vegetation retention controls, clearing of native vegetation does continue across the Metropolitan region, for agricultural land, for residential development, to assist in road works and to increase access for certain utilities.

Ecological impacts of clearing of native vegetation include:

- immediate loss of native plants
- immediate threat to biodiversity through loss of habitat for native animal and bird species
- increased fragmentation of remaining vegetation and edge effects, resulting in the further decline in presence and abundance of native plant and animal species over time
- increased water erosion, water-logging, raised groundwater tables depending on the replacement groundcover
- increased occurrence of landslips
- increased surface water run-off and non-point source pollution (i.e. nutrient run-off from fertiliser use or domesticated animals) of streams
- increased streamflow, accelerated streambank erosion, siltation of streambeds and loss of in-stream environmental values including habitat for fish and organisms which remove pollution

INTRODUCED SPECIES

Introduced species of plants and animals compete for food and space with native flora and fauna. Of the 4000 or so vascular plant species found in Victoria, approximately one quarter, are introduced and have become 'naturalised', reproducing freely in the wild (Ross 1993). Eighteen of the 25 introduced animal species, which have become naturalised in Australia, are found in Victoria (O'Brien 1990). This represents 17 percent of all terrestrial mammal species in the state.

Several introduced animal species - cats, foxes and dogs - prey upon native wildlife, contributing to the decline in populations of small and medium sized mammals, birds and reptiles. Weeds have a major impact on native vegetation communities, and are an increasing problem for remnant vegetation throughout the Metropolitan region. Disturbance or clearing of understorey vegetation, slashing, vehicle use and fire can provide opportunities for invasion. Grazing of domestic stock and recreational use can assist the dispersal of seeds into bushland. Small fragmented remnant vegetation is more vulnerable to infestation by pest plants and animals due to the pressures from surrounding land use. Many environmental weeds that cause significant damage are common in suburban gardens. For example, *English ivy* has invaded disturbed forest in the Dandenong Ranges around residential developments, gradually becomes established in forested areas and causes the death of trees.

Ecological problems associated with pest plant and animal infestations may include:

- modification of the floristic composition and ecological resilience of nature reserves, bushland and wetlands, threatening viability of native flora and reducing natural diversity
- degradation of riparian conditions where thickets of environmental weeds take hold on stream and river banks, leading to loss of habitat for terrestrial plant and animal species, loss of shading and nutrient input for aquatic species

- chemical contamination of native plants, animals, soils and streams where spraying with herbicides is used to reduce pest plant infestation
- erosion where removal of large numbers of weeds is not followed by adequate planting
- impeded access and reduced habitat and food plants for native fauna
- reduction in populations of native plants and animal species through predation, competition for resources and introduction of disease
- prevention of regeneration, soil disturbance, soil erosion, and weed dispersal
- reduction of nesting and breeding sites for native wildlife
- loss of species or diversity in a local or regional context

AGRICULTURE

Agricultural activity in the Metropolitan Melbourne region is highly diversified with the dominant activities being livestock raising, intensive (horticultural) cropping, and mixed and hobby farming.

Ecological problems associated with agricultural activity may include:

- increased nutrient run-off and contamination of surface water run-off from pastures and cropping land, where the riparian zone has been disturbed, degraded or destroyed by clearing and/or grazing
- accelerated soil erosion, soil slumping and compaction
- degradation of riparian ecosystems where grazing and stock watering is permitted along stream and river banks - leading to loss of habitat for terrestrial species, and stream bank erosion and degradation of water quality and habitat for aquatic species
- long term native vegetation and native bird habitat loss in paddocks where isolated native trees or clumps of vegetation fail to regenerate because of grazing in the understorey or through repeated removal by cropping
- chemical contamination and toxic impacts on the health of native fauna, and
- increasing pressure for clearing native vegetation to keep farms viable

FIRE MANAGEMENT

Fire can either benefit or damage an ecosystem, depending on the length of time between burns, the intensity of the fire, the season when it occurs, soil characteristics and so on. The ecological effects of fire in the Australian environment are not fully understood. Fragmented ecosystems, particularly grasslands in need of regular burning, are at risk from lack of fire whereas upland forest vegetation close to urban developments are at risk from too frequent prescribed burns, grazing and/or slashing to reduce fuel loads.

TOURISM AND RECREATION

Over the last two decades, the State Government has sought to improve existing recreation areas, increase public open space and establish connections between existing and new areas by developing bicycle and walking track networks throughout Metropolitan Melbourne.

Disturbance to wildlife breeding sites, vegetation trampling, erosion and increased litter have been identified as impacts of visitors within Parks Victoria managed parks (MRC 1999) and similar impacts can be anticipated across much of the Metropolitan open space network.

The environmental impacts of general recreational use include:

- soil compaction and erosion
- weed invasion
- disturbance and removal of native vegetation
- increased fire risk, and
- litter
- disturbance to fauna

TRANSPORT AND ROAD CONSTRUCTION

The environmental implications of road improvements and widening can be significant. Native vegetation beside road reserves and railway lines may have high conservation and landscape values as it often contains the last remnants to be found in an area. This is frequently the case in agricultural areas where vegetation is extensively cleared for production. Such linear corridors of vegetation allow native fauna to travel between larger areas of bushland and improves the genetic viability of populations of particular species and allows populations to disperse after breeding or relocate to new habitat after fire or, possibly, in response to the greenhouse effect.

In general, VicRoads is responsible for the management and funding of highways and main roads across the Region, and VicTrack and its leasees are responsible for management of railway reserves. These public authorities and local councils should consider factors such as the blending of roadway alignments with surrounding landforms, maintenance and enhancement of rail and road-side vegetation, and the rehabilitation and revegetation of rail and road-sides after construction work, including the use of plants grown from locally collected seed.

Ongoing maintenance of roads and rail lines also has an impact on remnants.

7.2.1 DEVELOPMENT TRENDS IN OUTER MELBOURNE

SE GROWTH CORRIDOR: CITIES OF CASEY AND CARDINIA

The City of Casey is the dominant growth area for south-eastern Melbourne. This represents an annual increase of approximately 2.1% in the population and 2.8% for households. The municipality extends south to Western Port Bay although growth is concentrated in the north along the Cranbourne - Pakenham corridor. Growth rates in neighbouring Cardinia, which has a significant rural and horticultural hinterland, are projected to be 2.2% in population and 3.1% for households annually although most growth is expected after 2006 when land supply in Casey is more restricted. (DoI 2000b: 40-1)

The majority of original native vegetation in the Berwick – Pakenham corridor has been cleared or substantially lost, through agricultural and urban development. The overall botanical significance of the area on a state wide level is considered low although a small number of sites of local significance in the corridor have been identified (DCFL 1989). Some areas of remnant river red gums are important elements of the previous vegetation association of the region (Parks Victoria, 1998).

This area is expected to account for the largest share of lot creation and consumption from existing vacant lots and release of additional broadhectare land in the short to medium term. This will accompany the projected increase in population.

The most significant impact is likely to be from the increased demand for recreational activities on the reserves and open space such as the Cardinia Creek Parklands and the Cranbourne Botanical Gardens.

PLENTY GROWTH CORRIDOR: CITY OF WHITTLESEA

The City of Whittlesea, bounded to the west by Merri Creek and the East by Plenty River, is one of the identified growth corridors for outer Melbourne. The southern parts of the municipality are well-established urban areas, while the north remains rural in character. Population levels are expected to rise by about 1.5% annually over the next twenty years. With the full development of Mill Park, future demand is likely to expand towards South Morang and areas east of Plenty Road (DOI, 2000b).

Significant although highly fragmented areas of Plains Grassy Woodland are found in this local government area. This vegetation type is very rare, and considered depleted with less than seven percent of the remaining areas protected in conservation reserves statewide.

There are a number of major conservation reserves in the area that are important reservoirs of biodiversity: South Morang and Mill Park wetlands along the Plenty River; Yan Yean Reservoir Park; riparian reserves along Darebin and Merri Creeks, Toorourrong Reservoir and Plenty Gorge Park incorporating Yarrambat, Morang Wetlands and Plenty – Janefield sites. The acquisition of the Craigieburn Grasslands has improved protection for a diversity of grassland communities and accompanying threatened flora and fauna (Beardsell, 1997).

Five sites of faunal and habitat significance representing significant stands of River Red Gum and associated native grasslands have been recommended for inclusion in the Plenty Growth Corridor Red Gum protection zone. The sites: Fenwick and surrounds, Summerhill Road, Edgars Creek Headwaters, Mernda to Yan Yean and Dunnetts Rd Swamp comprise the largest area of River Red Gum grassy woodland in greater Melbourne, most of which is on private land. While livestock grazing pressure is a key threat to these sites, any zoning changes that allowed rural subdivision would not be recommended. Beardsell (1987) considers there is far greater scope to incorporate sustainable conservation management with traditional broadhectare farming than rural subdivision. This habitat supports threatened species such as red-chested button quail, the striped legless lizard and potentially the southern lined earless dragon.

Large numbers of remnant river red gum have been cleared for development in the southern part of the corridor.

Urban expansion is likely to affect areas of remnant grassland and grassy woodland. The proposed Hume freeway link from north of Craigieburn to the Metropolitan Ring Road runs north along the Merri Valley and has been the subject of a Planning Panel hearing. This affects land and significant environmental values (the grasslands in the Craigieburn area, Cooper Street and Central Creek areas and the river red gum grassy woodlands east of Craigieburn) in both Whittlesea, Hume, and Darebin.

Further farming intensification including increased stock grazing, removal of rocks and increased chemical usage can have deleterious effects particularly for grassland wildlife that require the native flora and rocky ground cover for survival (Beardsell 1997).

CITY OF HUME

The City of Hume is projected to have the fifth largest net increase in population of all Melbourne Local Government Areas (LGAs) over the next 20 years (DOI 2000b). This represents an annual increase of approximately 1.5% in the population and 2.1% for households. At present, the southern part of Hume is predominantly urban, while the north remains rural. There is a strong industrial base to the area, particularly in the form of motor vehicle, industrial and heavy engineering industries (DOI 2000b). Hume is bounded to the east by Merri Creek, to the south-west by sections of the Maribyrnong River, Jacksons Creek and to the east by the Calder Highway.

All major waterways in this area, with the exception of Moonee Ponds Creek, are recognised as having highly significant environmental values (Parks Victoria, 1998). The natural vegetation remaining is small, scattered remnants, categorised as Grassland BVT, which is now very rare, and considered depleted. Diggers Rest Rail Reserve Grassland is a plains grassland site, dominated by Kangaroo grass and a variety of native tussock grasses. It was listed as a site of national significance in 1990 (DCE 1990). The site has since deteriorated considerably due to massive soil disturbance and inadequate burning. By comparison, the Evans St. Reserve in Sunbury, considered to be of State botanical significance, (DCE, 1990) is a little-disturbed remnant, now under the guardianship of a committee of management.

The Striped Legless Lizard, which is classified as vulnerable in Victoria and listed under the FFG Act, has been recorded in native grasslands west of Melbourne. Despite their small size, these scattered areas are likely to represent important refuges for this species.

There are two main residential areas in Hume: Sunbury in the north-west, and Merri, adjacent to Merri Creek. Some urban development is planned for the fringes of the current Sunbury township and this is expected to further encroach into previously cleared agricultural land. Major growth is anticipated along the Merri Creek corridor, east and west of the Hume Highway (Hughes 1997). As with the City of Whittlesea, the proposed Hume freeway link from north of Craigieburn to the Metropolitan Ring Road could have significant consequences for the biodiversity of the Merri Valley.

There is also expected to be moderate recreational pressure from the expanding regional population (PV 1998), increasing the likelihood of degradation of these waterways.

CITY OF WYNDHAM

The City of Wyndham, on the south western fringe of Melbourne, is expected to have the second largest growth rate of all Melbourne LGA's and the third largest net increase in population over the coming 20 years (DOI 2000). The expected annual rate of growth for Wyndham is 2.3% for population, and 3.0% for households. Wyndham is a mix of residential, open space and horticultural in land use. In addition to the commercial centre of Werribee, Wyndham contains the Western Treatment Plant and two Defence Force Bases (DOI 2000).

The City of Wyndham contains a number of publicly owned or reserved sites identified as having international conservation significance, including the Sewage Treatment Lagoons at Werribee and the Point Cook Coastal Park. Sections of the Laverton Saltworks are also recognised as having international significance for fauna. This site is part private and part public uncommitted Crown Land (Schulz *et al.* 1991). These sites all form part of the Port Phillip Bay (Western Shoreline) Ramsar area, and contain significant tidal lagoons, saltmarshes and grasslands that are used by large numbers of wading birds. At least 11 species of threatened bird, including the Orange-Bellied Parrot have been recorded. The vulnerable Striped Legless Lizard is also found at Point Cook.

The Wyndham LGA area contains three sites regarded as having national botanical significance: the Southwest Rail Reserve at Little River, the Southwest Rail Reserve at Manor and the Truganina Cemetery Grassland. Combined, these sites contain populations of four threatened herbs and a number of regionally significant Plains Grassland species. They are dominated by *Themeda triandra* (Kangaroo Grass), in which the Striped Legless Lizard is commonly found. All of these sites are publicly owned. A proposal to double the railway line to Geelong would put the rail reserves at risk. All sites face degradation from weed invasion and inappropriate fire regimes. The upper reaches of Skeleton Creek are considered of Regional faunal significance. The area is suggested to contain the Striped Legless Lizard and the Southern lined Earless Dragon (DCE 1990).

Significant future residential development is expected in the areas north and south of the Werribee River, north of the Geelong Highway (Hughes 1997). Much of the residential development, particularly to the north, will encroach into previously rural land that has limited biodiversity value. To the south, close to Point Cook, major new housing and recreation developments are planned with likely consequences for the adjacent salt marshes and wetlands. There is also likely to be some impact on remnant, riparian vegetation and water quality along Skeleton Creek and the Werribee River.

BRIMBANK AND MELTON

Brimbank is currently the third largest municipality in Melbourne in terms of population, but is expected to have a relatively low rate of growth over the next 20 years. As such, the population in Brimbank is only expected to increase by 0.1% per annum, and households by 0.8% per

annum. Brimbank has a large industrial base, but also has a large residential population (DOI 2000b).

Adjoining Brimbank to the west, is the local government area of Melton, which has the fastest rate of population growth of all Melbourne LGAs. The population is expected to more than double during the next 20 years (DOI 2000), with projected annual growth in population of 4.0% and households of 4.7%. Currently, the City of Melton is predominantly rural, however, there are some large and new urban developments in the east.

Within this area of Melbourne are numerous sites of significance, including the Derrimut Grassland and the North Western Rail Reserve. The Derrimut Grassland Reserve occupies an area of roughly 160 ha. It is of national botanical significance, being representative of the FFG listed Western (Basalt) Plains Grassland Community. It contains 5 rare or threatened flora species and the striped legless lizard. Development to the north and east and the western Ring Road have affected drainage in the Reserve.

The North Western Rail Reserve, covering approximately 5 ha along a 25 kms stretch, between Deer Park and Parwan, was also considered to have national botanical significance when assessed in 1990 (DCE 1990). Recent reports indicate that the vast majority of the site has been destroyed. The Deer Park Grassland, regarded as having state botanical significance, was approximately 200 ha of privately owned industrial land that faced degradation from grazing by cattle and rabbits. It has since been subdivided with much of the area lost to urban development. Thirty hectares has been retained and recently transferred to management by Parks Victoria.

Jensz Swamp, located 8.5 km south of Bacchus Marsh on private land, is a site of regional faunal significance because it provides habitat for two threatened bird species and two species of migratory birds listed under international agreements with China and Japan (CAMBA and JAMBA). Similarly, Bingham's Swamp, located 7.5 km south-south-east of Bacchus Marsh on private land, is regarded as regionally significant for fauna, with two threatened bird species and three JAMBA/CAMBA species recorded. The site also supports a sizeable and diverse assemblage of bats, including the regionally rare Broad-nosed Bat (Schulz *et al* 1991).

Significant urban expansion is proposed along the western freeway corridor near the population centres of Melton, Melton South and Melton west. At Melton South, urban development will extend to the Werribee River, and in Melton West, to Djerriwarh Creek. The population centre of Burnside is expected to expand across Kororoit Creek and in Sunshine, development will occur north along the Maribyrnong River (Hughes 1997).

Although the majority of the Derrimut Grassland is reserved, the integrity of the site is potentially threatened by nearby residential development. In particular, the changes to local drainage patterns likely to result from residential development could have implications for its long-term viability. The upper Werribee River is likely to be affected by urban development in Melton South. This area is classified as having regional significance for fauna (Parks Victoria 1998). The upper reaches of Kororoit Creek also likely to be affected. To the west of Melton, substantial impact on biodiversity is expected from urban expansion on Djerrwarrh Creek, which links two disjunct sections of Long Forest Flora Reserve.

The impact of a proposed realignment of the Western Freeway, between the townships of Melton and Bacchus Marsh through agricultural land is not known.

7.2.2 DEVELOPMENT TRENDS IN INNER MELBOURNE

EASTERN FREEWAY EXTENSION – CITIES OF WHITEHORSE AND KNOX

Population increases in the established suburbs of Melbourne are projected to increase, but at more moderate rates than the outer areas. For example, the City of Whitehorse is projected to have population increases of 0.7% and household increases of 1% per annum. Most of this development will be single dwelling with some medium and high density developments almost exclusively in highly urbanised areas. Minimal biodiversity impact from new urban development is expected other than the increased pressure on recreational and open space sites. The proposed extension of the Eastern Freeway may see the loss of substantial remnants of native vegetation which have persisted in the steep terrain of Mullum Mullum Creek (Yugovic *et al*, 1990). This will be dependent on the specific alignment and construction plans for the freeway.

7.3 ISSUE IDENTIFICATION

The principles underlying biodiversity protection are:

- protect key sites of biodiversity
- maintain the viability of populations and increase the diversity of species within remnants
- ensure movement of migratory species
- reduce susceptibility of species to disease and threats such as weed invasion and predation from pest animals (Bennett 1997)

The threats to biodiversity of major immediate concern in the Melbourne Metropolitan region are:

- the incremental loss of remnant native vegetation and associated habitat and native species through increasing urban land development, and the possible development of transport corridors through high conservation areas as well as continuing low-level clearing and the decline of isolated vegetation fragments
- poor and inadequate management of remnant vegetation that has been established for protection
- the impact of grazing on remnant grassland and wetland communities, and predatory introduced species, particularly cats, dogs and foxes, on local wildlife
- the pressures placed on the open space network by the high and increasing demand which recreational users and visitors place on the region's natural environment

The longer term all-embracing threat of induced climate change also demands careful consideration in the metropolitan strategy.

Given the nature of these threats, notions that once a species is represented in a conservation reserve, it is safe, deny the overwhelming evidence that individual populations are dynamic and

part of a larger ever-changing environment. Individual reserves are components of dynamic landscape systems, where inputs from outside the reserve may override ongoing ecosystem processes within. Many important environmental values - habitat and native species - exist mainly or only on private land. Therefore whole landscape systems must be managed as integrated units to achieve effective conservation of dynamic living organisms.

Effective conservation of biodiversity will require changes to current approaches to land use practices, pollution control, resource consumption, waste and recycling, valuation of natural resources and the role of the community and individuals in protecting the environment. This must be done using the precautionary principle, whereby the gaps in our knowledge and understanding of the environment, and the uncertainties we face about the future are reflected in policies that at all costs, guard against irreversible impacts on biodiversity.

7.4 BEST PRACTICE

Some examples of good practice are described below.

Habitat protection, restoration and community involvement:
The Growing a Green Web project, by the City of Casey in partnership with Greening Australia Victoria, is engaging broad cross cultural community involvement to restore vegetation in an urban area with limited remaining natural vegetation, at the same time building understanding and commitment to the environment.

The on-going re-establishment of vegetation and wildlife corridors along the lower reaches of the Yarra River linking the disjunct sections of the Yarra Valley parklands provides an important case study in habitat restoration for migratory and threatened species as well as valuable recreational corridors. In addition, the development of a fish ladder at Dights Falls, has restored access to a significant length of the Yarra for five native fish species.

The Merri Creek Management Committee, a body dedicated to the restoration and conservation of a major creek system in Metropolitan Melbourne, has achieved impressive results through its coordination of four local councils, Melbourne Water, local industry and residents. Strategic long-term planning, sound financial management and community participation have been key factors in the Committee's success.

The management of the Evans Street grasslands in Sunbury, by a Committee of Management highlights the important role communities can play to protect pockets of biodiversity. This dedicated community group voluntarily undertakes weeding and propagation for replanting of native species, and arranges a regular control burn by the CFA. The group's ability to focus on a single area contrasts markedly with larger agencies responsible for the management of many small reserves that can be faced with conflicting priorities.

Infrastructure:
Installation of telephone lines in Cape Tribulation National Park in north Queensland departed from the norm of cutting a 5 metre easement in vegetation beside the road. Instead, the line was installed under the table drain along the roadside and in some sections, by using hand held

machinery through the vegetation. This resulted in no clearing of easements and no tree removal.

Introduced species:
The introduction of by-laws in the Shire of Eltham (now Nillumbik) to control the sale and distribution of environmental weeds through nurseries and inform the community of the risks associated with introduced common garden plants is an important step in reducing weed invasion into remnant vegetation.

The establishment of dog training programs by Parks Victoria to improve responsible pet ownership is an innovative method to increase awareness of the impacts of pets on native vegetation, streamsides and water quality.

Community Education:
Many measures to protect biodiversity involve increasing awareness and understanding of the biodiversity values by the general public. Protection of the endangered Hooded Plover, which nests along sections of Victoria's coastline including Mornington Peninsula and Point Cook, can be enhanced by keeping people off the beach during the plovers' short nesting season. Signs, temporary fencing and efforts to raise community interest in the plover have been used effectively to retain breeding success of known colonies.

Councils responsible for coastal management in and around Sydney beaches have established a program to protect the fragile intertidal zone. Local residents have undertaken basic training and act as volunteers explaining the importance of conserving the zone from risks such as uncontrolled shellfish collection, trampling and rubbish dumping. Coupled with signs in a variety of languages this educative rather than enforcement approach to coastal protection has proved highly effective.

7.5 POLICY OPTIONS

There are a number of measures that should be considered within the Melbourne Metropolitan Strategy. In particular there is a need to establish effective coordination in planning across state and local government to ensure implementation of the following policy measures.

ASSIST ACHIEVEMENT OF BIODIVERSITY STRATEGY GOALS

- reverse across the landscape, the long-term decline in the extent and quality of native vegetation through protection of remnant vegetation and replanting, leading to a net gain
- maintain and, where necessary, restore the ecological processes and the biodiversity dependent upon terrestrial, freshwater and marine environments
- maintain and improve the present diversity of species and ecological communities and their viability across each bioregion, and increase the viability of threatened species
- ensure that there is no further preventable decline in the viability of any rare species or of any rare ecological community.

URBAN AND INDUSTRIAL EXPANSION AND RURAL RESIDENTIAL DEVELOPMENT

- Promote and facilitate further urban consolidation in areas other than those identified as having significance for biodiversity
- Establish stronger controls to limit broad hectare subdivisions where remnant vegetation or threatened species habitat is located.
- Prevent loss of habitat from future infrastructure installation such as gas and water pipelines, telephone and power lines through the development of ecological codes of conduct with service providers to ensure:
  - alignments are over cleared land rather than remnant vegetation wherever possible.
  - the method of installation is the least damaging.

  Note: Utilities often prefer roadside reserves because use of public land is administratively easier, less expensive and access along a road makes it easier to install and service equipment. As reserves are managed by a number of authorities this can lead to no single body taking responsibility for vegetation protection.
- Establish stricter conditions on land development permits to improve the requirement for open space or off-sets in lieu of open space as a means of restoring and protecting important habitat such as remnant vegetation and riparian zones. This is particularly relevant for industrial estate developments.
- Increase the provision of accessible strategic advice, such as the new format planning schemes being developed under the new format planning schemes, to local government planning processes to promote development in the least sensitive areas and to protect and promote corridor areas such as the Metropolitan green wedges.
- Enhance current information management systems so that information about biodiversity values for any particular area can be easily accessed early in the planning cycle by local government, developers, and conservation groups.

NATIVE VEGETATION AND HABITAT RETENTION & REHABILITATION

- The Metropolitan Strategy should recognise the importance of retaining stands of natural vegetation in the region, and the importance of maintaining and establishing wildlife corridors and re-establishing connections between fragmented patches of remnant vegetation, particularly in the light of evidence of human induced climate change.
- All efforts should be made to protect and properly manage any remaining areas of remnant vegetation, particularly where identified as sites of significance. For example, high priority should be given to protecting remnants of Plains Grassy Woodland and Grassland, such as those within the Plenty Corridor. Grassland reserves within the Hume, Wyndham, Brimbank and Melton LGA's, although reserved, continue to be degraded and are therefore in need of improved management.
- Small fragments of sites of botanical significance exist throughout the metropolitan region. Further investigation should be carried out to identify important remnant vegetation, which probably still persist and require protection.
- Permits for clearing of native vegetation on agricultural and residential land should be reviewed to ensure they are not issued where the native vegetation to be cleared:
  - contributes to an existing or proposed wildlife or vegetation corridor or refugia, and

  - if cleared, would not diminish the viability or value of any remaining associated area of native vegetation or habitat.
- Consideration of the establishment of biodiversity off-setting mechanisms as a condition of future developments should be investigated to meet the commitment to no net loss of biodiversity.
- Mechanisms for enforcement of controls is urgently required including:
  - Greater use of redeemable bonds to ensure compliance with permit conditions
  - The range of enforcement options such as a 'halt to works' order should be expanded;
  - Retrospective permits for vegetation clearance should be prohibited. Prosecutions for illegal clearing should be sought or rehabilitation should be considered in exchange for a stay in legal action/prosecution;
  - The level of fine for infringement of regulations should be increased to at least cover the cost of revegetation;
  - As enforcement is difficult to police, emphasis on areas of greatest significance should receive closest scrutiny.
- Incentives to encourage the retention of native vegetation are required. Rate policies should be reviewed to provide financial incentives for the retention of native vegetation on freehold land: rates should not be levied or should be significantly reduced on protected remnant vegetation. Other incentive schemes should be canvassed with the state and federal governments such as amendments to the Taxation Act to provide full deductibility for fencing for protection of remnant vegetation.
- Identify potential areas for environmental rehabilitation where the re-establishment of effective wildlife corridors and refugia may be undertaken, and then target activity and assistance - in the form of rate rebates or other incentives - toward the restoration of environmental links in these areas.

WETLANDS & RIPARIAN (STREAMSIDE) VEGETATION

- Strong and effective planning provisions to protect remnant wetlands, and restrictions on developments in floodplain areas should be incorporated across the region through local planning controls.
- The development of habitat links for the ongoing viability of the remaining vegetation fragments, particularly along creek and waterways should be developed in accordance with Melbourne's open space network planning framework.
- No clearing of riparian native vegetation should be permitted, irrespective of its condition. Planting of inappropriate species should also be discouraged.
- No agricultural or residential use of riparian zone land should be allowed, and restoration of native vegetation buffers should be made a priority. Rate incentives should be investigated as a means of encouraging rapid response by landholders.
- Fencing to protect the riparian zone and stream banks from grazing should be implemented, with rate incentives provided to assist meeting costs.
- Continued cooperation between municipalities and agencies such as Melbourne Water, DNRE, and EPA in projects such as catchment planning and stream improvement works.

INTRODUCED SPECIES

- Development of an integrated approach to weed eradication among all agencies and the community to target and control problem areas is required.
- Development of appropriate government local laws to control the planting, sale and removal of environmental weeds throughout the region should be developed in association with the nursery industry and plant propagation groups.
- Strong regulations, backed up by on-going community education programs is required to control domestic pets, in an effort to protect native wildlife and water quality. Responsible pet ownership programs should be continued and broadened.
- Feral animal eradication programs – particularly of foxes and cats - should be introduced or expanded.

FIRE MANAGEMENT AND BIODIVERSITY

- Many of the areas of remnant vegetation in Melbourne Metropolitan will require active management for fire to ensure the maintenance of suitable habitat for endangered and threatened species of plants and animals. Effective burning regimes for small grassland remnants can prove difficult in built-up residential and industrial areas. Coordination of government agencies such as DNRE and Parks Victoria with the CFA, industry and residents will be required.
- In outer urban and rural areas, local government should play a lead role in adoption of an ecological code of practices for roadside management, which addresses fire management among other issues, taking into account the guidelines developed by the Victorian Roadsides Conservation Committee.

TOURISM AND RECREATION

- Recreational pressures should be monitored annually to assess environmental impacts in the region. Assessment should include information and assessments of visitor numbers, demands and impacts of tourists on specific parks and other natural sites, studies on traffic flows, associated pollution problems, and environmental impacts and constraints. The strategy should seek to 'rest' and 'rotate' recreational areas to protect them and assist their regeneration; identify and provide resources for restoration works to repair the inevitable damage which intensive use creates to infrastructure, paths and the bush, and incorporate community activity in these restoration and protective programs.
- Major expansion of the open space network to diffuse increasing recreational pressures should occur in accordance with the original intent of the strategic open space purchase program

TRANSPORT AND ROAD CONSTRUCTION

- Effective traffic management such as speed restrictions and safe passage via under-road tunnels for wildlife where required should be investigated.

- Any further freeway development / expansion should in the first instance be assessed in the light of alternative transport policies, should not be constructed along native vegetation and waterway corridors, and should be planned to minimise impacts on biodiversity.
- Conservation of roadside reserves should be a priority when realigning or upgrading roads.
- In outer urban and rural areas, local government should play a lead role in adoption of an ecological code of practices for roadside management, which addresses fire management among other issues, taking into account the guidelines developed by the Victorian Roadsides Conservation Committee.

COMMUNITY INVOLVEMENT

- Promote and facilitate urban community involvement in the stewardship of biodiversity values;
- In the urban fringe encourage landholder involvement in schemes such as Landcare and Land for Wildlife.
- Promote community group projects that assist in restoring and rehabilitating flora and fauna habitats, e.g. Botanic Guardians, Parks Victoria Community Grants.

8. INDUSTRIAL AND HOUSEHOLD WASTE

8.1 BACKGROUND

Waste management remains an important issue for all levels of government. During recent years residential kerbside garbage and recycling collection have been consolidated and enhanced while an increased emphasis has been placed on voluntary industrial waste minimisation through eco-efficiency and cleaner production. In Victoria, currently over 90 per cent of homes have access to kerbside recycling, with a further 5% with access to drop off services (EcoRecycle Victoria, 1999-2000). Residential kerbside garbage and recyclable collection appear to be here for the foreseeable future, with the National Packaging Covenant providing an avenue for future sustainability. Technological enhancements to the collection, sorting and reprocessing of recycled materials continue to be pursued.

In 1992, the Victorian State Government set a target to reduce waste deposited at landfills by 50% by the year 2000. According to the Victorian Auditor-General (May 2000), the desired outcome has not been achieved, but as noted by the Environment Protection Authority, the target was set during a "low point in economic activity in Victoria" and "no calculation has been made for population changes since 1992". EcoRecycle also note that the "1997/98 data incorporates landfills located outside the major urban areas" and that there has also been an "increase of materials recycled from 1,52,000 tonnes in 1992-1993 to 3,092,794 in 1997/98" (Victorian Auditor-General May 2000). EcoRecyle also note that the current level of materials recycled represents a 44% diversion rate from landfill (ie total waste = waste to landfill + materials recycled). Further, when the government set the target, no accurate data were available on which to base the 50% reduction target. During the last few years, weighbridges have been increasingly installed at landfill, contributing to more rigorous and accurate reporting of waste going to landfills in Victoria.

Location and management of landfill sites remain contentious issues and are highlighted by mistrust from the community, particularly in relation to prescribed waste facilities. Prescribed waste generated in Victoria increased by 54,294 tonnes from 597,706 tonnes in 1995 to 652,000 tonnes in 1998. Low-level contaminated soil accounted for approximately one third of this increase. This increase further exacerbates the need for both eco-efficiency within industry and plans for future repositories, long term containment facilities or soil banks. There is a continuing need to carefully plan for buffer distances and transport routes for any proposed new landfill or containment sites.

8.1.1 INSTITUTIONAL ARRANGEMENTS

The Intergovernmental Agreement on the Environment notes that the polluter pays principles should apply to waste generators and users should pay full life cycle costs.

Environment Australia delivers national leadership on environmental issues through programs and policy. A key broad strategic and policy framework is the National Strategy for Ecologically Sustainable Development (NSESD) that incorporates waste minimisation and management. The NSESD is based on Agenda 21, the Rio Declaration on Environment and Development.

Environment Australia has placed a focus on Cleaner Production and Eco-efficiency by developing strategies, undertaking research projects and funding proposals.

The Environment Protection Authority (EPA) is a statutory body responsible for protecting the beneficial uses of the air, water and land from the adverse impacts of wastes and unwanted noise in Victoria. The EPA utilises the Environment Protection Act 1970, State Environment Protection Policies, Industrial Waste Management Policies, and a range of tools including Best Practice Environmental Guidelines to help manage waste.

The EPA offers a range of incentives such as loans and grants aimed at increasing the uptake of cleaner production by industry. The Corporate Plan 1999-2000 notes that the EPA intends to embrace waste minimisation through the Packaging Covenant, cleaner production partnerships and revised prescribed waste regulations.

EcoRecycle is Victoria's peak waste management organisation. Their mission is to minimise the creation of waste, promote the sustainable use of resources, and better manage the disposal of residuals. Similar to the Federal and State Governments, EcoRecycle has also increased its focus on industrial waste reduction.

Metropolitan Regional Waste Management Groups. There are four Regional Waste Management Groups that represent the Melbourne Metropolitan region. These Groups have statutory responsibilities for waste management within their region, including the development of waste management plans.

Waste Management Plans must be submitted to the EPA for approval and must incorporate waste minimisation and resource recovery, waste collection, transport and disposal and the provision of future landfill capacity.

8.1.2 CURRENT POLICIES, PRACTICES, LEGISLATION AND CONVENTIONS

Commonwealth and State governments are promoting improved management of industrial waste through policies, strategies, education (for example the Waste Wise Program), cleaner production and eco-efficiency. The benefits of these programs and policies are to reduce the amount of waste produced and disposed of by industry through pro-active measures. Reduction of waste from industry also decreases the need to transport wastes, should facilitate longer operating times for landfill sites, and reduce the long-term need for prescribed waste landfills.

Commonwealth Department of the Environment and Heritage major waste management initiatives are:

- National Environment Protection Measures for the Movement of Controlled Waste – a collaborative project between NEPC and ANZECC.
- Living Cities initiative to support resource recovery centres.
- ANZECC released its Strategy - *Towards Sustainability - Achieving Cleaner Production* in May 1999. The Strategy establishes a framework for increasing the adoption of cleaner production in Australia.

(Department of the Environment and Heritage Annual Report 1998-99)

All States and Territories (other than NT), major business in the packaging chain, and some local government organisations have agreed to a voluntary National Packaging Covenant. The Covenant is based on the principles of 'shared responsibility' and 'product stewardship' and applies throughout the packaging process - from raw materials to retailers and ultimate disposal. A National Environment Protection Measure on Used Packaging Materials (NEPM) supports the Covenant. The Covenant places obligations on business and each state and territory to ensure implementation and ultimately a reduction in the use of raw materials, improved resource recovery and recycling. "Central to the Covenant is the implementation of a sustainable kerbside recycling system" (EcoRecycle Victoria Business Plan and Strategy 1999-2000).

Under the Victorian *Environment Protection Act 1970*, solid waste going to landfill in the metropolitan area, Mornington Peninsula, Geelong, Ballarat and Bendigo incurs a fee of $4 per tonne until 30 June 2002. In February 1999, the levy for hazardous waste going to landfill was increased to $10 per tonne to provide an incentive to reduce hazardous waste going to landfill.

In April 1998, the EPA released the new industrial waste strategy for Victoria*, Zeroing in on Waste.* It encourages businesses to adopt innovative approaches to reducing industrial waste and improving the management of residual wastes. In 1998 the EPA also released the draft SEPP for the Prevention and Management of Contaminated Land.

In June 1999, the EPA released the draft Industrial Waste Management Policy (Prescribed Industrial Waste) for public consultation. The policy focuses on avoidance and minimisation of prescribed industrial waste.

8.1.3 OTHER MAJOR STUDIES

The community has demonstrated clear opposition to traditional landfilling of hazardous industrial waste. A review of the management of industrial waste was completed in April 2000 in an attempt to address community concerns and to develop long-term options for the management and disposal of hazardous wastes (HWCC, April 2000). This report by the Hazardous Waste Consultative Committee makes a range of suggestions regarding the management and disposal of hazardous waste, and recommends a four to five year transitional period. The report does not consider "any potential sites for repositories, long term containment facilities or soil banks, but rather developed a set of criteria which could be applied through the planning process for locating such infrastructure" (HWCC, April 2000). The EPA has noted that in response to this Report amendments have been made to the Draft Industrial Waste Management Policy (Prescribed Industrial Waste).

A national survey on Life Cycle Assessment undertaken in 1998 by RMIT and the University of NSW on behalf of EcoRecycle and the Beverage Industry Environment Council (BIEC) concluded that the greater the recycling rate of households the greater the environmental benefits (EcoRecycle Victoria, Dec 1999). This study indicates support for the continuation of kerbside recycling. It is understood that a major study currently underway also notes that the environmental benefits of kerbside recycling are significantly greater than the financial cost.

The National Packaging Covenant has identified the need to ensure the efficiency and sustainability of kerbside recycling through assistance to local government to implement efficient

kerbside recycling systems in accordance with agreed service standards. With this objective in mind, EcoRecycle has recently completed the development of a *Guide to Preferred Service Standards for Kerbside Recycling in Victoria.* The standards will set a benchmark for best practice kerbside recycling for the next 5-10 years and will allow councils to adopt efficient and sustainable kerbside recycling systems for their communities.

8.1.4 TECHNOLOGICAL FACTORS

Waste and recycling collection systems are fast becoming more automated and more reliant upon technology. Mobile garbage bins are now the most common container for domestic waste collection. Efficient materials recovery facilities are being developed in order to extract high levels of resources from the waste stream (Chapman, 1999 and Golder, 1995). Since 1995 there has been a significant rationalisation of MRF's throughout Melbourne.

EcoRecycle's *Guide to Preferred Service Standards for Kerbside Recycling in Victoria* recommends a move towards mobile recycling bins in outer areas of Melbourne and in provincial and major rural cities. In the inner urban areas of Melbourne, where vehicle access to automated bin lift vehicles may be limited, the standards have recommended the addition of a crate for paper, to increase yields and amenity of residents and to minimise Occupational Health and Safety Issues within the waste management service industry.

8.2 DATA AND TRENDS

Data collection has improved over recent years and had been particularly enhanced by the installation of an increased number of weighbridges at landfill sites. Significant improvements have been achieved in waste management at the municipal level but green, organic, commercial and industrial waste requires attention in order to reduce the amount of waste being deposited at landfill. Many municipal councils, in conjunction with Regional Waste Management Groups and private industry have undertaken various trials for collection and recycling of green and organic waste and many local government's have introduced regular collection of green waste material.

According to the EPA there has been a slight decrease in the amount of solid waste going to landfill from the Melbourne metropolitan area since 1992/93. Note in Figure 41 that data for 1997/98 and 1998/99 includes waste for all Victoria.

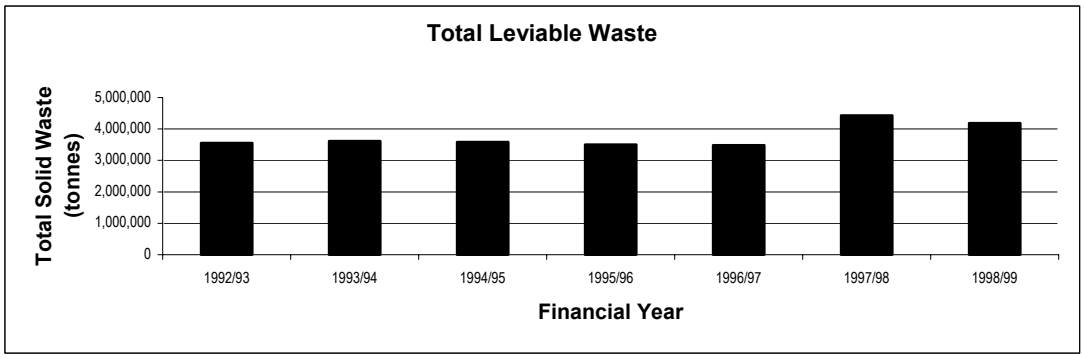

FIGURE 41. TOTAL WASTE DISPOSED OF TO LANDFILL IN VICTORIA.
Source: Victoria, March 1998, EcoRecycle Victoria Landfill Statistics.

According to the 1998 BIEC/EcoRecycle Recycling and Garbage Bin Analysis household garbage stream and recycling stream is increasing, however the overall diversion rate (amount of household waste diverted to recycling) is marginally decreasing.

Figure 42 illustrates the estimated total amounts of material collected for recycling in Victoria between 1993 and 1997. EcoRecycle explains that the decrease in the *collected* recycled materials 1997/98 can be attributable to the steel industry processing considerable amounts of material in 1996 stockpiled from previous years.

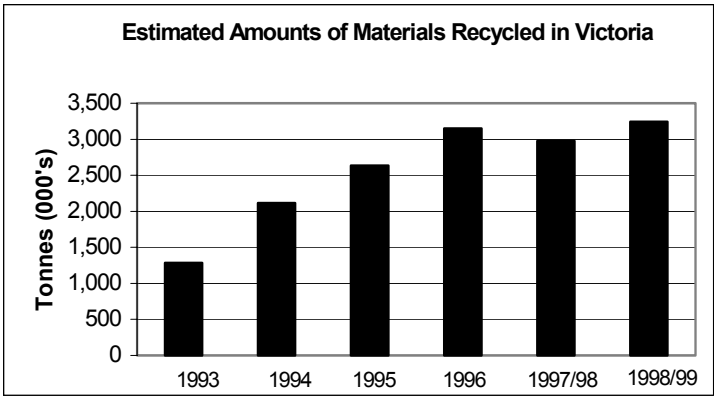

FIGURE 42. QUANTITIES OF MATERIALS COLLECTED FOR RECYCLING IN VICTORIA.
Source: Salmon Consulting, Annual Survey of Victorian Recycling Industries, 1999.
Further analysis of the data in Figure 42 is provided in Table 16.

The following table illustrates details of the trends in recycled materials by major categories. Recycling levels have increased for ten categories. The most notable decreases are in food waste, aluminium, non-ferrous metals and plastic. EcoRecycle note that analysis is required to further understand the results of the data that were obtained from relevant industries and industry associations. It was also noted that data is subject to the receipt of completed returns from the recycling industry, which can vary on a year-to-year basis.

GREEN ORGANIC WASTE

Facilities composting green waste have the potential, if not properly managed, to emit odours, dust, discharges to stormwater, leachate, groundwater and soil pollution. Composting facilities, in particular large scale facilities, producing more than 10 tonnes of compost daily, are required to adhere to the Environment Protection Act 1970, related State Environment Protection Policies and Environmental Guidelines for Composting and Other Organic Recycling Facilities. Inappropriate composting techniques can also lead to the spread of plant pathogens, pests and weeds (Institute of Horticultural Development, 1997).

Table 16 shows the estimated amounts of material recycled in Victoria.

RECYCLABLE MATERIAL	1993	1994	1995	1996	1997/ 1998	1998/ 1999
Aluminium		40	38	45	9	12
Asphalt			10	19	125	371
Brick & Brick Rubble		45	130	102	126	271
Cardboard/Other Paper	277	245	397	469	382	271
Newsprint	63	75	85	84	139	137
Concrete	300	450	550	748	834	899
Food Waste		400	400	531	316	146
Garden/Green Waste	95	95	199	152	183	120
Glass Containers		111	110	111	110	158
Non-Ferrous Metals		60	57	120	20	21
Packaging Steel					10	10
Plasterboard			6	10	20	27
Plastic	36	42	43	44	53	10
Rubber	20	20	16	15	25	77
Sawdust						8
Seaweed		16	18	11	23	33
Sheet Glass		12	12	15	14	10
Steel	492	492	540	630	540	503
Textiles & Clothing			13	30	19	10
Timber		10	10	12	30	148
Totals	**1,283**	**2,113**	**2,634**	**3,148**	**2,978**	**3,242**

TABLE 16. ESTIMATED AMOUNTS OF MATERIAL RECYCLED IN VICTORIA.
Source: Salmon Consulting, Annual Survey of Victorian Recycling Industries, 1999

Accurate figures on the amount of organic waste generated are unavailable, however, an audit in 1999 indicated that approximately 184,000 tonnes of green organics were handled by local government (Deni Green, 1999), whereas a study in 1996 by Krstic, noted that in the South East Region alone between 100,000 and 165,000 tonnes of green waste is generated annually.

The most significant impediment to the reprocessing of organic waste is the availability of adequate and sustainable markets for the end product. Considerable research and trials have been undertaken and EcoRecycle are currently developing a green waste action strategy.

PRESCRIBED WASTE

Prescribed waste includes solid and liquid wastes. Classification of prescribed waste is set out in the *Environment Protection (Prescribed Waste) Regulations 1998*. The final report of the HWCC (2000) "recognise that there will still be hazardous wastes generated for the foreseeable future. These must either be safely stored (pending reclamation) or consigned to well located, designed and operated long term containment facilities…"

Figure 44 indicates that between 1995 and 1998 there was an increase of 54,294 tonnes of prescribed waste generated in Victoria.

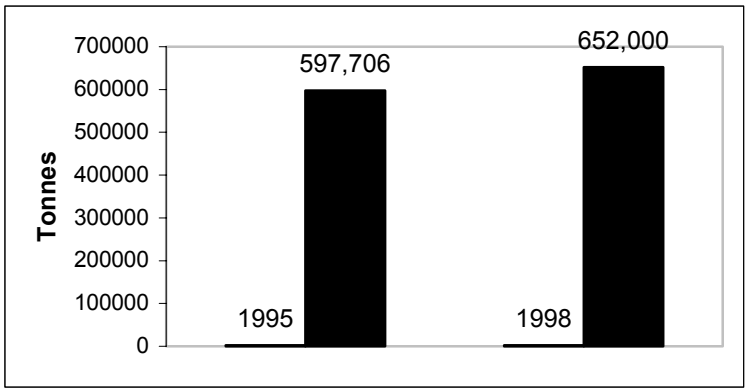

FIGURE 44. PRESCRIBED WASTE GENERATED IN VICTORIA
Note: Excludes waste discharged to sewer; 1995 data includes 54,000 tonnes of contaminated soil; 1998 data includes 72,000 tonnes of contaminated soil
Source: Prescribed Wastes Generated in Victoria (Hazardous Waste Consultative Committee – Discussion Paper No 1, pp 8-9).

8.3 SCENARIOS

Under the "business as usual scenario":

a) Victoria faces a range of significant issues regarding the transport, handling, storage and treatment of prescribed waste.

b) Prescribed waste transport and storage will continue to generate concern in the community as existing facilities will require additional transport through sensitive residential and commercial areas.

c) The slow rate of reduction in waste being deposited at landfill means that traditional landfills will be required for many years to come.

d) Organic, commercial and industrial waste will continue to take up an excessively high proportion of landfill space.

8.4 ISSUE IDENTIFICATION

PRESCRIBED WASTE

The increase in hazardous waste generation between 1995 and 1998 highlights the need for both eco-efficiency within industry and plans for future repositories, long term containment facilities or soil banks.

At present prescribed waste is required to be disposed of at the Tullamarine facility or at the Pacific Waste landfill at Lyndhurst. It is anticipated that the Tullamarine facility will close within the next 12 months (HWCC, 2000). The anticipated lifespan of the Lyndhurst landfill is 9 years, taking into account the closure of the Tullamarine landfill.

In 2001, all prescribed waste will be required to be transported to Lyndhurst, unless, in the unlikely event, that other facilities are operational. Attention is urgently required to address transportation, as large proportions of the waste shall require transportation from the Western suburbs to Lyndhurst. Vehicles carrying prescribed waste are not permitted in the City Link tunnel, therefore further exacerbating transport problems in residential and commercial locations.

HWCC (2000), noted that the relatively low cost of disposing solid prescribed waste to landfill, (currently around $70 per tonne) is “the single major impediment to innovation” such as re-use, recycling or energy recovery. The HWCC anticipate that any new, highly engineered facility for prescribed waste will result in substantial increases in waste disposal costs.

The HWCC report recognised "that there will still be hazardous waste generated for the foreseeable future. These must be safely stored (pending reclamation) for consigned to well located, designed and operated long term containment facilities…"

BUFFERS FOR PRESCRIBED WASTE FACILITIES

The HWCC (2000) recommends, “That for any future hazardous waste facility, a system of concentric buffers be adopted and protected by a planning overlay:

- a core in which no land use other than a compatible hazardous waste facility will be permitted and which must be owned or controlled by the facility operator;
- an inner zone within which there will be no sensitive uses permitted, and,
- an outer zone that offers relevant levels of protection to sensitive land uses and which may limit other land uses or development”.

CONTAMINATED SOILS

In 1998, almost 35 per cent of the hazardous waste sent to specially engineered landfills was contaminated soil (HWCC, 2000). A significant proportion of these soils are deemed to contain low levels of contaminants. The EPA has indicated that over the next 3 – 5 years up to 1,000,000 m^3 of contaminated soils will potentially be generated; the majority is expected to come from major central city development sites. The HWCC makes numerous recommendations regarding the management of low level contaminated soils, of particular note are their recommendations to aim for best practice utilising remediation; both on site and at suitable soil remediation facilities. These processes should reduce the pressure on prescribed waste landfills, although remediation is considered to cost between $80 to $200 per tonne compared with current $20 to $60 per tonne cost to landfill contaminated soils.

PROJECTIONS

Minimal data is available on which to base projections, however existing data indicates:

- increase in the quantity of contaminated soil over next couple of years;
- minimal decrease in waste going to landfill;
- slight increase in recycling rates; and
- continuing increase in the generation of prescribed waste.

LANDFILL SITES

Victoria currently has ample landfill and this keeps landfill charges low when compared to other parts of Australia and other developed countries. The availability of landfill minimises pressure on landfill operators to implement best practice (Environmental Futures Forum, Landfill, September 1998). The most significant constraint for future landfills is the availability of *suitable* space.

The Eastern Regional Waste Management Group (Eastern RWMG) appears to be the only metropolitan region that has insufficient suitable landfill space within its own region and needs to utilise landfill in other regions. To address this situation the Group focuses on providing and operating transfer stations, actively encouraging composting and resource recovery in order to reduce waste and transport costs.

The Western RWMG note that they have ample existing landfill space for the next 50 to 60 years. The Northern RWMG opened a new landfill site in June 2000. This site has an expected life span of 100 years. The South Eastern RWMG estimates that the Clayton/Springvale area contains enough landfill airspace to last another 11 to 16 years. It is anticipated that a transfer station will be required to consolidate and compact council handled waste prior to transport to landfills in the Baxter area.

The location and management of landfill sites are contentious issues particularly in relation to prescribed waste facilities. There is a continuing need to carefully plan for buffer distances and transport routes for any proposed new landfill or other waste storage or treatment site.

In summary, there appears to be adequate available and accessible landfill space for most regions. Transfer stations and Materials Recycling Facilities (MRF's) are being utilised and developed to address resource recovery needs of the regions. Over the past three years, EcoRecyle has provided over $10 million in funding to establish a network of best practice transfer stations and resource recovery facilities throughout Victoria. Therefore, with the exception of prescribed waste, transporting waste over excessively long distances is not considered to be a major concern in the foreseeable future.

DOMESTIC AND NON-HAZARDOUS INDUSTRIAL WASTE

During recent years there has been an increased recognition of the need to address industrial waste minimisation through eco-efficiency and cleaner production. Residential kerbside garbage

and recyclable collection are well established systems with high participation rates. Technological enhancements to the collection and sorting of recycled materials continue to be pursued. The National Packaging Covenant provides a mechanism for future sustainability.

Transfer stations are provided in each Metropolitan Regional Waste Management Group (MRWMG) area. In 1995 fourteen transfer stations serviced the Greater Melbourne.

As all MRWMG's are planning for additional waste transfer stations, it is anticipated that as increased yields from recycling and green waste programs are realised that the locations, operation and function of transfer stations and MRF's could develop into regional resource recovery centres (Golder, 1995).

- In 1992 the Victorian State Government set a target to reduce waste deposited at landfills by 50% by the year 2000.
- According to the 1998 BIEC/EcoRecycle Victoria Recycling and Garbage Bin Analysis household garbage stream and recycling stream is increasing, however the overall diversion rate (amount of household waste diverted to recycling) is marginally decreasing.
- Data collection has improved over recent years.

8.5 BEST PRACTICE

TRANSFER STATIONS AND MATERIALS RECYCLING FACILITIES - BEST PRACTICE

It is considered by EcoRecycle that in relation to transfer stations and materials recycling facilities that Melbourne is already operating at best practice levels.

HCCC RECOMMENDATIONS

The following is a summary of recommendations made by HCCC that reflect best practice:

- retrieval repositories and long-term waste containment facilities be phased in over the next three to five years;
- one or more repositories be designed to take those prescribed wastes for which retrieval possibilities are seen to exist;
- one, or a small number, of long-term waste containment facility(ies) as an alternative to current prescribed waste landfills – designed to best practice standards and utilising the most advanced monitoring technologies; and
- that the determination of the suitability of potential sites be achieved in accordance with the criteria and assessment factors identified in the report (detailed Primary Exclusion Criteria, Secondary Exclusion Criteria and Generic Assessment Factors are included in the report).

8.6 POLICY OPTIONS

- The Metropolitan Strategy should consider the need for land to be set aside for landfills, transfer stations, containment facilities and soil banks in strategic locations that minimise disturbances to residential areas and provide for transport routes that take into consideration economic, social and environmental impacts.

- The impact of transporting prescribed waste through residential and commercial areas from the Western Suburbs should be considered, particularly as these vehicles are unable to travel in the City Link tunnel.

- A decision is urgently required on future design and siting of hazardous waste retrieval repositories and long-term waste containment facilities.

- The Victorian Auditor-General's Office report on *Reducing Landfill: Waste management by municipal councils*, contains a range of recommendations including:

    - improved data collection;
    - more attention to be focused on commercial and industrial sectors;
    - improved accountability for regional waste management groups/plans; and
    - waste management policy and objectives to be clearly articulated and supported by measurable targets.

- It is anticipated that through the implementation of cleaner production practices and other related best practices such as waste exchange facilities, the quantities of commercial and industrial waste will be further reduced. However, industrial waste minimisation remains voluntary and should be supported by substantial financial incentives, effective marketing and education, legislation and significantly increased disposal costs.

- Consideration could be given to the development of an overarching strategic waste management plan to facilitate the integration of waste management for the whole of the Greater Melbourne Area.

- Management of landfills should aim at best practice in the areas of:

    - containing and treating leachate;
    - capturing and utilising gas emissions;
    - capping and rehabilitating spent landfill sites;
    - odour control through management practices; and
    - buffer zones.

- Improved performance and accountability is needed for regional waste management plans and for specific industry agreements.

9. URBAN DEVELOPMENT MODELS

Any study of environmental issues and their impact on metropolitan strategies must move beyond a study of urban habitat and ecology to an examination of the energy use - including transport energy use - associated with different models of urban form.

Williams, Burton and Jenks (2000:7) argue that "to realise the 'sustainable city' there has to be a clear and common-held concept of what it will look like, how it will function, and how it will change over time". There is general consensus on the various alternative models of urban form. The following models are adapted from those presented by Minnery (1992), Banister (1992), Newton (2000), Loder and Bayly (1993), and many other commentators. These are broadly the categories outlined in the Land Use Planning section in Chapter 3 Urban Air Quality.

Compact city (conventional consolidation):
Intensification of population and activity through infill development and higher density housing anywhere in a metropolitan area, but particularly in inner and middle ring suburbs.

Compact city, or multi-node city (traditional neighbourhood, or urban village, development):
*I*ntensified development of mixed use, higher density areas within 400 metres of a public transport location, with increased street connectivity, in both the existing metropolitan area, and in new development areas on the urban fringe.

Dispersed city (business as usual, fringe or edge city):
Low density development of detached housing and separated single uses in car dependent suburbs, with retail and commercial development concentrated in vehicle oriented regional nodes linked by freeways or major arterial roads. This type of development occurs in extending outer suburbs, usually without greenbelts.

Corridor city:
Urban development is channelled into a number of linear corridors following public transport routes and separated by rural green belts (or "wedges"). Development can be compact or dispersed in corridors.

Decentralisation and new towns (ultra city):
Housing and employment located in existing small towns, regional towns, or newly constructed towns outside and separated from the metropolitan area.

9.1 PREVAILING TYPE AND LOCATION OF DEVELOPMENT

Australia is one of the world's most urbanised countries. Over 60 per cent of Australians live in metropolitan areas of over 100,000 people and 40 per cent live in the two biggest cities, Sydney and Melbourne. About two thirds of population growth is occurring in the five metropolitan capitals (Armstrong et al, 1995: 40). The Australian Urban and Regional Development Review (Wettenhall, 1994) estimated that the post war spread of Australian cities exceeded one million hectares and cost $4.2 - $5 billion annually compared to the $3 - $5 billion invested annually in new manufacturing plant and equipment.

Unlike many European and British cities, high density housing has not been constructed on the urban fringe of Australian cities. The development model generally followed is one of low density allotments and detached housing. No particular regard is usually given to public transport access, energy efficient design, water conservation and reuse, or integrated uses. The Australian Urban and Regional Development Review report *Green Cities* (Armstrong et al, 1995) identified a "rigid conservatism" in greenfields subdivision design based on car use usually far from public transport, a standard hierarchy of roads culminating in courts, restricted access and movement inside and from the subdivision, and separated uses. Housing type and orientation was dictated by subdivision layout, especially the street, and lot size with little real housing variety or opportunity for energy efficient housing. *Green Cities* concluded that this prevailing pattern determined consumer expectations of layout and housing type and reinforced conservative attitudes by the development industry of what will sell. Market choice was "locked into a conservative and mutually reinforcing set of seller and buyer expectations".

9.2 THE TREND TO DISPERSAL

Most new housing in Australian cities still consists of conventional detached housing in new suburbs on the urban fringe (Minnery and Barker 1998, Buxton and Searle et al,1997). Approvals for Melbourne's inner and middle ring suburbs have totalled about 10,000 a year compared to 15,000 in outer and fringe area suburbs (Department of Infrastructure, 1998).

Despite the potential of urban form to affect energy use and reduce car dependency, political and market forces have assisted the dispersal of key city elements such as housing, office, retail and service facilities. This dispersal is likely to be aided by urban freeways. Freeways and suburban expansion of office and retail facilities are increasingly likely to determine the form and functioning of cities, reversing the traditional land use control of infrastructure requirements. Decisions on these issues in the next five years are likely to decide the future.

O'Connor and Stimson (1994,1996) and McKenzie (1996) argue that the capital city of Melbourne should no longer be seen as a single centred but as a multi centred metropolis functionally connected through an ever widening commuter belt. Brotchie (1992), Brotchie et al (1993, 1995), O'Connor (1992, 1994, 1998), and O'Connor and Stimson (1994, 1996) identify elements they believe are associated with dispersal: central city employment is proportionally declining, manufacturing has relocated to outer suburbs, employment and housing have dispersed, and outer urban population grown. This has led, they argue, to dispersed commuter patterns with shorter circumferential trips within the outer suburbs replacing longer radial trips to the central city and leading to lower work trip times.

To O'Connor and Brotchie the transition to an information and global economy favours regionally self contained suburban areas. This model is based on increased urban productivity through decentralised multi functional suburban and industrial centres integrating production through a connected freeway system.

There is a long history of opposition to urban consolidation in Australia by governments, planners, communities, academics and the development industry. Stretton (1996) and Troy (1992, 1996) argue in favour of conventional detached housing on relatively large lots on an

extending urban fringe and criticise the arguments for consolidation on environmental, economic, equity and lifestyle grounds. These and other critics such as Kirwan (1992, 1992a) often argue on economic grounds that urban consolidation will not reduce housing or land costs, or that the infrastructure costs of conventional fringe area subdivision have been exaggerated. Stretton and Troy claim that infrastructure costs associated with new housing on the fringe should be compared with the costs of expanding existing infrastructure capacity needed to cater for increased densities, although there is little evidence of insufficient capacity.

9.3 SELF CONTAINED NEIGHBORHOODS

Self contained neighbourhoods are higher density mixed use suburbs with high local employment. These suburbs provide the potential for greater substitution of walking and cycling for mechanised travel to gain access to local services, and for public transport as a substitute for car-based travel for long trips (Katz, 1994; Kaufman and Morris, 1995; Newman and Kenworthy, 1992). The success of this approach is contingent on land use and transport being developed and utilised in a mutually supportive way.

This concept is being proposed in Australia and other countries in the following ways:

- existing metropolitan areas would be redeveloped by revitalizing higher density inner urban areas through infill, use of shop top housing and conversion of existing buildings, and by rebuilding suburban centres around transit stations in the form of higher density mixed use urban clusters with a high degree of street connectivity
- new outer suburban “greenfields” sites would be designed using the same principles of transit oriented, medium density, mixed use development with high street connectivity

9.4 AVERAGE LOT DENSITIES ON THE URBAN FRINGE

Some states have attempted to impose or encourage higher densities on the urban fringe. The Victorian government used a Ministerial Direction in the early 1990s to require a minimum lot size of 15 lots per hectare, but this was removed in 1993. The Queensland SEQ2001 regional framework proposes a 15 lot per hectare average dwelling density, a 50 per cent increase. Detached housing on single lots would continue to dominate but urban expansion would be reduced to 60 per cent less than previous trends to the year 2011.

The New South Wales government is also seeking to increase density on the urban fringe as a means to help achieve more compact cities. The New South Wales government is planning for an increase in multi unit housing in Sydney as a proportion of new dwellings from forty two per cent in 1995 to sixty five per cent by 2001. At the same time, this government is planning to increase the dwelling density on the urban fringe from the current 11 per hectare to a modest 15 by the year 2011 (Holliday and Norton, 1995). Dwelling density figures for urban release areas in Sydney show an increase in average net residential density from 11.6 dwellings per hectare in 1992, to 12.09 in 1996.

9.5 THE EFFECT OF URBAN CONSOLIDATION ON FRINGE AREA DEVELOPMENT

The construction of medium density housing in established metropolitan areas can also reduce the spread of cities on greenfields sites on the urban fringe. Urban consolidation is typically defined as an increase in population and/or dwellings within an existing urban area (Roseth, 1991), or the fullest use of an existing urban area (Lock, 1995). Intensification refers to both built form and activity. Intensification of built form is occurring in two ways:

- firstly, incremental redevelopment of existing housing and reuse or demolition of other buildings such as on former industrial sites is occurring
- secondly, many large urban developments occur on greenfield sites on government owned land such as former school sites and mega developments such as dockland redevelopment projects, or on private land through, for example, demolition of industrial buildings

The Victorian state government has identified 620 redevelopment sites with a potential yield of 60,951 dwellings (Department of Infrastructure, 1997). By 1996, new housing starts on the urban fringe in Melbourne had fallen to fifty per cent of the total down from eighty per cent in 1994 (Maclellan 1996). Other Australian governments have also moved to identify suitable redevelopment sites. For example, in Sydney, 487 hectares are being redeveloped in the inner south for eventual resident and workforce targets of 20,000 (Spiller Gibbons and Swan, 1998). Medium density housing therefore seeks to provide greater diversity of housing choice both in established areas and on the urban fringe, better match house size and type with individual and community needs, increase the supply of affordable housing, help limit outward urban growth, and reduce the wasteful use of infrastructure (DPD, 1995, 1).

Urban consolidation policies have led to a reversal of the loss of population from inner and middle ring suburbs and an increase in medium density housing in Melbourne (Reynolds and Porter, 1998). It has also reduced the outward spread of Sydney and Melbourne, but has less impact in other Australian cities. Urban consolidation in Sydney has accounted for a high proportion of new housing starts and this is projected to increase to 65 per cent by 2001. This development is relatively transit oriented with 75-80 per cent of the recent population increase in the middle and inner ring suburbs of Sydney within one kilometre of a rail station. The proportion in the inner and middle ring suburbs of Melbourne has been even higher at over 90 per cent. In Sydney, a significant shift has occurred in dwelling approvals towards central locations since 1990 with inner areas accounting for about 25 per cent of all new housing construction. In the South Sydney area alone, 4,750 new dwellings were built between 1993-97 and 6,350 in the central city area (Spiller Gibbons and Swan, 1998).

A Brisbane City Council task force in 1991 showed the potential for reversing inner city population loss. It recommended a range of mixed use and medium density housing projects in four inner suburbs to address the 13 per cent population fall from 1976-91 and raise the population from 12,000 to 30,000 people (Brisbane City Council, 1992). A substantial increase in the building of apartments in these areas has occurred although between 1991 -96 only one inner suburb reversed the population loss and that by only 917 people (Minnery and Barker, 1998).

9.6 URBAN FORM AND ENVIRONMENTAL BENEFITS

Urban form refers to the generalised shape of an urban region and the disposition of its major components (Brunton, Brindle, 1999). It is represented commonly by population density, land use types and the degree of land use mix, but other characteristics include subdivision and building design, transport patterns, and infrastructure provision.

It is generally accepted that urban form affects the way cities function and can lead to social, economic or environmental benefits or problems. Manipulating land uses and forms, in particular the shape, size, density and uses in cities, is seen widely as a way to promote environmental benefits. Conversely, the physical form of cities has led to serious environmental, social and economic problems. Urban sprawl has led to the spread of cities into valuable agricultural land, the loss of habitat, and off site impacts particularly on waterways and estuaries. Cities have become increasingly dependent on private vehicles with increases in travel times, congestion, and air pollution. Melbourne has not experienced the downgrading in importance of the central city core characteristic of many cities in the United States, or the flight of the middle classes to the suburbs. However it did experience a dramatic loss in population from the inner and middle ring suburbs to the outer suburbs.

Australia's high per capita energy consumption, low urban densities and high levels of road use make major contributions to very high per capita carbon dioxide emissions. Per capita motor vehicle travel is about 20 per cent higher than the OECD average (ABS 1994, OECD 1994). The Australian National Greenhouse Gas Inventory has shown that over one quarter of Australia's greenhouse gas emissions arise from urban non-transport energy use and 12 per cent from transport use. All transport accounted for 25 per cent of Australian sectoral CO_2 emissions from energy use in 1990-91, with road transport making by far the highest contribution at 76 per cent of the total transport emissions in CO_2 equivalent terms (NGGIC, 1996, BTCE, 1995).

The concentration on urban form as a way to achieve environmental benefits such as energy savings has been disputed. Stretton (1996) has suggested that because energy savings of only 6-7 per cent are possible through extensive changes to urban form and reducing car travel other measures may be more cost effective. Similarly, Morris (1993, pp.147-9, 158-9) argues that since road transport worldwide contributes less that 5 per cent of anthropogenic greenhouse gases, their reduction "will have far reaching economic and lifestyle implications and will make only a small contribution to the global problem". Others however, derive different conclusions by concentrating on vehicle energy savings in the context of total potential urban savings. Pears (1995, 1995a), for example, estimates that when emissions from waste and some other production of materials for urban infrastructure are included almost half of Australia's total greenhouse gas emissions and two thirds of emissions from energy are generated in urban areas or through energy conversion for urban use. Barton (1990) has estimated that up to 70 per cent of delivered energy is subject to the influence of land use planning. The contribution of Australian cities to transport emissions can be seen from the fact that seventy per cent of national road transport kilometres occur in urban areas (Wilkenfeld, 1995).

9.7 COMPACT CITY MODELS

Williams, Burton and Jenks (2000:7)) argue that "until fairly recently, there was some consensus - although there was also considerable scepticism - that compact urban forms offered the most sustainable future". "First wave" research pointing to the benefits of the compact city relied on U.K. work including the ECOTEC (1993) study of an urban area and into choice of transport mode to local and other centres, carried out for the Department of Environment and the Department of Transport, and Rickaby's (1987) study of alternative settlement patterns using integrated land use/transport models predicting that changes in planning policy will affect the distribution of population and employment. The work by Australians Newman and Kenworthy has also supported the arguments in favour of compactness. There has also been support for the compact city in the U.S. Van and Senior (2000) have assessed the U.S. research where there has been a more extensive study of the impacts of mixed land uses on travel and a greater interest in New Urbanism.

A gradual consensus emerged that compact cities emphasising higher density mixed use urban form, offered the best environmental, social and economic future. The benefits claimed included reduced car travel and emissions, lower infrastructure costs, more varied and intensified social activities particularly those associated with the public realm, protection of countryside, better access to services, and a range of claimed benefits relating to quality of life. These benefits were strongly contested (Breheny 1992, Troy 1992). Some commentators also claim that many of the arguments supporting these alleged benefits "have been derived from assertion and theory" (Williams 2000:30).

"Second wave" research has now been published. This analyses various elements of urban form including density, compactness, concentration, dispersal, mixed uses, housing type, or reviews earlier work, such as Newman and Kenworthy's, examining the validity of conclusions, statistical methods used, and the possibility of the impact of variables other than urban form, such as fuel price. This empirical or statistical work into the general compact city model should be differentiated from other studies with stated or implied criticisms of urban consolidation, such as the studies by O'Connor and Brotchie into dispersal factors and trends, or work based partly on different ideological or other value based positions, such as the work of Troy and Stretton.

This "second wave" research tends to support the original conclusions, although not with the same emphasis, and while pointing to complexities and the effect of variables other than urban form. In particular, the reciprocal impacts of land use and transport are still contentious. Unambiguous conclusions are hampered by the complexity of land use and transport patterns, and are affected by values and ideological positions. Current knowledge is based on models, empirical comparisons of different land use patterns and is added to by some recent studies.

The main elements of the debate over the interaction between urban form and transport are outlined below.

9.8 DENSITY AND TRAVEL

There is still considerable debate over whether urban population and employment density independently affect travel demand and modal choice. A wide range of studies suggest the

importance of urban density in reducing travel demand and that transport energy use falls as dwelling density increases (Owens, 1986). Some of this work has been criticised, including Newman and Kenworthy's claims made on the basis of inter city comparisons that transport fuel consumption rises as densities fall below about 30 persons per hectare. Common criticisms of Newman and Kenworthy's work are that income, car ownership, or fuel price are more important factors than population density in determining private vehicle use (Kirwan, 1992, Pucher, 1990).

9.9 MIXED USES

There are also conflicting views about the impact of mixed uses on travel demand. Some studies suggest that mixed land uses may increase vehicle use (Webster et.al. 1988). A number of commentators have argued that generally accepted beliefs that intensified urban form can reduce traffic and affect travel patterns are simplistic and that intensification is only one element to be considered (Breheny, 1995, Handy, 1994). Van and Senior (2000:141) comment that there is "increasing specticism about the strength, and even the existence, of the impacts of land use diversity on travel behaviour". However their research found that land use mix affected some transport decisions, and that car use for commuting declines as land use mix increases. In the U.S studies, Ewing et.al (1994) found significant differences in travel behaviour between residents in higher density mixed use, and low density areas. Frank and Pivo (1994) and Cervero (1996) found that mixed uses affected commuting behaviour.

However, a general picture emerged by the early 1990s that redeveloped mixed use activity areas around public transport modes within existing cities, in preference to outer urban fringe area development produce transport savings (Banister, 1992, ECOTEC 1993). Winter and Farthing (1997) report that the provision of local facilities with new residential developments reduces average trip distances but may not significantly affect foot journeys. ECOTEC (1993) reported a clear relationship between the distance from a local centre, the frequency of vehicle use and average journey distance. Hanson (1982) reported similar findings.

There is considerable research to indicate that density and land use mix are both related to modal choice and that as these increase, transit usage and walking rise while single occupant vehicle use falls. Increasing this level of land use mix at trip origins and destinations achieves the same results (Frank and Pivo,1994). Localization of employment and services, accessibility and high quality public transport are critical variables affecting results of studies. For example, higher density centres without these factors may lead to an increase in cross town vehicle use.

It is sometimes argued that the conventional consolidation model may lead to increased vehicle use, congestion and emissions particularly in inner city areas. In particular, medium density single use housing dispersed anywhere in a city, not linked to policies discouraging vehicle ownership and use (such as car parking limitations and other measures) or the provision of alternatives to cars (such as improved public transport) is said to encourage car use. This argument also proposes that under this compact city model, air quality could be adversely affected through higher peak concentrations of primary pollutants.

Chapter 3 Urban Air Quality evaluated evidence that this compact city model of consolidation across a metropolitan area showed the highest exposure to air particles, but this was due to the greater population concentration. Even the corridor city model performed far better than the

dispersed or fringe city and its business as usual scenario on photochemical smog, particles, and emissions.

Newton (2000) also has pointed to the strong comparative environmental performance of compact city forms. He evaluated the urban environmental performance of six urban development scenarios involving different types of compactness, dispersal and corridor development. He concluded that the compact city was the most fuel efficient of all urban forms with 43 per cent less fuel consumption than business-as-usual, or laissez-faire, low density, dispersed development. The compact model delivered the lowest output of carbon dioxide emissions due to greater use of public transport and fewer vehicle kilometres travelled, with emission savings of 11,500 tonnes each day. Greater compactness also resulted in lower pollutant emissions for VOC, oxides of nitrogen, Carbon monoxide and Sulphur Dioxide. A corridor model in 2011 would deliver a 55 per cent improvement over the base situation for 1991. In contrast, business as usual development would result in an increase by 71 per cent in the population exposed to smog at levels above those considered appropriate by current Air NEPM standards.

9.10 URBAN FORM AND TRAFFIC

A range of empirical studies have investigated the relationship between urban form and travel patterns in a variety of localities. The original ECOTEC (1993) study estimated that transport emissions could be reduced by 16 per cent through land use policies and other measures. Rickaby (1987) forecast that centralisation of population and employment would reduce travel distances by about 21 per cent. This suggested that large increases in recentralisation are needed for large decreases in road use.

Williams (2000) and Simmonds and Coombe (2000) point to the complexity of travel patterns in relation to employment and shopping, and argue that while intensification can lead to better access to some local employment, intrazonal commuting can lead to traffic increases. Simmonds and Coombe (2000) conclude that a more compact land use strategy may reduce traffic in localities, but on its own is unlikely to reduce travel demand or car use across a city. Another study by Titheridge, Hall and Banister (2000) found that intensification resulted in the smallest increase in travel compared to three dispersal policies and the lowest increase in energy consumption and emissions. Masnavi (2000) found significantly lower car use in high density mixed use areas compared to low density single use areas, and calculated that the compact city model can reduce use of private cars by up to 70 per cent, and reduce the distance travelled for non-work trips by 75 per cent compared with low density single use urban form, although did not necessary lead to increased use of public transport. He argued that higher densities alone may have little affect, and that a combination of higher density and mixed uses promoted sustainability best. These conclusions are similar to those of the Victorian *Greenhouse Neighbourhood Study* (see below).

9.11 IMPACTS OF TRANSPORT INFRASTRUCTURE

Transport infrastructure continues to affect land use. For over twenty five years it has been commonplace to point to the self defeating impacts of freeway construction encouraging vehicle

use ultimately to the point where the capacity of the new roads is exceeded and congestion becomes endemic. The U.K. *Royal Commission on Environmental Pollution, Transport and the Environment* (1994) reviewed evidence which analyzed the impact on land development of the M40 motorway from London to Oxford, and outer ring roads such as the London orbital motorway, the M25. The M40 opened up access to land which was developed contrary to the approved development plan. Traffic generated by new developments "added to highway problems and brought forward the need for further improvements to the road network".

The Commission evaluated modelling which showed that outer ring roads encourage car-based decentralization of employment particularly service and retail (1994).

Between 1989 and 1991, an estimated 26 million square feet of offices (enough for 160,000 workers) were completed in the districts surrounding the (M25); and in 1993 some 50 million square feet of office space were awaiting construction or planning permission… Such development generates traffic and undermines the strategic purpose of the road; the traffic generated will cause greater congestion than had been expected, and thereby reduce the achieved time savings to less than had been assumed when calculating whether road constructions was justified.

9.12 SUMMARY: INTERNATIONAL STUDIES

In conclusion, U.K. and U.S. studies generally point to the environmental, social, and economic benefits of a multi nodal city with consolidation applied selectively around mixed use activity centres linked to high quality (including high frequency) reliable public transport. These changes to urban form need to be linked to other measures aimed at discouraging car travel, such as residential, commercial and retail car parking restrictions, pricing measures, traffic restrictions, and ultimately perhaps restrictions on car use. Such other variables may be also important influences on the amount of vehicle use. Variables such as the accessibility and availability of high quality public transport and the localisation of employment and services may exert powerful reinforcing impacts on each other. There is evidence also that high quality public transport can reduce car use independently of urban form (Mees, 2000).

Locational factors are not the only type of variables which influence the type of transport use. Fuel pricing and demographic characteristics may also be important. Studies report that with increasing income, trip frequency increases (Hanson, 1982), as do commuting distances (Cervero, 1996) and overall transport energy consumption (Naess, 1993). Other studies report that total travel distance correlates positively with car ownership (Naess and Sandberg, 1996), that car ownership increases as the distance from the city centre increases (Mogridge 1985, Naess and Sandberg 1996). Car ownership tends to be lower in the inner areas of many larger cities, although this can depend on income levels, urban form, and public transport quality. Chapter 3 Urban Air Quality, and Chapter 4 Greenhouse Gas Emissions and Energy Efficiency, have shown that typically households in inner suburbs of Melbourne and Sydney own fewer cars per capita than households in the outer suburbs and the Melbourne average, and are less likely to use them to travel to work.

A high proportion of the recent increase in medium density development in the inner suburbs of Melbourne has been located within 400 metres of a public transport stop. However, new mixed

use developments are rare and there are few examples of measures designed to limit car ownership and use. Increased public transport use is not encouraged. It is likely that the absence of these other factors, the increase in medium density development has not led to a major increase in public transport use and may have added to private vehicle use in the inner city areas. Most of Melbourne's new medium density development has been targeted at medium to high income levels, and car use may be higher for these groups in the absence of factors designed to discourage such use. Planning policy has allowed the construction of medium density housing anywhere in a residential zone in the Melbourne metropolitan area. Medium density development dispersed across a city, located over 400 metres from a public transport stop, and not linked to mixed uses, may increase car use in certain areas.

9.13 AUSTRALIAN STUDIES INTO DENSITY, MIXED USE AND TRAVEL PATTERNS

A number of major Australian studies have provided empirical support for the benefits of the compact city multi nodal or urban village model and have examined the influence of urban form on travel patterns and energy use. The *Better Cities* program assisted this research, and a number of other studies, outlined below, support the general conclusions of the benefits of the compact city type. After reviewing considerable research, the *Australian Urban and Regional Development Review* concluded that changing urban structure to emphasise compactness, concentration around a strong central city, increased density, transit supportive development, and localised employment and services can contribute to transport energy savings and over a period of about twenty years significantly increase the sustainability of cities (Armstrong et.al, 1995).

The Australian evidence that changes to the urban form of our cities could lead to substantial reductions to transport and housing energy use and infrastructure costs includes a wide range of studies. Kinhill (1995) found that greenfield residential densities of 15 lots per hectare and higher street connectivity led to a six per cent saving on infrastructure costs compared to a conventional "sprawl" scenario using 10 lots per hectare. The Kinhill study also found that infrastructure costs were likely to be inversely related to density. McGlynn et al (1991) compared total annual transport energy use for Australia's capital cities under four scenarios: base case involving expansion at urban fringes, market driven with utilization of spare capacity in established areas; policy forced with more direct government driven re-urbanization; and urban centres focusing all population and employment growth into established centres. All scenarios reduced growth in energy consumption compared with the base case, summarised in Table 17 below. Non transport infrastructure savings for urban centres compared to the base case ranged from $2.1 - $4.2 billion.

CITY TOTAL ANNUAL TRANSPORT USE 1988 AND 2005 (PJ)			
SCENARIO	**1988**	**2005**	**% INCREASE**
Base case growth	382.8	518.3	35.4
Market Driven	382.8	502.2	31.2
Policy Focused	382.8	485.0	26.7
Urban Centres	382.8	459.6	20.1

TABLE 17. ENERGY USE SCENARIOS AGAINST A BASE CASE. Source: McGlynn et al.

Maunsell and Glazebrook (1994) have reviewed an extensive literature on the effects of road and public transport oriented policies and have catalogued the benefits of integrating transport and land use planning around mixed use activity centres. The options for Melbourne's future pattern of land use and development were summarized in a review for the Commonwealth Department of Housing and Regional Development: continuing present trends towards dispersal of employment closer to homes linked by private transport and use of tele-commuting; a reversal towards traditional neighborhood land use and transport patterns, of modes for employment, high density housing around transport interchanges; and a combination of the two.

The *Victorian Greenhouse Neighbourhood Project* (Loder and Bayly, 1993) quantified the effects of increasing dwelling density and introducing mixed uses on energy use, transport patterns and greenhouse gas emissions, and associated infrastructure costs, in a new outer suburban greenfields site. This study demonstrated the significant impact of urban form on energy use.

Three alternative residential neighbourhood designs were modelled on a site on the western metropolitan fringe of Melbourne: the conventional subdivision of the 1980s, with a net density of 10 dwellings per hectare, few local employment and retailing opportunities, a hierarchical street network with a curvilinear street pattern and many culs-de-sac, with mainly single storey detached houses on standard lots with no particular regard for solar access; subdivisions shaped by the Victorian Code for residential development 1 (VicCode 1) with a net density of 15 dwellings per hectare, some mix of dwelling types, a more interconnected than hierarchical street network with some culs-de-sac and solar access to 70 per cent of lots; a traditional neighbourhood design (TND) with a net density averaging 25 dwellings per hectare, a greater mix of attached and detached dwelling types, a high level of local retail and employment opportunities with one job available for every two resident workers, a highly interconnected street network typical of the inner grid pattern areas of Melbourne, with few culs-de-sac, good public transport services and solar access to 70 per cent of lots.

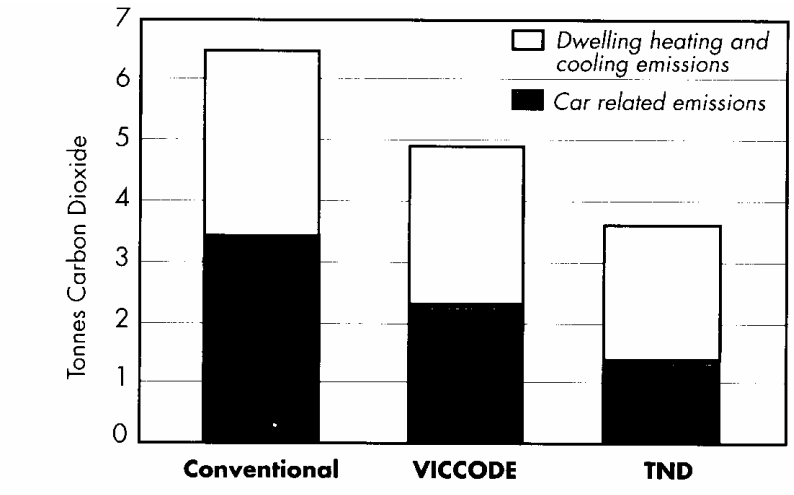

FIGURE 45. COMBINED DWELLING HEATING AND COOLING AND CAR-RELATED GREENHOUSE GAS EMISSION REDUCTIONS BY NEIGHBOURHOOD TYPE (TONNES CO_2 PER DWELLING PER YEAR).

Source: Greenhouse Neighbourhood Project.

The three major parameters considered in the study were housing energy use, transport energy use, and infrastructure costs. The study found that substantial savings in energy requirements and greenhouse gas emissions could be achieved through changes in urban form. Use of the TND model in comparison with conventional development practices, led to carbon dioxide emission reductions of up to 42 per cent by combining land use and transport related factors to reduce car travel and by using dwelling siting and design to reduce heating and cooling related emissions.

Savings of up to 57 per cent of transport energy use could be achieved primarily by increasing the proportion of local employment, retail and related land uses which provided high levels of self containment for daily activities. Increased residential densities alone led to more limited reductions in travel and emissions but remained important.

Energy savings of up to 26 per cent over conventional detached housing could be made by designing houses to make the most of solar energy for heating and cooling, and using shared walls and floors like those in terrace or apartment housing. Density alone was less important than increasing solar access. As the degree of attachment between dwellings and story height increased energy requirements were reduced. A combination of improving solar access and thermal performance through attached housing forms rather than separate dwellings with poor solar access is the key to reducing dwelling heating and cooling energy requirements at higher densities.

The study also found that car travel time and distance travelled per dwelling reduced markedly with the increase in density from Conventional to VicCode to TND neighbourhood types, as can be seen in the following table. Increased density was a significant factor in reducing transport greenhouse gas emissions. But the greatest gains were made when there was a higher density in combination with a mix of land uses and local employment opportunities leading to greater self containment and fewer longer external trips. This regional reduction led to major savings in emissions.

RESIDENTIAL DENSITY	**NEIGHBOURHOOD TYPE**		
(dwellings/hectare)	Conventional	VicCode	TND
10	**8.3**		
15	7.6	**7.0**	
25	7.0		**5.4**

TABLE 18. ESTIMATES OF HOURLY A.M. PEAK CAR TRAVEL TIME PER DWELLING (MINUTES).
Source: Greenhouse Neighbourhood Project.

The Victorian *Urban Villages Project* (Alexander et.al.,1996) investigated the potential for redeveloping the existing urban area of Melbourne into urban villages. Six redevelopment scenarios were prepared. In addition to considering the capacity of urban villages to accommodate additional dwellings and residents, the project also sought to assess the effect of urban village development on energy consumption and greenhouse gas emissions from the heating and cooling of dwellings. Estimates suggest that redevelopment of metropolitan Melbourne on the basis of urban village principles, rather than continuation of urban consolidation at 1991-92 levels would result in significant energy and greenhouse gas savings. The minor urban village scenario would lead to a saving of 3 per cent, moderate emphasis in 8.6 per cent savins, and a major emphasis in savings of about 14 per cent.

9.14 ECOSYSTEM DYNAMICS

Urban development and many land uses are major threats to ecosystems, both by converting the land surface and through off site effects. The reduce habitat, change landscapes and related biophysical values, affect water movement and quality, modify nutrient cycles energy flows and runoff patterns, and often severely disrupt and modify ecosystems.

Following Alberti's (2000) approach, four characteristics can be proposed to investigate the relationship between urban form and ecological conditions: urban concentration, land use intensity, land use heterogeneity, and land use connectivity. Alberti also argues the importance of examining a broad range of ecological processes, not a selective number, in assessing ecological integrity.

Land use is a critical factor in deciding the ways ecosystems continue to operate. Transformation of natural and human landscapes can occur in ways that reduce ecological impacts. This principle can be adopted through:

Prevention:
This involves identifying environmental features to be protected and putting in place protective regimes.

Adaptation:
This involves relating environmental values to urban fabric, for example, by protecting remnant vegetation and stream sides in subdivisional layouts.

Ecosystem evaluation:
An ecosystem approach, not compartmentalised species-by-species protection strategies should be adopted. This position should include the adoption of the principle of cumulative effects and threshold levels. Ecosystems can seem to be functioning satisfactorily prior to catastrophic collapse.

Environmental indicators:
A broad range of indicators should be selected in order to evaluate the environmental performance of policies aimed at a broad range of ecological processes.

9.15 CONCLUSIONS

1. **Urban form:**
   This does matter. The type of urban form adopted in a city affects the way a city functions and the quality of its environment, although it is not the only factor. U.K., U.S., Australian, and other studies, on balance, strongly suggest that urban form does influence environmental, social and economic outcomes.

2. **Urban ecology:**
   The traditional concentration on aspects of urban ecology, such as habitat protection, linear and regional open space connections, protection of waterways and estuarine areas, and protection of other resources in land use planning, is not sufficiently broad in scope if the

metropolitan strategy is to adequately integrate consideration of environmental issues. Similarly, a concentration on air and water quality, noise, waste and chemicals in isolation from land use and transport considerations, and catchment management issues cannot adequately deal with emissions and health considerations.

3. **Compact city:**
   Studies consistently point to the superior environmental performance of compact city models. In particular, this international research shows that:

   - by favouring the compact city, land use policies can reduce transport emissions through reduced trip numbers and lengths. Australian, and to a lesser extent U.S. studies have reinforced the findings of earlier U.K. studies, although later U.K. studies have examined a more complex interplay of variables. The complex factors referred to by the later studies, such as the different trip purposes (particularly for work, shopping and leisure), the tendency for compactness not to affect public transport use and car ownership, have implications for Melbourne. Much of Melbourne's new medium density development has been constructed within 400 metres of a public transport stop, but it unlikely that this proximity in itself has lowered car use or increased public transport use. These developments make extensive provision for private car parking, and the quality and frequency of most public transport is poor. It is likely that this development despite its proximity to public transport, is not transit oriented.
   - the compact city and corridor models also result in significantly lower air pollutant levels.

4. **Density:**
   Similarly, increasing density alone may not lead to lower car use and the resulting environmental benefits of lower emissions, pollution and energy use. However, studies consistently show that increased density coupled with mixed uses close to public transport locations achieves environmental benefits including lower transport emissions.

5. **Outer urban growth:**
   Despite claims by a number of Australian commentators that urban consolidation does not significantly reduce outward sprawl, recent evidence suggests that a combination of consolidation within the established metropolitan area, and higher densities in newly developed outer suburbs can significantly reduce the extent of sprawl. The design and location of new suburban growth are other critical factors. Car dependent street design in suburbs located far from public transport and from services and facilities, linked to car dependent regional shopping facilities will perpetuate car use regardless of density. This finding has significant implications for protecting agricultural land both on the city fringes and within the metropolitan area, for off site water quality, air quality and protection of remnant habitat.

6. **The multi nodal-Urban Village model:**
   The urban village compact city model, with its coupling of higher density development with mixed uses and public transport use achieves the best environmental outcomes. A multi nodal city also linked to strong policies discouraging car ownership and use, and to the provision of alternatives such as high quality public transport and walking will achieve even better traffic and environmental outcomes. This finding implies that greater regulation over the type of medium density housing will be required, including its location, street orientation

and car parking provision. A policy of urban consolidation which allows medium or high density development to occur anywhere in the metropolitan area may not achieve significant environmental outcomes. This policy may continue an emphasis on car use, and maintain long trip lengths.

7. **Corridor-wedge development:**
   Melbourne's corridor-wedge pattern of strategic planning performs well environmentally, both in reducing transport emissions and protecting environmental and resource assets compared to unrestricted outward sprawl. Traditionally, corridor planning has not adequately considered density or other important elements of urban form, such as mixed uses, and provision of local retail facilities in place of car based regional centres. Coupled with higher density mixed use transit oriented development in development corridors, and urban village redevelopment in the existing metropolitan area, the corridor model can continue to deliver important environmental outcomes. This finding has important implications for Melbourne's green wedges. These are under continued threat.

10. POLICY OPTIONS AND IMPLEMENTATION

The following policy options could be considered in relating environmental factors to urban form (and transport energy use).

Intensification within metropolitan area:
Develop mixed use, higher density urban form around public transport locations, particularly rail stations in accordance with the Victorian *Urban Villages Study* and the Compact City multi node model.

A change in urban consolidation policy would be required, involving a shift in the policy of allowing mixed use development anywhere in the metropolitan area, to concentrating it around nominated public transport locations. Government would play a more active role in ensuring the adoption of the currently optional use of the Residential 2 and Mixed Use zones. A percentage of affordable housing would be required in any medium density development of 50 units and above. Greater emphasis would be placed on housing affordability and diversity.

A range of additional measures aimed at reducing per capita car ownership levels and use would be introduced, including restrictions on car parking in residential and mixed use developments, introduction of priority lanes for multi passenger vehicles, giving priority to bicycles, and pricing measures. These would be linked with improved public transport and lower fares.

Intensification in outer urban areas:
Require higher density mixed use urban form with high street connectivity in outer urban growth corridors.

Currently, most development planning in outer urban areas is in effect carried out by the development industry and consultants, with councils generally playing a reactive role. The government would introduce a minimum density requirement of 25 lots per hectare for new greenfields subdivisions. Councils would be equipped to play a more proactive role by government preparing in consultation with local councils, the development industry, and the community, a development approvals policy which included:

- a requirement for greater street connectivity
- minimum energy efficiency requirements for buildings
- storm and waste water reuse and greater use of porous materials
- habitat protection and open space provision
- a range of mixed uses and a broader diversity of housing
- better public transport provision.

The extension and development of growth corridors in areas removed from public transport should be re-examined.

Retail and freeway development:
The type of retail development is a critical component of the type of urban form adopted in a city, particularly when linked to freeways. Prevent any expansion of regional retail centres, and stand alone retail centres, and promote a broader range of uses in strip and local shopping centres.

Ensure that new suburban development is linked to smaller mixed use centres. Prevent the expansion of the freeway network.

There is clear international evidence that new freeway construction does not ultimately reduce but adds to congestion by encouraging vehicle use. The State Planning Policy Framework provisions on retail and freeway development should be revised to include similar provisions to the U.K. PPG6 and PPG13 policies.

Public transport:
Link existing and new suburbs to an improved public transport service, with better integration of modes.

Corridor development:
Maintain the pattern of corridor development and link to a new policy of urban village development.

Energy use and greenhouse gas emissions:
Most growth in emissions results from growth in energy use, with emissions from both transport energy and stationary energy increasing by about 20 per cent between 1990-98. Urban development strategies, linked to a greenhouse and energy policies have the potential to significantly affect energy consumption particularly in the residential, commercial and transport sectors. Reduction of energy use through changes to urban form should be linked with other areas of activity such as reducing the level of organic wastes.

Green wedges and environmental areas within the metropolitan area and beyond the urban fringe:
Protect green wedges and other environmentally significant areas around the urban fringe from further urban development, inappropriate uses and incremental small lot rural rezonings.

Legislative protection would be provided for all green wedges and other environmentally significant areas.

Uses in the Victorian Planning Provisions, with the emphasis on as of right and discretionary provisions, are a major threat to the continued environmental values of these areas. These uses should be revised and the range of prohibited uses increased. Relevant policies, particular provisions and overlays (such as the Native Vegetation provision) should be strengthened.

Flood plains would be protected and building prevented on flood plains. Planning controls would be introduced to protect remnant wetlands. An expanded land purchase program to extend the metropolitan parks system would be introduced. Creek habitats would be protected and improved.

Ecosystem evaluation:
Protection of the broadest range of values, and selection of appropriate methodologies and indicators should be a guiding principle of urban development.

Catchment management:
Better integration between the catchment management and land use planning systems is needed. Measures such as land use controls over vegetation clearance, protection of remant habitat, revegetation and protection of streamsides, an evaluation of suitable land uses, and controls over erosion and sediment arising from construction would be introduced.

Inner suburban areas consume up to two to three times less water per capita than outer suburban areas. Smaller lot size is the major determinant of water consumptions. Medium density development can therefore make an important contribution to lower urban water use.

Noise:
The growth of traffic is expected to increase ambient noise levels, particularly from commercial vehicles. Urban planning can make important contributions to controlling traffic noise.

Implementation policy instruments:
Government commitments to a greater use of regulation would be acted upon in the metropolitan strategy to achieve environmental outcomes. The most effective U.S. policy instruments to achieve integrated land use/transport are funding programs such as the ISTEA program, and requirements for transit oriented higher density mixed use development as conditions for public transport funding. The applicability of these kinds of instruments could be examined.

Coordination:
Significant failures in coordination between government agencies have hampered integrated solutions to urban problems. The failure to achieve whole of government responses in catchment management has contributed to the cause and continuation of serious environmental problems in waterways and bays. During most of the 1990s, agency decisions on environmental, planning, and transport issues tended to be sectoral. Government responses were not coordinated effectively around policies and measures aimed at controlling road use, reducing energy use, implementing alternative approaches to urban form, and protecting environmental values. The development of metropolitan and greenhouse policies provide the opportunity to remedy this deficiency.

Inter agency processes based on an adoption of a cross sectoral environmental ethic are essential for delivering a metropolitan strategy which achieves environmental objectives. The strategy should be developed and monitored by a unit acting independently from resource sections of government. A matrix management model of implementation is appropriate with strong monitoring and reporting to Cabinet on implementation. Government funding, regulatory and other implementation mechanisms should both deliver and not work against adoption of strong environmental outcomes.

APPENDIX 1

PARKS AND CONSERVATION RESERVES IN METROPOLITAN STRATEGY REGION

List of parks and conservation reserves in Port Phillip Region administered by the Department of Natural Resources and Environment (does not include small reserves not mapped on public land layer).

PARK RESERVE	NAME	AREA TYPE
3190	Port Phillip Bay Coastal Reserve	Coastal Reserve
3191	Flinders - Somers Coastal Reserve	Coastal Reserve
3192	Western Port Intertidal Coastal Reserve	Coastal Reserve
3193	Phillip Island Coastal Reserve	Coastal Reserve
3194	San Remo - Pt Smythe Coastal Reserve	Coastal Reserve
2843	Spargo Creek E.A.	Education Area
2847	Tonimbuk E.A.	Education Area
2850	Gembrook E.A.	Education Area
2851	Hoddles Creek E.A.	Education Area
2852	Lang Lang E.A.	Education Area
3435	Harold Holt - Mud Islands Fisheries Res.	Fisheries Reserve
3438	Harold Holt - Point Nepean Fisheries Res.	Fisheries Reserve
3439	Point Cook Fisheries Res.	Fisheries Reserve
2856	Gulf Station H.A	Historic Reserve
2857	Puffing Billy H.A	Historic Reserve
2867	Mississippi No. 1 Mill H.A	Historic Reserve
2868	Ada River Sawmills H.A	Historic Reserve
2874	Coolart H.A	Historic Reserve
3288	Brisbane Ranges National Park	National Park - Schedule 2, National Parks Act
3290	Mornington Peninsula National Park	National Park - Schedule 2, National Parks Act
3291	Dandenong Ranges National Park	National Park - Schedule 2, National Parks Act
3292	Kinglake National Park	National Park - Schedule 2, National Parks Act
3293	Churchill National Park	National Park - Schedule 2, National Parks Act
3301	French Island National Park	National Park - Schedule 2, National Parks Act
3306	Organ Pipes National Park	National Park - Schedule 2, National Parks Act
3321	Yarra Ranges National Park	National Park - Schedule 2, National Parks Act
1490	Goldie B.R	Natural Features Reserve - Bushland Reserve

1491	Wallan Wallan B.R.	Natural Features Reserve - Bushland Reserve
1576	Gorong I106 B.R	Natural Features Reserve - Bushland Reserve
1577	Coimadai B.R.	Natural Features Reserve - Bushland Reserve
1578	Yangardook B.R	Natural Features Reserve - Bushland Reserve
1598	Queenstown G57 B.R.	Natural Features Reserve - Bushland Reserve
1599	Queenstown G58 B.R	Natural Features Reserve - Bushland Reserve
1600	Toolangi B.R	Natural Features Reserve - Bushland Reserve
1601	Yering Gorge B.R.	Natural Features Reserve - Bushland Reserve
1602	Tarrawarra G61 B.R	Natural Features Reserve - Bushland Reserve
1603	Healsville Gorge B.R.	Natural Features Reserve - Bushland Reserve
1604	Mooroolbark G63 B.R.	Natural Features Reserve - Bushland Reserve
1606	Wandin Yallock G65 B.R	Natural Features Reserve - Bushland Reserve
1607	Gembrook G66 B.R	Natural Features Reserve - Bushland Reserve
1608	Gembrook G67 B.R	Natural Features Reserve - Bushland Reserve
1610	Gembrook G69 B.R	Natural Features Reserve - Bushland Reserve
1611	Nayook B.R.	Natural Features Reserve - Bushland Reserve
1612	Pakenham G71 B.R.	Natural Features Reserve - Bushland Reserve
1613	Pakenham G72 B.R.	Natural Features Reserve - Bushland Reserve
1614	Nar-Nar-Goon G73 B.R.	Natural Features Reserve - Bushland Reserve
1615	Nar-Nar-Goon G74 B.R	Natural Features Reserve - Bushland Reserve
1616	Nar-Nar-Goon G75 B.R	Natural Features Reserve - Bushland Reserve
1617	Nar-Nar-Goon G76 B.R	Natural Features Reserve - Bushland Reserve
1618	Jindivick G77 B.R.	Natural Features Reserve - Bushland Reserve
1619	Jindivick G78 B.R	Natural Features Reserve -

		Bushland Reserve
1623	Drouin West G82 B.R	Natural Features Reserve - Bushland Reserve
1624	Drouin West G83 B.R.	Natural Features Reserve - Bushland Reserve
1626	Whiskey Creek B.R.	Natural Features Reserve - Bushland Reserve
1629	Tubba Rubba Creek B.R	Natural Features Reserve - Bushland Reserve
1630	Moorooduc G89 B.R	Natural Features Reserve - Bushland Reserve
1631	Bittern B.R.	Natural Features Reserve - Bushland Reserve
1635	Balnarring G94 B.R.	Natural Features Reserve - Bushland Reserve
1636	Balnarring G95 B.R.	Natural Features Reserve - Bushland Reserve
1637	Balnarring G96 B.R.	Natural Features Reserve - Bushland Reserve
1638	Corinella Cemetery B.R.	Natural Features Reserve - Bushland Reserve
1639	Grantville B.R	Natural Features Reserve - Bushland Reserve
1669	Pheasant Creek B.R	Natural Features Reserve - Bushland Reserve
1682	Temple Ridge B.R.	Natural Features Reserve - Bushland Reserve
1686	Panton Hill G145 B.R	Natural Features Reserve - Bushland Reserve
1687	Greensborough G146 B.R	Natural Features Reserve - Bushland Reserve
1689	Queenstown G148 B.R	Natural Features Reserve - Bushland Reserve
1694	Yering B.R	Natural Features Reserve - Bushland Reserve
1696	Tarrawarra G155 B.R.	Natural Features Reserve - Bushland Reserve
1701	Mallesons Lookout B.R.	Natural Features Reserve - Bushland Reserve
1706	Monbulk G165 B.R	Natural Features Reserve - Bushland Reserve
1709	Olinda G168 B.R.	Natural Features Reserve - Bushland Reserve
1712	Lyrebird Haunt B.R.	Natural Features Reserve - Bushland Reserve
1714	Wandin Yallock G173 B.R.	Natural Features Reserve - Bushland Reserve

1720	Gilwell Park B.R.	Natural Features Reserve - Bushland Reserve
1721	Beenak G180 B.R.	Natural Features Reserve - Bushland Reserve
1723	Britannia Creek G182 B.R	Natural Features Reserve - Bushland Reserve
1724	Beenak G183 B.R	Natural Features Reserve - Bushland Reserve
1726	Belgrave G185 B.R.	Natural Features Reserve - Bushland Reserve
1731	Selby G190 B.R.	Natural Features Reserve - Bushland Reserve
1732	Belgrave South B.R.	Natural Features Reserve - Bushland Reserve
1734	Selby G193 B.R.	Natural Features Reserve - Bushland Reserve
1735	Myanook B.R.	Natural Features Reserve - Bushland Reserve
1736	Black Hill B.R.	Natural Features Reserve - Bushland Reserve
1738	Menzies Creek B.R.	Natural Features Reserve - Bushland Reserve
1741	Emerald B.R.	Natural Features Reserve - Bushland Reserve
1742	Mount Majestic B.R.	Natural Features Reserve - Bushland Reserve
1743	Wright Forest B.R.	Natural Features Reserve - Bushland Reserve
1745	Gembrook G204 B.R	Natural Features Reserve - Bushland Reserve
1750	Neerim G209 B.R.	Natural Features Reserve - Bushland Reserve
1754	Yannathan G213 B.R	Natural Features Reserve - Bushland Reserve
1755	Longwarry B.R	Natural Features Reserve - Bushland Reserve
1761	Wannaeue B.R.	Natural Features Reserve - Bushland Reserve
1762	Dromana G221 B.R	Natural Features Reserve - Bushland Reserve
1763	Balcombe Creek B.R	Natural Features Reserve - Bushland Reserve
1766	Balnarring G225 B.R.	Natural Features Reserve - Bushland Reserve
1767	Moorooduc G226 B.R	Natural Features Reserve - Bushland Reserve
1769	Crib Point G228 B.R.	Natural Features Reserve -

		Bushland Reserve
1770	Crib Point G229 B.R	Natural Features Reserve - Bushland Reserve
1771	French Island G230 B.R	Natural Features Reserve - Bushland Reserve
1773	Corinella B.R.	Natural Features Reserve - Bushland Reserve
1776	Ventnor B.R	Natural Features Reserve - Bushland Reserve
1996	Yannathan I97 B.R.	Natural Features Reserve - Bushland Reserve
1997	Lang Lang B.R	Natural Features Reserve - Bushland Reserve
2905	Labertouche Cave G.R.	Natural Features Reserve - Geological Reserve
2906	Brittania Creek Cave G.R.	Natural Features Reserve - Geological Reserve
2907	Fossil Beach G.R.	Natural Features Reserve - Geological Reserve
2904	Seven Acre Rock N.F.S.R.	Natural Features Reserve - Natural Features and Scenic Reserve
2895	Mount Anakie S.R.	Natural Features Reserve - Scenic Reserve
2770	Everard Park SS.R.	Natural Features Reserve - Streamside Reserve
2783	Monbulk Creek, Belgrave Heights SS.R.	Natural Features Reserve - Streamside Reserve
2784	Cannibal Creek SS.R.	Natural Features Reserve - Streamside Reserve
2786	Tarago River, Robin Hood SS.R	Natural Features Reserve - Streamside Reserve
2787	Tarago River, Neerim South SS.R.	Natural Features Reserve - Streamside Reserve
2788	Lang Lang River, Topiram SS.R.	Natural Features Reserve - Streamside Reserve
2790	Bass River. SS.R.	Natural Features Reserve - Streamside Reserve
2803	Deep Creek K16 SS.R.	Natural Features Reserve - Streamside Reserve
2804	Deep Creek K17 SS.R.	Natural Features Reserve - Streamside Reserve
2805	Deep Creek K18 SS.R.	Natural Features Reserve - Streamside Reserve
2813	Cobbledicks SS.R.	Natural Features Reserve - Streamside Reserve
2814	Werribee River SS.R.	Natural Features Reserve - Streamside Reserve

2815	Clarke Road SS.R.	Natural Features Reserve - Streamside Reserve
2816	Kororoit Creek K36 SS.R.	Natural Features Reserve - Streamside Reserve
2817	Kororoit Creek K37 SS.R.	Natural Features Reserve - Streamside Reserve
2819	Jacksons Creek SS.R.	Natural Features Reserve - Streamside Reserve
2833	Bulla Bulla SS.R.	Natural Features Reserve - Streamside Reserve
12	Baluk Willam N.C.R.	Nature Conservation Reserve
16	Beaconsfield N.C.R.	Nature Conservation Reserve
28	Boomers N.C.R.	Nature Conservation Reserve
40	Buckley N.C.R	Nature Conservation Reserve
55	Coranderrk N.C.R	Nature Conservation Reserve
104	Grantville N.C.R	Nature Conservation Reserve
105	Gresswell Forest N.C.R	Nature Conservation Reserve
114	Hurdy Gurdy Creek N.C.R	Nature Conservation Reserve
132	Kangerong N.C.R	Nature Conservation Reserve
154	Adams Creek N.C.R.	Nature Conservation Reserve
167	Main Ridge N.C.R	Nature Conservation Reserve
228	Nyora N.C.R	Nature Conservation Reserve
231	One Tree Hill N.C.R	Nature Conservation Reserve
262	Sassafras Creek N.C.R	Nature Conservation Reserve
264	Smiths Gully & Peter Franke N.C.R.	Nature Conservation Reserve
268	St Andrews N.C.R	Nature Conservation Reserve
289	The Gurdies N.C.R	Nature Conservation Reserve
312	Upper Beaconsfield N.C.R	Nature Conservation Reserve
325	Warramate Hills N.C.R	Nature Conservation Reserve
360	Yellingbo N.C.R.	Nature Conservation Reserve
361	North Western Port N.C.R	Nature Conservation Reserve
362	Mount Martha N.C.R	Nature Conservation Reserve
363	Bald Hill N.C.R	Nature Conservation Reserve
366	Reef Island and Bass River Mouth N.C.R	Nature Conservation Reserve
368	Warrandyte - Kinglake N.C.R	Nature Conservation Reserve
163	Long Forest F.F.R.	Nature Conservation Reserve - Flora and Fauna Reserve
90	Gisborne F.R	Nature Conservation Reserve - Flora Reserve
110	Holden F.R.	Nature Conservation Reserve - Flora Reserve
198	Mount Charlie F.R	Nature Conservation Reserve - Flora Reserve
278	T Hill F.R	Nature Conservation Reserve - Flora Reserve
1609	Gembrook G68 F.R.	Nature Conservation Reserve - Flora Reserve

1768	Tyabb F.R.	Nature Conservation Reserve - Flora Reserve
559	Mud Islands W.R.	Nature Conservation Reserve - Wildlife Reserve (no hunting)
564	The Spit W.R	Nature Conservation Reserve - Wildlife Reserve (no hunting)
3361	Woodlands Historic Park	Other Park - Schedule 3, National Parks Act
3363	Haining Park	Other Park - Schedule 3, National Parks Act
3365	Langwarrin Flora & Fauna Reserve	Other Park - Schedule 3, National Parks Act
3366	Lysterfield Park	Other Park - Schedule 3, National Parks Act
1992	Phillip Island Nature Park	Phillip Island Nature Park
4069	Lerderderg S.P. (RFA addition)	Proposed National Parks Act park or park addition
3503	Durdidwarrah Creek Reference Area	Reference Area
3504	Stony Creek (Durdiwarrah) Reference Area	Reference Area
3505	Musk Creek Reference Area	Reference Area
3506	Ruths Gully Reference Area	Reference Area
3507	Ah Kows Gully Reference Area	Reference Area
3508	Pyrete Range Reference Area	Reference Area
3510	Disappointment Reference Area	Reference Area
3511	Watts Creek Reference Area	Reference Area
3512	Deep Creek Reference Area	Reference Area
3513	Walsh Creek Reference Area	Reference Area
3514	Mount Gregory Reference Area	Reference Area
3515	Diamond Creek Reference Area	Reference Area
3516	Bennie Creek Reference Area	Reference Area
3523	Joey Creek Reference Area	Reference Area
3524	Yan Yean (north) Reference Area	Reference Area
3525	Yan Yean (south) Reference Area	Reference Area
1518	Plenty Gorge R.P.	Regional Park - not scheduled under National Parks Act
3227	You Yangs R.P	Regional Park - not scheduled under National Parks Act
3229	Macedon R.P	Regional Park - not scheduled under National Parks Act
3230	Wandong R.P	Regional Park - not scheduled under National Parks Act
3231	Crossover R.P	Regional Park - not scheduled under National Parks Act
3253	Kurth Kiln R.P	Regional Park - not scheduled under National Parks Act
3326	Arthurs Seat State Park	State Park - Schedule 2B, National

		Parks Act
3329	Bunyip State Park	State Park - Schedule 2B, National Parks Act
3339	Lerderderg State Park	State Park - Schedule 2B, National Parks Act
3351	Warrandyte State Park	State Park - Schedule 2B, National Parks Act
3352	Werribee Gorge State Park	State Park - Schedule 2B, National Parks Act
3440	Western Port W.M.C.A	Wildlife Management Co-operative Area

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